

**ZPP 416  
ENGINE SERVICE  
MANUAL**

# ZPP 416 - Engine DOHC

## **GENERAL**

### **TIMING SYSTEM**

TIMING BELT

### **CYLINDER HEAD ASSEMBLY**

CYLINDER HEAD

### **MAIN MOVING SYSTEM**

CAM SHAFT  
CRANK SHAFT  
FLY WHEEL  
PISTON

### **COOLING SYSTEM**

ENGINE COOLANT HOSE / PIPES

ENGINE COOLANT PUMP  
RADIATOR  
RADIATOR CAP  
THERMOSTAT

### **LUBRICATION SYSTEM**

OIL PUMP

### **ENGINE BLOCK**

ENGINE BLOCK

### **INTAKE AND EXHAUST SYSTEM**

EXHAUST MANIFOLD  
INTAKE MANIFOLD

**GENERAL****SPECIFICATION** E5EC07D6

Description	Specification	Limit
<b>General</b> Type Number of cylinders Bore Stroke Total displacement Compression ratio Firing order	In-line, Double Over Head Camshaft 4 76.5mm (3.0118 in) 87mm (3.4252 in) 1599 cc (97.54 cu.in) 10 1-3-4-2	
<b>Valve timing</b> Intake valve Opens (BTDC) Closes (ABDC) Exhaust valve Opens (BBDC) Closes (ATDC) Valve overlap	 5° 35°  43° 5° 10°	
<b>Cylinder head</b> Flatness of cylinder head surface Flatness of manifold mounting surface Oversize rework dimension of valve seat hole Intake 0.3mm (0.012 in.) O.S. 0.6mm (0.024 in.) O.S. Exhaust 0.3mm (0.012 in.) O.S. 0.6mm (0.024 in.) O.S.	Max. 0.03mm (0.0012 in.) 0.15mm (0.0059 in.)  30.7 ~ 30.721 mm (1.2087 ~ 1.2095 in.) 31.0 ~ 31.021 mm (1.2205 ~ 1.2213 in.)  27.3 ~ 27.321mm (1.0748 ~ 1.0756 in.) 27.6 ~ 27.621mm (1.0866 ~ 1.0874 in.)	0.1 mm (0.0039in.) 0.2mm (0.008in.)
<b>Oversize rework dimensions of valve</b> Guide hole 0.05mm (0.002 in.) O.S. 0.25mm (0.010 in.) O.S. 0.50mm (0.020 in.) O.S.	 11.05 ~ 11.068mm (0.435 ~ 0.4357 in.) 11.25 ~ 11.268mm (0.443 ~ 0.4436 in.) 11.50 ~ 11.518mm (0.453 ~ 0.4535 in.)	
<b>Camshaft</b> Cam lobe height Intake  Exhaust  Journal O.D Bearing oil clearance End play	 43.4484mm (1.7106 in.)  43.8489mm (1.7263 in.)  ø27mm (1.0630 in.) 0.035 ~ 0.072mm (0.0014 ~ 0.0028 in.) 0.1 ~ 0.2mm (0.004 ~ 0.008 in.)	42.9484mm (1.6909in.) 43.3489mm (1.7.66in.)

Description	Specification	Limit
<b>Valve</b> Valve length Intake Exhaust Stem O.D. Intake Exhaust Face angle thickness of valve head (Margin) Intake Exhaust Valve stem to valve guide clearance Intake Exhaust	  91.7mm (3.6102 in.) 92.3mm (3.6339 in.)  5.955 ~ 5.97mm (0.2344 ~ 0.2350 in.) 5.935 ~ 5.95mm (0.2337 ~ 0.2343 in.)  1.1mm (0.0433 in.) 1.3mm (0.0512 in.)  0.03 ~ 0.06mm (0.0012 ~ 0.0024 in.) 0.05 ~ 0.08mm (0.0020 ~ 0.0031 in.)	      0.8mm (0.031in.) 1.0mm (0.039in.)  0.10mm (0.0039in.) 0.15mm (0.0059in.)
<b>Valve guide</b> Installed dimension O.D. Intake Exhaust Service size	 12.8mm (0.504 in.) 12.8mm (0.504 in.) 0.05, 0.25, 0.50mm (0.002, 0.010, 0.020 in.) oversize	
<b>Valve seat</b> Width of seat contact Intake Exhaust Seat angle Oversize	 0.8 ~ 1.2mm (0.031 ~ 0.047 in.) 1.3 ~ 1.7mm (0.051 ~ 0.066 in.) 45° 0.3, 0.6mm (0.012, 0.024 in.) oversize	
<b>Valve spring</b> Free length Load Squareness	 44.00mm (1.7323 in.) 21.6kg/ 35mm (47.6lb/1.3780 in.) 45.1kg/ 27.2mm (99.4lb/1.071 in.) 1.5° or less	
<b>Cylinder block</b> Cylinder bore Out- of- round and taper of cylinder bore Clearance with piston	 76.50 ~ 76.53mm (3.0118 ~ 3.0130 in.) Less than 0.01mm (0.0004 in.)  0.025 ~ 0.045mm (0.0009 ~ 0.0017 in.)	
<b>Piston</b> O.D. Service size	 76.465 ~ 76.495mm (3.0104 ~ 3.0116 in.) 0.25 mm (0.010 in.) oversize	
<b>Piston ring</b> Side clearance No. 1 No. 2 Endgap No. 1 No. 2 Oil ring side rail Service size	 0.04 ~ 0.085 mm (0.0015 ~ 0.0033 in.) 0.04 ~ 0.085 mm (0.0015 ~ 0.0033 in.)  0.15 ~ 0.30 mm (0.0059 ~ 0.012 in.) 0.30 ~ 0.45 mm (0.012 ~ 0.0177 in.) 0.2 ~ 0.7 mm (0.0078 ~ 0.0275 in.) 0.25 mm (0.010 in.) oversize	  0.1 mm (0.004 in.) 0.1 mm (0.004 in.)  1.0 mm (0.039 in.) 1.0 mm (0.039 in.) 1.0 mm (0.039 in.)

## ZENITH POWER PRODUCTS - 416

EM -4

ENGINE DOHC

Description	Specification	Limit
<b>Connecting rod</b> Bend Twist Connecting rod big end to crankshaft side clearance Connecting rod bearing oil clearance Undersize	0.05mm (0.0020 in.) or less 0.1mm (0.0039 in.) or less 0.100-0.250mm (0.0039-0.0098 in.)  0.018-0.036mm (0.0007-0.0014 in.) 0.25, 0.50, 0.75mm (0.010, 0.020, 0.030 in.)	0.4mm (0.0157in.)
<b>Crankshaft</b> Pin O.D. Journal O.D. Bend Out- of- round, taper of journal and pin End play	45 mm (1.77 in.) 50 mm (1.97 in.) 0.03 mm (0.0012 in.) or less 0.005 mm (0.0002 in.) or less 0.05- 0.175 mm (0.0019- 0.0068 in.)	
<b>Undersize rework dimension of pin</b> 0.25mm (0.010 in.) 0.50mm (0.020 in.) 0.75mm (0.030 in.)	44.725 ~ 44.74mm (1.7608 ~ 1.7614 in.) 44.475 ~ 44.49mm (1.7509 ~ 1.7516 in.) 44.225 ~ 44.24mm (1.7411 ~ 1.7417 in.)	
<b>Undersize rework dimension of journal</b> 0.25mm (0.010 in.) 0.50mm (0.020 in.) 0.75mm (0.030 in.)	49.727 ~ 49.742mm (1.9577 ~ 1.9583 in.) 49.477 ~ 49.492mm (1.9479 ~ 1.9485 in.) 49.227 ~ 49.242mm (1.9380 ~ 1.9386 in.)	
<b>Flywheel</b> Runout	0.1mm (0.0039 in.)	0.13mm (0.0051in.)
<b>Oil pump</b> Clearance between outer circumference and front case (body clearance) Front case tip clearance Side clearance Inner gear Outer gear	0.12 ~ 0.18mm (0.0047 ~ 0.0070 in.) 0.025 ~ 0.069mm (0.001 ~ 0.0027 in.)  0.04 ~ 0.085mm (0.0016 ~ 0.0033 in.) 0.04 ~ 0.09mm (0.0016 ~ 0.0035 in.)	
<b>Engine oil pressure</b> Engine at idle [Oil temperature is 90 to 100°C (194 to 215°F)]	147KPa (1.5 kg/ cm <sup>2</sup> , 21.33psi)	
<b>Relief spring</b> Free height Load	46.6mm (1.8346 in.) 6.1kg at 40.1mm (13.42lb/ 1.578 in.)	
<b>Cooling method</b>	Water-cooled, pressurized, forced circulation with electrical fan	
<b>Coolant</b> Quantity Radiator Type	6.5 liter  Pressurized corrugated fin type	
<b>Radiator cap</b> Main valve opening pressure  Vacuum valve opening pressure	81.4 ~ 108 kpa (11.8 ~ 15.6 psi.,0.83 ~ 1.1kg/cm <sup>2</sup> )  -6.86 kpa (-1.00 psi, -0.07 kg/cm <sup>2</sup> or less	
<b>Coolant pump</b>	Centrifugal type impeller	

**GENERAL****EM -5**

Description	Specification	Limit
<b>Thermostat</b> Type Valve opening temperature Full-opening temperature	Wax pellet type with jiggle valve 82°C (180°F) 95°C (203°F)	
<b>Engine coolant temperature sensor</b> Type Resistance	Heat-sensitive thermistor type 2.31 ~ 2.59k $\Omega$ at 20°C(68°F) 146.9 ~ 147.3 $\Omega$ at 110°C(230°F)	
<b>Air cleaner</b> Type Element	Dry type Un woven cloth type	
<b>Exhaust pipe</b> Muffler Suspension system	Expansion resonance type Rubber hangers	

 **NOTE**

*O.D. = Outer Diameter*

*I.D. = Inner Diameter*

*O.S. = Oversize Diameter*

*U.S. = Undersize Diameter*

## TIGHTENING TORQUE

Item	Nm	Kg.cm	lb.ft
<b>Cylinder Block</b>			
Front engine support bracket bolt and nut	45 ~ 55	450 ~ 550	33 ~ 41
Engine support bracket stay bolt	45 ~ 55	450 ~ 550	33 ~ 41
Oil pressure switch	13 ~ 15	130 ~ 150	10 ~ 11
<b>Cylinder head</b>			
Cylinder head bolt	30+(90°)+Release all bolts+30+(90°)	300+(90°)+Release all bolts+300+(90°)	22+(90°)+Release all bolts+22+(90°)
Intake manifold bolts or nuts	15 ~ 20	150 ~ 200	11 ~ 15
Exhaust manifold nut	25 ~ 30	250 ~ 300	18 ~ 22
Cylinder head cover bolt	8 ~ 10	80 ~ 100	6 ~ 7
Camshaft bearing cap bolt	12 ~ 14	120 ~ 140	9 ~ 10
Rear plate bolt	32 ~ 35	320 ~ 350	24 ~ 26
<b>Main Moving system</b>			
Connecting rod cap nut	32 ~ 35	320 ~ 350	24 ~ 26
Crankshaft bearing cap bolt	55 ~ 60	550 ~ 600	41 ~ 44
Fly wheel M/T bolt	120 ~ 130	1200 ~ 1300	89 ~ 96
Drive plate A/T bolt	120 ~ 130	1200 ~ 1300	89 ~ 96
<b>Timing system</b>			
Crankshaft pulley bolt	140 ~ 150	1400 ~ 1500	103 ~ 111
Camshaft sprocket bolt	80 ~ 100	800 ~ 1000	59 ~ 74
Timing belt tensioner bolt	20 ~ 27	200 ~ 270	15 ~ 20
Timing belt idle bolt	43 ~ 55	430 ~ 550	32 ~ 41
Timing belt cover bolt	8 ~ 10	80 ~ 100	6 ~ 7
Front case bolt	20 ~ 27	200 ~ 270	15 ~ 20
<b>Engine Mounting</b>			
Right mounting insulator (large) bolt	90 ~ 110	900 ~ 1100	66 ~ 81
Right mounting insulator (small) nut	50 ~ 65	500 ~ 650	37 ~ 48
Transmission mount insulator bolt	90 ~ 110	900 ~ 1100	66 ~ 81
Transmission insulator bracket to side member bolts	30 ~ 40	300 ~ 400	22 ~ 30
Front roll stopper insulator bolt	45 ~ 60	450 ~ 600	33 ~ 44
Front roll stopper bracket to sub frame bolt	30 ~ 40	300 ~ 400	22 ~ 30
Rear roll stopper insulator bolt	45 ~ 60	450 ~ 600	33 ~ 44
Rear roll stopper bracket to sub frame bolt	30 ~ 40	300 ~ 400	22 ~ 30
Oil filter	12 ~ 16	120 ~ 160	9 ~ 12
Oil pan bolts	10 ~ 12	100 ~ 120	7 ~ 9
Oil pan drain plug	40 ~ 45	400 ~ 450	30 ~ 33
Oil screen bolts	15 ~ 22	150 ~ 220	11 ~ 16

**GENERAL****EM -7**

Item	Nm	Kg.cm	lb.ft
Alternator support bolt and nut	20 ~ 25	200 ~ 250	15 ~ 18
Alternator lock bolt	12 ~ 15	120 ~ 150	9 ~ 11
Alternator brace mounting bolt	20 ~ 27	200 ~ 270	15 ~ 20
Coolant pump pulley	8 ~ 10	80 ~ 100	6 ~ 7
Coolant pump bolt	12 ~ 15	120 ~ 150	9 ~ 11
Coolant temperature sensor	25 ~ 30	250 ~ 300	18 ~ 22
Coolant inlet fitting bolt	17 ~ 20	170 ~ 200	13 ~ 14
Thermostat housing bolt	15 ~ 20	150 ~ 200	11 ~ 14
Air cleaner body mounting bolts	8 ~ 10	[80 ~ 100	6 ~ 7
Resonator mounting bolts	4 ~ 6	40 ~ 60	3 ~ 4
Intake manifold to cylinder head nuts and bolts	15 ~ 20	150 ~ 200	11 ~ 14
Surge tank stay to cylinder block bolts	18 ~ 25	180 ~ 250	13 ~ 18
Throttle body to surge tank bolts	15 ~ 20	150 ~ 200	11 ~ 14
Exhaust manifold to cylinder head nuts	25 ~ 30	250 ~ 300	18 ~ 22
Exhaust manifold cover to exhaust manifold bolts	15 ~ 20	150 ~ 200	11 ~ 14
Oxygen sensor to exhaust manifold	50 ~ 60	500 ~ 600	37 ~ 44
Front exhaust pipe to exhaust manifold nuts	30 ~ 40	300 ~ 400	22 ~ 30
Front exhaust pipe bracket bolts	30 ~ 40	300 ~ 400	22 ~ 30
Front exhaust pipe to catalytic converter bolts	40 ~ 60	400 ~ 600	30 ~ 44

**SERVICE STANDARD**

Standard value	
Antifreeze	Mixture ratio of anti-freeze in coolant
ETHYLENE GLYCOL BASE FOR ALUMINUM	50%



## MAINTENANCE

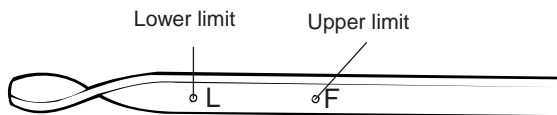
## CHECKING ENGINE OIL

1. Position the vehicle on a level surface.
2. Warm up the engine.

 **NOTE**

*If a vehicle has been out of service for a prolonged period of time, warm up the engine for approximately 20 minutes.*

3. Turn off the engine, and wait 2 or 3 minutes, then check the oil level.
4. Check that the engine oil level is within the level range indicated on the oil dipstick. If the oil level is found to have fallen to the lower limit (the L mark), refill to the "F" mark.



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 **NOTE**

*When refilling, use the same type of engine oil.*

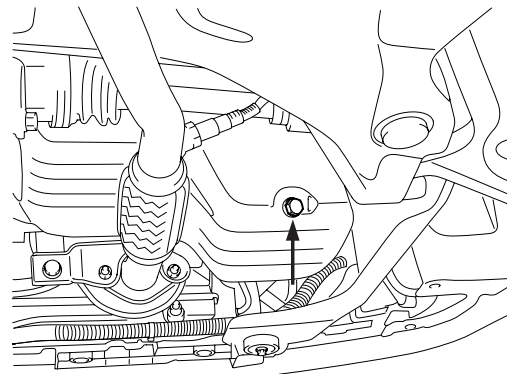
5. Check that the oil is not dirty or contaminated with coolant or gasoline, and that it has the proper viscosity.

## CHANGING ENGINE OIL

 **CAUTION**

***Be careful not to burn yourself, as the engine oil is hot.***

1. Run the engine until it reaches normal operating temperature.
2. Turn off the engine.
3. Remove the oil filler cap and the drain plug (on the oil pan). Drain the engine oil.



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4. Install and tighten the drain plug to the specified torque.

**Tightening torque**

Drain plug : 40 ~ 45 Nm (400 ~ 450 kg.cm, 30 ~ 33 lb.ft)

5. Fill the crankcase with fresh engine oil through the oil filler cap opening.

Drain and Refill Without oil filter :

3.0 liter (3.17 U.S.qts, 2.64 Imp.quts)

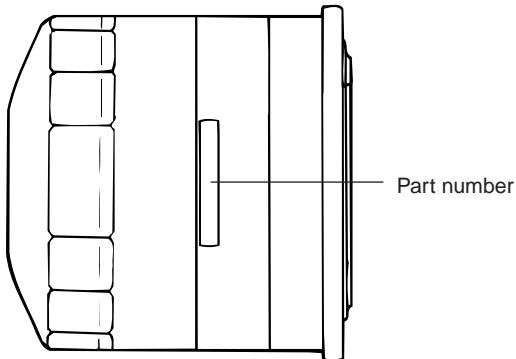
Drain and Refill With oil filter :

3.3 liter (3.48 U.S.qts, 2.64 Imp.quts)

6. Install the oil filler cap.
7. Start and run the engine.
8. Turn off the engine and then check the oil level. Add oil if necessary.

### FILTER SELECTION

All Hyundai engines are equipped with a high quality, disposable oil filter. This filter is recommended as a replacement filter on all vehicles. The quality of replacement filters varies considerably. Only high quality filters should be used to assure the most efficient service. Make sure that the rubber gasket from the old oil filter is completely removed from the contact surface on the engine block before installing the new filter.



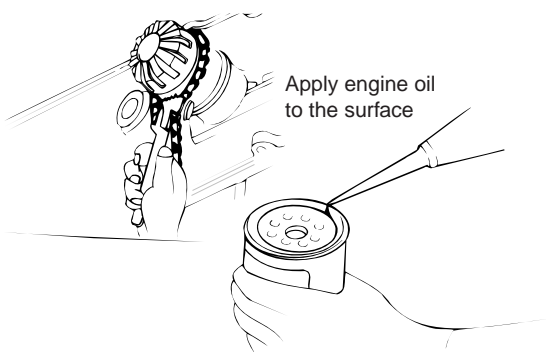
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### PROCEDURE FOR REPLACING THE OIL FILTER

#### CAUTION

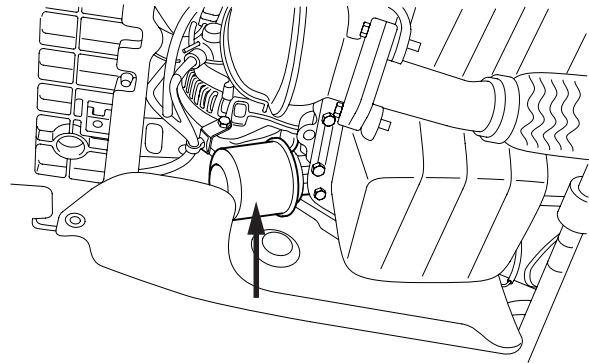
***Be careful not to burn yourself, as the engine and engine oil are hot.***

1. Use a filter wrench to remove the oil filter.
2. Before installing the new oil filter on the engine, apply clean engine oil to the surface of the rubber gasket.



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3. Tighten the oil filter to the specified torque.



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#### **Tightening torque**

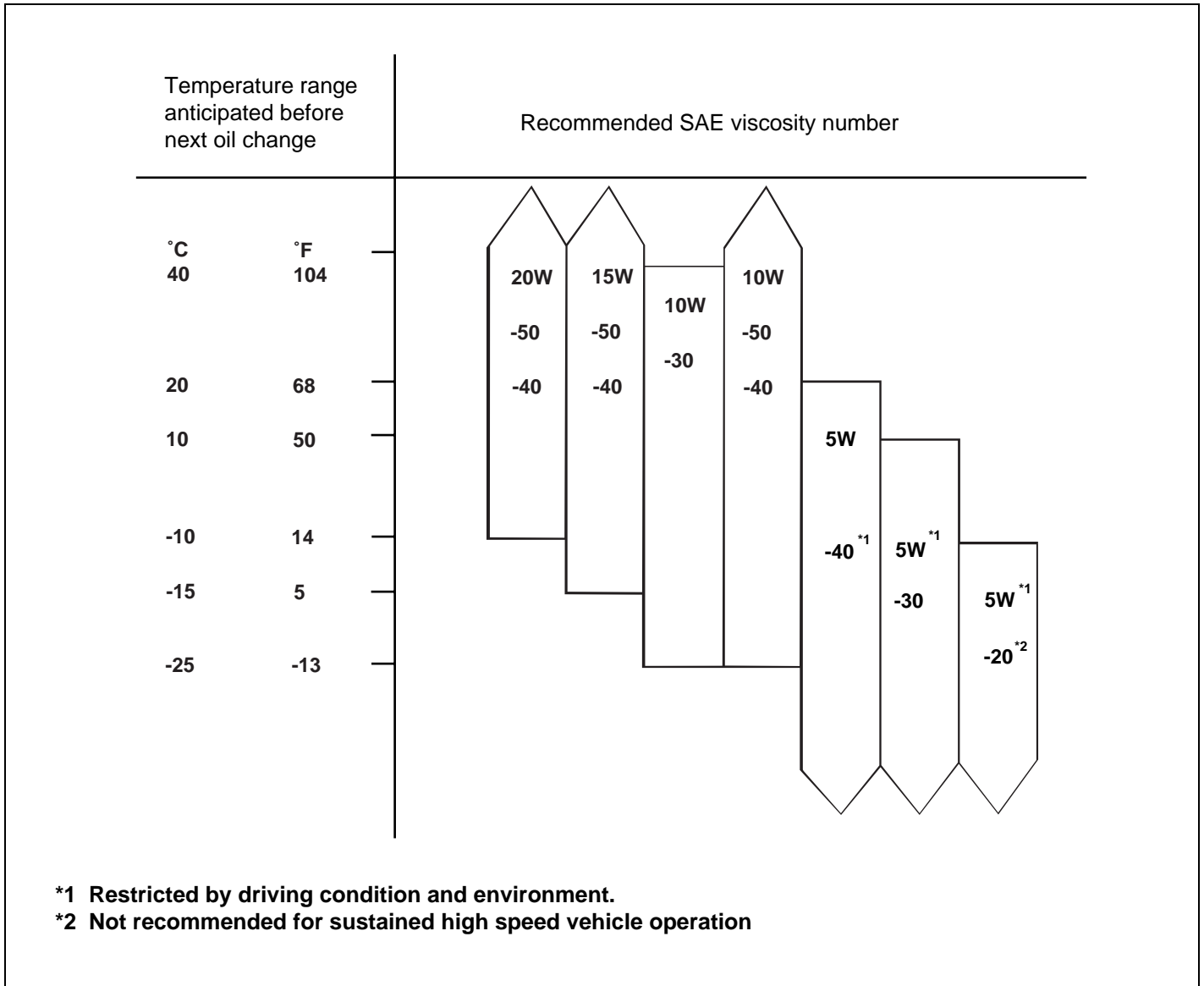
Oil filter : 12 ~ 16 Nm (120 ~ 160 kg.cm, 9 ~ 12 lb.ft)

4. Run the engine to check for engine oil leaks.
5. After turning off the engine, check the oil level and add oil as necessary.

## SELECTION OF ENGINE OIL

Recommended API classification : SH OR ABOVE

Recommended SAE viscosity grades :



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 **NOTE**

For best performance and maximum protection of all types of operation, select only those lubricants which:

1. Satisfy the requirements of the API classification.
2. Have proper SAE grade number for expected ambient temperature range.

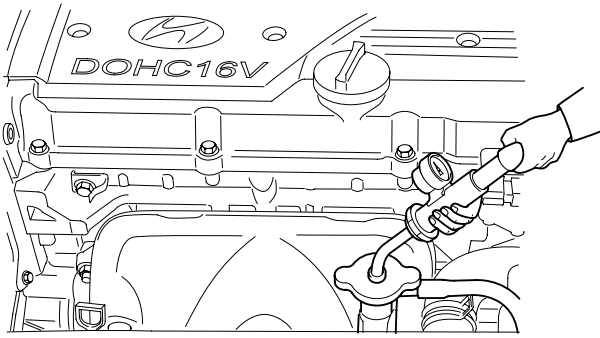
Lubricant that does not have both an SAE grade number and an API service classification on the container should not be used.

**CHECKING COOLANT LEAK**

1. Wait until the engine is cool, then carefully remove the radiator cap.
2. Confirm that the coolant level is up to the filler neck.
3. Install a radiator cap tester to the radiator filler neck and apply 140 KPa (1.4 kg/cm<sup>2</sup>, 20psi ) pressure. Hold it for two minutes in that condition, while checking for leakage from the radiator, hoses or connections.

**NOTE**

1. *Radiator coolant may be extremely hot. Do not open the system because hot, or scalding water could gush out causing personal injury. Allow the vehicle to cool before servicing this system.*
  2. *Be sure to clean away any moisture from the places checked completely.*
  3. *When the tester is removed, be careful not to spill any coolant from it.*
  4. *Be careful, when installing and removing the tester and when testing, not to deform the filler neck of the radiator.*
4. If there is leakage, repair or replace with the appropriate part.



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**RADIATOR CAP PRESSURE TEST**

1. Remove the radiator cap, wet its seal with engine coolant, then install it on the tester.
2. Increase the pressure until the gauge stops moving.

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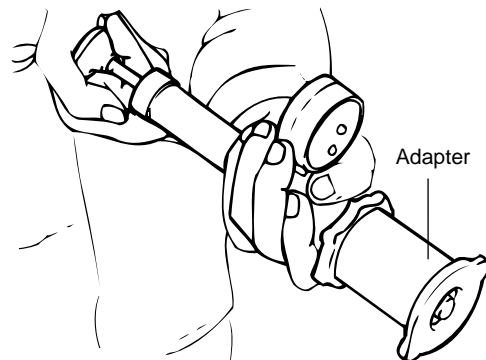
Main valve opening pressure :  
83 ~ 110 kPa (0.83 ~ 1.1 kg/cm<sup>2</sup>, 12 ~ 16 psi)  
Vacuum valve opening pressure :  
-7 kPa (-0.07 kg/cm<sup>2</sup>, -1.0 psi)

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3. Check that the pressure level is maintained at or above the limit.
4. Replace the radiator cap if the reading does not remain at or above the limit.

**NOTE**

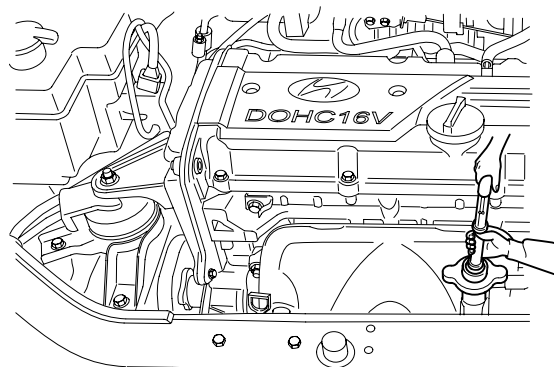
*Be sure that the cap is clean before testing, since rust or other foreign material on the cap seal will cause an incorrect reading.*



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**SPECIFIC GRAVITY TEST**

1. Measure the specific gravity of the coolant with a hydrometer.
2. Measure the coolant temperature and calculate the concentration from the relation between the specific gravity and temperature, using the following table for reference.



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**RELATION BETWEEN COOLANT CONCENTRATION AND SPECIFIC GRAVITY**

Coolant temperatur °C (°F) and specific gravity					Freezing temperature °C (°F)	Safe operating temperature °C (°F)	Coolant concentration (Specific volume)
10 (50)	20 (68)	30 (86)	40 (104)	50 (122)			
1.054	1.050	1.046	1.042	1.036	-16 (3.2)	-11 (12.2)	30%
1.063	1.058	1.054	1.049	1.044	-20 (-4)	-15 (5)	35%
1.071	1.067	1.062	1.057	1.052	-25 (-13)	-20 (-4)	40%
1.079	1.074	1.069	1.064	1.058	-30 (-22)	-25(-13)	45%
1.087	1.082	1.076	1.070	1.064	-36 (-32.8)	-31 (-23.8)	50%
1.095	1.090	1.084	1.077	1.070	-42 (-44)	-37 (-35)	55%
1.103	1.098	1.092	1.084	1.076	-50 (-58)	-45 (-49)	60%

**Example**

The safe operating temperature is -15°C (5°F) when the measured specific gravity is 1.058 at coolant temperature of 20°C (68°F)

 **CAUTION**

- *If the concentration of the coolant is below 30%, its anti-corrosion properties will be adversely affected.*

- *If the concentration is above 60%, both the anti-freeze and engine cooling property will decrease, affecting the engine adversely. For these reasons, be sure to maintain the concentration level within the specified range.*
- *Do not use together with another brand's product.*

**RECOMMENDED COOLANT**

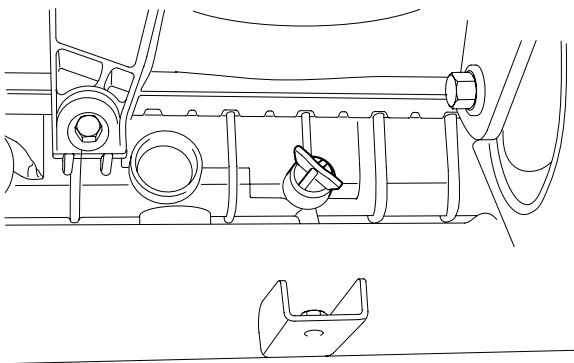
Antifreeze	Mixture ratio of anti freeze in coolant
ETHYLENE GLYCOL BASE FOR ALUMINUM	50% [Except tropical areas] 40% [Tropical areas]

## CHANGING ENGINE COOLANT

**CAUTION**

*When pouring engine coolant, be sure to shut the relay box lid and not to let coolant spill on electrical parts or the paint. If any coolant spills, rinse it off immediately.*

1. Slide the heater temperature control lever to maximum heat. Make sure the engine and radiator are cool to the touch.
2. Remove the radiator cap.
3. Loosen the drain plug, and drain the coolant.

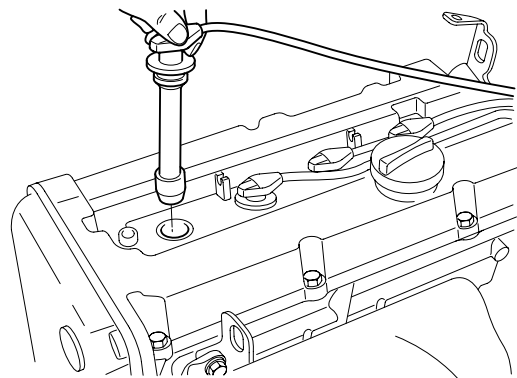


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4. Tighten the radiator drain plug securely.
5. Remove, drain and reinstall the reservoir. Fill the tank halfway to the MAX mark with water, then up to the MAX mark with antifreeze.
6. Pour coolant into the radiator up to the base of the filler neck, and install the radiator cap loosely.
7. Start the engine and let it run until it warms up (the radiator fan comes on at least twice).
8. Turn off the engine. Check the level in the radiator, add coolant if needed.
9. Put the radiator cap on tightly, then run the engine again and check for leaks.

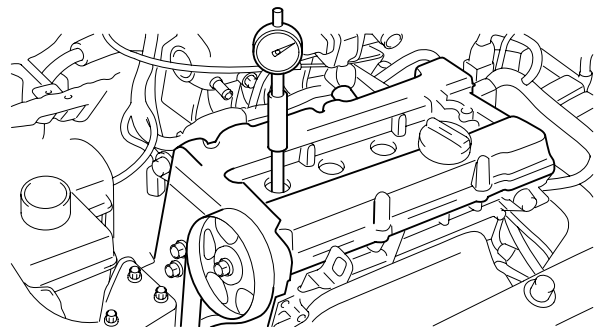
## CHECKING COMPRESSION PRESSURE

1. Before checking engine compression, check the engine oil level. Also check that the starter motor and battery are all in normal operating condition.
2. Check the DTC and note it. Use the scan tool to clear the ECM'S memory.
3. Start the engine and wait until engine coolant temperature reaches 80 ~ 95°C (176 ~ 205°F).
4. Disconnect the fuel pump connector.
5. Turn off engine and disconnect the spark plug cables.



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6. Remove the spark plugs.
7. Disconnect the I.G. connector.
8. Crank the engine to remove any foreign material in the cylinders.
9. Insert the compression gauge into the spark plug hole.



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10. Depress the accelerator pedal to open the throttle fully.

**EM -14****ENGINE DOHC**

11. Crank the engine and read the gauge.

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Standard value : 1500kpa (15Kg/cm<sup>2</sup>, 218 psi)

Limit : 1400kpa (14Kg/cm<sup>2</sup>, 203 psi)

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12. Repeat steps 9 to 11 over all cylinders, ensuring that the pressure differential for each of the cylinders is within the specified limit.

**Limit**


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Max 100 kpa (1.0 kg/cm<sup>2</sup>, 14 psi) between cylinders

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13. If a cylinder's compression or pressure differential is outside the specification, add a small amount of oil through the spark plug hole, and repeat steps 9 to 12.

- 1) If the addition of oil makes the compression to rise, it is likely that there may be wear between the piston ring and cylinder wall.
- 2) If compression remains the same, valve seizure, poor valve seating or a compression leak from the cylinder head gasket are all possible causes.

**Tightening torque**


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Spark plug : 20 ~ 30 Nm (200 ~ 300 kg.cm, 14 ~ 22 lb.ft)

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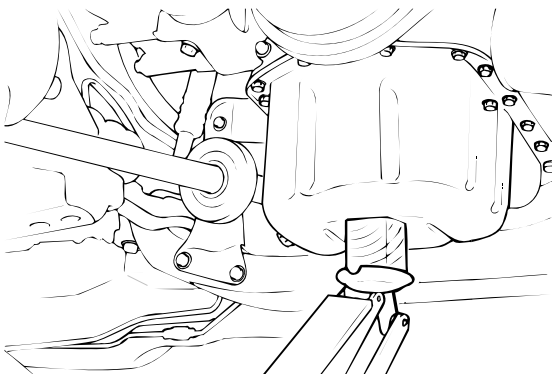
**ADJUSTING TIMING BELT TENSION**

1. Rotate the steering wheel counter-clockwise throughly.

**NOTE**

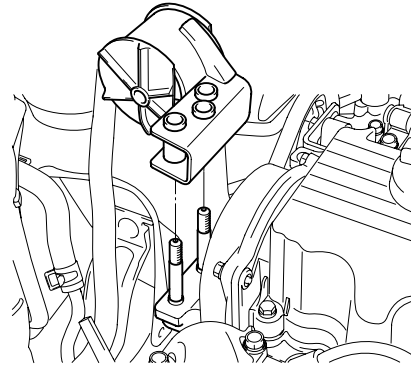
*Do watch not to over load.*

2. Lift the vehicle by using of jack.



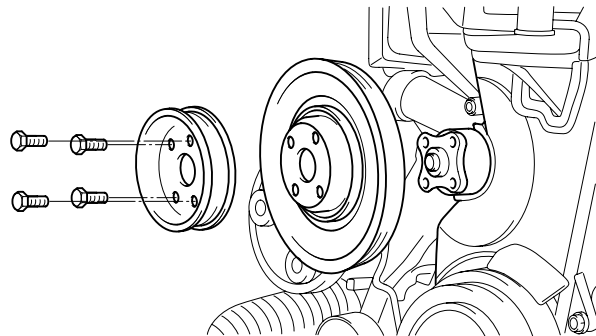
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3. Remove the engine support bracket. (14mm bolt and 2nuts, 17mm bolt)



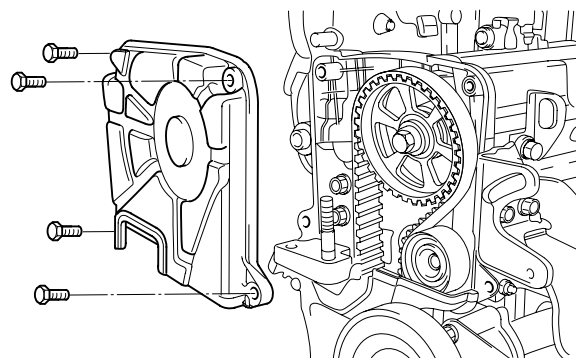
KDDC003B

4. Remove the drive belts and the water pump pulley. (10 mm 4 bolts)



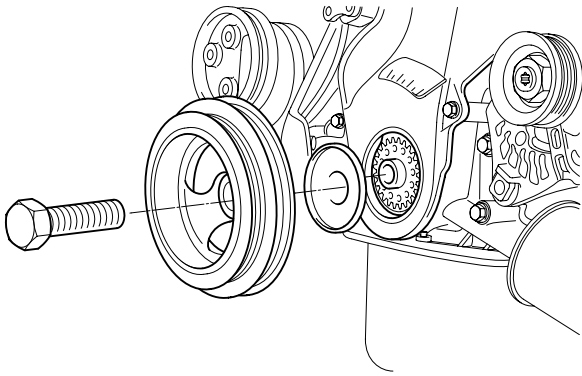
KDDC004B

5. Remove the timing belt upper cover. (10 mm 4 bolts)



KCDC002C

6. Remove the crankshaft pulley.

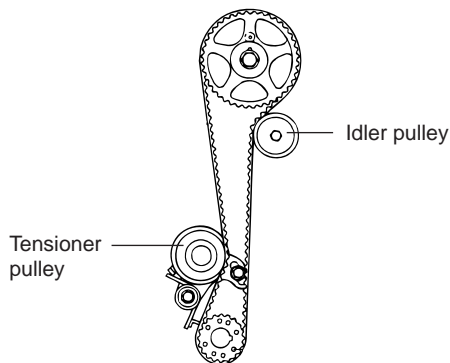


KDDC007B

7. Remove the timing belt lower cover.  
8. Place the piston of No. 1 cylinder to TDC of the compression stroke by rotating the crankshaft clockwise.

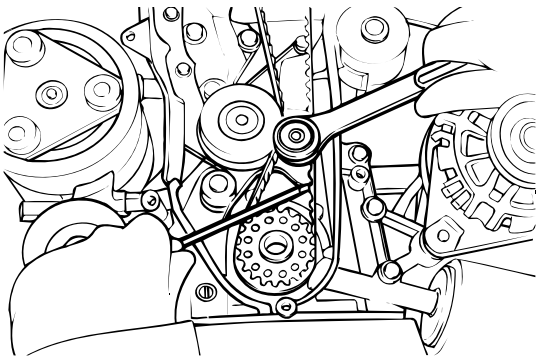
**NOTE**

*Crankshaft is to be rotated clockwise otherwise, the tension is inadequately adjusted.*



EDDB091A

9. Loosen the tensioner bolt of pivot side and slot side.



EDDA092A

10. Rotate the crankshaft clockwise as many as 2 teeth of camshaft sprocket.

11. Check that the teeth of the sprocket and belt coincide with each other.  
12. Tighten the slot side bolt first and then tighten the bolt of pivot side.  
13. Check the tension of the timing belt.  
When the tensioner and the tension side of the timing belt are pushed in horizontally with a moderate force [approx. 49N (11 lb)], the timing belt log end is approx. half of the tensioner mounting bolt head radius (cross flats) away from the bolt head center.



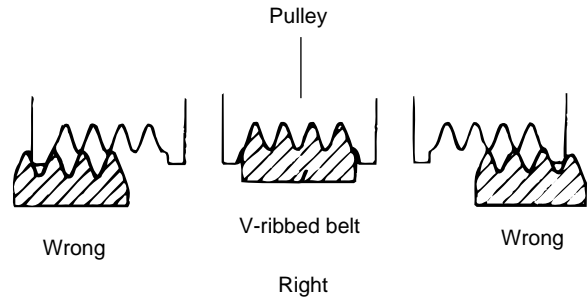
EDKE108A

14. Rotate the crankshaft pulley two turns clockwise so that the timing belt positions on the pulleys.  
15. Install the timing belt lower cover.  
16. Install the crankshaft pulley.  
17. Install the timing belt upper cover.  
18. Install the water pump pulley and engine support bracket.



**ADJUSTING DRIVE BELT TENSION**

1. Check that the belts are not damaged and are properly fit for the pulley grooves.
2. Apply 100 N (22 lbs.) force to the back and midway portion of the belt between the pulleys as shown in the illustration, measure the amount of deflection with a tension gauge.

**CAUTION**

1. **When installing the V-ribbed belt, check that the V-ribs are properly aligned.**
2. **If noise or slippage is detected, check the belt for wear, damage, or breakage on the pulley contact surface, and check the pulley for scoring. Also check the amount that the belt is deflected.**

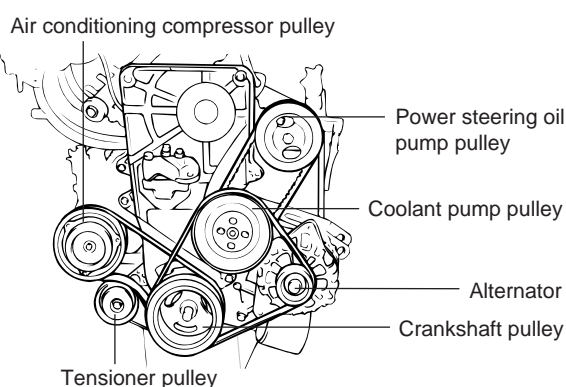
ECA9980A

**STANDARD VALUE:**

Items		Inspection	Adjustment	
			New	Used
For alternator	Deflection mm (in.)	5.1~6.0(0.200~0.236)	4.0~4.4(0.157~0.173)	5.0~5.7(0.200~0.224)
	Tension N (lb)	350~500(79~112)	650~750(143~165)	400~500(88~110)
For air conditioner	Deflection mm (in.)	8(0.31)	5.0~5.5(0.20~0.22)	6.0~7.0(0.24~0.28)
	Tension N (lb)	250~500(56~112)	470~570(106~128)	320~400(72~90)
For power steering	Deflection mm (in.)	6.0~9.0(0.24~0.35)	-	-

**NOTE**

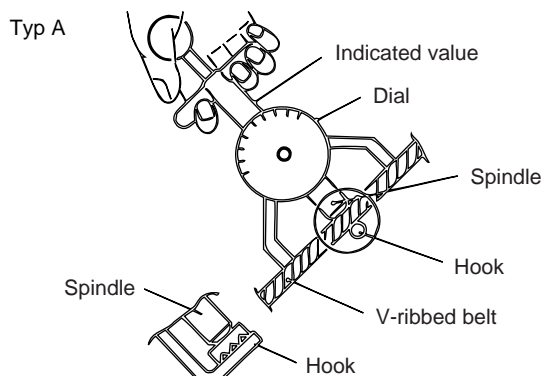
1. The belt tension must be measured half - way between the specified pulleys.
2. When a new belt is installed, adjust the tension to the central value of the standard range indicated under "New" in the above table. Let the engine idle for 5 minutes or more, and check the standard value indicated under "Inspection."
3. When adjusting a belt which has been used, or newly installed, after 5 minutes or more of operation, refer to the standard value indicated under "Used" in the above table.
4. Refer to the standard value indicated under "Inspection" for periodic inspections.



ECPD001B

**TYPE A TENSION GAUGE**

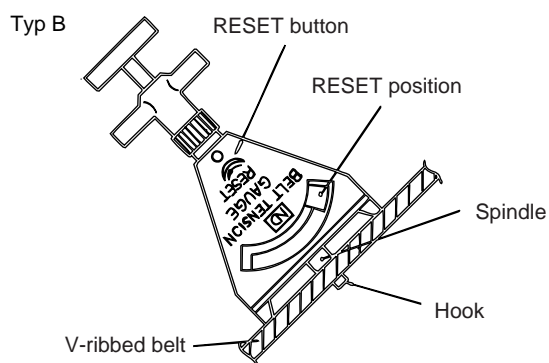
Do not let the dial section of the tension gauge contact other objects during measurement.



ECA9980C

**TYPE B TENSION GAUGE**

1. When measuring, turn the reset button in the direction of the arrow and set the gauge needle to the RESET position.
2. If the tension gauge is removed from the belt, the needle will still indicate the tension. Read the tension value after removing the gauge.



ECA9980D

**ADJUSTING THE ALTERNATOR BELT****CAUTION**

*If the belt is too loose, it will cause noise or sudden wear.*

*If the belt is too tight, the engine coolant pump bearing or the alternator can get damaged.*

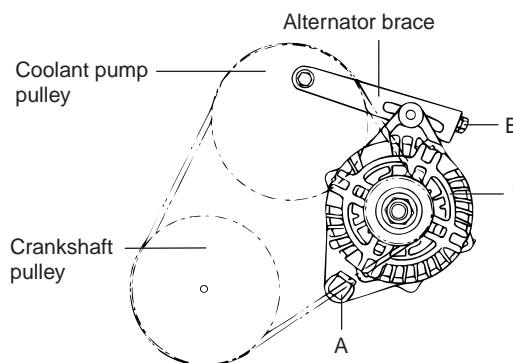
1. Loosen the alternator nut "A" and the tension adjuster lock bolt "B".
2. Using the tension adjuster bolt, adjust the belt tension to the specification.
3. Tighten the adjuster lock bolt "B".
4. Tighten the alternator nut "A".
5. Check the tension or the deflection of belt, readjust if necessary.

**Tightening torque**

Alternator support bolt and nut :  
20 ~ 25 Nm (200 ~ 250 kg.cm, 14 ~ 18 lb.ft)

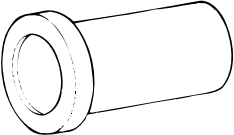
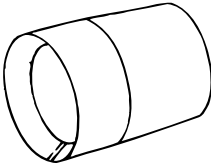
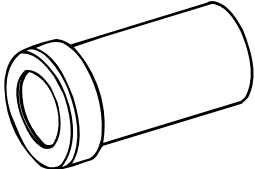
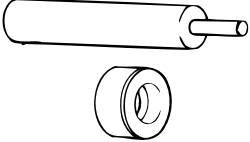
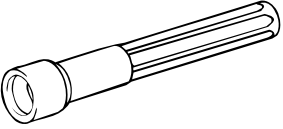
Alternator lock bolt B :  
12 ~ 15 Nm (120 ~ 150 kg.cm, 9 ~ 11 lb.ft)

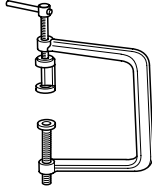
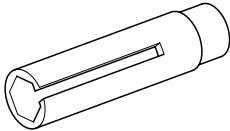
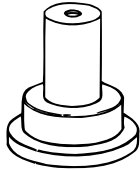
Alternator brace mounting bolt :  
20 ~ 27 Nm (200 ~ 270 kg.cm, 15 ~ 20 lb.ft)



ECKA010H

**SPECIAL TOOLS** E0845550

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal installer (09231 - 22000)	 <p style="text-align: right;">ECKA010C</p>	Installation of the front oil seal
Crankshaft front oil seal guide (09231 - 22100)	 <p style="text-align: right;">ECKA010D</p>	Guide of oil seal
Camshaft oil seal installer (09221 - 21000)	 <p style="text-align: right;">EDDA005B</p>	Installation of the camshaft oil seal
Valve guide installer (09221 - 3F100 A/B)	 <p style="text-align: right;">ECKA010B</p>	Removal and installation of valve guides
Valve stem oil seal installer (09222 - 22001)	 <p style="text-align: right;">ECKA010A</p>	Installation of valve stem oil seals

Tool (Number and name)	Illustration	Use
Valve spring compressor (09222 - 28000) Valve spring compressor holder (09222 - 28100)	 <p style="text-align: right;">EDDA005C</p>	Removal and installation of intake and exhaust valves
Water temperature sensor socket wrench (09221 - 25100)	 <p style="text-align: right;">EDKD101B</p>	Removal and installation of the water temperature sensor
Crankshaft rear oil seal installer (09231 - 21000)	 <p style="text-align: right;">EDDA005F</p>	Installation of engine rear oil seal and crankshaft rear oil seal

## TROUBLESHOOTING E6712BDA

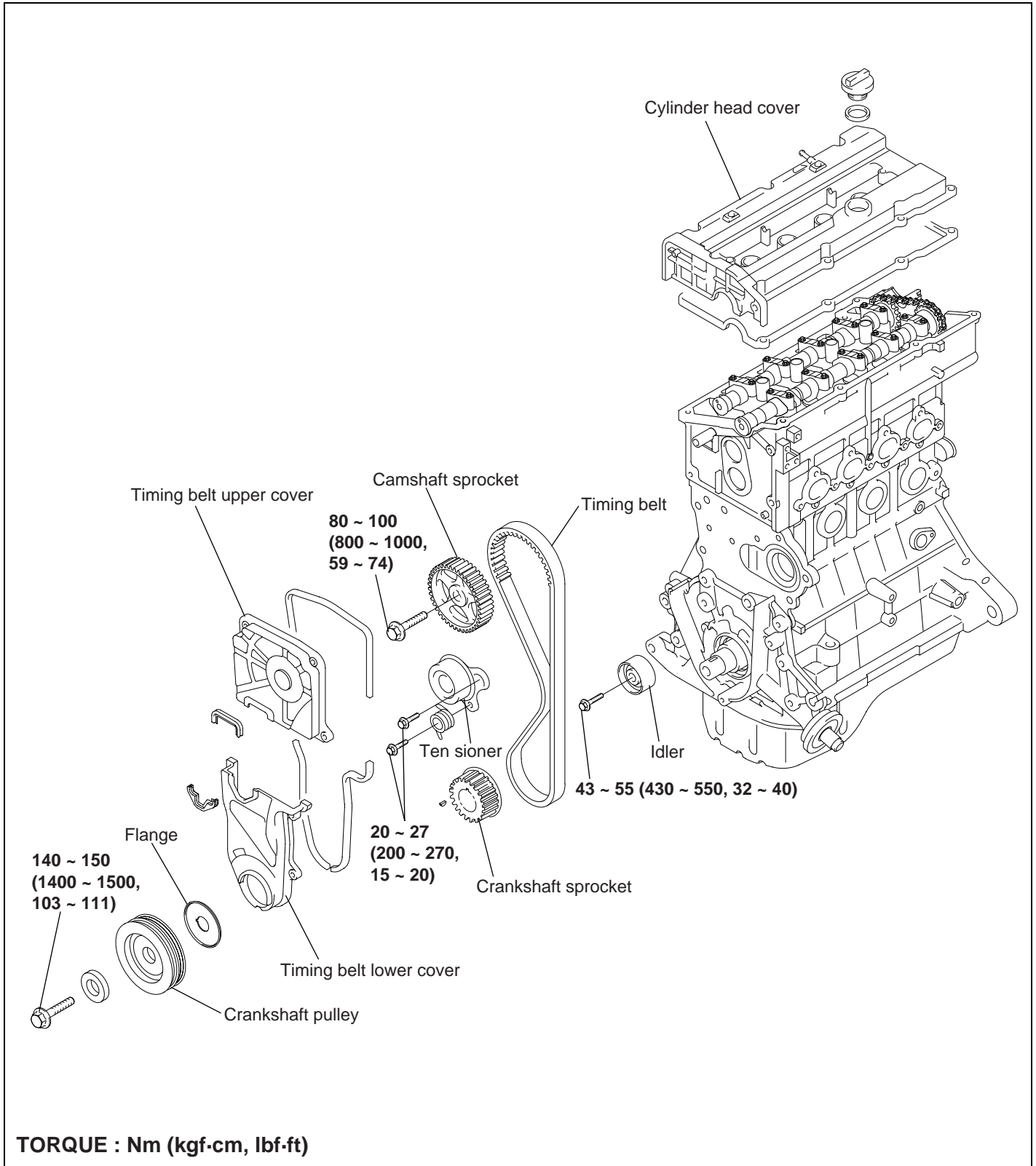
Symptom	Probable cause	Remedy
Low compression	Blown cylinder head gasket	Replace gasket
	Worn or damaged piston rings	Replace rings
	Worn piston or cylinder	Repair or replace piston and/or cylinder block
	Worn or damaged valve seat	Repair or replace valve and/or seat ring
Low oil pressure	Low engine oil level	Check engine oil level
	Faulty oil pressure switch	Replace
	Clogged oil filter	Replace
	Worn oil pump gears or cover	Replace
	Thin or diluted engine oil	Change and determine cause
	Oil relief valve stuck (open)	Repair
	Excessive bearing clearance	Replace
High oil pressure	Oil relief valve stuck (closed)	Repair
Excessive engine vibration	Loose engine roll stopper (front, rear)	Re-tighten
	Loose transaxle mount bracket	Re-tighten
	Loose engine mount bracket	Re-tighten
	Loose center member	Re-tighten
	Broken transaxle mount insulator	Replace
	Broken engine mount insulator	Replace
	Broken engine roll stopper insulator	Replace
Noisy valves	Thin or diluted engine oil (low oil pressure)	Change
	Worn or damaged valve stem or valve guide	Replace
	HLA abnormal operation	Speed the engine up (for venting) or Replace the HLA
Connecting rod and/or main bearing noise	Insufficient oil supply	Check engine oil level
	Thin or diluted engine oil	Change and determine cause
	Excessive bearing clearance	Replace
Timing belt noise	Incorrect belt tension	Adjust belt tension
Low coolant level	Leakage of coolant	
	1. Heater or radiator hose	Repair or replace parts
	2. Faulty radiator cap	Tighten or replace clamps
	3. Thermostat housing	Replace gasket or housing
	4. Radiator	Repair or replace
	5. Engine coolant pump	Replace parts
Clogged radiator	Foreign material in coolant	Replace coolant

Symptom	Probable cause	Remedy
Abnormally high coolant temperature	Faulty thermostat	Replace parts
	Faulty radiator cap	Replace parts
	Restricted flow in cooling system	Clear restriction or replace parts
	Loose or missing drive belt	Adjust or replace
	Faulty water pump	Replace
	Faulty electric fan	Repair or replace
	Insufficient coolant	Refill coolant
Abnormally low coolant temperature	Faulty thermostat	Replace
	Faulty temperature sensor wiring	Repair or replace
Inoperative electrical cooling fan	Damaged thermo sensor, electrical motor, radiator fan relay and wiring, fuse	Replace or repair
Exhaust gas leakage	Loose connections	Retighten
	Broken pipe or muffler	Repair or replace
Abnormal noise	Detached baffle plate in muffler	Replace
	Broken rubber hanger	Replace
	Pipe or muffler contacting vehicle body	Correct
	Broken pipe or muffler	Repair or replace

# TIMING SYSTEM

## TIMING BELT

### COMPONENTS E4B24FDE

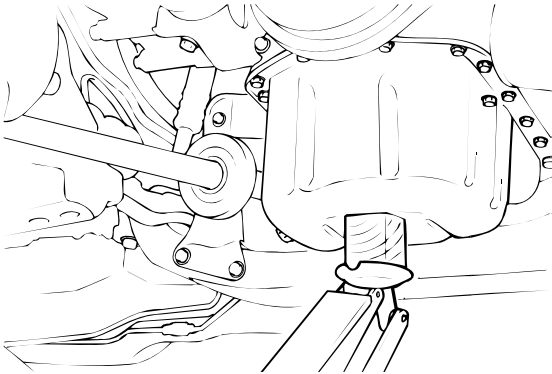


**TORQUE : Nm (kgf-cm, lbf-ft)**

**TIMING SYSTEM**

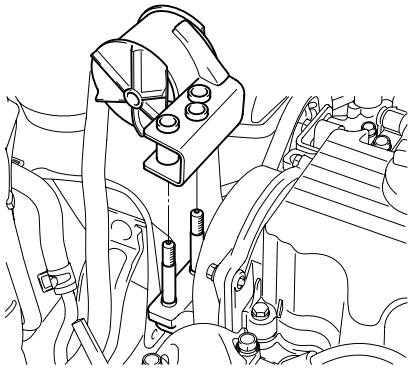
**DISASSEMBLY** EE695E6A

1. Lift the vehicle by using of jack.



KCDA125K

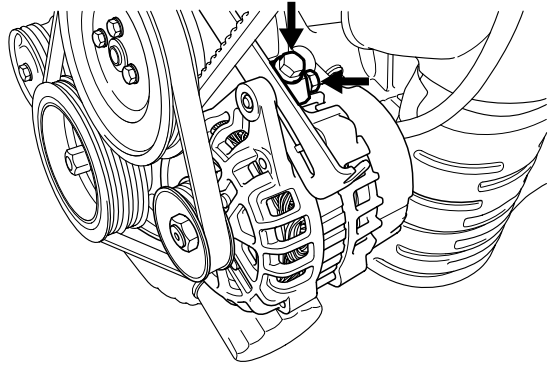
2. Remove the engine support bracket. (14 mm bolt and 2 nuts, 17 mm bolt)



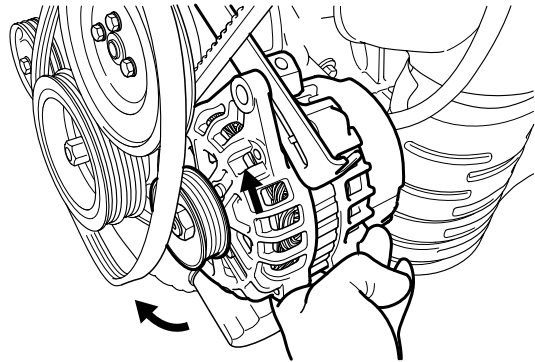
KDDC003B

3. Remove the power steering belt.
4. Remove the air conditioning compressor belt.

5. Remove the alternator belt.

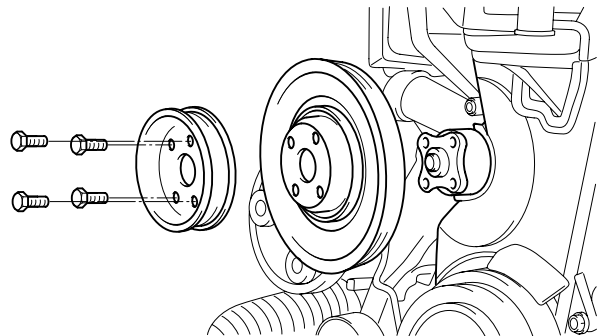


KBPD160A



KBPD160B

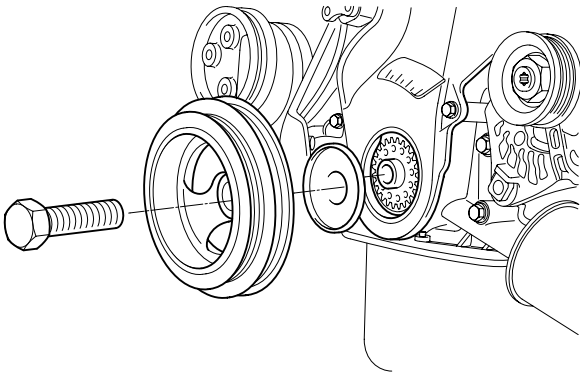
6. Remove the coolant pump pulley.



KDDC004B

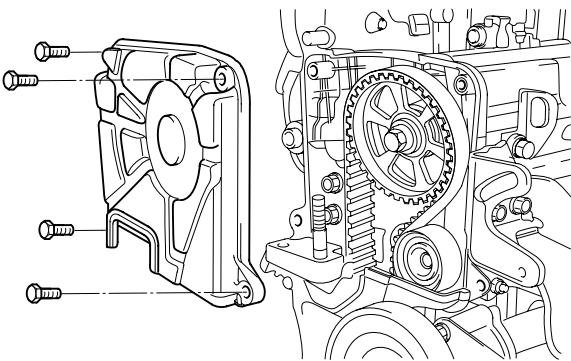


7. Remove the crankshaft pulley.



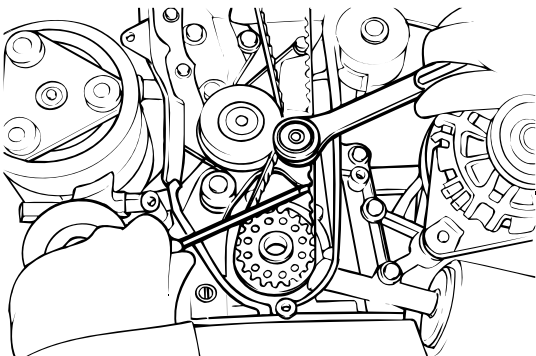
KDDC007B

8. Remove the timing belt cover.



KDCD002C

9. Move the timing belt tensioner pulley toward the coolant pump and temporarily secure it.

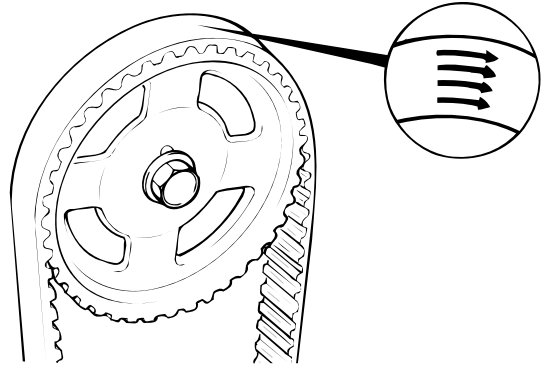


EDDA092A

10. Remove the timing belt.

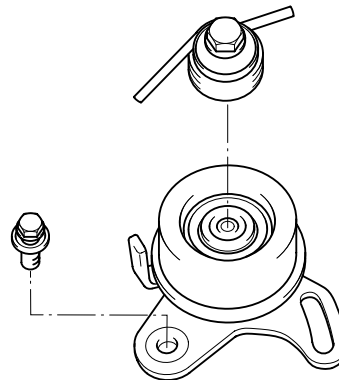
**NOTE**

If the timing belt is reused, mark with an arrow to indicate direction of rotation (on the front of the engine) to make sure that the belt is reinstalled in the same direction as before.



ECDA121B

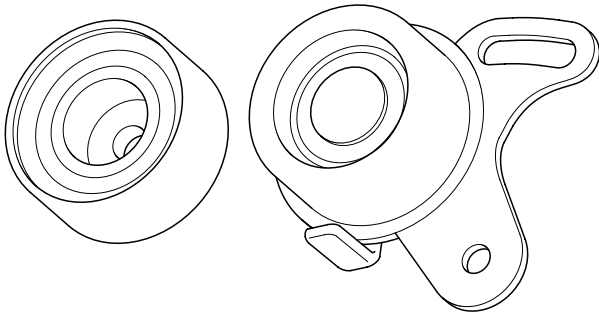
11. Remove the camshaft from the camshaft sprocket.  
 12. Remove the crankshaft sprocket and flange.  
 13. Remove the timing belt idler.  
 14. Remove the timing belt tensioner.



KDPC008C

**TIMING SYSTEM****INSPECTION** E193FC6F**SPROCKETS TENSIONER PULLEY, AND IDLER PULLEY**

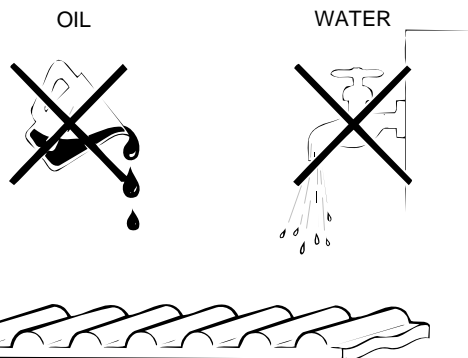
1. Check the camshaft sprocket, crankshaft sprocket, tensioner pulley, and idler pulley for abnormal wear, cracks, or damage.  
Replace as necessary.
2. Inspect the tensioner pulley and the idler pulley for easy and smooth rotation and check for play or noise.  
Replace as necessary.
3. Replace the pulley if there is a grease leak from its bearing.



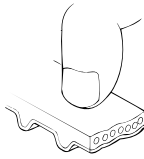
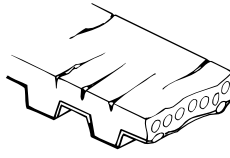
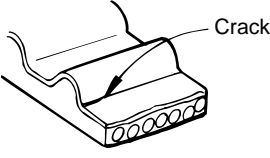
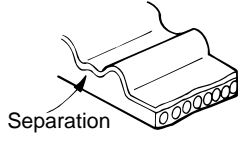
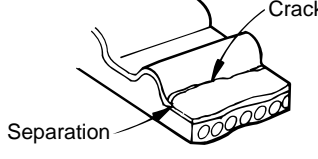
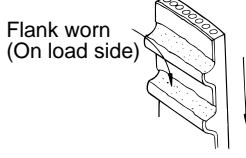
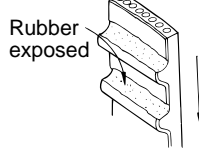
EDKD106A

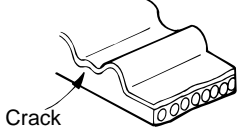


**TIMING BELT**

1. Check the belt for oil or dust deposits. Replace, if necessary.  
Small deposits should be wiped away with a dry cloth or paper. Do not clean with solvent.
2. When the engine is overhauled or belt tension adjusted, check the belt carefully. If any of the following flaws are evident, replace the belt with a new one.



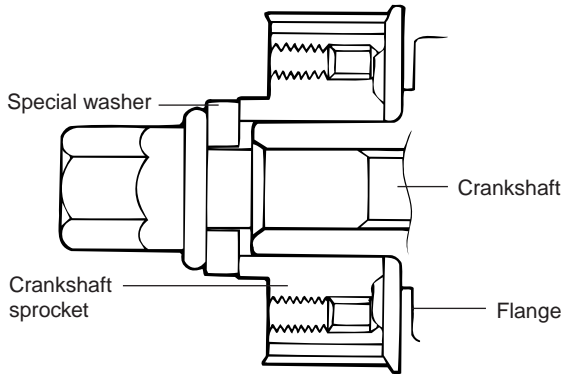
EDDA093B

Description	Flaw conditions
1. Hardened back surface <ul style="list-style-type: none"> <li>• Back surface is glossy, non-elastic and so hard that when your fingernail is pressed into it. no mark is produced.</li> </ul>	 <p style="text-align: right;">EDDA093C</p>
2. Cracked back surface rubber	 <p style="text-align: right;">EDDA093D</p>
3. Cracked or separating canvas	 <p style="text-align: right;">EDDA093E</p>
	 <p style="text-align: right;">EDDA093F</p>
	 <p style="text-align: right;">EDDA093G</p>
4. Badly worn teeth (initial stages) <ul style="list-style-type: none"> <li>• Canvas on load side of tooth flank worn (Fluffy canvas fibers, rubber gone and color changed to white, and unclear canvas texture)</li> </ul>	 <p style="text-align: right;">EDDA093H</p>
5. Badly worn teeth (last stage) <ul style="list-style-type: none"> <li>• Canvas on load side of tooth flank worn down and rubber exposed (tooth width reduced)</li> </ul>	 <p style="text-align: right;">EDDA093I</p>

Description	Flaw conditions
6. Cracked tooth bottom	 <p>Crack</p> <p style="text-align: right;">EDDA093J</p>
7. Missing tooth	 <p>Tooth missing and canvas fiber exposed</p> <p style="text-align: right;">EDDA093K</p>
8. Side of belt badly worn   <b>NOTE</b> <i>Normal belt should have precisely cut sides as if cut by a sharp knife.</i>	
9. Side of belt cracked	

**REASSEMBLY** E6A34B7C

1. Install the flange and crankshaft sprocket as shown. Pay close attention to their mounting directions.



ECNC094B

2. Install the camshaft sprocket and tighten the bolt to the specified torque.

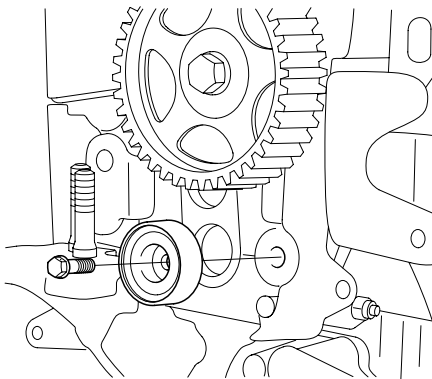
**Tightening torque**

Camshaft sprocket bolt :  
80 ~ 100 Nm (800 ~ 1000 kg.cm, 59 ~74 lb.ft)

3. Install the idler and tighten the idler bolt to the specified torque.

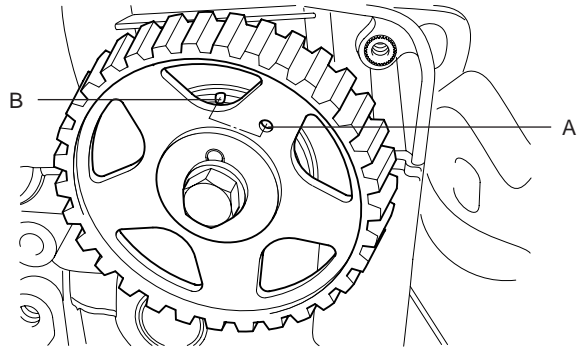
**Tightening torque**

Idler bolt : 43 ~ 55 Nm (430 ~ 550 kg.cm, 32 ~ 41 lb.ft)

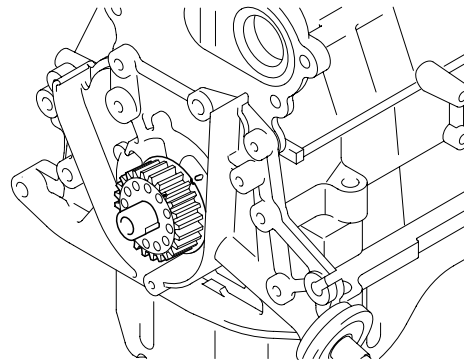


EDKE103A

4. Align the timing marks of the camshaft sprocket (A) and camshaft bearing cap (B). Then align the timing marks of crankshaft sprocket and front case with the No.1 piston placed at top dead center on its compression stroke as shown in the illustration.

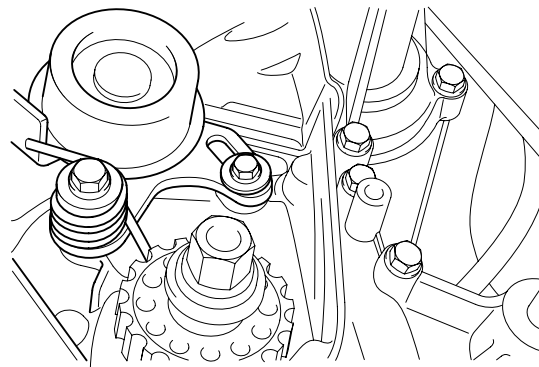


ECDD008F



EDKE107A

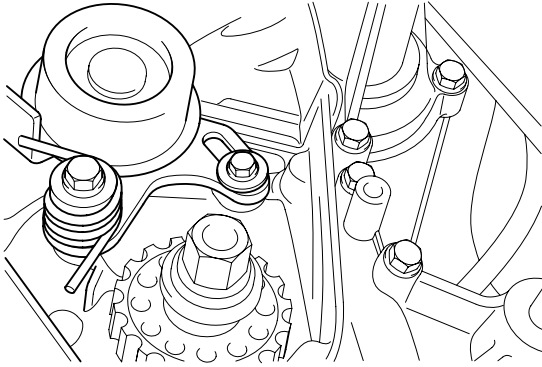
5. To install the timing belt tensioner, first mount the tensioner, spring, and spacer. Temporarily tighten the bolts. Next, temporarily tighten the tensioner long hole side washer and bolts. Install the bottom end of the spring against the front case as shown in the illustration.



KDPC008D

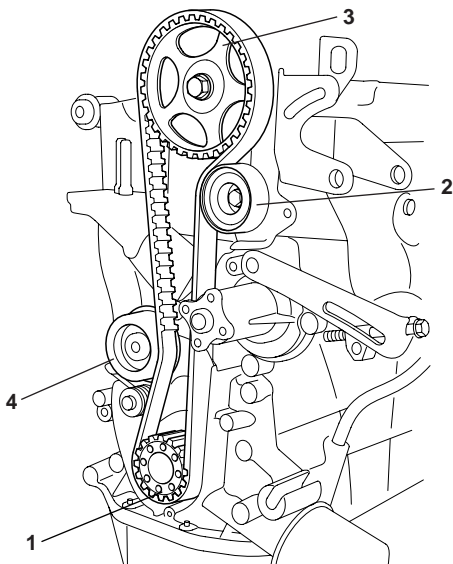
**TIMING SYSTEM****EM -29**

6. Secure the tensioner, positioned towards the water pump.



KDPC008E

7. Install the timing belt on the crankshaft sprocket.  
 (1) Crankshaft sprocket (2) Timing belt idler (3)  
 Camshaft sprocket (4) Timing belt tensioner.



EDKE109A

8. Install the timing belt on the camshaft sprocket. When the timing belt is installed on the camshaft sprocket, make sure that the tension side is tight. Then, check to ensure that when the tension side is tightened by turning the camshaft sprocket in a reverse direction and all timing marks are in line.

9. Tighten the tensioner bolts.

**Tightening torque**

Tensioner attaching bolt :  
 20 ~ 27 Nm (200 ~ 270 kg.cm, 15 ~ 20 lb.ft)

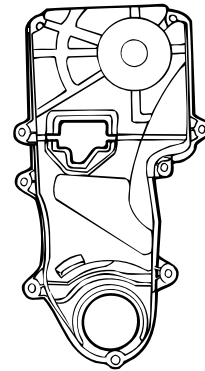
10. Turn the crankshaft two turns in its operating direction (clock-wise) and realign the camshaft sprocket timing mark with the top dead center position.

11. Then recheck the belt tension. Verify that when the tensioner and the tension side of the timing belt are pushed in horizontally with a moderate force [approx. 49N (11lb)], the timing belt cog end is approx. 1/2 of the tensioner mounting bolt head radius (across flats) away from the bolt head center.



EDKE108A

12. Install the timing belt cover.



EDDA094F

**Tightening torque**

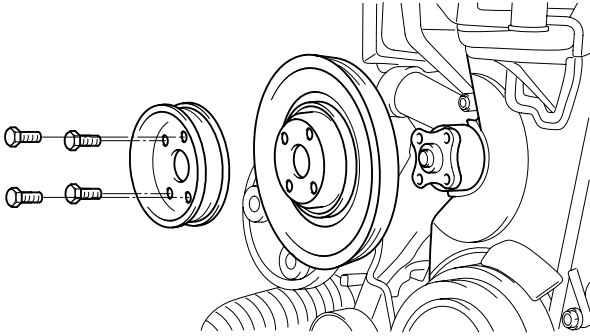
Timing belt cover bolt :  
 8 ~ 10 Nm (80 ~ 100 kg.cm, 6 ~ 7 lb.ft)

13. Install the crankshaft pulley. Make sure that the crankshaft sprocket pin fits the small hole in the pulley.

**Tightening torque**

Crankshaft pulley bolt :  
 140 ~ 150 Nm (1400 ~ 1500 kg.cm, 103 ~ 111 lb.ft)

14. Install the water pump pulley.



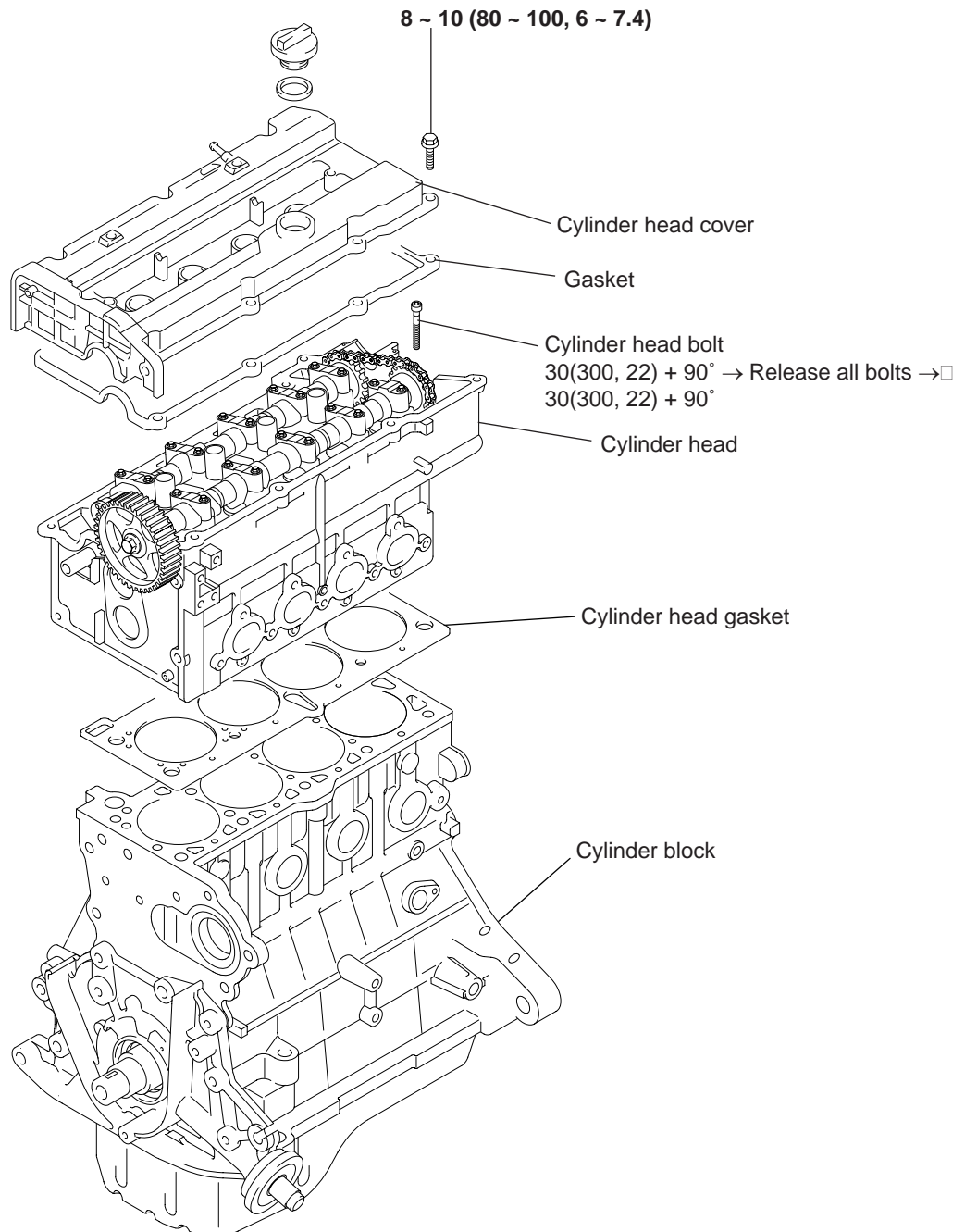
KDDC004B

15. Install the alternator belt and adjust the belt tension.
16. Install the air conditioning compressor belt and adjust the belt tension.
17. Install the power steering belt and adjust the belt tension.

# CYLINDER HEAD ASSEMBLY

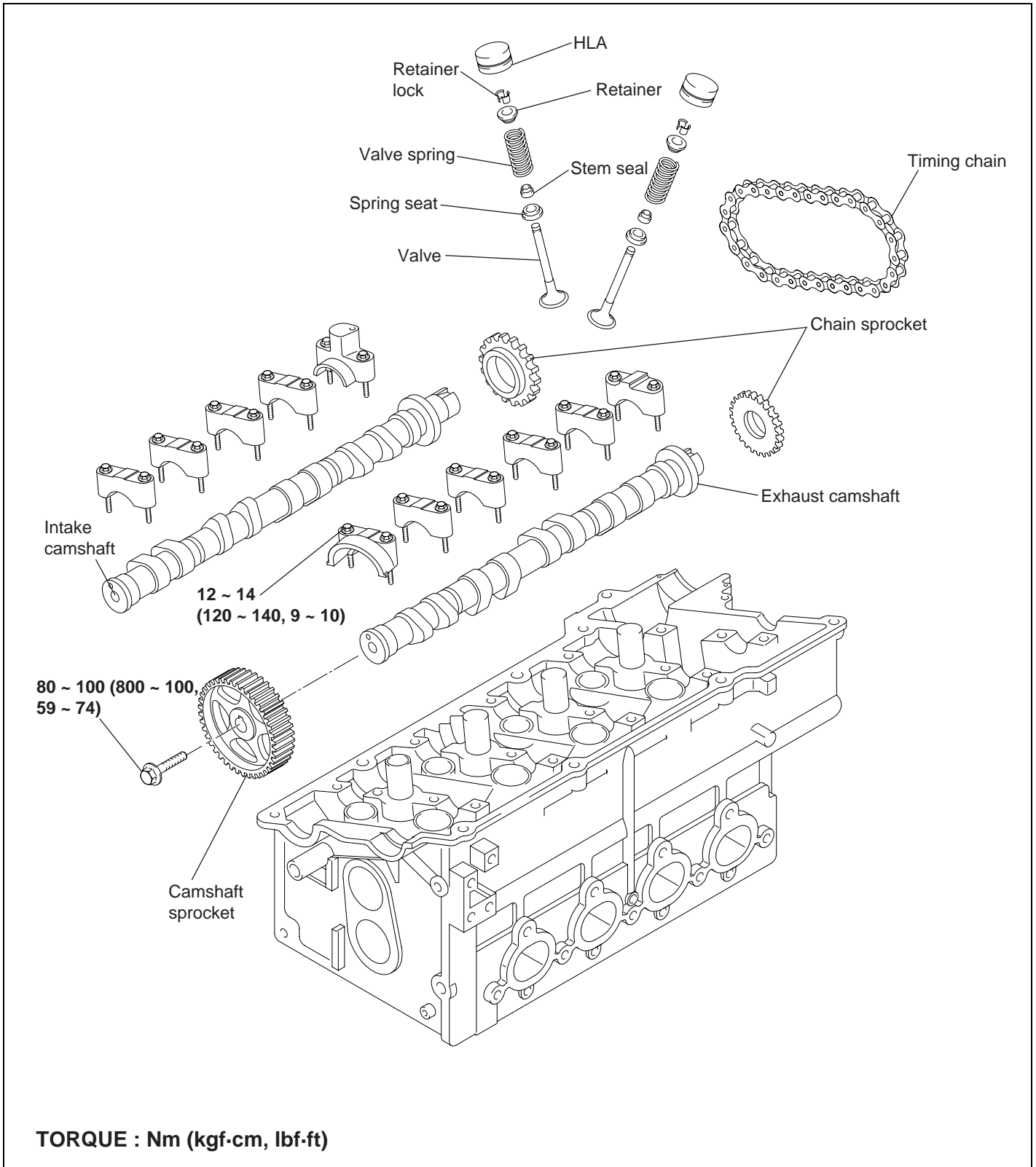
## CYLINDER HEAD

### COMPONENTS E804EE47



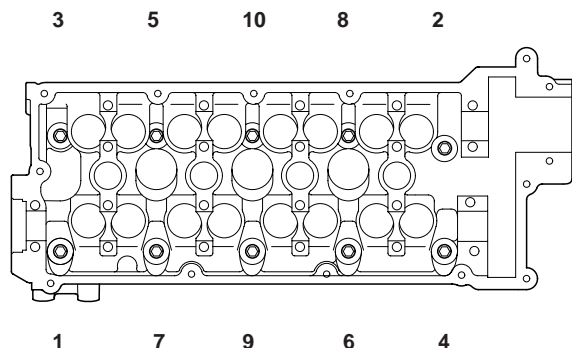
**TORQUE : Nm (kgf.cm, lbf.ft)**





**CYLINDER HEAD ASSEMBLY****EM -33****DISASSEMBLY** EBCFA4C6

- Using a tool remove the cylinder head bolts in the order shown in the illustration.

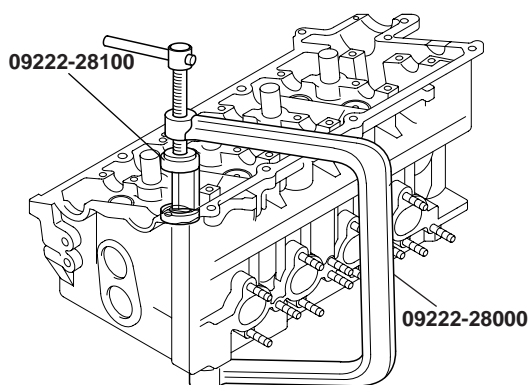


EDKD115A

- Using the special tool (09222-28000, 09222-28100), remove the valve retainer lock. Next remove the spring retainer, valve spring, spring seat and valve.

**NOTE**

Arrange these parts so that they can be reinstalled in their original positions.

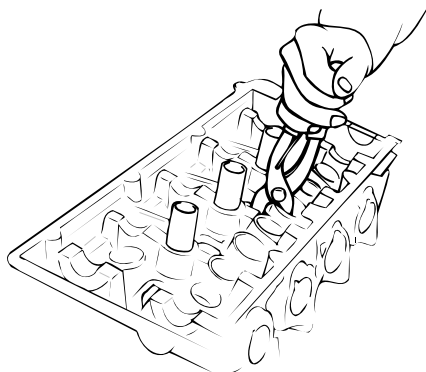


EDKD116A

- Remove the valve stem seals with pliers.

**NOTE**

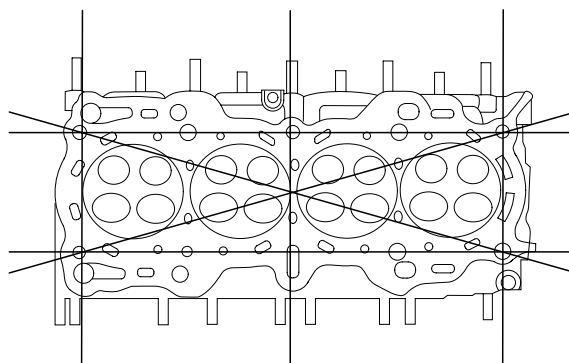
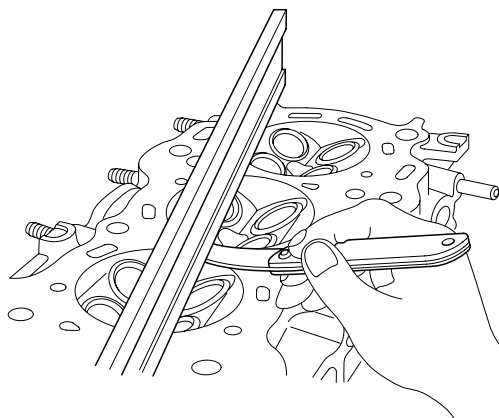
Do not reuse the valve stem seals.



EDDE088B

**INSPECTION** EE4FDB50**CYLINDER HEAD**

- Check the cylinder head for cracks, damage and coolant leakage. If cracked, replace the cylinder head.
- Remove scale, sealing compound and carbon deposits completely. After cleaning the oil passages, apply compressed air to verify that the passages are not clogged.



ECKD001H

- Check the cylinder head surface for flatness in the direction as shown in the illustration. If flatness exceeds the service limit in any direction, either replace the cylinder head or machine the cylinder head matching surface lightly.

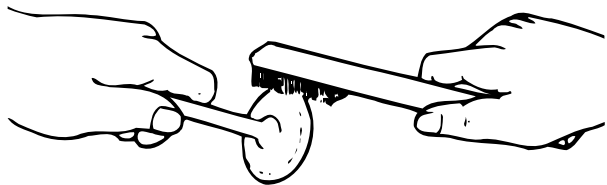
**Flatness of cylinder head gasket surface**

Standard : Less than 0.03 mm (0.0012 in.)

Limit : 0.05 mm (0.002 in.)

**VALVES**

- Using a wire brush, clean the valve thoroughly.



ECA9281A

- Check each valve for wear, damage and distortion of the head and the stem at B position. Replace, if necessary. If stem end, A, is hollowed out or worn, resurface as necessary. This correction must be limited to a minimum. Also resurface the valve face. Replace the valve if the margin has decreased to less than the service limit.

**Margin**

[Standard]

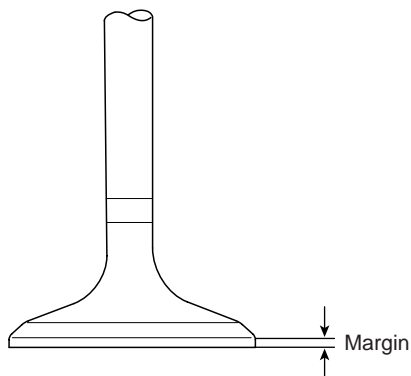
Intake : 1.1 mm (0.043 in.)

Exhaust : 1.3 mm (0.051 in.)

[Limit]

Intake : 0.8 mm (0.028 in.)

Exhaust : 1.0 mm (0.040 in.)



ECKD221A

**VALVE SPRINGS**

- Check the free height of each valve spring. If they exceed the service limit, replace the springs.
- Using a square, test the squareness of each spring. If a spring is excessively out-of-square, replace it.

**Valve spring**

[Standard]

Free height : 44 mm (1.7323 in.)

Load :

21.6 kg/35 mm (47.6 lb/1.3780 in.)

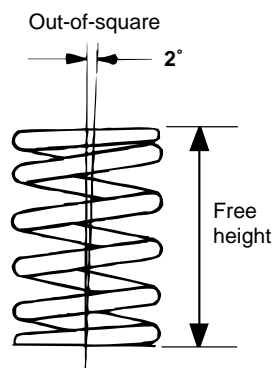
45.1 kg/27.2 mm (99.4 lb/1.0709 in.)

Out of square : 1.5°

[Limit]

Free height : - 1.0 mm (- 0.039 in.)

Out of square : 3°



ECA9281C

Check the valve stem-to-guide clearance. If the clearance exceeds the service limit, replace the valve guide with the next oversize part.

**Valve stem-to-clearance**

[Standard]

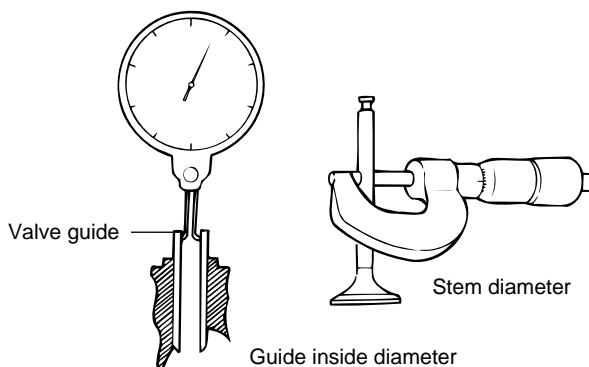
Intake : 0.03 ~ 0.06 mm (0.0012 ~ 0.0024 in.)

Exhaust : 0.05 ~ 0.08 mm (0.0020 ~ 0.0031 in.)

[Limit]

Intake : 0.1 mm (0.0040 in.)

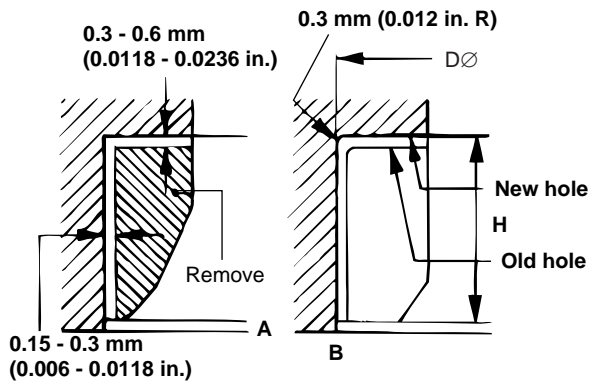
Exhaust : 0.15 mm (0.0059 in.)



ECA9281D

**CYLINDER HEAD ASSEMBLY****EM -35****REPLACING THE VALVE SEAT RING**

1. Cut away the inner face of the valve seat to reduce the wall thickness.



ECA9281F

2. Enlarge the diameter of the valve seat so that it matches the specified oversize hole diameter of the new valve seat ring.
3. Heat the cylinder head to about 250°C (480°F) and press - fit an oversize seat ring for the bore in the cylinder head.
4. Using lapping compound, lap the valve to the new seat.

**Valve seat contact width**

Intake : 0.8 ~ 1.2 mm (0.0315 ~ 0.0472 in.)

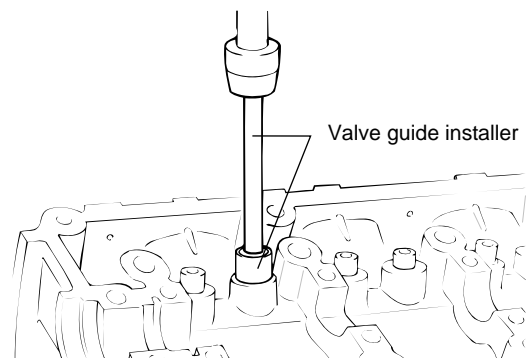
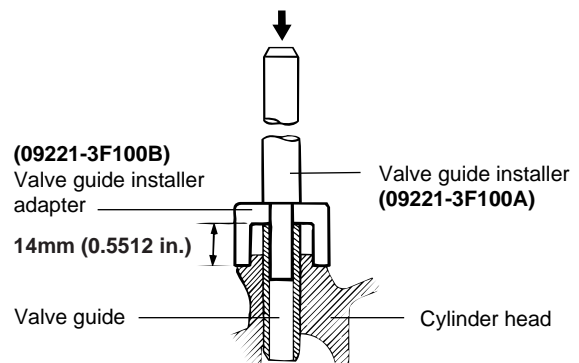
Exhaust : 1.3 ~ 1.7 mm (0.0512 ~ 0.0670 in.)

**VALVE SEAT INSERT OVSIZES**

Description	Size mm (in.)	Size mark	Seat ring height H mm (in.)	Oversize hole diameter I.D. mm (in.)
Intake valve Seat ring	0.3 (0.012) O.S.	30	5.1~5.3(0.2008~0.2087)	30.7~30.721 (1.2087~1.2095)
	0.6 (0.024) O.S.	60	5.4~5.6(0.2126~0.2205)	31.0~31.021(1.2205~1.2213)
Exhaust valve Seat ring	0.3 (0.012) O.S.	30	6.2~6.4(0.2441~0.2520)	27.3~27.321(1.0748~1.0756)
	0.6 (0.024) O.S.	60	6.5~6.7(0.2560~0.2638)	27.6~27.621(1.0866~1.0874)

**REPLACING VALVE GUIDE**

1. Using the special tool (09221-3F100 A/B), withdraw the old valve guide toward the bottom of cylinder head.
2. Recondition the valve guide hole so that it can match the newly press-fitted oversize valve guide.



ECDE109C

3. Using the special tool (09221-3F100 A/B), press-fit the valve guide. The valve guide must be press-fitted from the upper side of the cylinder head.
4. After the valve guide is press-fitted, insert a new valve and check for proper the clearance
5. After the valve guide is replaced, check that the valve is seated properly. Recondition the valve seats as necessary.

**VALVE GUIDE OVERSIZES**

Over size mm (in.)	Size mark	Oversize valve guide hole size mm (in.)
0.05 (0.002)	5	11.05~11.068 (0.4350~0.4357)
0.25 (0.010)	25	11.25~11.268 (0.4429~0.4436)
0.50 (0.020)	50	11.50~11.518 (0.4528~0.4535)

## CYLINDER HEAD ASSEMBLY

EM -37

## REASSEMBLY EC46B95A

 **NOTE**

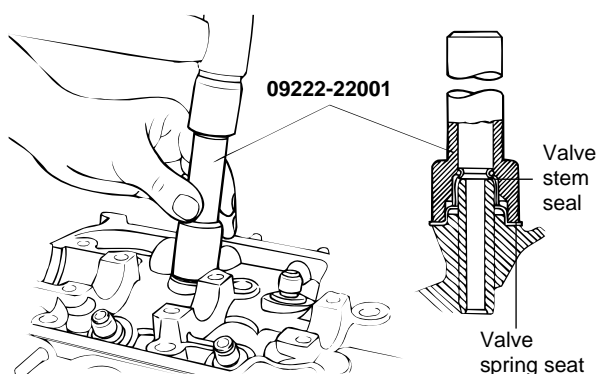
1. Clean each part before assembly.
2. Apply engine oil to the sliding and rotating parts.

1. Install the spring seats.  
Using a special tool (09222-22001), tap the seal in position lightly.

 **NOTE**

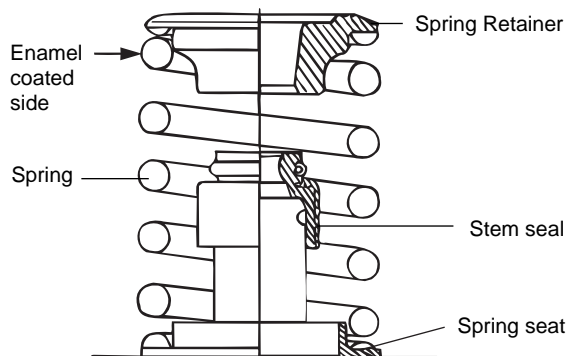
- Do not reuse old valve stem seals.
- Incorrect installation of the seal could result in oil leakage past the valve guides.

2. Apply engine oil to each valve. Insert the valve into the valve guide.  
Avoid pushing the valve into the seal by force. After inserting the valve, check that it moves smoothly.



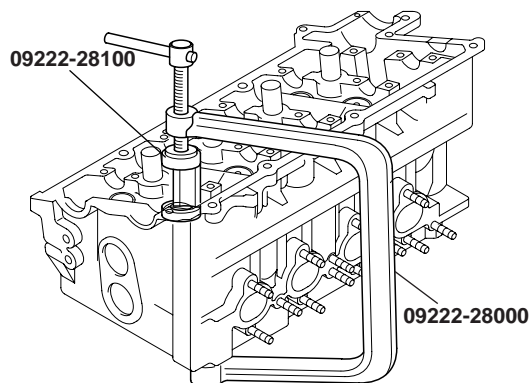
ECHB930A

3. Place valve springs so that the side coated with enamel faces toward the valve spring retainer and then install the retainer.



ECA9290B

4. Using the special tool (09222-28000, 09222-28100), compress the spring and install the retainer locks. After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.

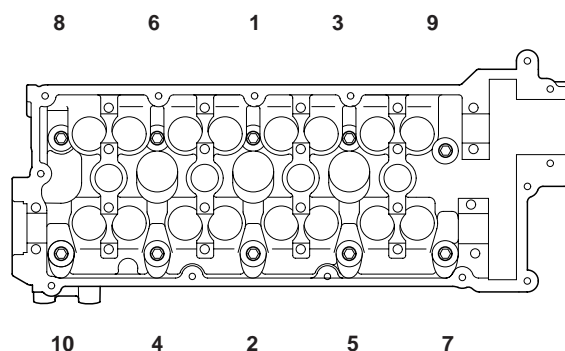


EDKD116A

 **NOTE**

When the spring is compressed, Check that the valve stem seal is not pressed against the bottom of the retainer.

5. Clean both gasket surfaces of the cylinder block and cylinder head.
6. Verify the identification marks on the cylinder head gasket.
7. Install the gasket so that the surface with the identification mark faces toward the cylinder head.
8. Tighten the bolts to the specified torque in the sequence shown.



EDKD700A

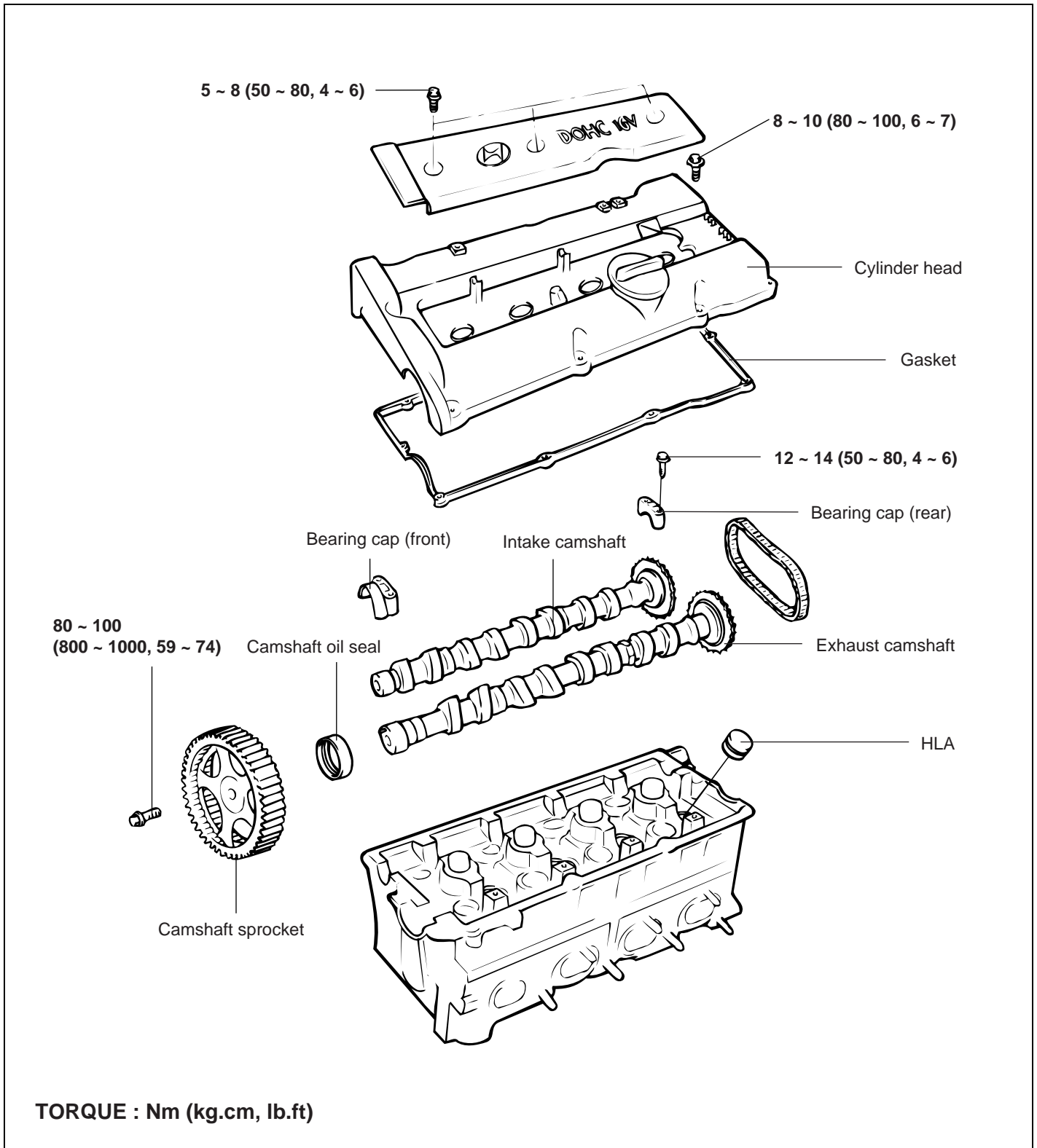
**Cylinder head bolt**

30 Nm (300 kg.cm, 22 lb.ft)+90°+Release all bolts  
+ 30 Nm(300kg.cm, 22 lb.ft)+90°

# MAIN MOVING SYSTEM

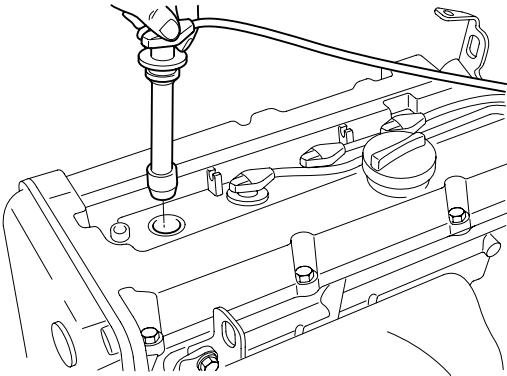
## CAM SHAFT

### COMPONENTS EE8F4E76



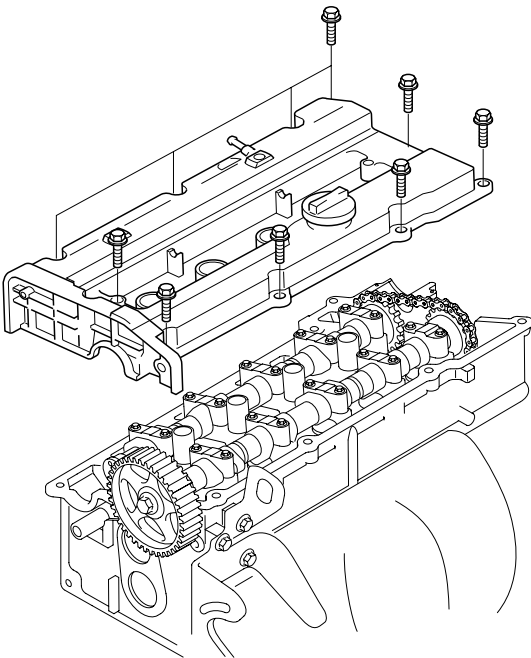
**MAIN MOVING SYSTEM****DISASSEMBLY** EBF99CFA

1. Disconnect the breather hose and the P.C.V. hose.
2. Loosen the center cover bolts and then remove the center cover.
3. Remove the ignition coil assembly and the spark plug cables.



KCDC002B

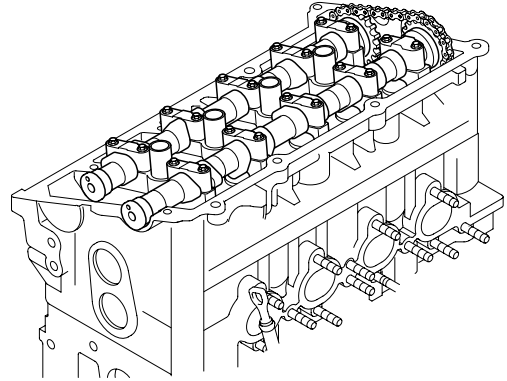
4. Loosen the cylinder head cover bolts and then remove the cylinder head cover.



EDKE104A

5. Remove the camshaft sprocket.

6. Remove the camshaft bearing caps and timing chain.



EDKE124A

7. Remove the camshaft.
8. Remove the HLA.



**INSPECTION** ECDFFBF8

1. Check the camshaft journals for wear. If the journals are badly worn, replace the camshaft.
2. Check the cam lobes for damage. If the lobe is damaged or worn excessively, replace the camshaft.

---

**Standard value**

Intake : 43.4484 mm (1.7106 in.)

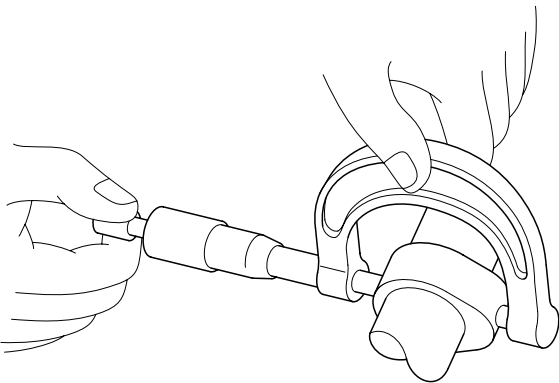
Exhaust : 43.8489 mm (1.7263 in.)

Limit

Intake : 42.9484 mm (1.6909 in.)

Exhaust : 43.3489 mm (1.7066 in.)

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ECKD223A

3. Check the cam surface for abnormal wear or damage, and replace if necessary.
4. Check each bearing for damage. If the bearing surface is excessively damaged, replace the cylinder head assembly or camshaft bearing cap, as necessary.

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**Camshaft end play : 0.1 - 0.2 mm (0.0039 - 0.0079 in.)**

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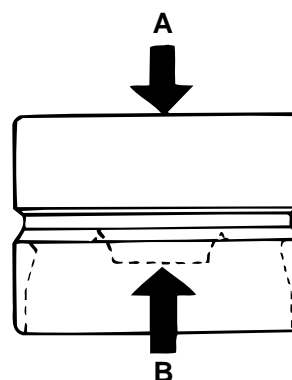
**OIL SEAL**

1. Check the lips for wear. If the lip threads are worn, replace.
2. Check the oil seal lip contacting surface of the camshaft. If it is worn, replace the camshaft.



**MAIN MOVING SYSTEM****EM -41****HLA ( HYDRAULIC LASH ADJUSTER)**

With the HLA filled with engine oil, hold A and press B by hand. If B moves, replace the HLA.

For other specific troubleshooting regarding HLA, refer to the table below.



EDDA020B

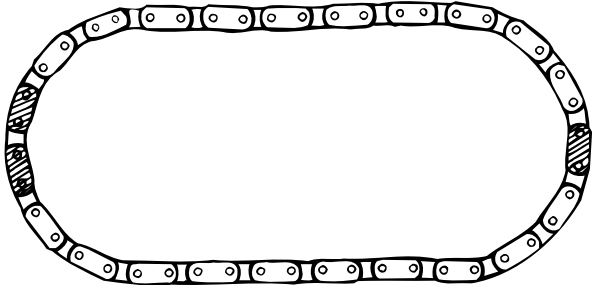
<b>Problem</b>	<b>Possible cause</b>	<b>Action</b>
Temporary noise on starting a cold engine.	Normal	This noise will disappear after the oil in the engine has reached normal pressure.
Continuous noise when engine is running after sitting more than 48 hours.	Oil leakage of the high pressure chamber on HLA, allowing air to get in.	Noise will disappear within 15 minutes when engine runs at 2000~3000 rpm If it doesn't disappear, refer to item 7 below
Continuous noise when engine is first started after rebuilding cylinder head.	Insufficient oil in cylinder head oil gallery.	
Continuous noise when engine is running after excessive cranking.	Oil drain out of the high-pressure chamber in HLA, allowing air to get in.	
Continuous noise when engine is running after changing HLA.	Insufficient oil in HLA.	 <b>CAUTION</b> <i>Do not run engine at a speed higher than 3000 rpm as this may damage HLA.</i>
Continuous noise during idle after high speed running.	Engine oil level too high or too low.	Check oil level. Drain or add oil as necessary.
	Excessive amount of air in the oil at high engine speed.	Check oil supply system
	Deteriorated oil	Check oil quality.
Noise continuous for more than 15 minutes.	Low oil pressure	Check oil pressure and oil supply system of each part of engine
	Faulty HLA.	Remove the cylinder head cover and press down on the HLA by hand. If it move, replace HLA.   <b>CAUTION</b> <i>Be careful of hot HLA.</i>

 **NOTE**

HLA noise could occur to your engine due to malfunction of HLA if you use additives besides engine oil regulated to HMC.

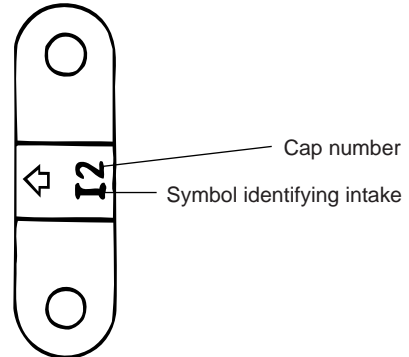
**TIMING CHAIN**

Check the bushing and plate of timing chain for wear. Replace if wear is severe.



EDDA020C

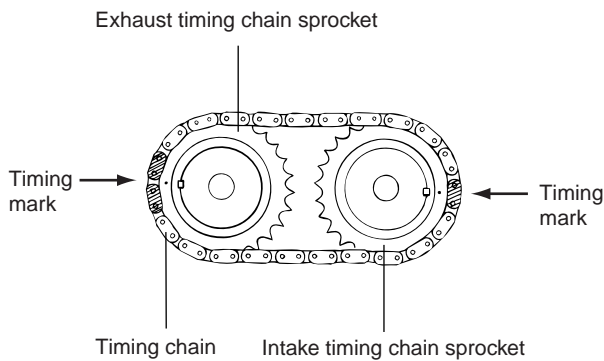
4. Install the bearing caps. The markings on the caps are for intake/exhaust identification.  
I: Intake camshaft  
E: Exhaust camshaft



EDDA021C

**REASSEMBLY** E1337F9D

1. Install the HLA.
2. Align the camshaft timing chain with intake timing chain sprocket and exhaust timing chain sprocket as shown.

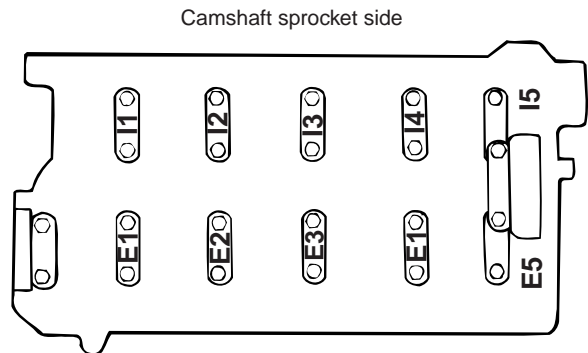


EDDA021A

5. Tighten the bearing caps to the specified torque in two or three steps as shown.

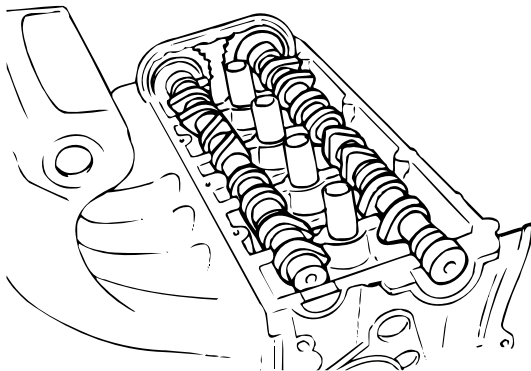
**Tightening torque**

Bearing cap bolt :  
12 ~ 14 Nm (120 ~ 140 kg.cm, 9 ~ 10 lb.ft)



EDDA021D

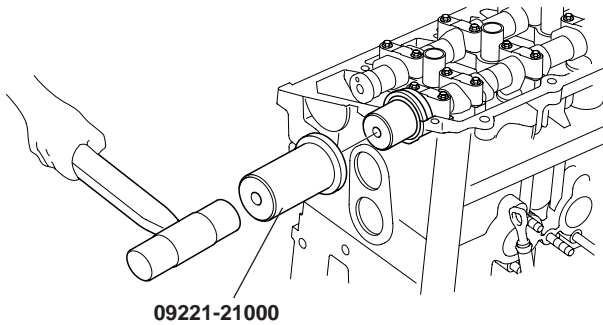
3. Install the camshaft after lubricating the camshaft journals with engine oil.



EDDA021B

**MAIN MOVING SYSTEM****EM -43**

6. Using the special tool, camshaft oil seal installer (09221 - 21000), press fit the camshaft oil seal. Be sure to apply engine oil to the oil seal lip. Insert the oil seal along the camshaft front end and install by driving the installer with a hammer until the oil seal is fully seated.



09221-21000

EDKD125A

7. Install the camshaft sprocket bolts to the specified torque.

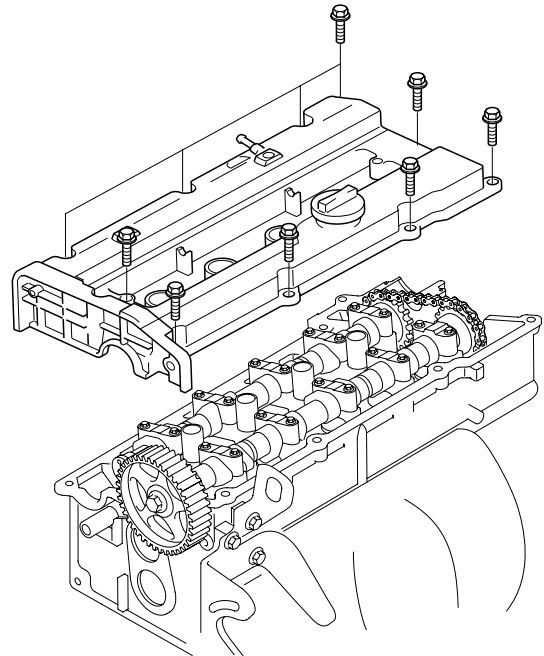
**Tightening torque**

Camshaft sprocket bolt :  
80 ~ 100Nm (800 ~ 1000 kg.cm, 59 ~ 74 lb.ft)

9. Install the cylinder head cover.

**Tightening torque**

Cylinder head cover bolts :  
8 ~ 10 Nm (80 ~ 100 kg.cm, 6 ~ 7 lb.ft)



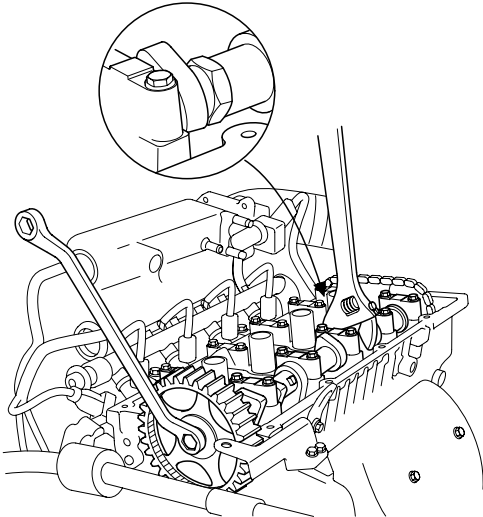
EDKE104A

10. Install the spark plug cables, ignition coil assembly and cylinder head center cover.
11. Install the timing belt and then tighten the timing belt tensioner pulley.
12. Install the timing belt cover.

**Tightening torque**

Timing belt cover : 8 ~ 10Nm (80 ~ 100 kg.cm, 6 ~ 7 lb.ft)

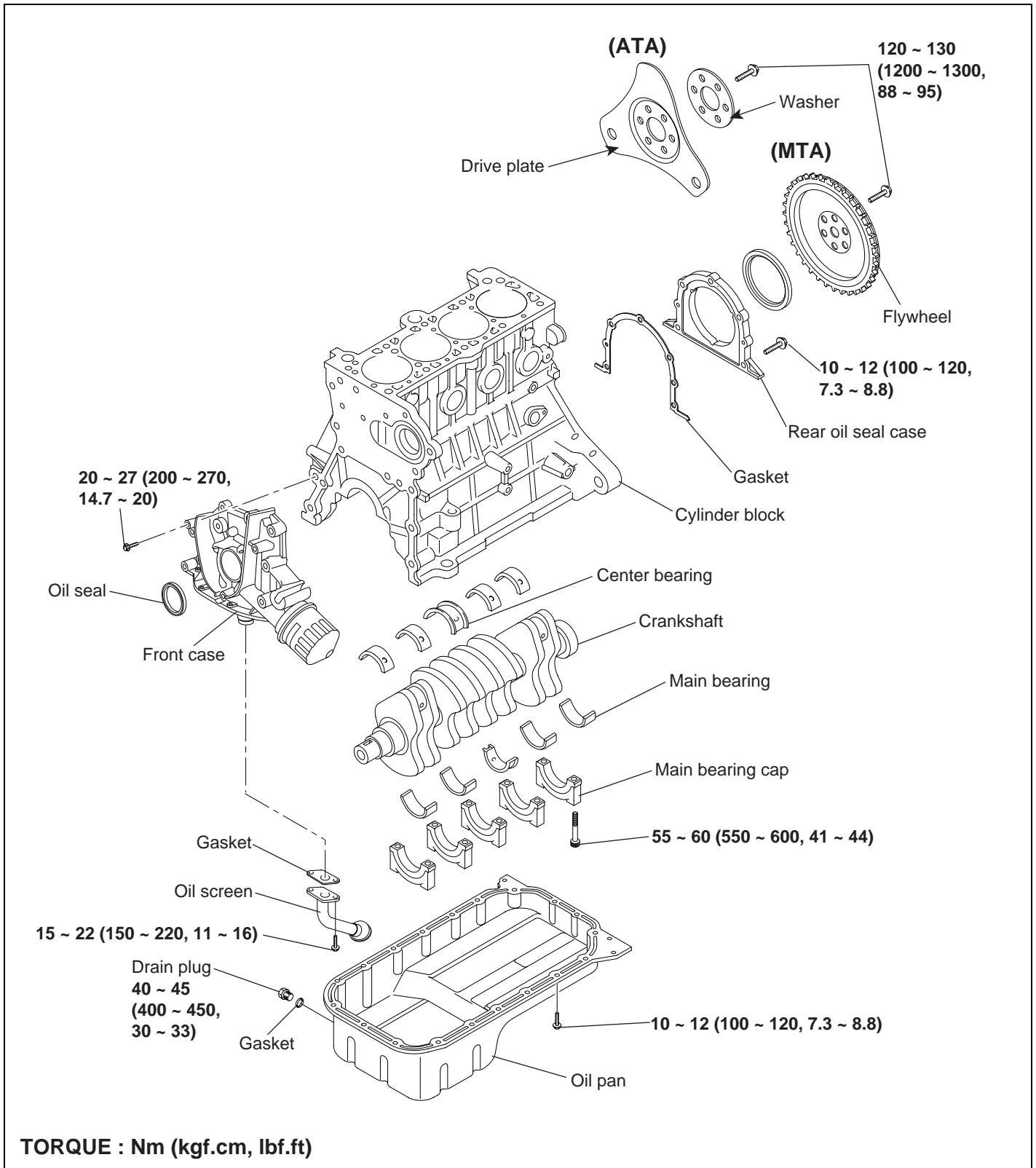
8. Align the camshaft sprocket and crankshaft sprocket timing marks. Place the piston in the No.1 cylinder to top dead center on the compression stroke. (Refer to the timing belt)



EDKE105A

CRANK SHAFT

COMPONENTS ED67A7AC



**MAIN MOVING SYSTEM****DISASSEMBLY** EA7E6C0F

1. Remove the timing belt, front case, flywheel, cylinder head assembly and oil pan. For details, refer to the respective chapters.
2. Remove the rear plate and the rear oil seal.
3. Remove the connecting rod caps.
4. Remove the main bearing caps and remove the crankshaft.
5. Remove the crankshaft position sensor wheel.

**CAUTION**

**Mark the main bearing caps to permit reassembly in the original position and direction.**

**INSPECTION** E76DB219**CRANKSHAFT**

1. Check the crankshaft journals and pins for damage, uneven wear, and cracks. Also check oil holes for clogging. Correct or replace any defective part.
2. Inspect the crankshaft journal for taper and out-of-round.

**Standard value**

Crankshaft journal O.D : 50 mm (1.9685 in.)

Crankshaft pin O.D : 45 mm (1.7717 in.)

Crankshaft journal, pin out-of-roundness and taper : 0.005 mm (0.0002 in.) or less

**MAIN BEARINGS AND CONNECTING ROD BEARINGS**

Visually inspect each bearing for peeling, melting, seizure, and improper contact. Replace the defective bearings.

**OIL CLEARANCE MEASUREMENT**

1. Measure the diameter of the crankshaft journal and pin.
2. Measure the diameter of the crankshaft bore and connecting rod bore.
3. Measure the thickness of the crankshaft bearing and connecting rod bearing.

4. Measure the clearance by the value that subtract the diameter of journal and pin and the thickness of bearing from the diameter of bore.

Connecting rod bearing oil clearance :  
0.018 ~ 0.036 mm (0.0007 ~ 0.0014 in.)

Crankshaft main bearing oil clearance  
NO. 1,2,4,5 : 0.022 ~ 0.040 mm (0.0009 ~ 0.0018 in.)

NO.3 : 0.028 ~ 0.046 mm (0.0011 ~ 0.0018 in.)

**OIL SEAL**

Check front and rear oil seals for damage or wear. Replace any seal that is defective.

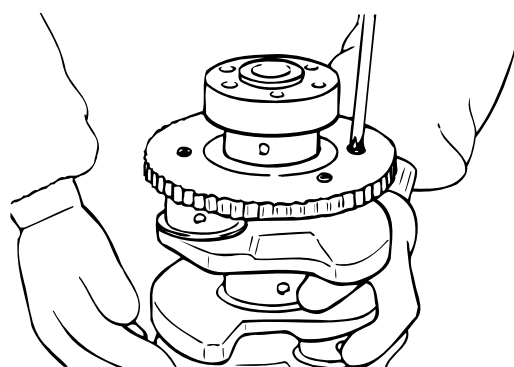
**CRANKSHAFT SENSOR WHEEL**

1. Remove the sensor wheel.
2. Check the sensor wheel for damage, cracks and wear, and replace if necessary.
3. Check the clearance between the sensor wheel and the crank position sensor with a depth gage.

**Standard value**

Clearance between sensor wheel and crank position sensor :

0.5 ~ 1.1 mm (0.020 ~ 0.043 in.)



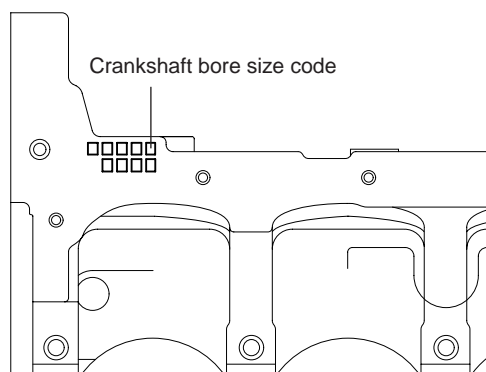
EDDA028C

**NOTE**

1. Measure the depth of the top of sensor wheel tooth and the cylinder block mounting block.
2. Measure the difference between sensor length and depth.
3. Sensor length is the distance between the end of the sensor and the inner point of the contacting face.

REPLACEMENT E8EBDEBC

1. Check the cylinder block crankshaft bore size code.



EDPC004C

 **NOTE**

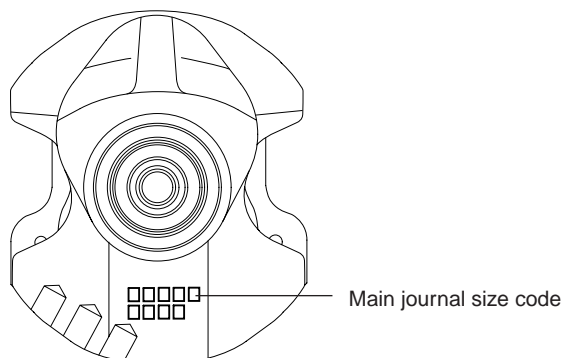
Record the cylinder block crankshaft bore size code letters on cylinder block as shown.  
Reading order is from left to right with front crankshaft bore size code shown first.

Class	Crankshaft bore diameter	Size code
a	54~54.006mm (2.1259~2.1262in.)	A
b	54.006~54.012mm (2.1262~2.1264in.)	B
c	54.012~54.016mm (2.1264~2.1266in.)	C

2. Check the crankshaft main journal size code.

 **NOTE**

Record the main journal size code letters on the crankshaft balance weight.  
Reading order is from left to right as shown, with No.1 main journal size code shown first.



ECPC004B

## CRANKSHAFT MAIN JOURNAL DIAMETER

Class	Main journal diameter	Size code
I	49.968 ~ 49.962 mm (1.9672 ~ 1.9670 in.)	
II	49.962 ~ 49.956 mm (1.9670 ~ 1.9667 in.)	b
III	49.956 ~ 49.950 mm (1.9667 ~ 1.9665 in.)	c

## MAIN JOURNAL BEARING THICKNESS

## No. 1, 2, 4, 5 (MAIN BEARING)

Color	Main journal bearing thickness
Yellow	2.002 ~ 2.005 mm (0.0788 ~ 0.0789 in.)
Green	2.005 ~ 2.008 mm (0.0789 ~ 0.0790 in.)
No color	2.008 ~ 2.011 mm (0.0790 ~ 0.0791 in.)
Black	2.011 ~ 2.014 mm (0.0791 ~ 0.0793 in.)
Blue	2.014 ~ 2.017 mm (0.0793 ~ 0.0794 in.)

## NO.3 (CENTER BEARING)

Color	Main journal bearing thickness
Yellow	1.999 ~ 2.002 mm (0.0787 ~ 0.0788 in.)
Green	2.002 ~ 2.005 mm (0.0788 ~ 0.0789 in.)
No color	2.005 ~ 2.008 mm (0.0788 ~ 0.0790 in.)
Black	2.008 ~ 2.011 mm (0.0790 ~ 0.0791 in.)
Blue	2.011 ~ 2.014 mm (0.0791 ~ 0.0793 in.)

3. Choose proper main journal bearing in table.

**MAIN MOVING SYSTEM****EM -47****REASSEMBLY** E0ABCAB2

1. Install the upper main bearing inserts in the cylinder block.  
**When reusing the main bearings, remember to install them by referring to the location marks made at the time of disassembly.**
2. Install the crankshaft. Apply engine oil to the journals.
3. Install bearing caps and tighten cap bolts to the specified torque in the following sequence; center, No.2, No.4, front, and rear caps.  
Cap bolts should be tightened evenly in 2 to 3 stages before they are tightened to the specified torque.  
The caps should be installed with the arrow mark directed toward the crank pulley side of engine. Cap numbers must be correct.

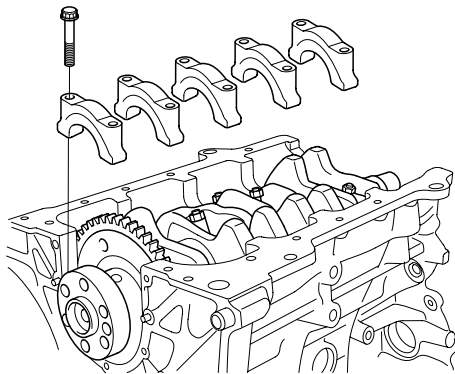
**Tightening torque**

Main bearing cap bolt :

55 ~ 60 Nm (550 ~ 600 kg.cm, 41 ~ 44 lb.ft)

Connecting rod cap bolt :

32 ~ 35 Nm (320 ~ 350 kg.cm, 24 ~ 26 lb.ft)



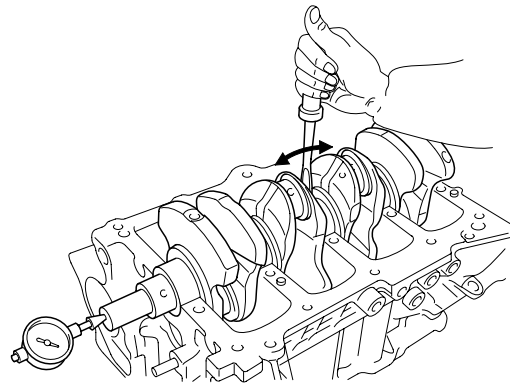
EDKE151A

4. Make certain that the crankshaft turns freely and has the proper clearance between the center main bearing thrust flange and the connecting rod big end bearing.

**Standard value**

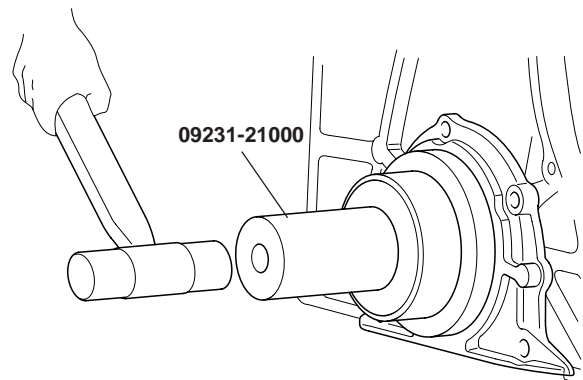
Crankshaft end play :

0.05 ~ 0.175 mm (0.0019 ~ 0.0068 in.)



ECKD001B

5. Install the oil seal in the crankshaft rear oil seal case. Use the Special Tool, Crankshaft Rear Oil Seal Installer (09231 - 21000) as shown. Press fit the oil seal all the way in, being careful not to misalign it.



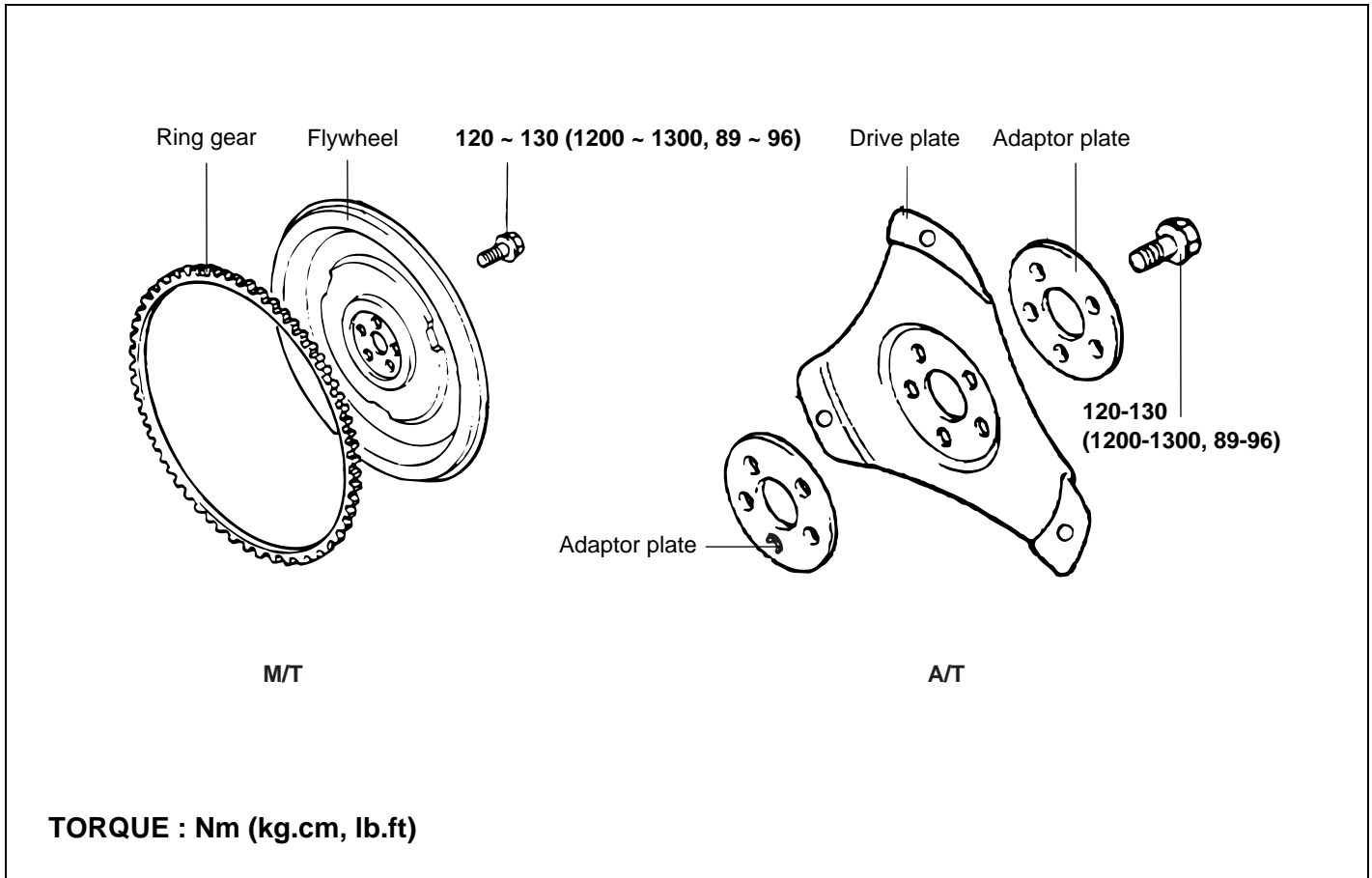
ECKD326A

6. Install the rear plate and tighten the bolts.
7. Install the connecting rod caps.
8. Install the flywheel, front case, oil pan and timing belt. For further details, refer to the respective chapters.



## FLY WHEEL

## COMPONENTS E3FB04C9



EDDA030A

M/T : Manual Transmission Vehicles  
 A/T : Automatic Transmission Vehicles

3. Check the ring gear for damage, cracks, and wear, and replace if necessary.

## DISASSEMBLY E543FBCD

1. Remove the Transmission and clutch.
2. Remove the flywheel.

## INSPECTION EB2E8F43

1. Check the clutch disc contacting surface of the flywheel for damage and wear. Replace the flywheel if excessively damaged or worn.
2. Check the clutch disc contacting surface of the flywheel for runout.

## REASSEMBLY E650BE51

Install the flywheel assembly and tighten the bolts to the specified torque.

**Tightening torque**

Flywheel bolt :

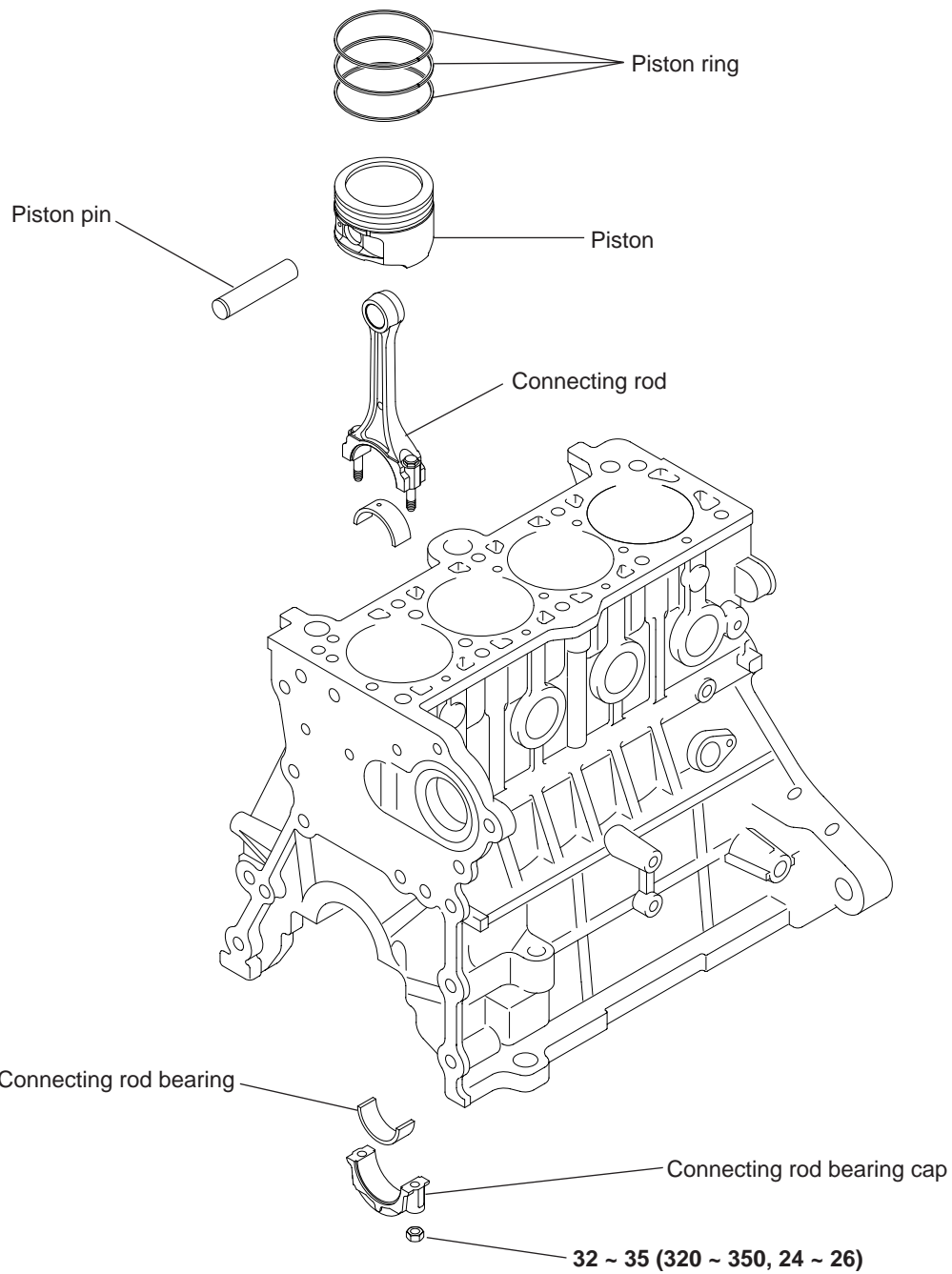
120 ~ 130 Nm (1200 ~ 1300 kg.cm, 89 ~ 96 lb.ft)

**Standard value**

Flywheel run - out : 0.1 mm (0.0039 in.)

PISTON

COMPONENTS E1D1ECDE

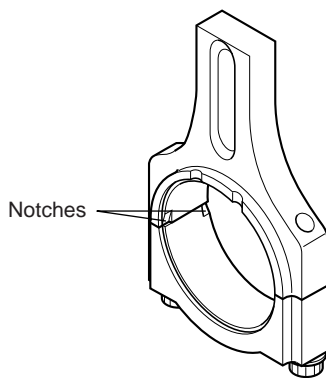


**TORQUE : Nm (kgf.cm, lbf.ft)**

**DISASSEMBLY** EEDFC26E**CONNECTING ROD CAP****CAUTION**

*Keep the bearings in order with their corresponding connecting rods (according to cylinder numbers) for proper reassembly.*

1. Remove the connecting rod cap bolts, then remove the caps and the big end lower bearing.
2. Push each piston connecting rod assembly toward the top of the cylinder.

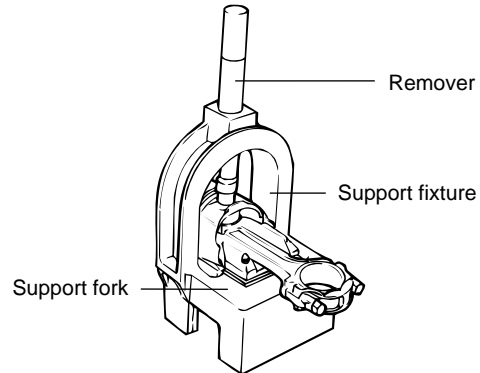


KFW3049A

**DISASSEMBLY AND REASSEMBLY OF THE PISTON PIN**

1. Using the special tools, disassemble and reassemble the piston and connecting rod.
2. The piston pin is press fit into the rod little end, and the piston floats on the pin.
3. The tool consists of a support fixture with fork inserts, guides, adapters, an installer and a remover. The piston is supported in the support fixture while the pin is being installed or removed. Guides help position the pin as it is installed or removed, while the rod is supported by fork inserts.

4. To remove the pin from the piston, place the piston in the support fixture with the rod resting on the fork inserts. Pass the remove tool through the top of the support fixture and use it to press out the pin.

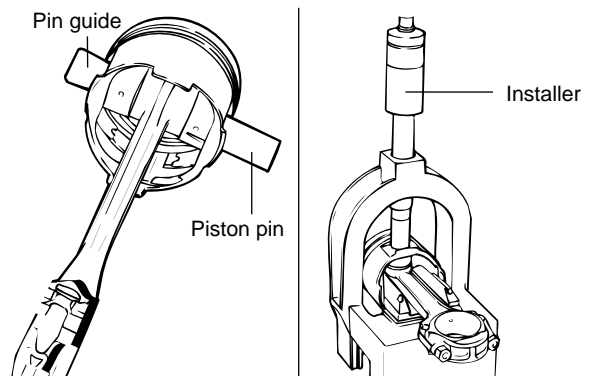


EDA9048A

5. To install a new pin, the proper fork inserts must be in place to support the rod.
6. Position the rod inside the piston. Insert the proper pin guide through one side of the piston and through the rod. Hand tap the pin guide so it is held by the piston. Insert the new pin into the piston from the other side and set the assembly into the support fixture with the pin guide facing down.

**NOTE**

*The pin guide should be centered on the connecting rod through the piston. If assembled correctly, the pin guide will sit exactly under the center of the hole in the tool's arch, and rest evenly on the fork inserts. If the wrong size pin guide is used, the piston and pin will not line up with the support fixture.*



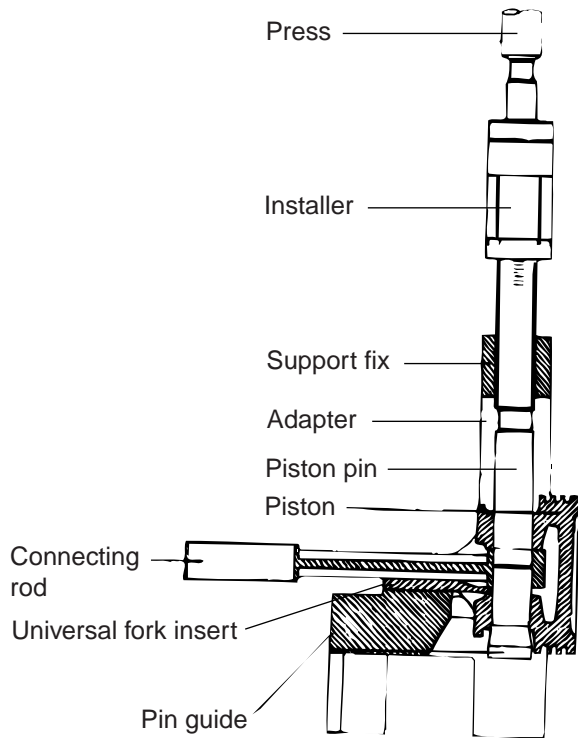
ECA9361C

**MAIN MOVING SYSTEM**

7. Insert the installer tool through the hole in the arch of the support fixture and use a hydraulic press to force the piston pin through the rod little end. Continue pressing until the pin guide falls free and the installer tool seats against the top of the arch.

**CAUTION**

***Do not exceed 1250 ± 500 kg (2765 ± 1102 lb) of force when the installing tool seats against the top of the arch.***



HEW20A55

**INSPECTION** E005DAEA**PISTONS AND PISTON PINS**

1. Check each piston for scuffing, scoring, wear and other defects. Replace any piston that is defective.
2. Check each piston ring for breakage, damage and abnormal wear. Replace the defective rings.  
When the piston requires replacement, its rings should also be replaced.
3. Check that the piston pin fits in the piston pin hole. Replace any piston and pin assembly that is defective. The piston pin must be smoothly pressed by hand into the pin hole (at room temperature).

**PISTON RINGS**

1. Measure the piston ring side clearance. If the measured value exceeds the service limit, insert a new ring in the ring groove to measure the side clearance. If the clearance still exceeds the service limit, replace the piston and rings together. If it is less than the service limit, replace the piston rings only.

**Piston ring side clearance**

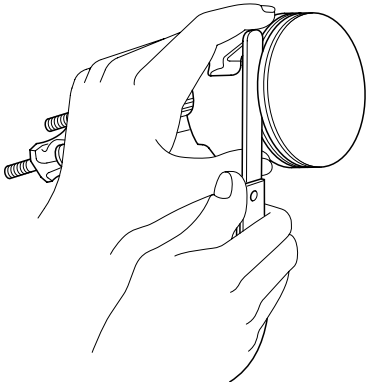
No.1 : 0.04 ~ 0.085 mm (0.0016 ~ 0.0033 in.)

No. 2 : 0.04 ~ 0.085 mm (0.0016 ~ 0.0033 in.)

Limit

No. 1 : 0.1 mm (0.004 in.)

No. 2 : 0.1 mm (0.004 in.)



ECKD001G

2. To measure the piston ring end gap, insert a piston ring into the cylinder bore. Position the ring at right angles in the cylinder wall by gently pressing it down with a piston. Measure the gap with a feeler gauge. If the gap exceeds the service limit, replace the piston ring.

**Piston ring end gap**

[Standard dimensions]

No. 1 : 0.15 ~ 0.30 mm (0.0059 ~ 0.012 in.)

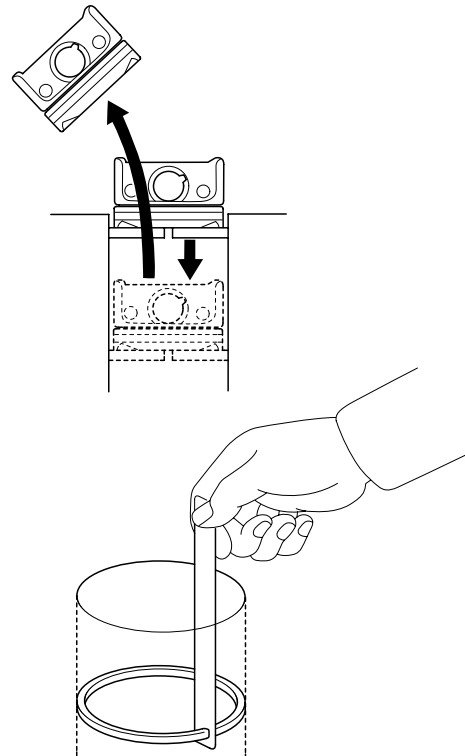
No. 2 : 0.30 ~ 0.45 mm (0.012 ~ 0.018 in.)

Oil ring side rail : 0.2 ~ 0.7 mm (0.0079 ~ 0.0276 in.)

[Limit]

No. 1, No. 2 : 1.0 mm (0.039 in.)

Oil ring side rail : 1.0 mm (0.039 in.)



ECKD001K

When replacing the ring without correcting the cylinder bore, check the gap with the ring situated at the low part of cylinder that is less worn out.

**MAIN MOVING SYSTEM****PISTON RING SERVICE SIZE AND MARK**

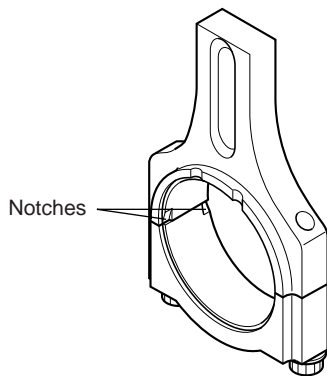
Standard	None
0.25 mm (0.010 in.) O.S	25

**NOTE**

*The mark can be found on the upper side of the ring next to the end.*

**CONNECTING RODS**

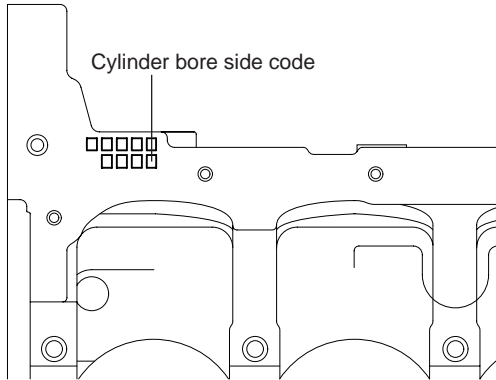
1. When the connecting rod cap is installed, make sure that the cylinder numbers, marked on rod end cap at disassembly, match.  
When a new connecting rod is installed, make sure that the notches holding the bearing in place are on the same side.
2. Replace the connecting rod if it is damaged at either end of the thrust faces. If it has a stratified wear in, or if the surface of the inside diameter of the small end is severely rough, replace the rod.



KFW3049A

**REPLACEMENT** EF4FCD8C

1. Check the cylinder bore size code on the cylinder block bottom face.

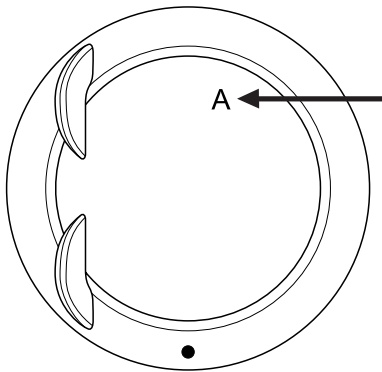


EDPE004B

**1.6 L**

Class	Cylinder bore inner diameter	Size code
A	76.5~76.51mm (3.0118~3.0121in.)	A
B	76.51~76.52mm (3.0121~3.0126in.)	B
C	76.52~76.53mm (3.0126~3.0129in.)	C

2. Check the piston size code on the piston top face.



KDPC005Z

**NOTE**

Stamp the grade mark of basic diameter with rubber stamp.

**1.6 L**

Class	Piston outer diameter	Size code
A	76.465~76.475mm (3.0104~3.0108in.)	A
B	76.475~76.485mm (3.0108~3.0112in.)	B
C	76.485~76.495mm (3.0112~3.0116in.)	C

3. Select the piston related to cylinder bore class.

**Oil clearance**

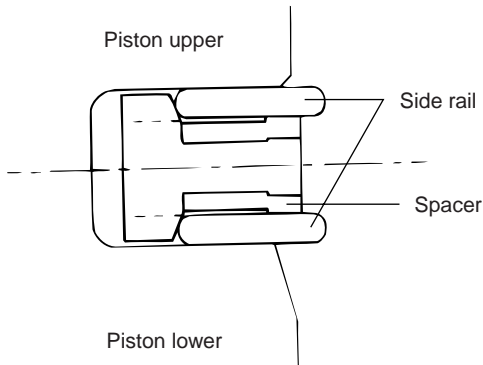
0.025 ~ 0.045mm (0.00098 ~ 0.00177in.)

## MAIN MOVING SYSTEM

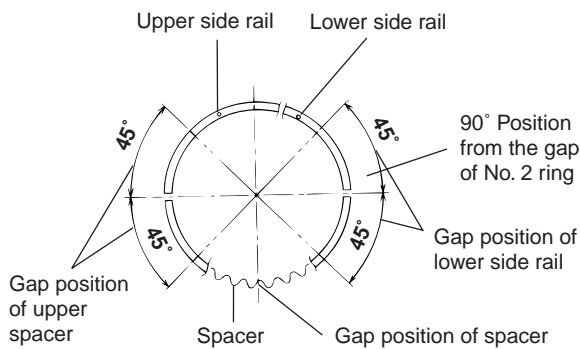
EM -55

REASSEMBLY ECCF87EF

1. Install the spacer.



ECA9082A



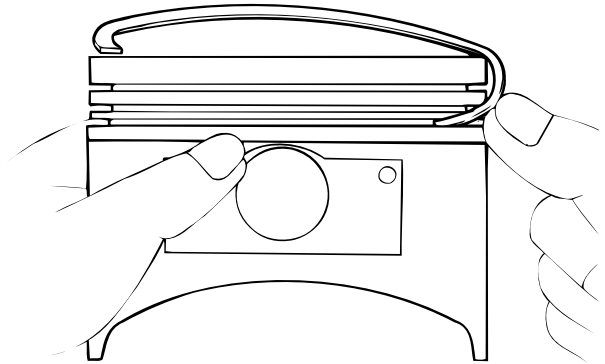
EDJA490A

2. Install the upper side rail. To install the side rail, first put one end of the side rail between the piston ring groove and spacer, hold it firmly, and press down with a finger on the portion to be inserted into the groove (as illustrated).

**CAUTION**

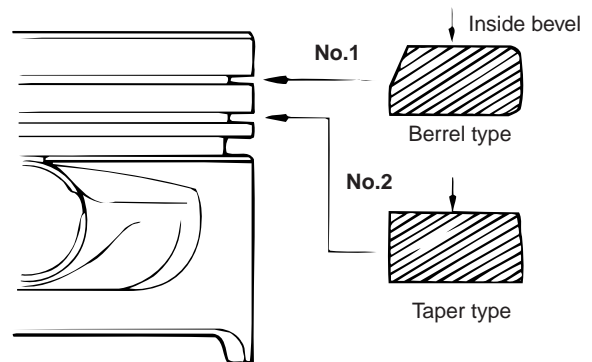
**Do not use a piston ring expander when installing side rail.**

3. Install the lower side rail by the same procedure described in Step 2.



ECA9380B

4. Apply engine oil around the piston and piston grooves.
5. Using a piston ring expander, install the No.2 piston ring.
6. Install the No. 1 piston ring.

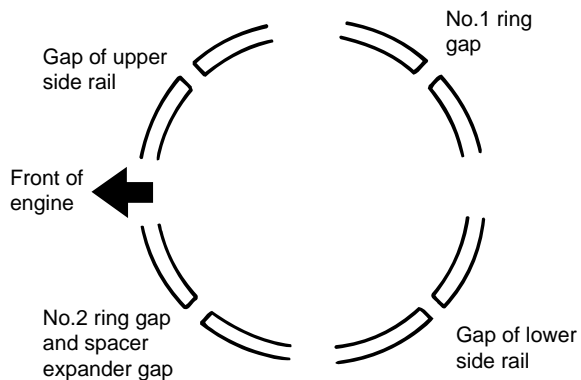


EDDA037B

7. Position each piston ring end gap as far away from its neighboring gaps as possible. Make sure that the gaps are not positioned in the thrust and pin directions.



8. Hold the piston rings firmly with a piston ring compressor as they are inserted into cylinder.



ECA9380D

9. Install the upper main bearings in the cylinder block.
10. Install the lower main bearings in the main bearing caps.
11. Make sure that the front mark of the piston and the front mark (identification mark) of the connecting rod are directed toward the front of the engine.
12. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.
13. When assembling, bolts should be fastened by the angle - torque controlled method as the following.
- 1) Apply oil to the thread of nuts and spot areas.
  - 2) Tighten the connecting rod bolt.

#### Tightening torque

Connecting rod cap nut :

32 ~ 35 Nm (320 ~ 350 kg.cm, 24 ~ 26 lb.ft)



#### CAUTION

**After removing the connecting rod bolt, do not use it again.**

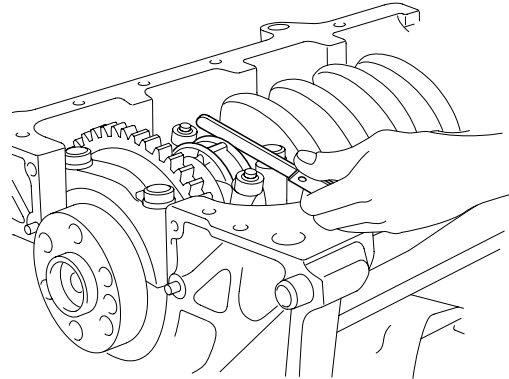
**When using a new bolt, do not tighten the bolt more than 3 times.**

14. Check the connecting rod side clearance.

#### Connecting rod side clearance

Standard : 0.10 ~ 0.25 mm (0.0039 ~ 0.0098 in.)

Limit : 0.4 mm (0.0157 in.)



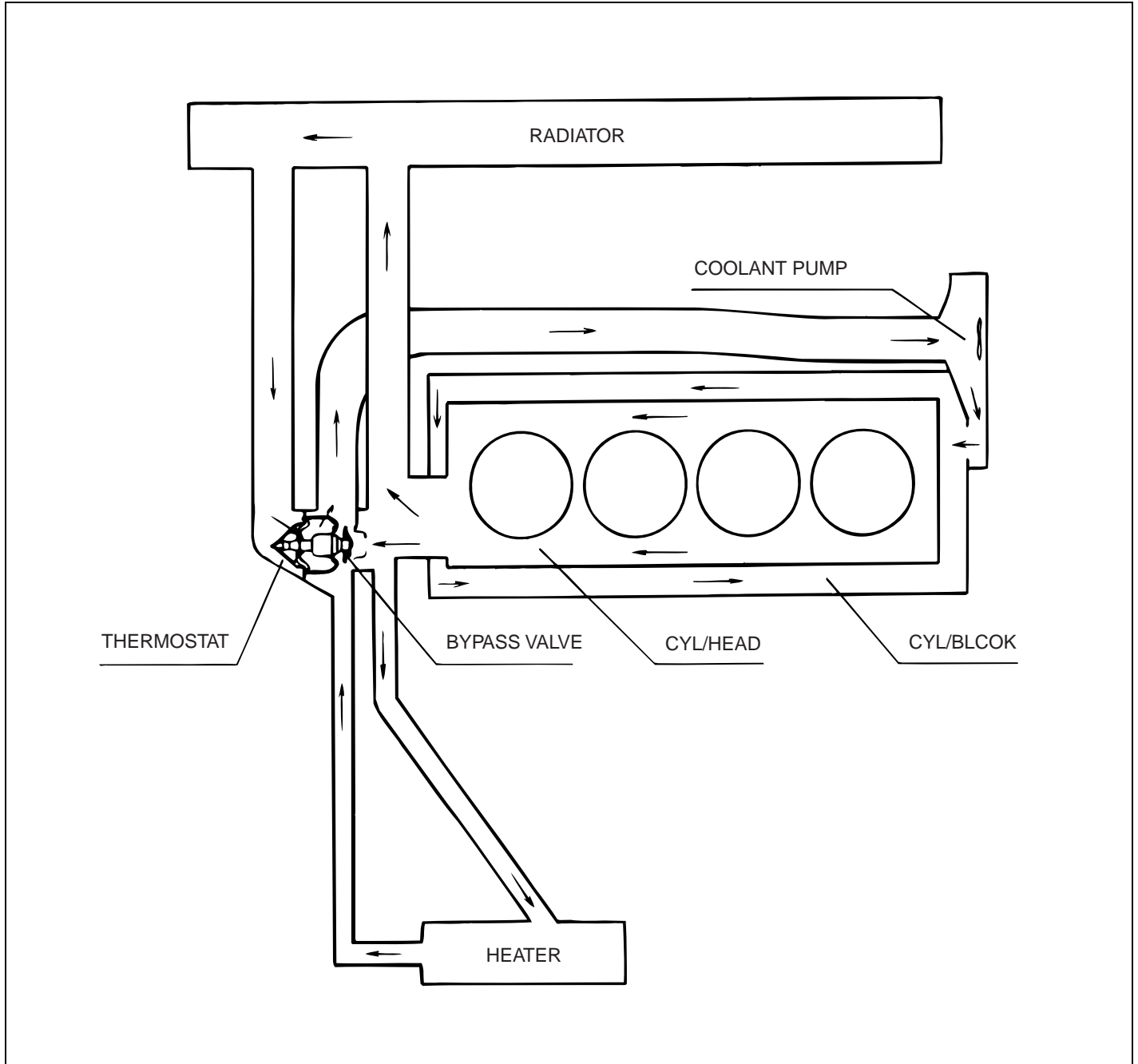
EDKD145A

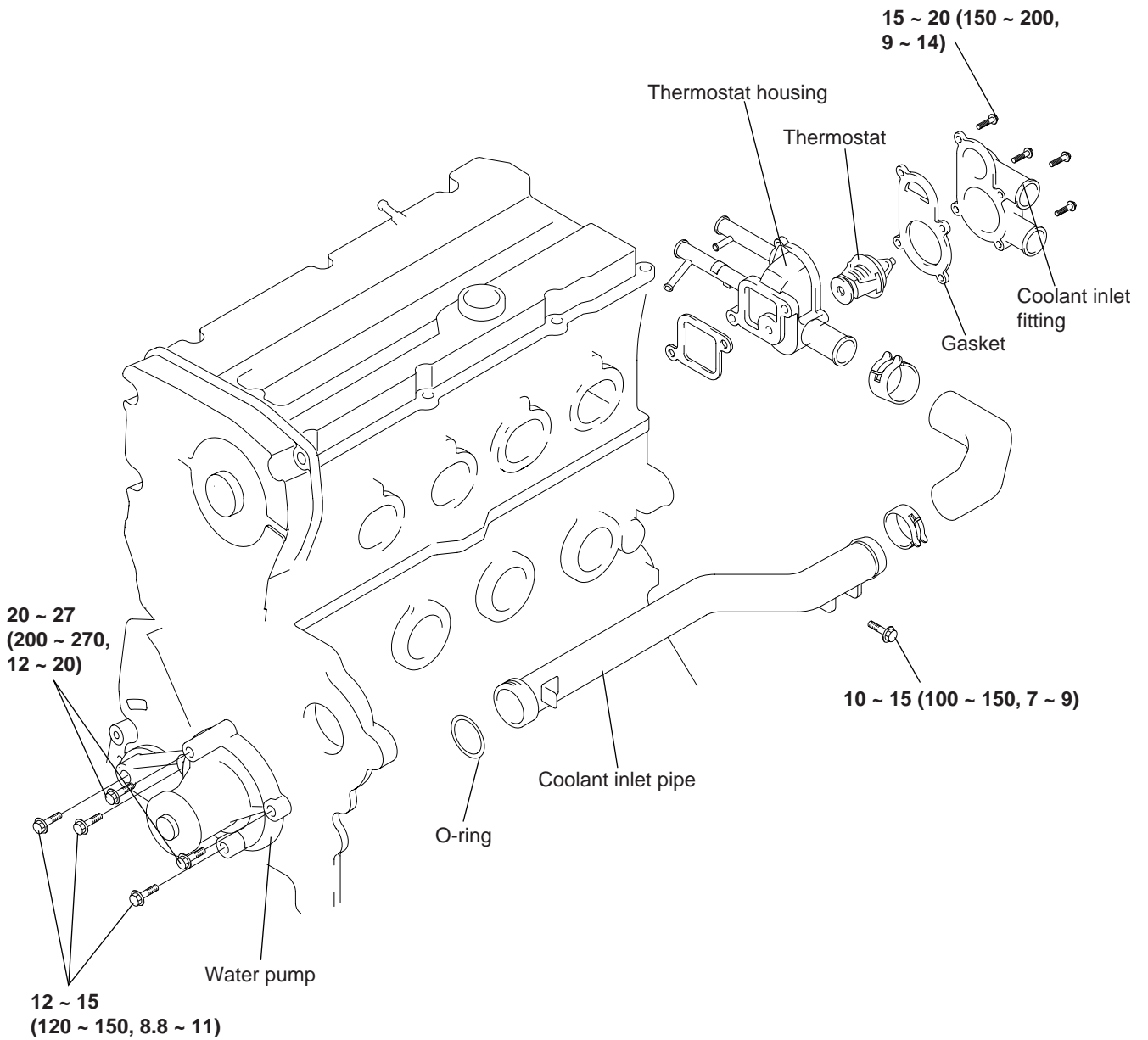
15. Install the oil screen.
16. Install the oil pan.
17. Install the cylinder head.

# COOLING SYSTEM

## ENGINE COOLANT HOSE / PIPES

### COMPONENTS E2BAF9FA





**TORQUE : Nm (kgf.cm, lbf.ft)**

**COOLING SYSTEM****EM -59****INSPECTION** E6CC2E0F

Check the coolant pipe and hoses for cracks, damage, or restrictions.

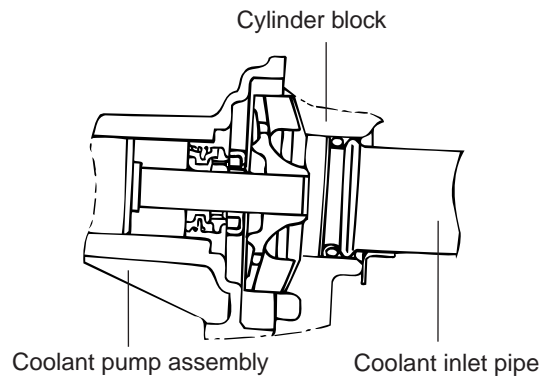
Replace if necessary.

**REASSEMBLY** E1DCE4A4

Fit on O-Ring in the groove provided at the coolant inlet pipe end, wet the O-ring with coolant and insert the coolant inlet pipe.

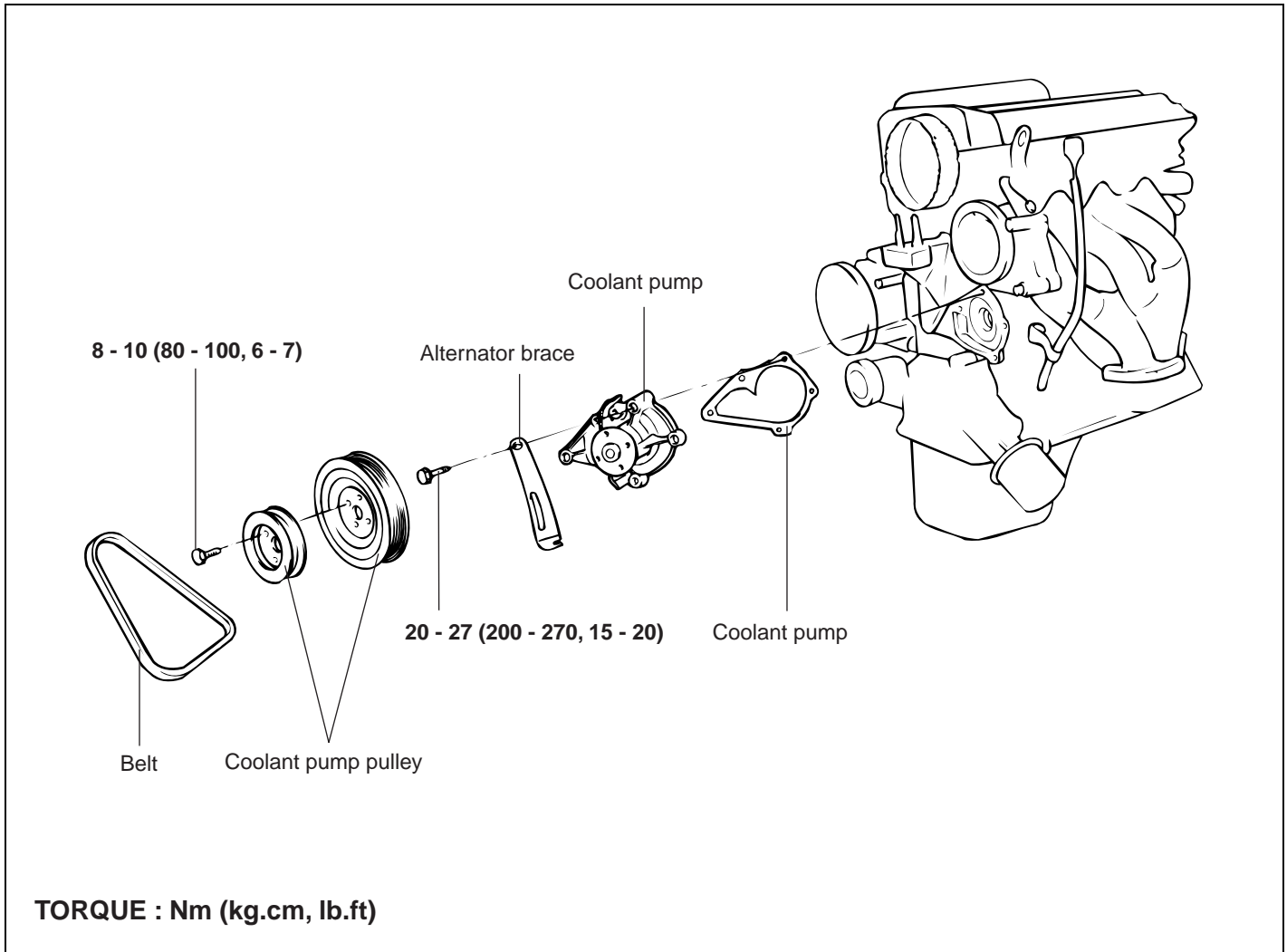
 **NOTE**

1. Do not apply oil or grease to the coolant pipe O-ring.
2. Keep the coolant pipe connections free of sand, dust, etc.
3. Insert the coolant pipe fully into the cylinder block.
4. Do not reuse the O-ring. Replace it with a new part.



ECKA040A

## ENGINE COOLANT PUMP

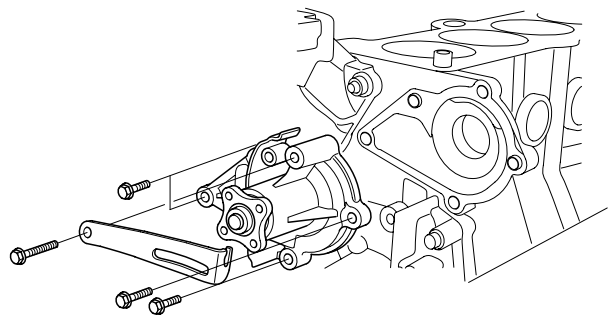
COMPONENTS E8D2CBAD

EDDA046A

DISASSEMBLY EA98DF28

1. Drain the coolant and disconnect the coolant inlet pipe connection hose from the coolant pump.
2. Remove the drive belt and engine coolant pump pulley.
3. Remove the timing belt covers and the timing belt idler.

4. Remove the coolant pump mounting bolts, then remove the alternator brace.



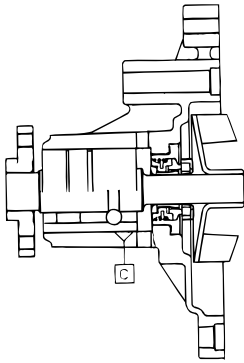
EDKE181A

5. Remove the coolant pump assembly from the cylinder block.

**COOLING SYSTEM****EM -61****INSPECTION**

E5229EB7

1. Check each part for cracks, damage or wear, and replace the coolant pump assembly if necessary.
2. Check the bearing for damage, abnormal noise and sluggish rotation, and replace the coolant pump assembly if necessary.
3. Check for coolant leakage. If coolant leaks then the seal is defective. Replace the coolant pump assembly.



EDKB051A

**REASSEMBLY**

E0C24D31

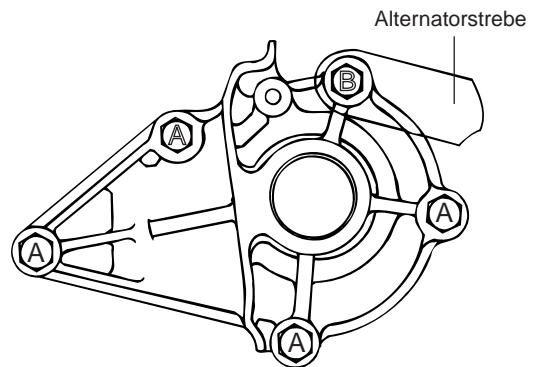
1. Clean the gasket surfaces of the coolant pump body and the cylinder block.
2. Install a new coolant pump gasket to the coolant pump and tighten the bolts to the specified torque.

**Tightening torque**

Coolant pump to cylinder block :

A : 12 ~ 15 Nm (120 ~ 150 kg.cm, 9 ~ 11 lb.ft)

B : 20 ~ 27 Nm (200 ~ 270 kg.cm, 15 ~ 20 lb.ft)



ECKA040B

3. Install the timing tensioner and timing belt. Adjust the timing belt tension.
4. Install the timing belt covers.
5. Install the coolant pump pulley and drive belt, and then adjust the belt tension.
6. Refill the system with clean coolant.
7. Run the engine and check for leaks.

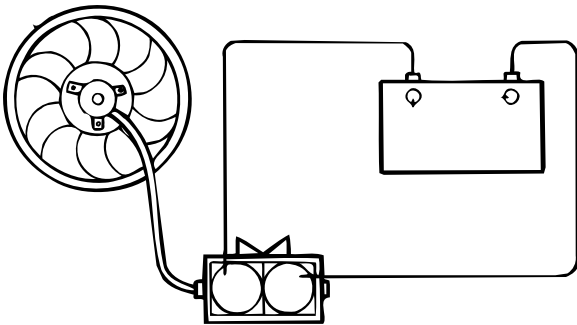
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**COOLING SYSTEM****EM -63****INSPECTION** EC662470

1. Check the radiator for bent, broken or plugged fins.
2. Check the radiator for corrosion, damage, rust or scale.
3. Check the radiator hoses for cracks, damage or deterioration.
4. Check the reservoir tank for damage.
5. Check the radiator cap spring for damage.
6. Test the pressure of the cap using a cooling system checker.
7. Check the radiator cap seal for cracks or damage.

**RADIATOR FAN MOTOR**

1. Check that the radiator fan rotates when the battery voltage is applied to the terminals.



ECDA064A

2. Check that abnormal noises are not produced while the motor is turning.

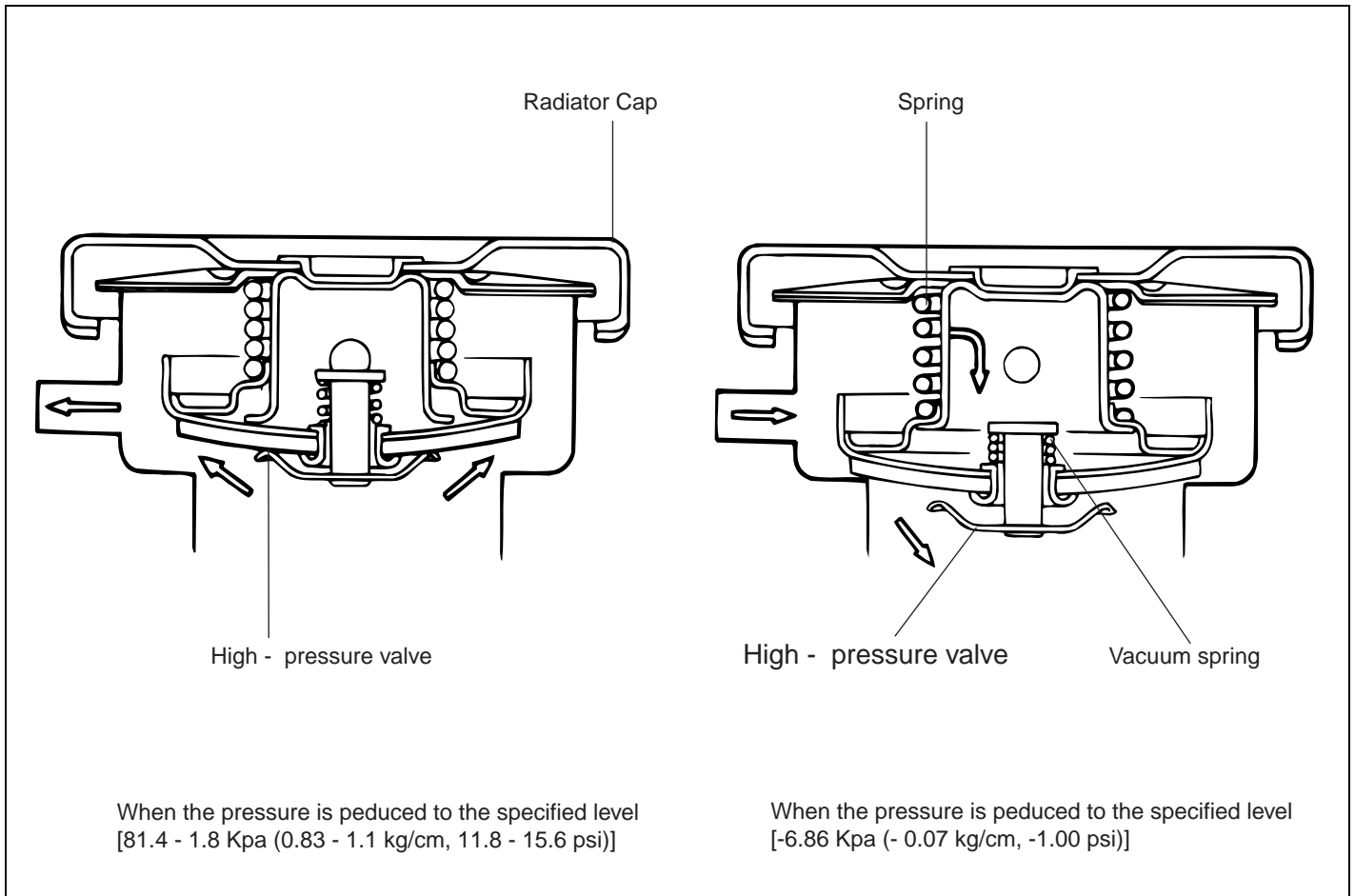
**REASSEMBLY** EF7E7B75

1. Fill the radiator and reservoir tank with clean coolant mixture.
2. Run the engine until the thermostat opens, and then stop the engine.
3. Remove the radiator cap, and add coolant up to the filler neck of the radiator, and then fill the reservoir tank to the upper level. Replace the radiator cap.
4. Check that there are no leaks from the radiator, hoses or connections.



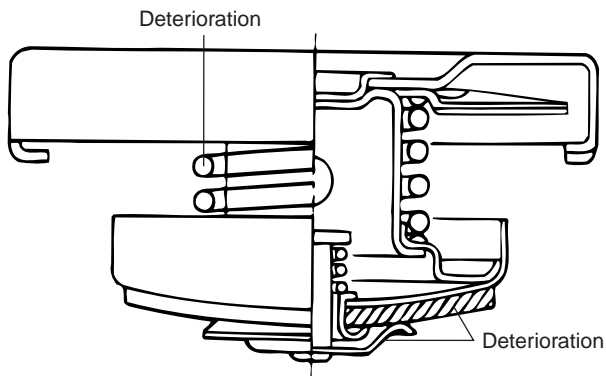
# RADIATOR CAP

## COMPONENTS EA37EA8B



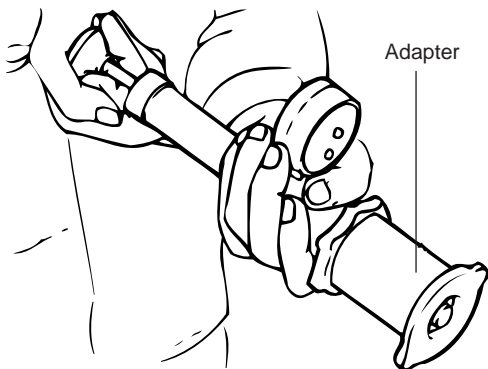
## INSPECTION E7AA67F9

1. Check the radiator cap for damage, cracks and deterioration.



ECDA068A

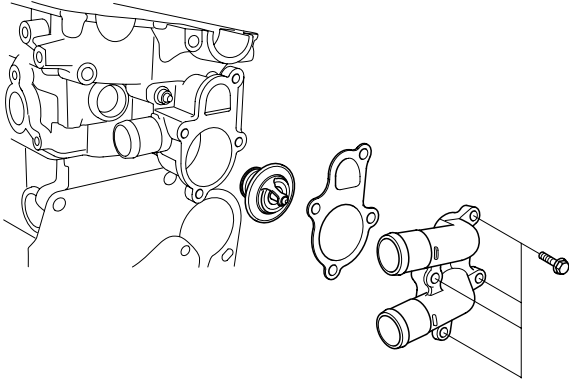
2. Attach a radiator cap tester to the radiator
3. Pump the tester until the pointer stabilizes.
4. If the pointer stays constant for 10 sec. at a point exceeding the service limit, the radiator cap is good.



ECDA068B

**THERMOSTAT****INSPECTION** EE55C20B

1. Drain the coolant so its level is below thermostat.
2. Remove the inlet fitting and gasket.



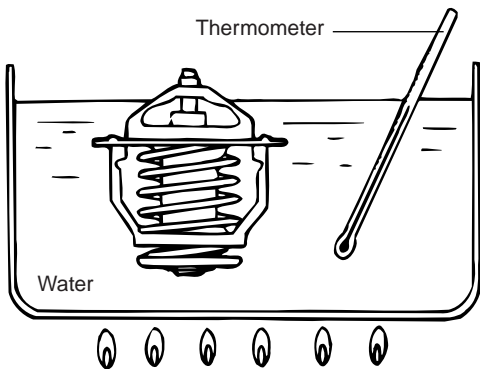
EDKE182A

3. Remove the thermostat.
4. Immerse thermostat in hot coolant to check proper valve opening temperature. Replace if necessary.

---

Valve opening temperature : 82°C (177°C)  
 Full opening temperature : 95°C (205 °F)

---



ECDA070A

**COOLANT TEMPERATURE SENSOR**

1. Heat the sensor by submerging it in hot engine coolant.
2. Check that the resistance is within the specified range.

**Resistance**


---

At : 20°C (68°F) : 2.31 ~ 2.59 k

---

**REASSEMBLY** E342AFA3

1. Check that the flange of the thermostat is correctly seated in the socket of the thermostat housing.
2. Install a new gasket and the coolant inlet fitting.
3. Refill the system with clean coolant.

**Tightening torque**


---

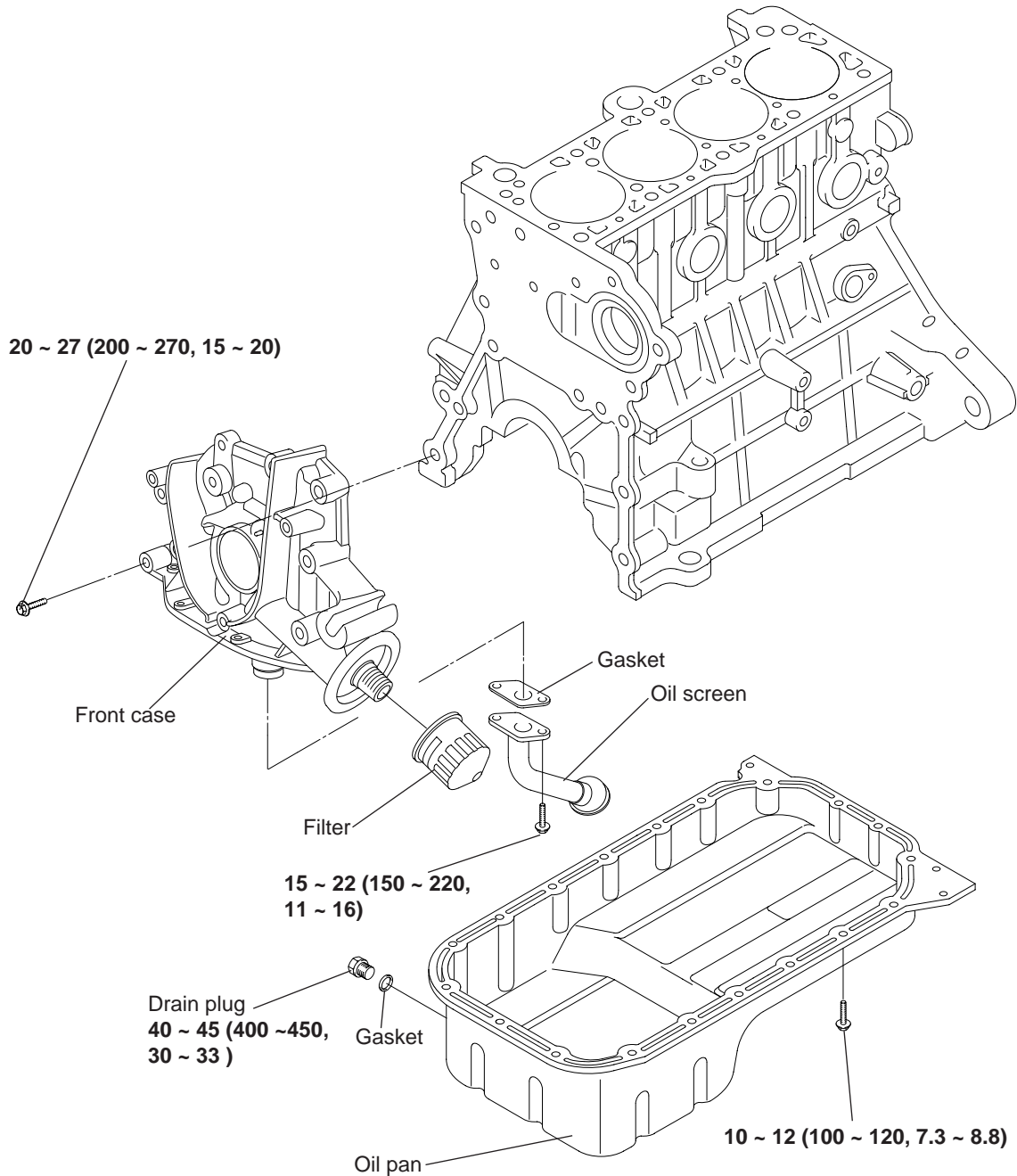
Coolant temperature sensor :  
 25 ~ 30 Nm (250 ~ 300 kg.cm, 18 ~ 22 lb.ft)

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# LUBRICATION SYSTEM

## OIL PUMP

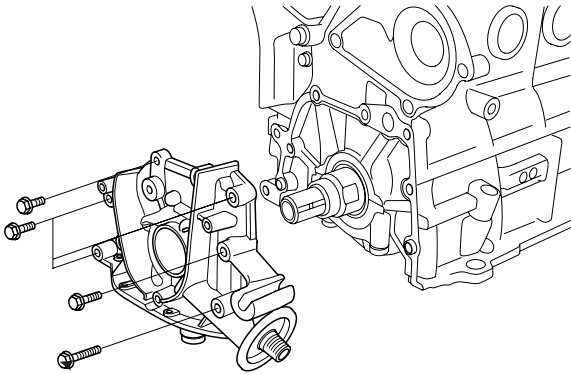
### COMPONENTS EDF9B71D



**TORQUE : Nm (kgf.cm, lbf.ft)**

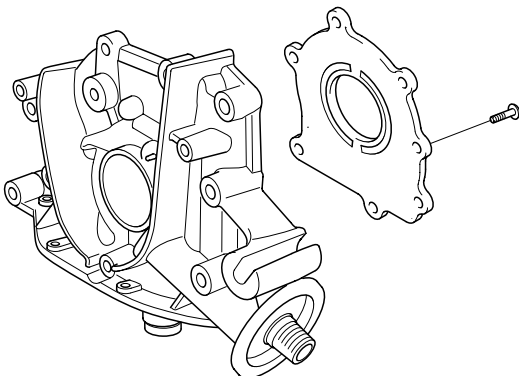
**DISASSEMBLY** E450CC2F

1. Remove the timing belt.
2. Remove all the oil pan bolts.
3. Remove the oil pan.
4. Remove the oil screen.
5. Remove the front case assembly.



EDKE208A

6. Remove the oil pump cover.



EDKE202A

7. Remove the inner and outer gears from the front case. The matching marks on the inner and outer gears indicate the direction of installation.

**INSPECTION** E9D08BBC**FRONT CASE**

1. Check the front case for cracks or damage. Replace as necessary.
2. Check the front oil seal for worn or damaged lips. Replace if defective.

**OIL PAN AND OIL SCREEN**

1. Check the oil pan for failure, damage or cracks. Replace if defective.
2. Check the oil screen for failure, damage and cracks and replace if defective.

**FRONT CASE AND OIL PUMP COVER**

Check the surfaces contacting the gears for damage or wear.

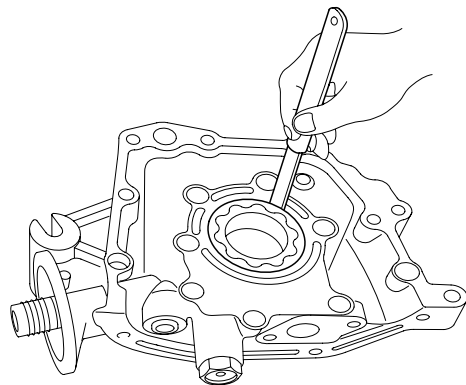
**OIL PUMP GEARS**

1. Check the gear tooth surfaces for wear or damage.
2. Measure the clearance between outer gear and front case.

---

Body clearance : 0.12 ~ 0.185 mm (0.0047 ~ 0.0073 in.)  
 Tip clearance : 0.025 ~ 0.069 mm (0.0010 ~ 0.0027 in.)  
 Side clearance  
 Inner gear : 0.06 ~ 0.11 mm (0.0023 ~ 0.0043 in.)  
 Outer gear : 0.04 ~ 0.085 mm (0.0016 ~ 0.0033 in.)

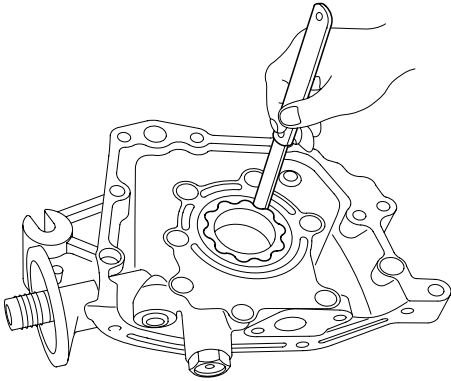
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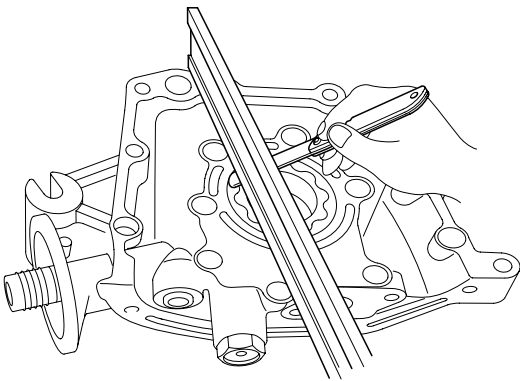
EDKD207A

**LUBRICATION SYSTEM****EM -69**

3. Check the tip clearance on the pump roter.



EDKD206A



EDKD205A

**RELIEF VALVE AND SPRING**

1. Check sliding condition of the relief valve inserted in the front case.
2. Inspect for distorted or broken relief valve spring.

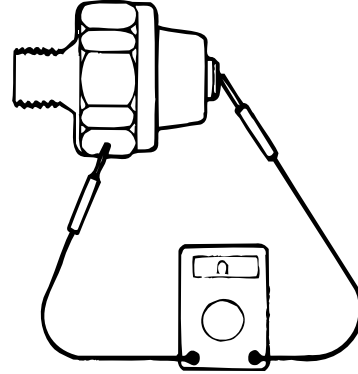
**Standard value**

Free height : 46.6 mm (1.8346 in.)

Load : 6.1 kg/40.1 mm (13.42 lb/1.578 in.)

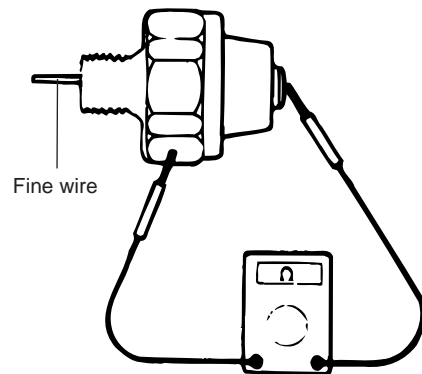
**OIL PRESSURE SWITCH (Normally Closed type STD.)**

1. Use an ohmmeter to check the continuity between the terminal and the body. If there is no continuity, replace the oil pressure switch.



EDDA061A

2. Check the continuity between the terminal and the body when the fine wire is pushed. If there is continuity even when the fine wire is pushed, replace the switch.
3. If there is no continuity when a 50 kPa (7 psi) pressure is applied through the oil hole, the switch is operating properly. Check for air leaks. If air does leak, the diaphragm is broken. Replace the switch.



EDDA061B

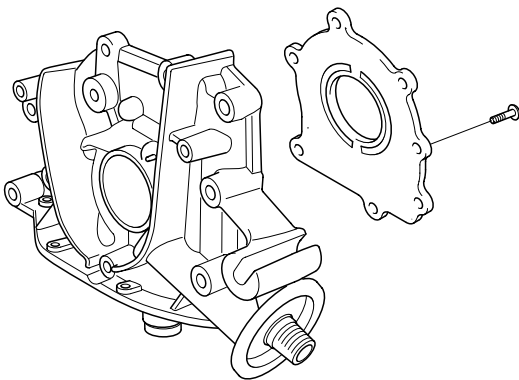
**REASSEMBLY** E1BA8FB0**OIL PUMP**

1. Install the outer and inner gears into the front case  
Make sure that the inner and outer gears are installed in the same direction as shown.
2. Install the oil pump cover and tighten the bolts to the specified torque. After the bolts have been tightened, check to ensure that the gear turns smoothly.

**Tightening torque**

Oil pump cover bolt :

8~ 12 Nm (80 ~ 120 kg.cm, 6 ~ 9 lb.ft)

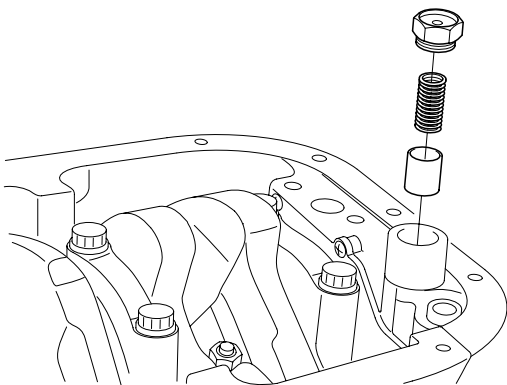


EDKE202A

3. Install the relief valve and spring. Tighten the plug to the specified torque. Apply engine oil to the relief valve.

**Relief valve plug**

40 ~ 50 Nm (400 ~ 500 kg.cm, 30 ~ 37 lb.ft)



EDKE204A

**FRONT CASE**

1. Install the front case assembly with a new gasket, and tighten the bolts to the specified torque.

**Tightening torque**

20 ~ 27 Nm (200 ~ 270 kg.cm, 15 ~ 20 lb.ft)

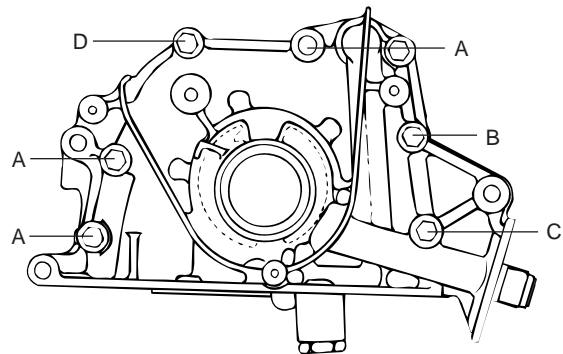
Length

A : 30 mm (1.18 in.)

B : 45 mm (1.77 in.)

C : 60 mm (2.36 in.)

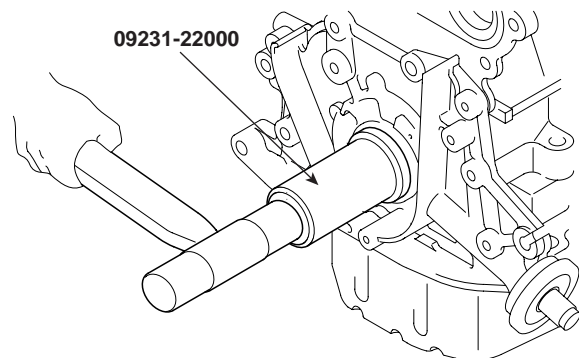
D : 22 mm (0.89 in.)



ECKA020E

**OIL SEAL**

1. Using the special tool, Crankshaft oil seal guide(09231 - 22100), install the oil seal.
2. Using the special tool, Crankshaft front oil seal installer (09231-22000), install the oil seal.

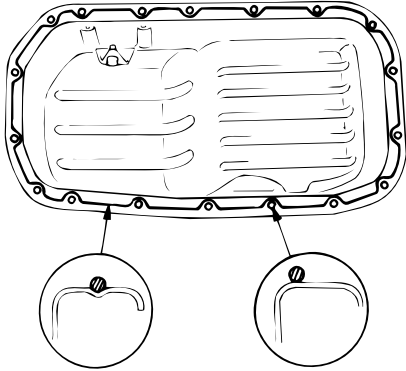


EDKE209A

3. Install the oil screen.
4. Clean both gasket surfaces of the oil pan and the cylinder block.
5. Apply sealant into the groove of the oil pan flange as shown.

 **CAUTION**

- **Apply sealant approx. 4mm (0.16 in.) in thickness.**
- **After application of sealant, do not exceed 15 minutes before installing the oil pan.**



ECDA018D

6. Install the oil pan and tighten the bolts to the specified torque.

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**Tightening torque**

Oil pan bolt : 10 ~ 12 Nm (100 ~ 120 kg.cm, 7 ~ 9 lb.ft)

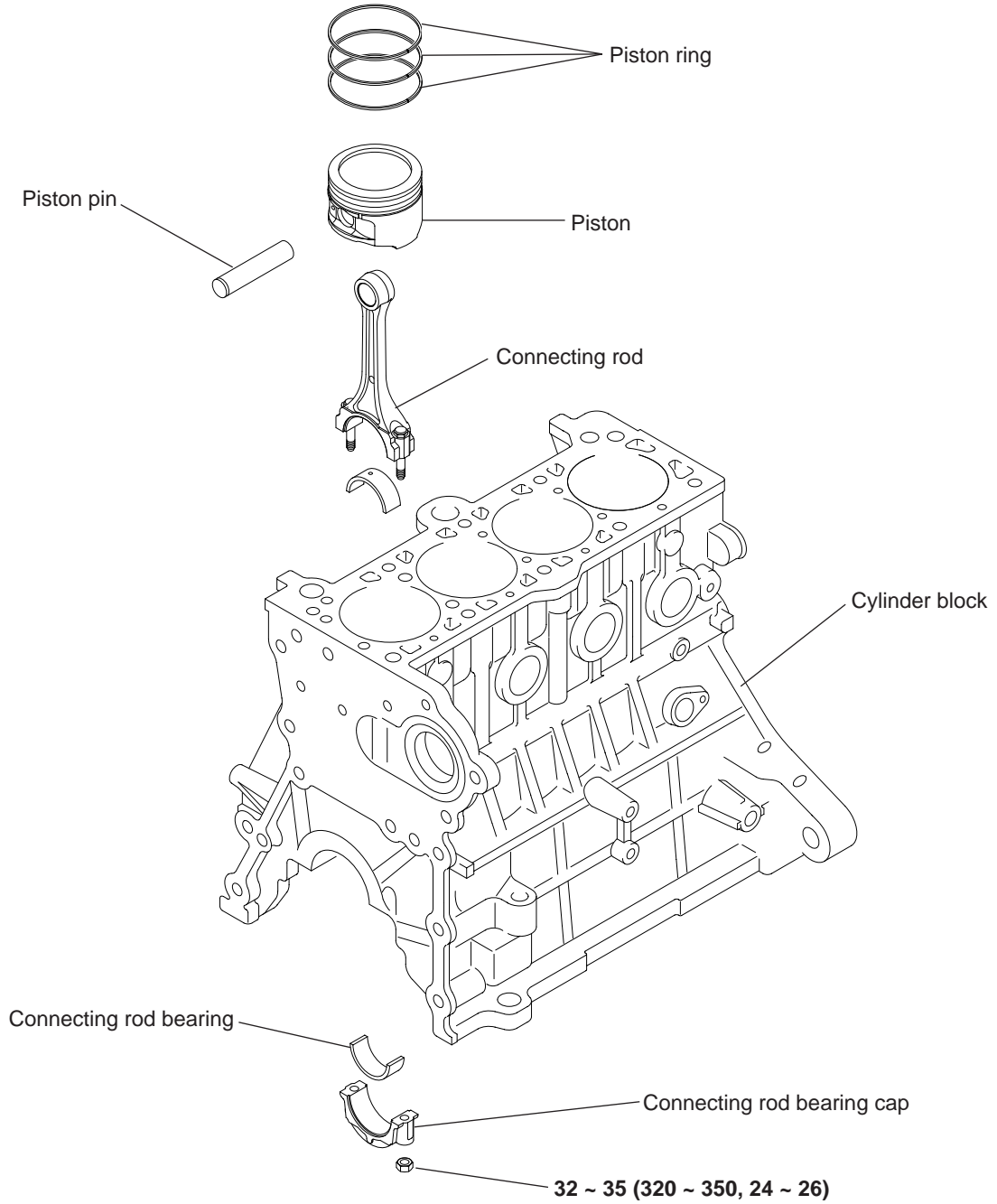
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# ENGINE BLOCK

## ENGINE BLOCK

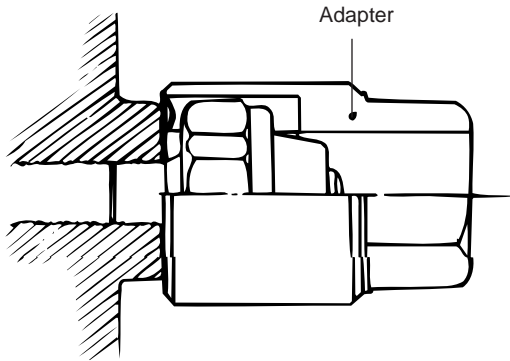
### COMPONENTS E362FF2F



**TORQUE : Nm (kgf.cm, lbf.ft)**

**ENGINE BLOCK****EM -73****DISASSEMBLY** EE96372F

1. Remove the timing belt, cylinder head, front case, fly-wheel, pistons and crankshaft.
2. Remove the oil pressure switch.



EDDA008A

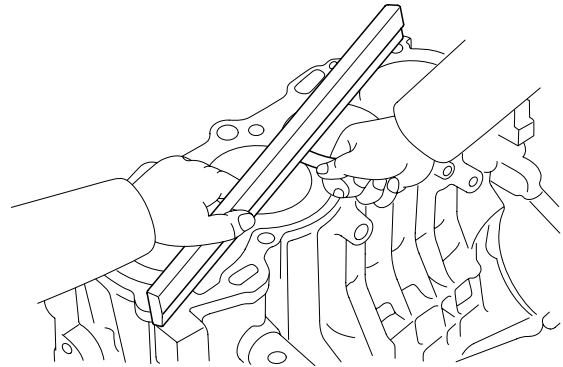
**INSPECTION** EBADEC3C

1. Check the engine block for scores, rust and corrosion. Also check for cracks or any other defects. Replace the block if defective.
2. Using a straight edge and feeler gauge, check the top surface of the block for warpage. Make sure that the surface is free from gasket chips or other foreign material.

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Standard : 0.03 mm (0.0012 in.) or less  
 Limit : 0.06 mm (0.0024 in.) or less

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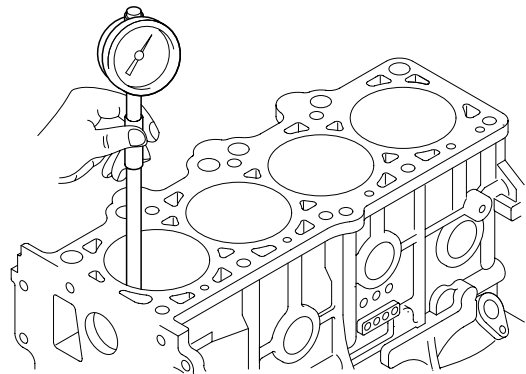
ECKD001L

3. Measure the cylinder bore with a cylinder gauge at three levels in the direction of A and B. If the cylinder bores show more than the specified out-of-round or taper or if the cylinder walls are badly scuffed or scored, the cylinder block should be rebored and honed. Oversize pistons and rings must be fitted.

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Cylinder I.D : 76.5 ~ 76.53 mm (3.0118 ~ 3.0130 in.)  
 Cylinder I.D taper : 0.01 mm (0.0004 in.) or less

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ECKD318A

4. If a cylinder ridge exists, cut away with a ridge reamer.
5. Oversize pistons are available in four sizes.

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**Pistom service size and mark mm (in.)**

0.25 (0.010) O.S. : 0.25

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6. When boring the cylinder to the oversize, maintain the specified clearance between the oversize piston and the bore, and make sure that all pistons used are the same oversize.

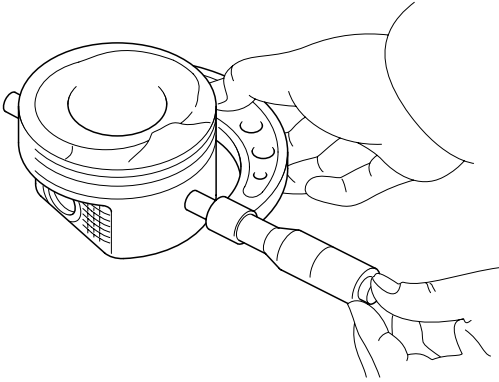
The standard measurement of the piston's outside diameter is taken 39.35 mm (1.55 in.) from the top land of the piston.

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**Piston - to - cylinder clearance**

0.025 ~ 0.045 mm (0.0010 ~ 0.0018 in.)

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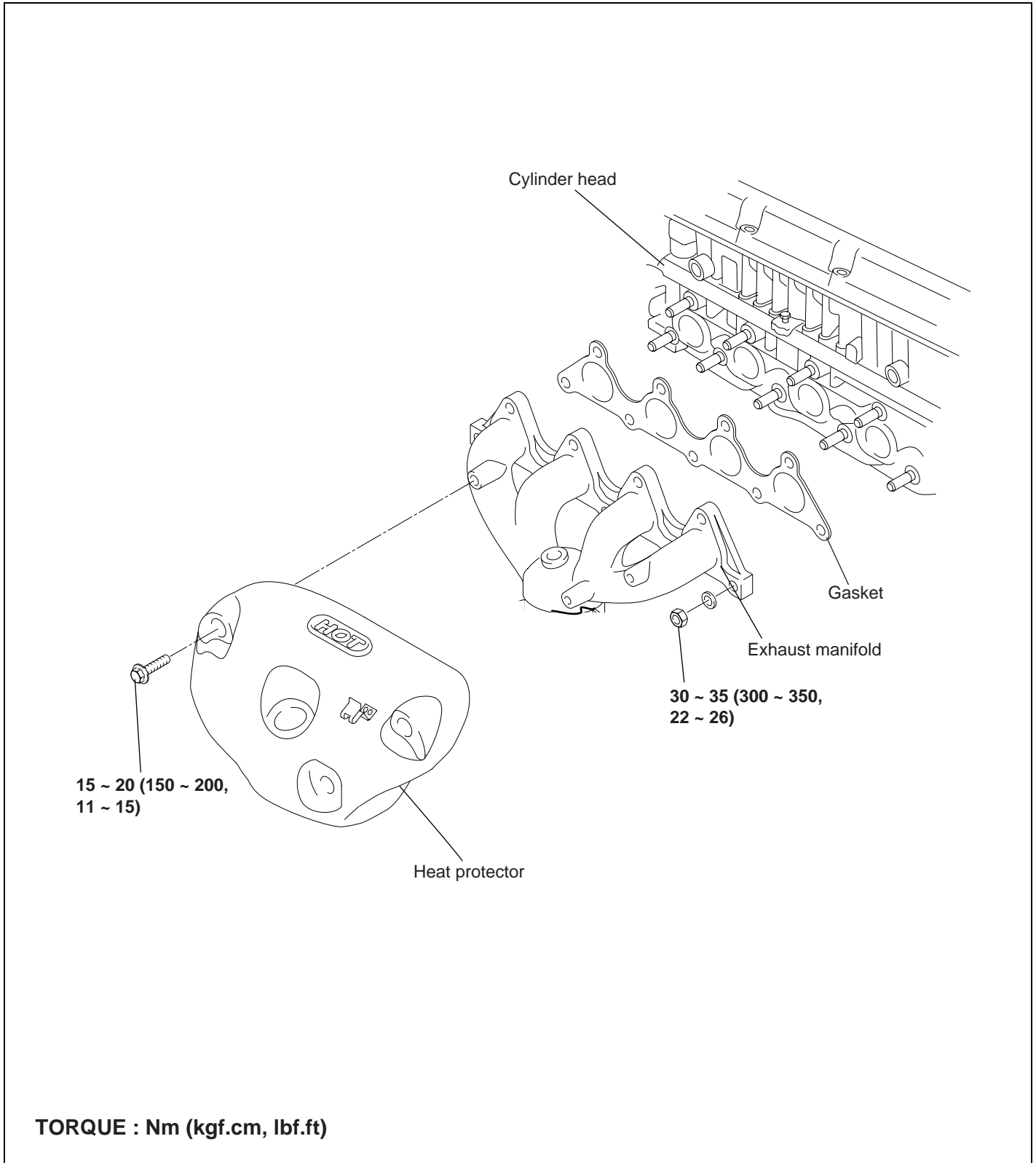
ECKD001D

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# INTAKE AND EXHAUST SYSTEM

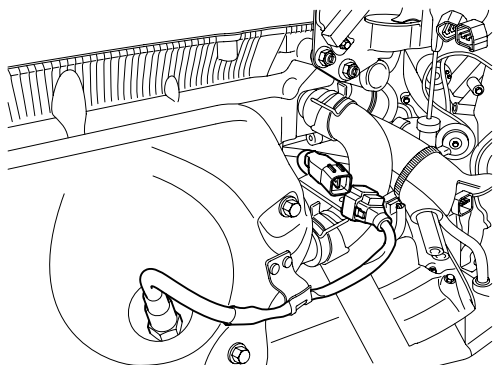
## EXHAUST MANIFOLD

### COMPONENTS E6FBC7D4



**INTAKE AND EXHAUST SYSTEM****EM -77****DISASSEMBLY** EAA67563

1. Disconnect the oxygen sensor connect.



KDPC007D

2. Remove the exhaust manifold heat protector.
3. Remove the exhaust manifold assembly from the cylinder head.
4. Remove the exhaust manifold gasket.

**INSPECTION** ED2622EE**EXHAUST MANIFOLD**

1. Check for damage or cracking.
2. Check for damage or cracking of welding between exhaust manifold and converter.

**REASSEMBLY** E1BC9FEF

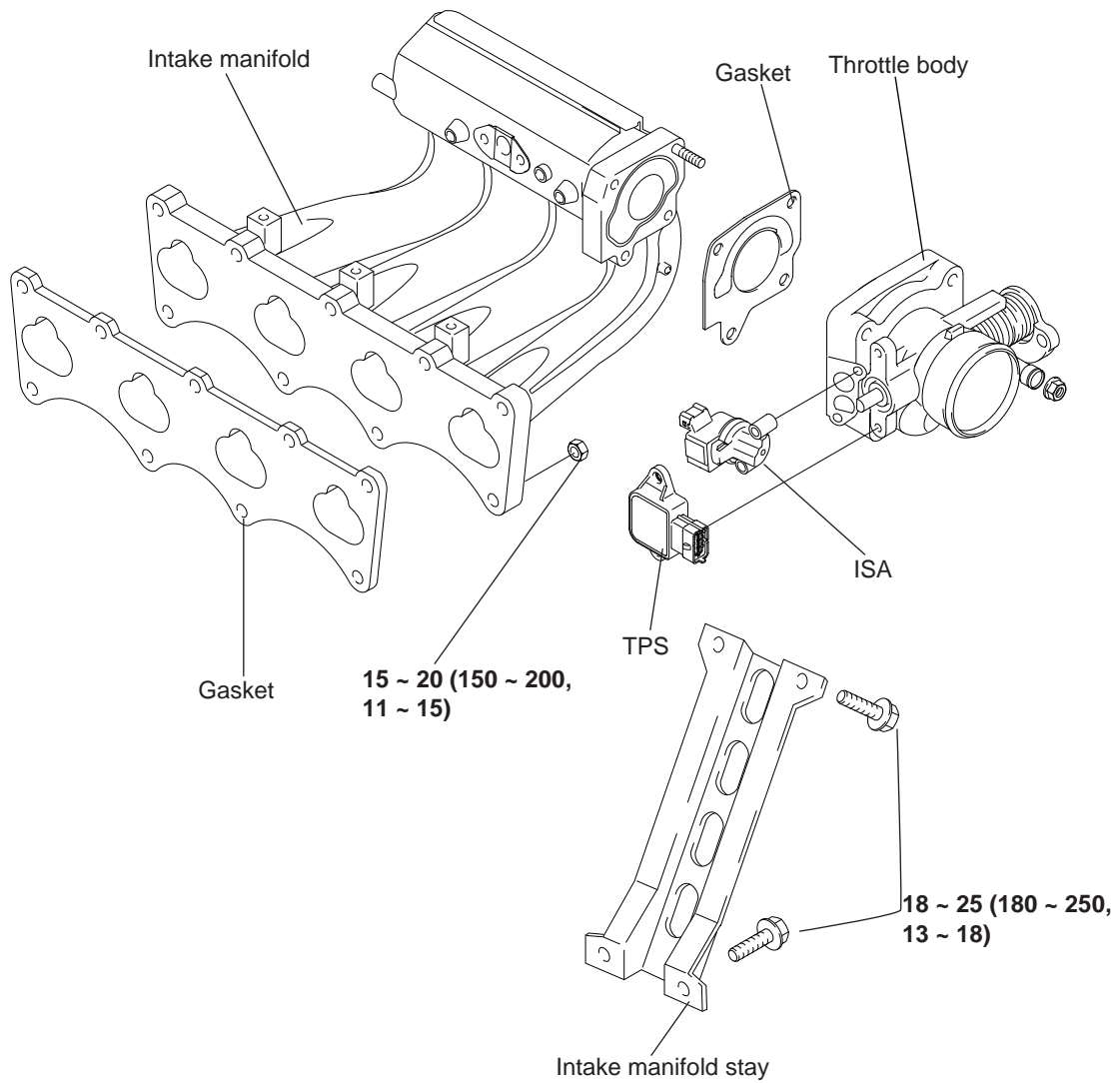
Install the exhaust manifold in the reverse order of removal.

**CAUTION**

***Replace the exhaust manifold gasket and lock nut when reassembling.***

# INTAKE MANIFOLD

## COMPONENTS EF98EE9D



**TORQUE : Nm (kg.cm, lb.ft)**