

Engine Mechanical System

GENERAL	EM
ENGINE BLOCK	EM -
MAIN MOVING SYSTEM	EM -
COOLING SYSTEM	EM -
INTAKE AND EXHAUST SYSTEM	EM -
CYLINDER HEAD ASSEMBLY	EM -
TIMING SYSTEM	EM -

GENERAL

GENERAL ECHA0100

SPECIFICATIONS

Description	Specification	Limit
General		
Type	In-line, Double Overhead Camshaft	
Number of cylinders	4	
Bore	86.5 mm (3.41 in.)	
Stroke	100 mm (3.94 in.)	
Total displacement	2351 cc (143.5 cu.in.)	
Compression ratio	10:1	
Firing order	1-3-4-2	
Idle R.P.M	725 ± 100 rpm	
Ignition timing at idling speed	BTDC 12° ± 8°	
Valve timing		
Intake valve		
Opens (BTDC)	18°	
Closes (ABDC)	54°	
Exhaust valve		
Opens (BBDC)	56°	
Closes (ATDC)	8°	
Cylinder head		
Flatness of gasket surface	Max. 0.03 mm (0.0012 in.)	0.2 mm (0.008 in.)
Flatness of manifold mounting surface	0.15 mm (0.0059 in.)	0.3 mm (0.012 in.)
Dimensions for reworking oversize valve seat hole		
Intake		
0.3 mm (0.012 in.) O.S	35.3-35.325 mm (1.39-1.3907 in.)	
0.6mm (0.024 in.) O.S	35.6-35.625 mm (1.40-1.4026 in.)	
Exhaust		
0.3mm (0.012 in.) O.S.	33.3-33.325 mm (1.31-1.3120 in)	
0.6mm (0.024 in.) O.S.	33.6-33.625 mm (1.32-1.3238 in.)	
Dimensions for reworking oversize valve guide hole (both intake and exhaust)		

Description	Specification	Limit
0.05mm (0.002in.) O.S.	12.05-12.068 mm (0.4751 in.)	
0.25mm (0.010in.) O.S.	12.25-12.268 mm (0.4830 in.)	
0.50mm (0.020in.) O.S.	12.50-12.518 mm (0.4928 in.)	
Camshaft		
Cam height		
Intake	35.493 mm (1.3974 in.)	34.993 mm (1.3776 in.)
Exhaust		
M/T	35.204 mm (1.3860 in.)	34.704 mm (1.3663 in.)
A/T	35.204 mm (1.3860 in.)	34.704 mm (1.3663 in.)
Journal O.D.	26 mm (1.02 in.)	
Bearing oil clearance	0.040-0.076 mm (0.0020-0.0030 in.)	
End play	0.1-0.15 mm (0.004-0.006 in.)	
Valve		
Valve length		
Intake	109.5 mm (4.311 in.)	
Exhaust	109.7 mm (4.319 in.)	
Stem O.D.		
Intake	6.565-6.580 mm (0.2585- 0.2591 in.)	
Exhaust	6.530-6.550 mm (0.2571- 0.2579 in.)	
Face angle	45°-45°5'	
Thickness of valve head (margin)		
Intake	1.0 mm (0.039 in.)	0.7 mm (0.028 in.)
Exhaust	1.5 mm (0.059 in.)	1.0 mm (0.039 in.)
Valve stem to valve guide clearance		
Intake	0.020-0.047 mm (0.0008-0.0019 in.)	0.1 mm (0.0039 in.)
Exhaust	0.050-0.085 mm (0.0020-0.0033 in.)	0.15 mm (0.0059 in.)
Valve guide		

Description	Specification	Limit
Length		
Intake	45.5 mm (1.791 in.)	
Exhaust	50.5 mm (1.988 in.)	
Service over size	0.05, 0.25, 0.50 mm (0.002, 0.010, 0.020 in.)	
Valve seat		
Width of seat contact	0.9-1.3mm (0.035-0.051 in.)	
Seat angle	-44° 5'	
Service size	0.3 mm (0.012 in.), 0.6 mm (0.024 in.) oversize	
Valve spring		
Free length	45.82 mm (1.804 in.)	44.82 mm (1.7646 in.)
Load	25.3kg/40mm (55.8 lb/1.57 in.) at installed height	
Out of squareness	Less than 1.5°	4°
Cylinder block		
Cylinder bore	86.5+0.03 mm (3.406+0.0012 in.)	
Out-of-roundness and taper of cylinder bore	Less than 0.01 mm (0.0004 in.)	
Flatness of gasket surface	Less than 0.05 mm (0.0020 in.)	0.1 mm (0.0039 in.)
Piston		
O.D.	85-0.03 mm (3.346-0.0012 in.)	
Piston-to-cylinder clearance	0.02-0.04 mm (0.0008- 0.0016 in.)	
Ring groove width		
No. 1	1.22-1.24 mm (0.048-0.049 in.)	
No. 2	1.51-1.53 mm (0.059-0.060 in.)	
Oil	2.81-2.83 mm (0.111-0.1114 in.)	
Service size	0.5 mm (0.020 in.) oversize	
Piston ring		
Side clearance		
No. 1	0.03-0.07 mm (0.0012-0.0028 in.)	

Description	Specification	Limit
No. 2	0.02-0.06 mm (0.0008-0.0024 in.)	0.1 mm (0.0039 in.)
Oil ring	0.06-0.15 mm (0.0024-0.0059 in.)	
End gap		
No. 1	0.25-0.35 mm (0.0098- 0.0138 in.)	0.8 mm (0.031 in.)
No. 2	0.40-0.55 mm (0.0157- 0.0216 in.)	0.8 mm (0.031 in.)
Oil ring side rail	0.10-0.40 mm (0.0039-0.0157 in.)	1.0 mm (0.039 in.)
Connecting rod		
Bend	0.05 mm (0.0020 in.)	
Twist	0.1 mm (0.004 in.)	
Connecting rod big end to crankshaft side clearance	0.10-0.25 mm (0.0040-0.0098 in.)	0.4 mm (0.0157 in.)
Piston pin press-in load	1250±500 kg (2756±1100 lb.f)	
Connecting rod pin O.D	48-48.015 mm (1.890-1.8903 in.)	
Connecting rod bearing oil clearance	0.015-0.048 mm (0.0008-0.0020 in.)	0.1 mm (0.0039 in.)
Crankshaft main bearing oil clearance		
No. 1,2,4,5 journal	0.018-0.036 mm (0.0007-0.0014 in.)	0.1 mm (0.0039 in.)
No. 3 journal	0.024-0.042 mm (0.0009-0.0016 in.)	
Crankshaft		
Journal O.D.	56.982-57.000 mm (2.2434-2.2441 in.)	
Out-of-round of journal and pin	Less than 0.015 mm (0.0006 in.)	
Taper of journal and pin	Less than 0.005 (0.0002 in.)	
End play	0.05-0.25 mm (0.0020- 0.0098 in.)	0.25 mm (0.0098 in.)
Flywheel		
Runout		0.13 mm(0.0051 in.)
Oil pressure at curb idle speed	80 kPa (11.6 psi)	
[Oil temperature is 75-90°C (167-194°F)]		
Oil pump		

Description	Specification	Limit
Tip clearance		
Drive gear	0.16-0.21 mm (0.0063-0.0083 in.)	0.25 mm(0.0098in.)
Driven gear	0.18-0.21 mm (0.0071-0.0083 in.)	0.25 mm(0.0098in.)
Side clearance		
Drive gear	0.08-0.14 mm (0.0031-0.0055 in.)	0.25 mm(0.0098in.)
Driven gear	0.06-0.12 mm (0.0024-0.0047 in.)	0.25 mm(0.0098in.)
Relief spring		
Free length	46.6 mm (1.835 in.)	
Load [61 N (13.5 lb)]	40.1 mm (1.579in.)	
Right silent shaft		
Front journal diameter	18.467-18.480 mm (0.7270-0.7276 in.)	
Rear journal diameter	40.951-40.967mm (1.6516-1.6129in.)	
Oil clearance		
Front	0.020-0.061 mm (0.0008-0.0024 in.)	
Rear	0.050-0.091 mm (0.0020-0.0036 in.)	
Left silent shaft		
Front journal diameter	18.467-18.480mm (0.7270-0.7276in.)	
Rear journal diameter	40.951-40.967 mm (1.6122-1.6130 in.)	
Oil clearance		
Front	0.020-0.054 mm (0.0008-0.0021 in.)	
Rear	0.042-0.083 mm (0.0017-0.0033 in.)	
Cooling method	Engine coolant cooling, forced circulation with electric fan	
Cooling system quantity	7.0 lit (7.4 U.S.qts., 6.1 Imp.qts.) [For DOHC]	
Thermostat		
Type	Wax pellet type with jiggle valve	
Normal opening temperature	82°C(180°F)	

Description	Specification	Limit
Opening temperature range	80°C-84°C (176°F-183°F)	
Wide open temperature	95°C (203°F)	
Radiator cap		
Main valve opening pressure	107.9±14.7 kPa (1.1±0.15 kg/cm ² , 15.64±2.13 psi)	
Main valve closing pressure	83.4 kPa (0.85 kg/ cm ² , 12.1 psi)	
Vacuum valve opening pressure	-6.86 kPa (-0.07 kg/ cm ² , -1.00 psi)	
Air cleaner		
Type	Dry type	
Element	Unwoven cloth type	
Exhaust pipe		
Muffler	Expansion resonance type	
Suspension system	Rubber hangers	
Coolant temperature sensor		
Type	Thermister type	
Resistance		
20°C (68°F)	2.45±0.14 kΩ	
80°C (176°F)	0.3222 kΩ	

SERVICE STANDARD

Standard value	
Coolant concentration	
Tropical area	40%
Other area	50%

LUBRICANT

Engine coolant	Ethylene glycol base for aluminum radiator
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SELANT

Engine coolant temperature sensor	LOCTITE 262, three bond No. 1324 or equivalent
Oil pressure switch	3M ATD No. 8660 or Three bond No. 1141E

NOTE

U.S. = Undersize Diameter

O.D.= Outer Diameter

I.D.= Inner Diameter

O.S.= Oversize Diameter

TIGHTENING TORQUE

ECHA0200

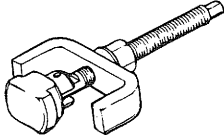
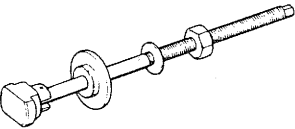
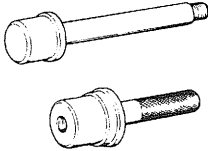
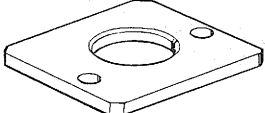
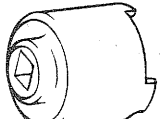
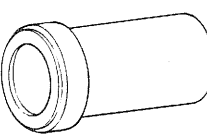
Item	Nm	kg.cm	Lb.ft
Engine mount insulator bolt	90-110	900-1100	65-80
Engine mounting bracket nuts	60-80	600-800	43-58
Engine mounting bracket bolts	60-80	600-800	43-58
Engine Support bracket bolt and nut	55-65	550-650	40-47
Front roll stopper bracket to cross member bolts	40-55	400-550	29-40
Front roll stopper insulator bolt and nut	50-65	500-650	36-47
Rear roll stopper bracket to cross member bolts	50-65	500-650	36-47
Rear roll stopper insulator bolt and nut	50-65	500-650	36-47
Transaxle mounting bracket bolts	60-80	600-800	43-58
Transaxle mounting insulator bolt	90-110	900-1100	65-80
Air conditioner compressor to bracket	23-27	230-270	17-20
Power steering oil pump to bracket	35-45	350-450	25-33
Front exhaust pipe to exhaust manifold	30-40	300-400	22-29
Rocker cover bolt	8-10	80-100	6-7
Center cover bolt	4-5	40-50	3-3.6
Camshaft sprocket bolt	80-100	800-1000	58-72
Camshaft bearing cap bolt	19-21	190-210	14-15
Crankshaft position sensor	10-13	100-130	7-9
Throttle body stay	15-22	150-220	11-16
Air cleaner body installation bolt	8-10	80-100	6-7
Crankshaft sprocket bolt	110-130	1100-1300	80-94
Damper pulley to crankshaft sprocket	20-30	200-300	14-22
Cylinder head bolt (cold engine)			
With change parts	63+Release all bolts +20+90°+90°	630+Release all bolts +200+90°+90°	46+Release all bolts +14+90°+90°
Without change parts.	20+90°+90°	200+90°+90°	14+90°+90°
Intake manifold stay	18-25	180-250	13-18
Tension pulley bracket bolt	23-27	230-270	17-20
Auto tensioner bolt	20-27	200-270	14-20
Tensioner pulley bolt	43-55	430-550	31-40
Idler pulley bolt	30-42	300-420	22-30
Front exhaust pipe clamp bolt	20-30	200-300	14-22
Oil pan (lower and upper)	10-12	100-120	7-9

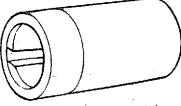
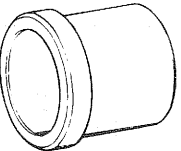
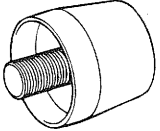
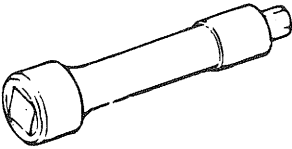
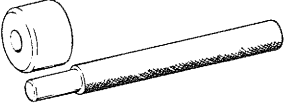
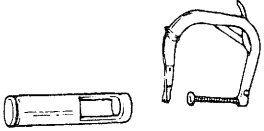
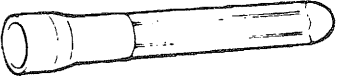
Item	Nm	kg.cm	Lb.ft
Oil pan drain plug	35-45	350-450	25-33
Oil screen	15-22	150-220	11-16
Oil pump sprocket nut	50-60	500-600	36-43
Oil pressure switch	8-12	80-120	6-9
Oil filter bracket bolt	20-27	200-270	14-20
Oil pump cover bolt	15-18	150-180	11-13
Oil seal case bolt	10-12	100-120	7-9
Plug cap	20-27	200-270	14-20
Front case bolt (M6)	20-27	200-270	14-20
Driven gear bolt	34-40	340-400	25-29
Engine coolant pump pulley bolt	8-10	80-100	6-7
Timing belt upper cover	8-10	80-100	6-7
Timing belt lower cover	8-10	80-100	6-7
Relief plug	40-50	400-500	29-36
Flywheel	130-140	1300-1400	94-101
Drive plate	130-140	1300-1400	94-101
Timing belt rear right cover	10-12	100-120	7-9
Timing belt rear left cover (upper)	10-12	100-120	7-9
Connecting rod cap bolt	20+90°	200+90°	14+90°
Crankshaft bearing cap bolt	25+90°	250+90°	18+90°
Engine hanger			
M8	25-30	250-300	18-22
M10	35-55	350-550	25-40
Alternator support bolt	20-25	200-250	14-18
Alternator brace bolt			
M8x90	8-12	80-120	6-9
M8x40	20-25	200-250	14-18
Engine coolant pump to cylinder block bolt	20-27	200-270	14-20
Engine coolant temperature sensor	20-40	200-400	14-29
Engine coolant inlet fitting attaching bolt	10-15	100-150	7-11
Air cleaner mounting bolts	8-10	80-100	6-7
Resonator mounting bolt (Nut)	8-10	80-100	6-7
Throttle body to intake manifold	15-22	150-220	11-16
Intake manifold mounting bolt (M8)	15-20	150-200	11-14
Intake manifold mounting nut	30-42	300-420	22-30
Tension rod bracket bolt to tension rod	35-55	350-550	25-40

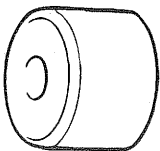
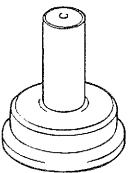
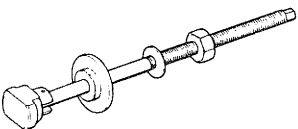
Item	Nm	kg.cm	Lb.ft
Ignition coil bolts	8-12	80-120	6-9
Power transistor bolts	10-12	100-120	7-9
Front exhaust manifold bolt to cylinder block	20-30	200-300	14-22
Center exhaust pipe nuts to catalytic converter	30-40	300-400	22-29
Center exhaust pipe bolts to main muffler	30-40	300-400	22-29
Center exhaust pipe bolt to bracket	10-15	100-150	7-11
Hanger bolt to body	10-15	100-150	7-11
Hanger bolt to main muffler	10-15	100-150	7-11
Exhaust manifold nuts to engine nut(8)	25-30	250-300	18-22
Exhaust manifold nuts to engine nut(10)	35-55	350-550	25-40
Oxygen sensor	40-50	400-500	29-36
Heat protector bolt to exhaust manifold	12-15	120-150	9-11
Air cleaner bracket bolt	10-13	100-130	7-9
Exhaust manifold cover to exhaust manifold bolt	12-15	120-150	9-11
Oxygen sensor to exhaust manifold	40-50	400-500	29-36
Front exhaust pipe bracket bolt	20-30	200-300	14-22
Main muffler hanger support bracket bolt	10-20	100-200	7-14
Oil level gauge	12-15	120-150	9-11
Stud bolt	30-40	300-400	22-29
Tensioner arm assembly	17-26	170-260	12-19
Balance shaft bolt	34-40	340-400	25-29
Starter bolt to cylinder block	27-35	270-350	20-25
Radiator fan motor bolt	8-10	80-100	6-7
Delivery pipe to cylinder block	10-13	100-130	7-9

SPECIAL TOOLS

ECHA0300

Tool (Number and name)	Illustration	Use
Counter balance shaft bearing puller (09212-32000)	 ECA9930K	Removal of front bearing of counter balance shaft
Counter balance shaft bearing puller (09212-32100)	 ECA9930L	Removal of rear bearing of counter balance shaft (use with 09212-32300)
Counter balance shaft bearing installer (09212-32200)	 ECA9930M	Installation of counter balance shaft front and rear bearing (use with 09212-32300)
Guide plate (09212-32300)	 ECA9930N	Removal and installation of counter balance shaft rear bearing (use with 09212-32100, 09212-32200)
Plug cap wrench (09213-33000)	 ECA9930O	Removal and installation of front case cap plug
Crankshaft front oil seal installer (09214-32000)	 ECA9930A	Installation of the crankshaft front oil seal (use with 09214-32100)

Tool (Number and name)	Illustration	Use
Crankshaft front oil seal guide (09214-32100)	 ECA9930B	Installation of the crankshaft front oil seal (use with 09214-32000)
Camshaft oil seal installer (09221-21000)	 ECA9930C	Installation of the camshaft oil seal (use with 09221-21100)
Camshaft oil seal guide (09221-21100)	 E2121100	1. Used as a guide when pressing in the camshaft oil seal (use with 09221-21000)
Cylinder head bolt socket (09221-32001)	 ECHA001E	Removal and installation of the cylinder head bolt
Valve guide installer (09222-21200A, 09222-21200B)	 ECA9930G	Removal and installation of the valve guide
Valve spring compressor (09222-28000) Valve spring compressor holder (09222-28100)	 ECA9930E	Removal and installation of the inlet or exhaust valve
Valve stem oil seal install (09222-28200)	 ECHA001G	Installation of the valve stem oil seal

Tool (Number and name)	Illustration	Use
Valve guide installer adapter (09222-28400)	 ECHA001I	Installation of the valve guide
Crankshaft rear oil seal installer (09231-21000)	 ECA9930H	1. Installation of the engine rear oil seal 2. Installation of the crankshaft rear oil seal
Piston pin remover and installer kit (09234-33001)	 ECA9930L	Removal and installation of the piston pin
insert (09234-33002)	 ECA9930J	Removal and installation of the piston pin (use with 09234-33001)

TROUBLESHOOTING

ECHA0400

Symptom	Probable cause	Remedy
Low compression	Damaged 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
Oil pressure drop	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 find out cause
	Oil relief valve stuck (open)	Repair
	Excessive bearing clearance	Replace
High oil pressure	Oil relief valve stuck (closed)	Repair
Excessive engine rolling and 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
Connecting rod and/main bearing noise	Insufficient oil supply	Check engine oil level
	Thin or diluted engine oil	Change and find out cause
	Excessive bearing clearance	Replace
Timing belt noise	Incorrect belt tension (alternator tensioner, timing belt)	Adjust belt tension
Low coolant level	Leakage of coolant	
	Damaged radiator core joint	Replace
	Corroded or cracked hoses (radiator hose, heater hose, etc)	Replace
	Faulty radiator cap valve or setting of spring	Replace
	Faulty thermostat	Replace
	Faulty engine coolant pump	Replace
Clogged radiator	Foreign material in coolant	Replace

Symptom	Probable cause	Remedy
Abnormally high coolant temperature	Faulty thermostat	Replace
	Faulty radiator cap	Replace
	Restriction of flow in cooling system	Replace
	Loose or missing drive belt	Adjust or replace
	Faulty engine coolant pump	Replace
	Faulty temperature wiring	Repair or replace
	Faulty electric fan	Repair or replace
	Faulty thermo-sensor on radiator	Replace
	Insufficient coolant	Refill coolant
Abnormally low coolant temperature	Faulty thermostat	Replace
	Faulty temperature wiring	Repair or replace
Leakage from oil cooling system	Loose hose and pipe connection	Retighten
	Blocked or collapsed hose and pipe	Replace
Inoperative electrical cooling fan	Damaged	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

CHECKING ENGINE OIL ECHA0500

1. Position a vehicle on a level surface.
2. Stop the engine.

NOTE

In the case of a vehicle that has been out of service for a prolonged period, run the engine for several minutes.

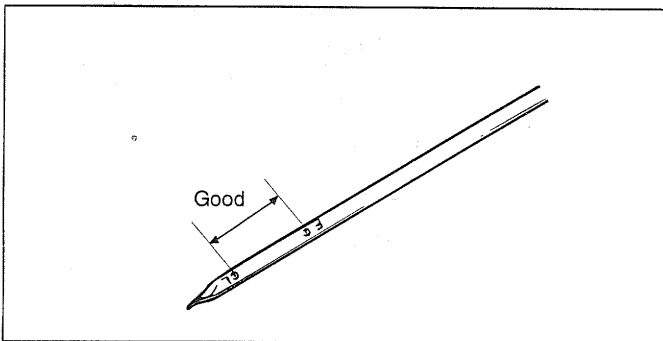
Stop the engine and wait for 5 minutes at least, and then check the oil level..

3. 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.

NOTE

When refilling, use the same type of engine oil as the used one.

4. Check that the oil is not dirty or mixed with coolant or gasoline and it has the proper viscosity.



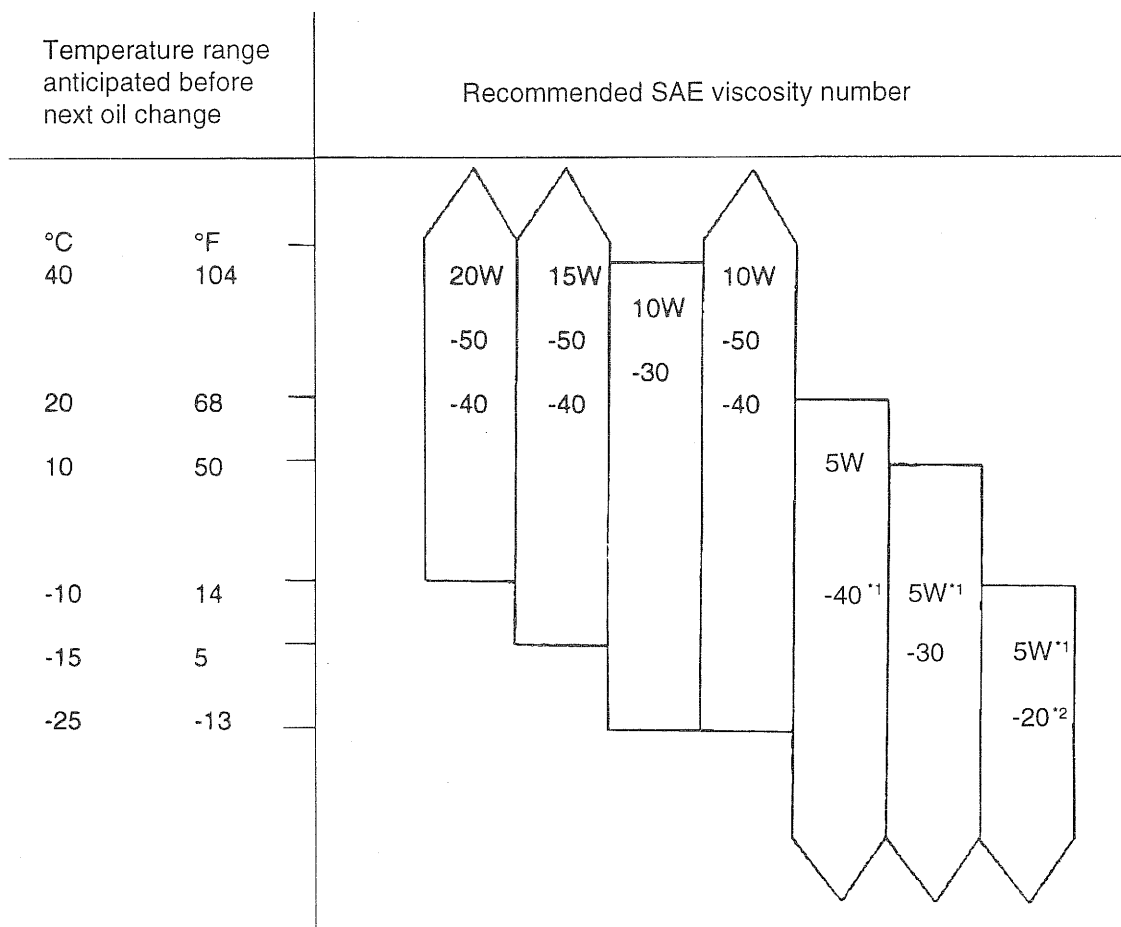
EDA9000A

SELECTION OF ENGINE OIL

ECHA0600

Recommended API classification: SD OR ABOVE SE OR ABOVE [For EC.]

Recommended SAE viscosity grades:



*1 Restricted by driving and climate condition.

*2 Not recommended for sustained high speed vehicle operation

EDA9990B

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 which do not have both a SAE grade number and an API service classification on the container should not be used.

CHANGING ENGINE OIL ECHA0700

1. Run the engine until it reaches normal operating temperature.
2. Stop the engine.
3. Remove the oil filler cap and the drain plug. Drain the engine oil.
4. Tighten the drain plug to the specified torque.

Tightening torque

Oil pan drain plug :

35-45 Nm (350-450 kg.cm, 25-33 lb.ft)

NOTE

Whenever tightening the oil drain plug, use a new drain plug gasket.

5. Fill new engine oil through the oil filler cap opening.

Capacity :

Drain and refill : 4.0 lit (4.23 U.S.qts., 3.51 Imp.qts.)

NOTE

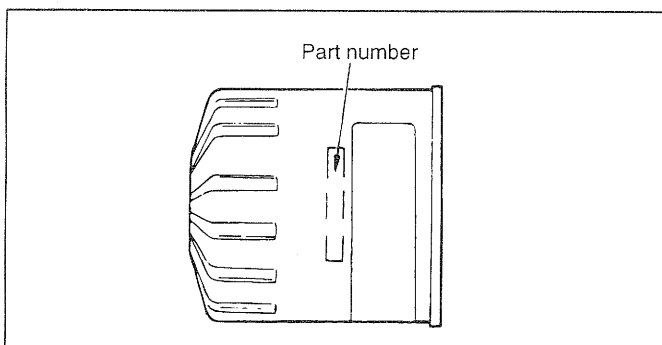
Do not overfill. This will cause oil aeration and loss of oil pressure.

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

REPLACING THE OIL FILTER ECHA0800

All Hyundai Motor Company engines are equipped with a high quality, throw-away oil filter. This filter is recommended as a replacement filter on all vehicles. The quality of replacement filters is various considerably.

High quality replacement 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 a new filter.



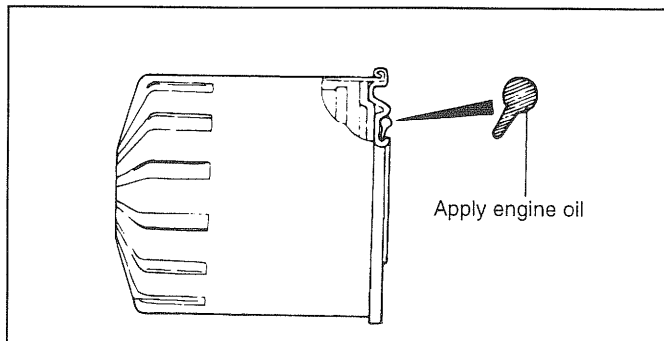
ECA9970A

PROCEDURE FOR REPLACING THE OIL FILTER

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

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

4. Start and run the engine and check for engine oil leak.
5. After stopping the engine, check the oil level and add oil as necessary.



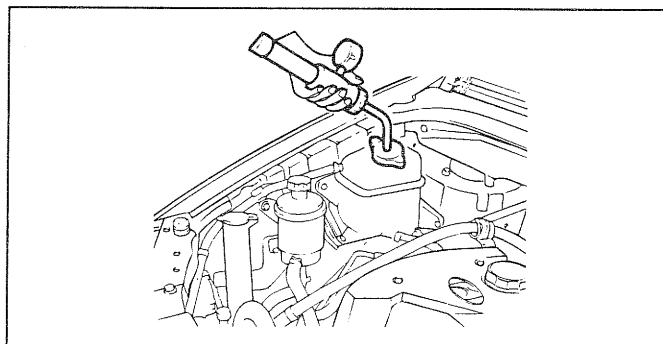
ECA9970B

CHECKING COOLANT LEAK ECHA0900

1. Loosen 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 150 KPa (21psi, 1.53 kg/cm²) 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 spray 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.



ECHA054A

RADIATOR CAP PRESSURE TEST

1. Use an adapter to attach the cap to the tester.
2. Increase the pressure until the gauge stops moving.

Main valve opening pressure :

107.9kPa $\pm$ 14.7kPa (1.1 $\pm$ 0.15 kg/cm², 15.64 $\pm$ 2.13)

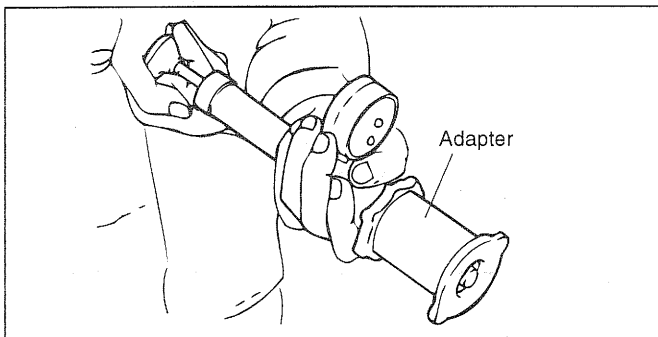
Main valve closing pressure :

83.4 kPa (0.85 kg/cm², 12.1 psi)

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

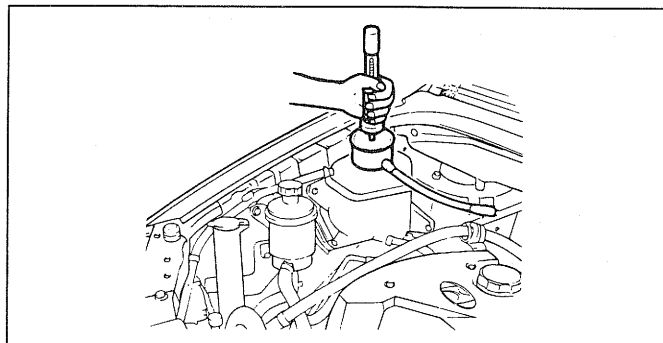
Be sure that the cap is clean before testing, since rust or other foreign material on the cap seal will cause an incorrect indication.



ECA9090A

SPECIFIC GRAVITY TEST ECHA1000

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.



ECHA054B

RELATION BETWEEN COOLANT CONCENTRATION AND SPECIFIC GRAVITY

Coolant temperature °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)

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.

CAUTION

- If the concentration of the coolant is below 30%, the anti-corrosion property will be adversely affected.
- if

- Do not use together with another brand's product.

RECOMMENDED COOLANT

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

CHECKING COMPRESSION PRESSURE ECHA1100

1. Before checking compression pressure, check the engine oil level. Also check that the starter motor and battery are all in normal operating condition.
2. Start the engine and wait until engine coolant temperature reaches 80-95°C (176-205°F).
3. Stop the engine and disconnect the spark plug cables.
4. Remove the spark plugs.
5. Crank the engine to remove any foreign material in the cylinders.
6. Insert the compression gauge into the spark plug hole.

7. Depress the accelerator pedal to open the throttle fully.
8. Crank the engine and read the gauge.

Standard value : 1200kpa (12.2Kg/cm², 170 psi)

Limit : 12.0 kg/cm² (1.18 MPa, 171 psi)

9. Repeat steps from 6 to 8 over all cylinders, ensuring that the pressure differential for each of the cylinders is within the specified limit.

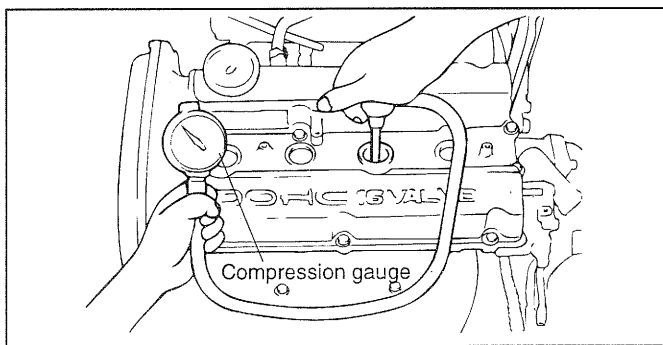
Limit : Max. 100 kpa (1.0 kg/cm² ,14 psi) between cylinders

10. If a cylinder's compression or pressure differential is below specification, add a small amount of oil through the spark plug hole, and repeat steps from 6 to 9.

- 1) If the addition of oil makes the compression to rise, it is possible 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

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



ECA9001A

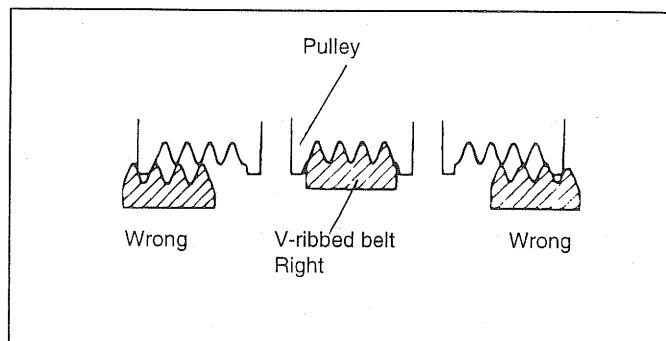
ADJUSTING DRIVE BELT TENSION

ECHA1200

1. Check that the belts are not damaged and are properly fit for the pulley grooves.

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 degree that the belt is deflected.



ECA9980A

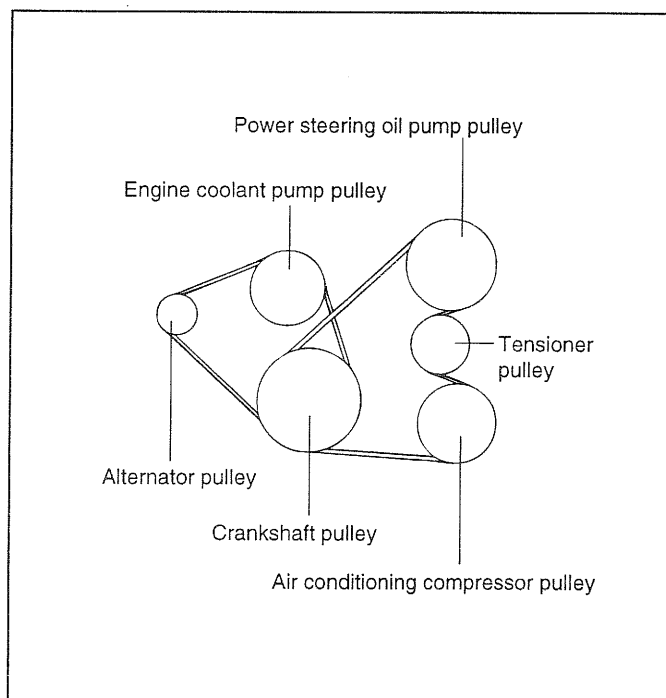
2. Apply 100 N (22 lbs.) force to the back and midway portion of the belt between the pulleys as shown in the illustration, measure the amount of deflection with a tension gauge.

STANDARD VALUE:

Items		Inspection	Adjustment	
			New	Used
For alternator	Deflection mm (in.)	9.0-10.4 (0.35-0.41)	7.5-9.0 (0.30-0.35)	10 (0.40)
	Tension N (lb)	350-500 (79-112)	600-700 (135-157)	400 (90)
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

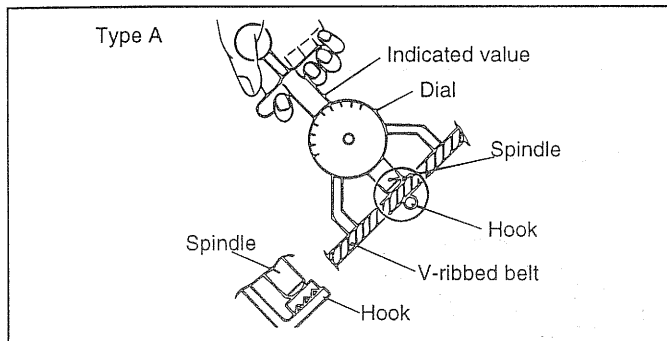
1. The belt tension must be measured between the specified pulleys.
2. When a new belt is installed, adjust the tension to the central value of the standard range indicated under "New" in the above table. And then let the engine idle for 5 minutes or more, and check the standard value indicated under "Inspection."
3. When adjusting a belt which has been used or a belt installed newly 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.



ECA9002A

A TYPE OF TENSION GAUGE

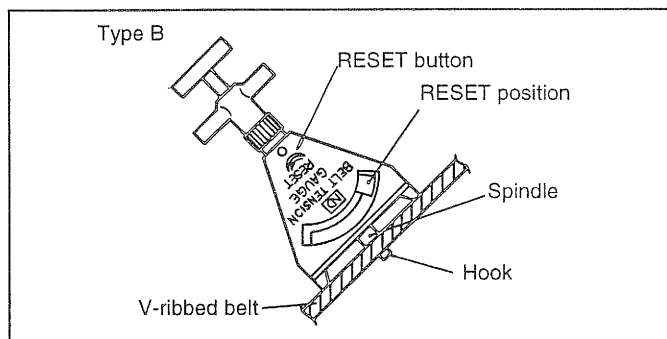
Do not let the dial section of the tension gauge contact other objects during measurement.



ECA9980C

B TYPE OF 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 will 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 nut A :

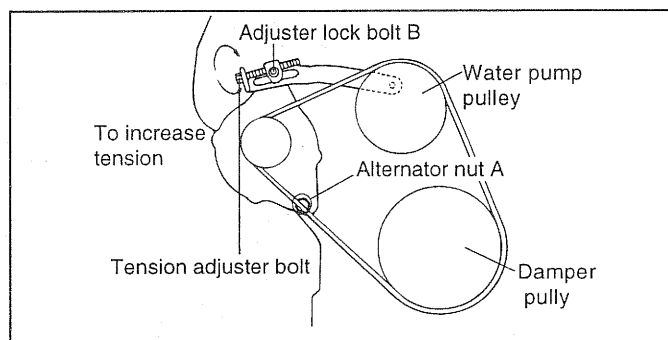
35-55 Nm (350-550 kg.cm, 25-40 lb.ft)

Adjuster lock bolt B :

20-25 Nm (200-250 kg.cm, 14-18 lb.ft)

Tension adjuster bolt :

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



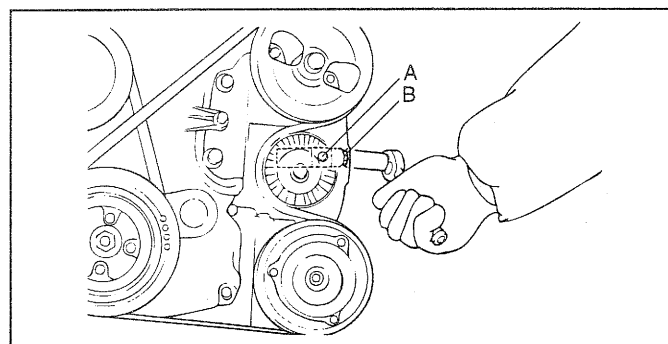
ECA9003A

ADJUSTING THE BELT OF POWER STEERING AND AIR CONDITIONER

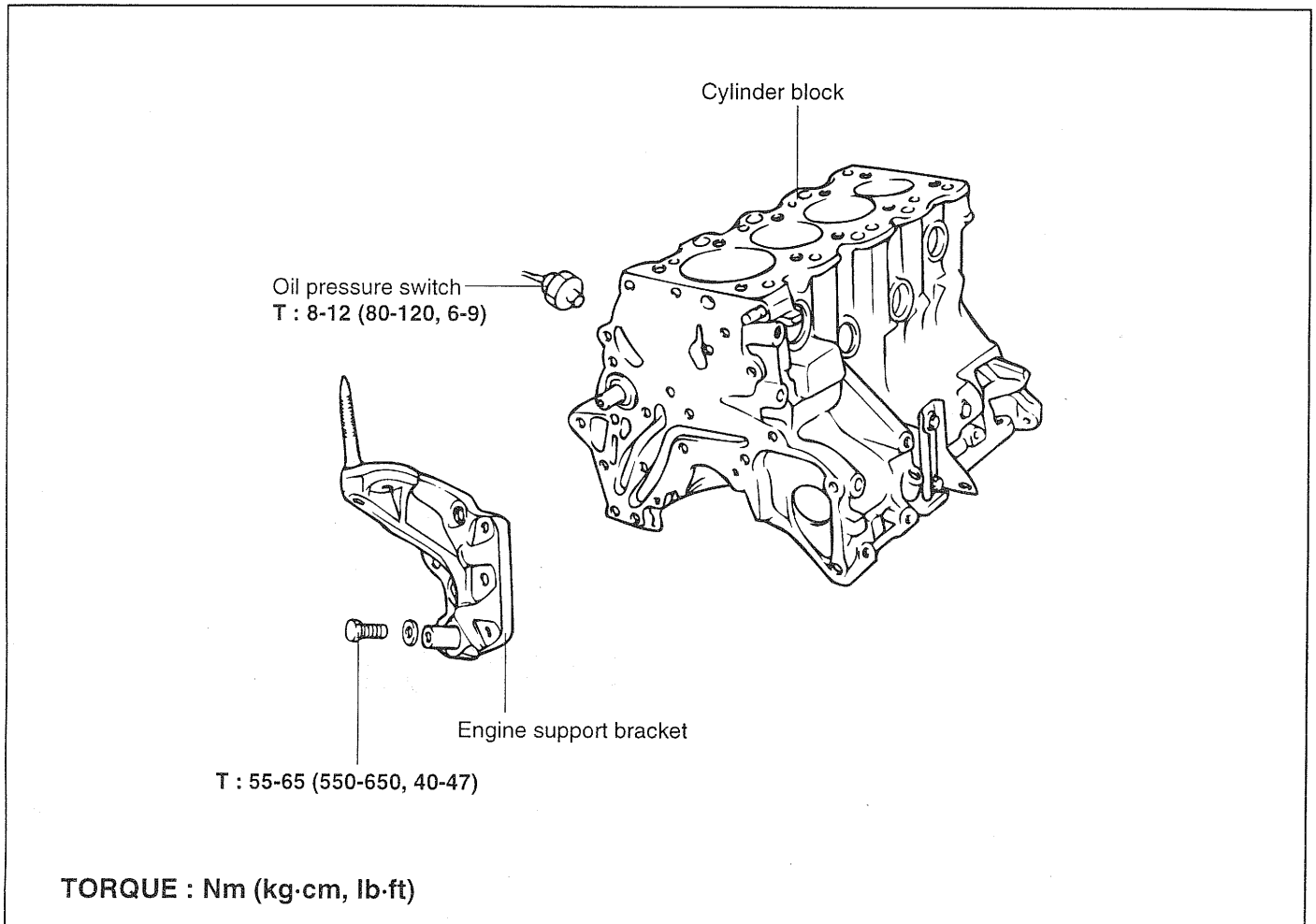
1. Loosen the tension pulley adjustment bolt A.
2. Adjust the belt deflection with the adjustment bolt B.
3. Tighten the fixing bolt A.
4. Recheck the belt deflection and readjust, if necessary.

NOTE

Before rechecking, crank the engine one more revolutions.



ECA9004A

ENGINE BLOCK**ENGINE BLOCK****CYLINDER BLOCK** ECHA1500

ECHA150A

DISASSEMBLY ECHA1600

Remove the cylinder head, timing belt train, front case, flywheel, piston and crankshaft.

For further details, refer to the appropriate section.

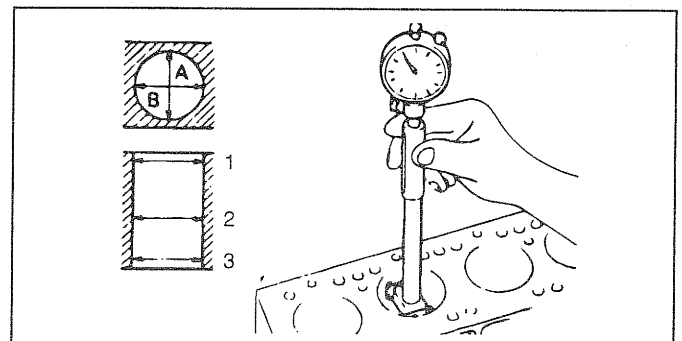
INSPECTION ECHA1700**CYLINDER BLOCK**

1. Visually check the cylinder block for scores, rust and corrosion. Also check for cracks or any other defects. Repair or replace the block if defective.
2. Measure the cylinder bore with a cylinder gauge at the three levels indicated in the directions of A and B.

Level 1: No. 1 piston ring position at TDC

Level 2 : Center of cylinder

Level 3 : Bottom of cylinder



ECA9450A

- If the cylinder bores show more than specified out-of-round or taper, or if the cylinder walls are badly scuffed or scored, the cylinder block should be rebored and honed. New oversize piston and rings should be installed.

Standard value

Cylinder bore : 86.5+0.03 mm (3.41+0.0012 in.)

Out-of-round and taper of cylinder bore :

Max. 0.01mm(0.0004 in.)

- If a ridge exists at the top of the cylinder, cut it away with a ridge reamer.

5.

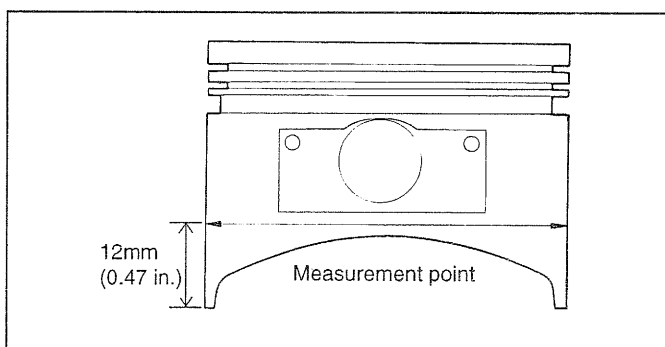
PISTON SERVICE SIZE AND MARK MM (IN.)

Identification Mark	Size
0.50	0.50 (0.020) O.S

- To rebores the cylinder bore to oversize, keep the specified clearance between the oversize piston and the bore, and make sure that all pistons used are of the same oversize. The standard measurement of the piston outside diameter is taken at a level 2 mm (0.08 in.) above the bottom of the piston skirt and across the thrust faces.

Piston-to-cylinder wall clearance :

0.02-0.04mm(0.0008-0.0016 in.)



ECA9451A

- Check for damage and cracks.
- Check the top surface of the cylinder block for flatness. If the top surface exceeds limits, grind to minimum limit or replace.

Standard value

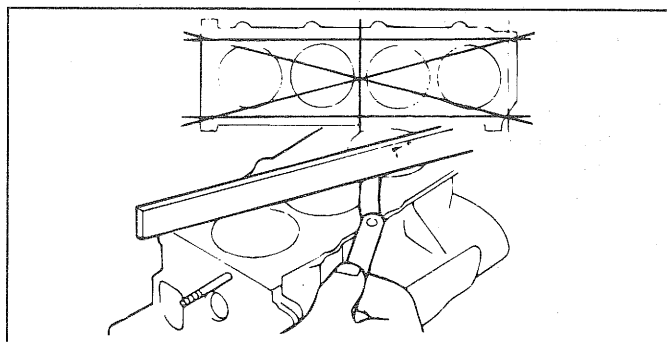
Flatness of cylinder block : Max. 0.05mm(0.0020 in.)

Service limit

Flatness of cylinder block : 0.1mm(0.0039 in.)

NOTE

When the cylinder head is assembled, grinding less than 0.2 mm (0.008 in.) is permissible.



ECA9450B

BORING CYLINDER

- Oversize pistons used should be determined basis of the largest bore cylinder.

Identification Mark	Size
0.50	0.50 mm (0.020 in.) O.S.

NOTE

Size mark is stamped on top of the piston.

- Measure the outside diameter of the piston to be used.
- On the basis of measured O.D., calculate the boring dimension.

Boring dimension = Piston O.D + 0.02 to 0.04 mm (0.0008 to 0.0016 in.) (clearance between piston and cylinder) - 0.02 mm (0.0008 in.) (honing margin.)

- Bore each of cylinders to the calculated size.

NOTE

To prevent distortion that may result from temperature rise during honing, bore the cylinders, holes in the firing order sequence.

- Hone the cylinders, finishing them to the proper dimension (piston outside diameter + gap with cylinder).

6. Check the clearance between the piston and cylinder.

NOTE

When boring cylinders, finish all four cylinders to the same oversize. Do not bore only one cylinder to the oversize.

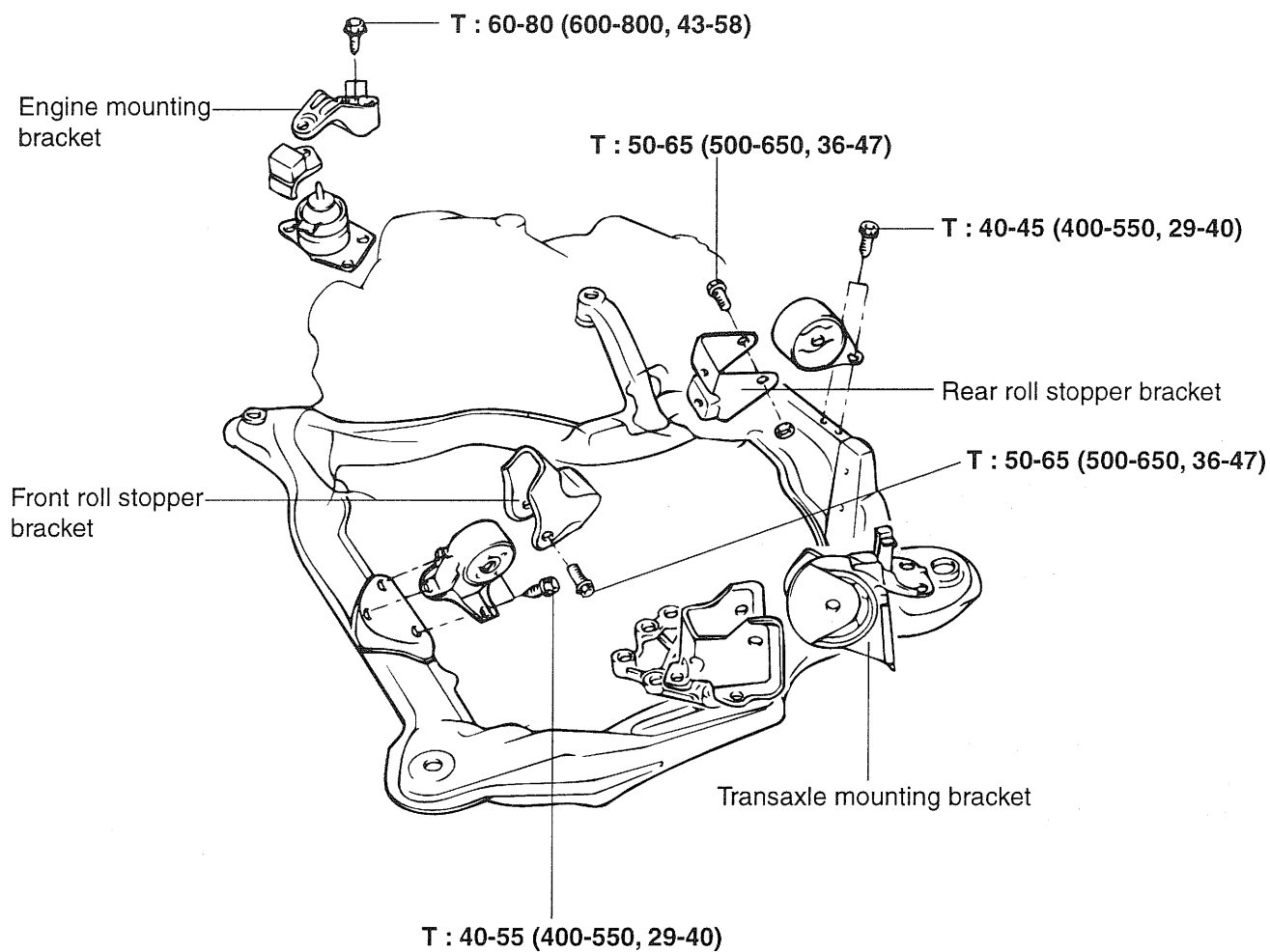
REASSEMBLY ECHA1800

Install the following parts by referring to their respective paragraphs.

1. Crankshaft
2. Flywheel
3. Piston
4. Cylinder head
5. Timing belt train
6. Front case

ENGINE MOUNTS

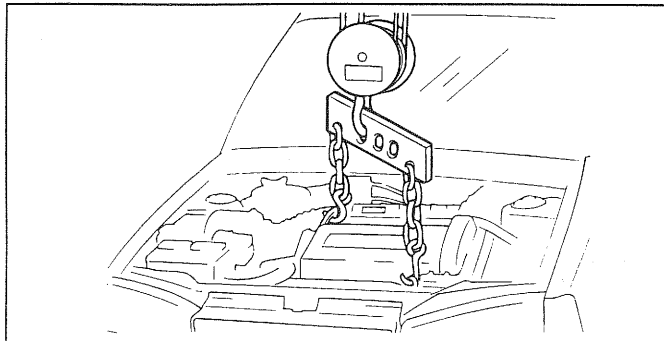
ENGINE MOUNTING ECHA2000



TORQUE : Nm (kg·cm, lb·ft)

REMOVAL ECHA2100

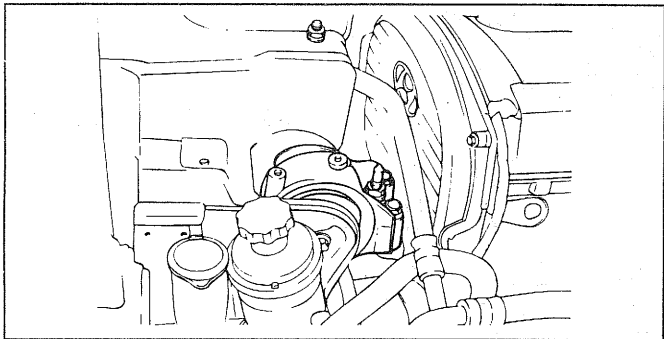
Hang a chain or cable to the engine hooks and lift enough so that there may be no pressure on the insulators.



ECA9120A

ENGINE MOUNTING

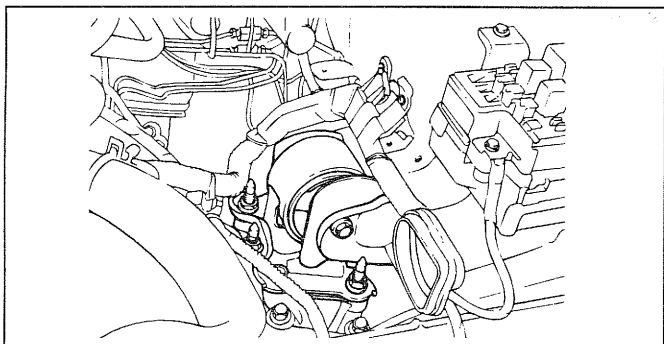
1. Remove the engine mounting insulator bolts.
2. Remove the engine mounting bracket from the engine.



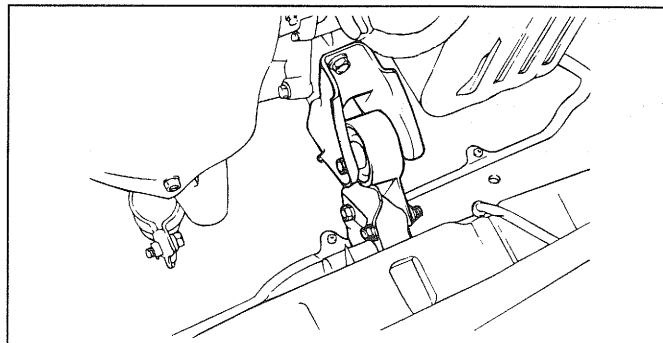
ECA9006A

TRANSAXLE MOUNTING

1. Remove the transaxle mounting insulator bolts.
2. Remove the transaxle mounting bracket from the transaxle.



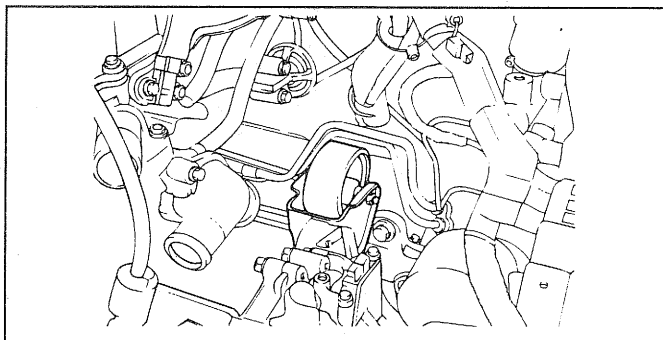
ECA9007A



ECA9008A

REAR ROLL STOPPER

1. Remove the bolt from the rear roll stopper.
2. Remove the rear roll stopper from the subframe.



ECA9009A

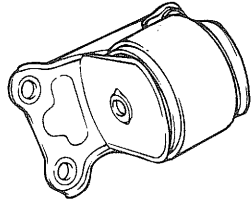
FRONT ROLL STOPPER

Remove the front roll stopper bracket from the sub-frame.

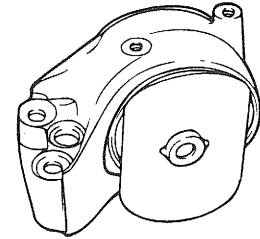
INSPECTION ITEMS

ECHA2200

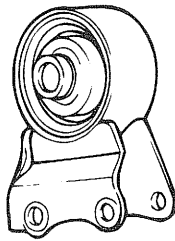
Transaxle mounting



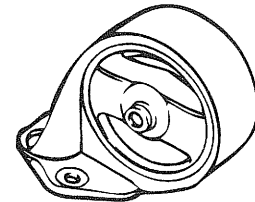
Engine mounting



Front roll stopper assembly



Rear roll stopper assembly

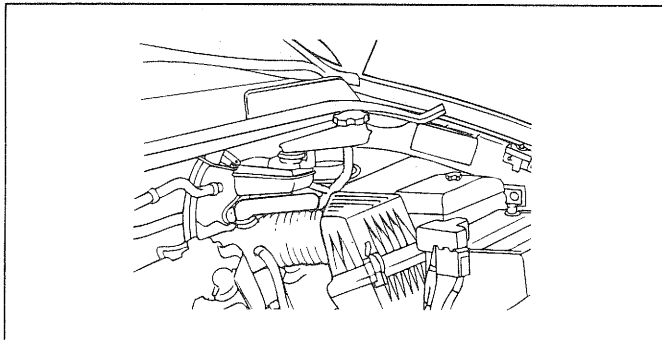


ENGINE AND TRANSAXLE ASSEMBLY

ECHA2300

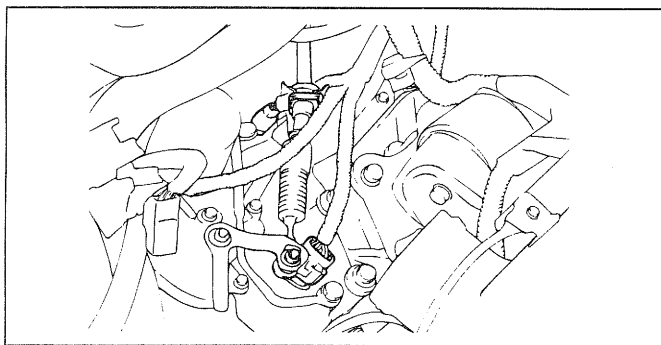
REMOVAL

1. Remove the battery.
2. Detach the air cleaner.

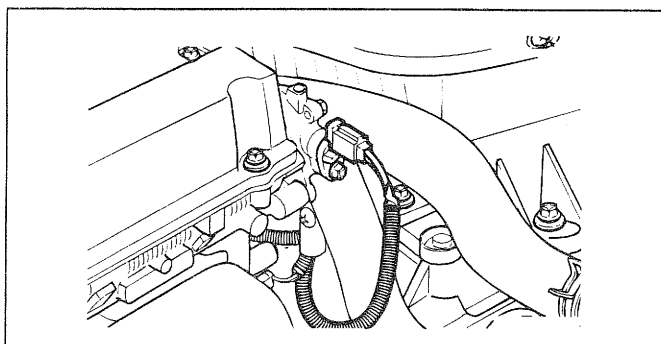


ECHA004A

3. Disconnect the engine harness connectors.
 1. Engine wiring connectors (alternator, starter, etc.)
 2. TPS connector
 3. Power steering switch connector, oil pressure gauge connector.
 4. Back up lamp switch connector.
 5. A/T solenoid, inhibit switch connector.
 6. Coolant temperature sensor.
 7. Ignition coil, power TR connector.
 8. Idle speed control valve (ISCV) connector.
 9. MAP and ATS connector.
 10. Oxygen sensor connector.



ECA9014A



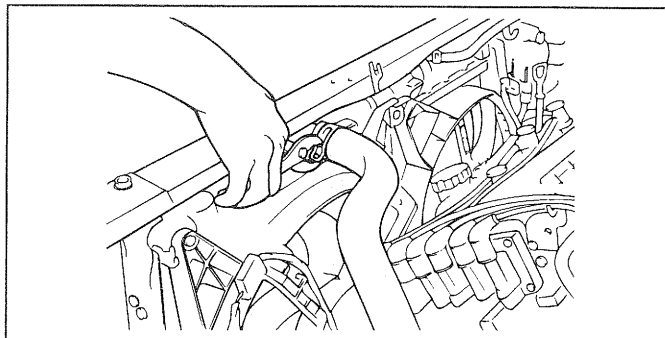
ECHA004C

4. Drain the engine coolant.
5. For a vehicle with automatic transaxles, disconnect the transaxle oil cooler hoses.

NOTE

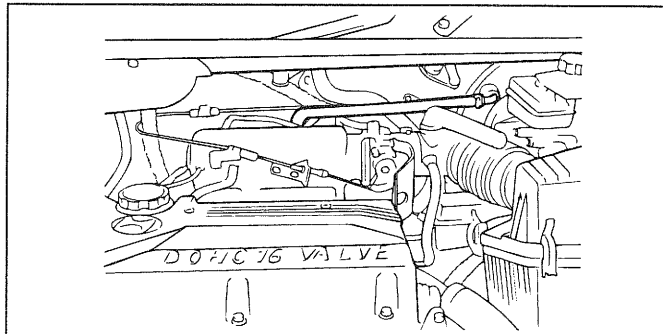
- When disconnecting the hoses, make identification marks to avoid making any mistake when installing them again.
- Be careful not to spill any of oil or fluid out of the hoses. Plug the openings to prevent the entry of foreign material.

6. Disconnect the radiator upper and lower hoses on the engine side then remove the radiator assembly.



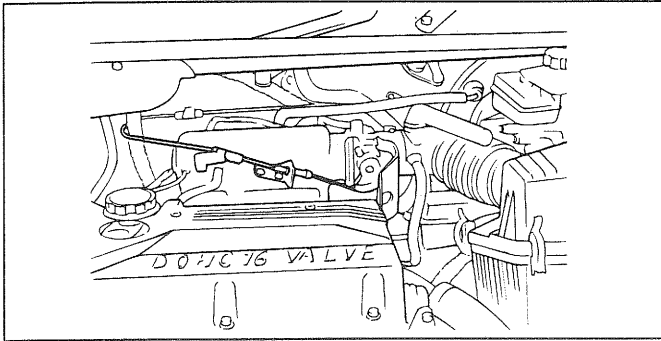
EDHA004D

7. Disconnect the engine ground.
8. Disconnect the brake booster vacuum hose.



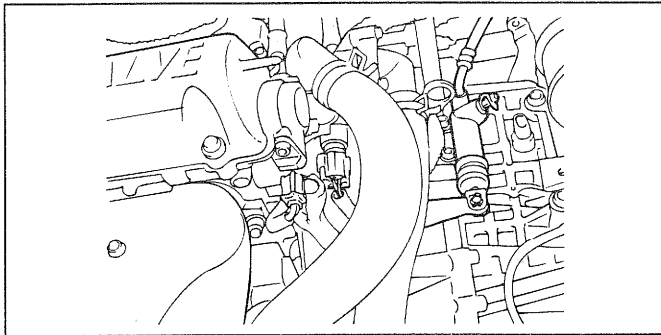
EDHA006B

9. Disconnect the heater hoses (inlet and outlet) on the engine side.
10. Disconnect the accelerator cable at the engine side.



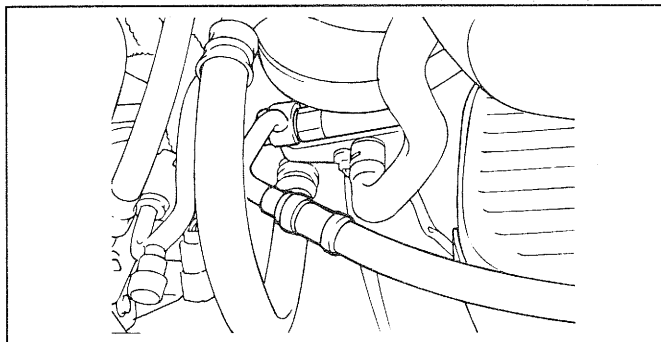
EDHA006E

11. Using a special tool, remove the main fuel line connected to delivery pipe (supply/return).
12. Disconnect the speedometer cable from the transaxle.
13. Disconnect the clutch cable or control cable from the transaxle.



ECHA004N

14. Disconnect the power steering suction hose and return hose from pump.

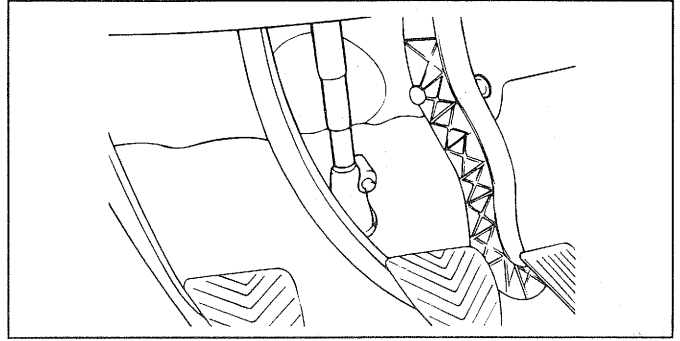


ECHA004H

15. Detach the steering dust cover in the room and then disassemble the gear box by loosening the universal joint bolt.

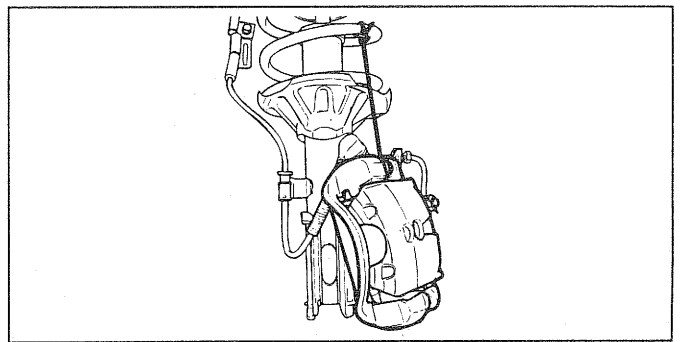
NOTE

Make sure that make identification marks between the universal joint and the gear box for the assembly.



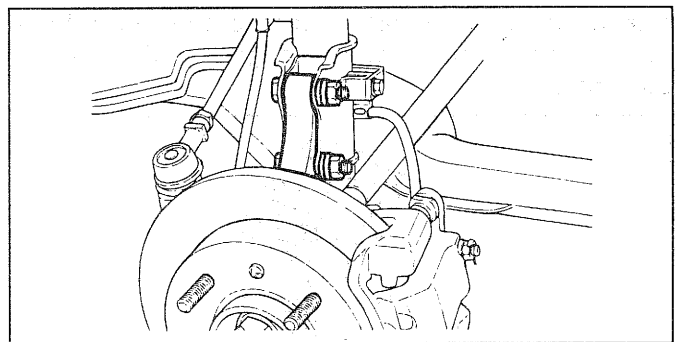
ECHA004I

16. Raise the vehicle and then remove the front tire.
17. Remove the calliper assembly from knuckle and then tie it upside.



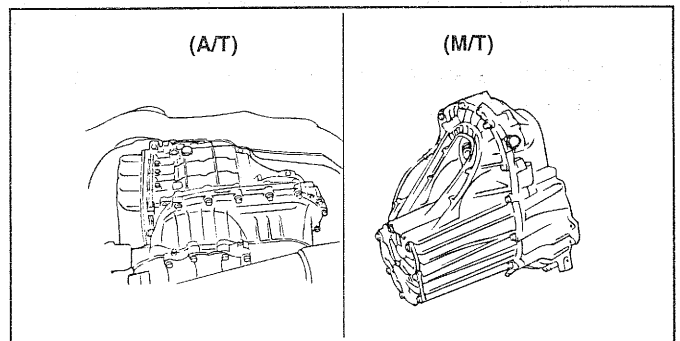
ECHA004J

18. Loosen the strut lower bolt and then remove it.



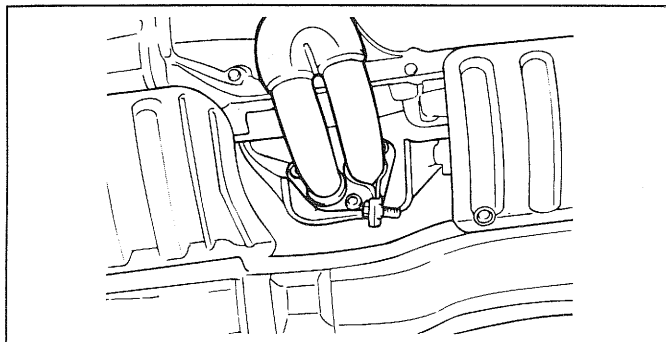
ECHA004K

19. Drain the transaxle oil.



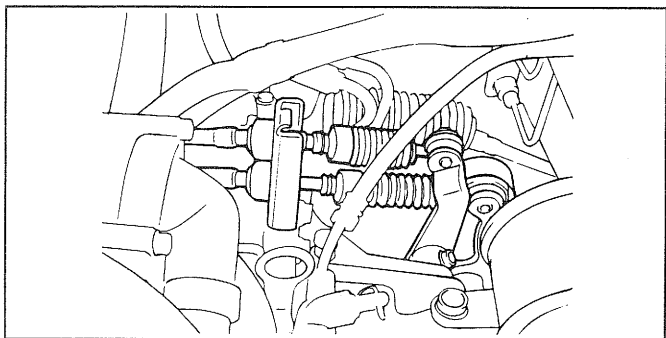
EDHA004Z

20. Remove the front muffler.



ECHA004M

21. Remove the transaxle control rod and extension rod (M/T only).

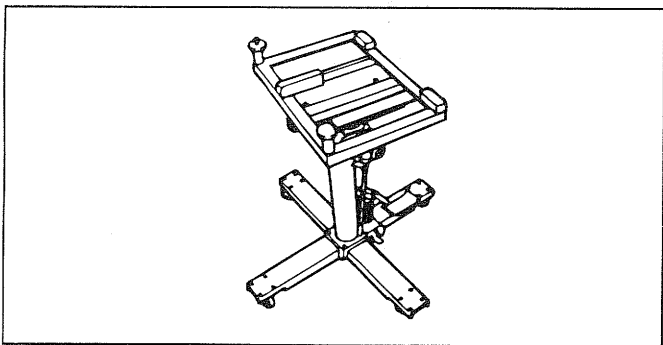


EDHA006F

22. Put the special die on the T/M jack and then adjust it to sub-frame.

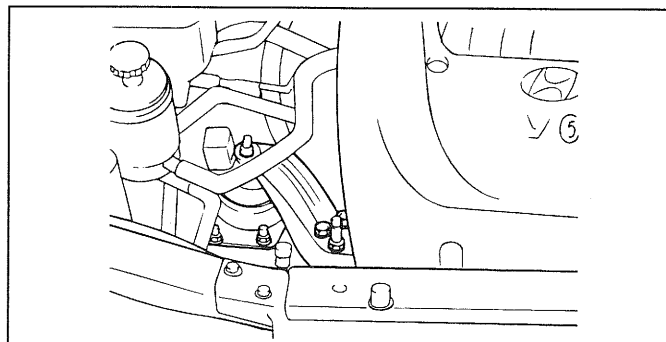
NOTE

Check that all the cables, harness connector, hose are disconnected from the engine and transaxle assembly.

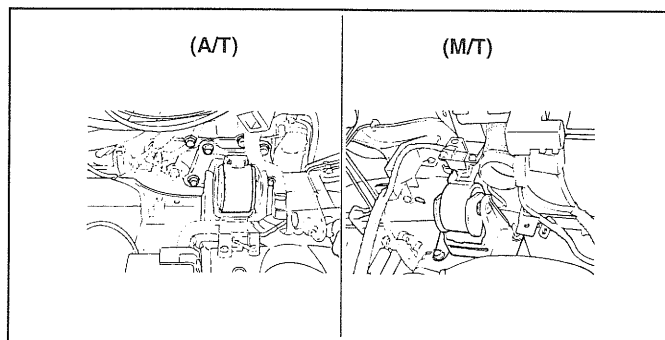


ECHA004O

23. Remove the engine mounting bracket and transaxle mounting bracket.

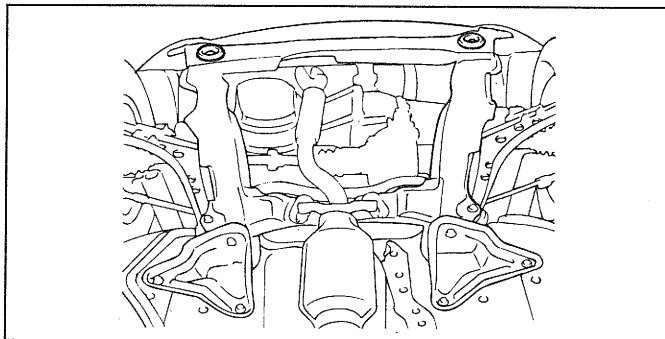


EDHA004A

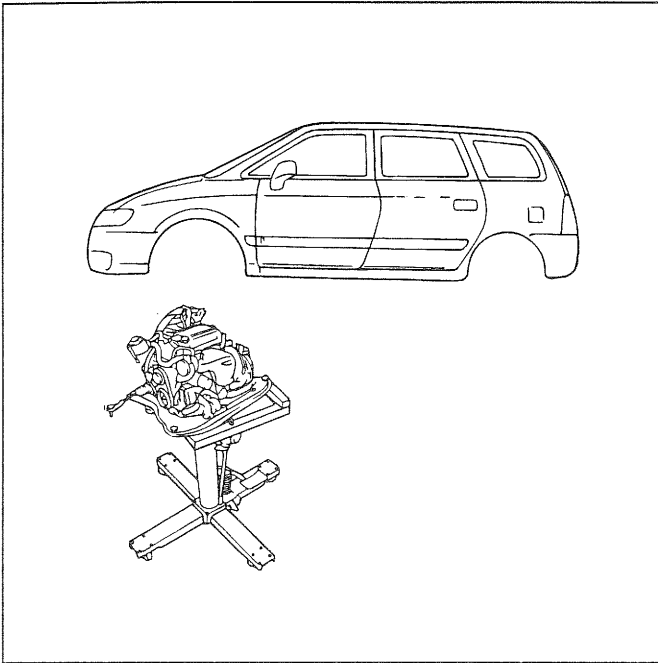


EDHA004C

24. Remove the sub-frame installation bolts.

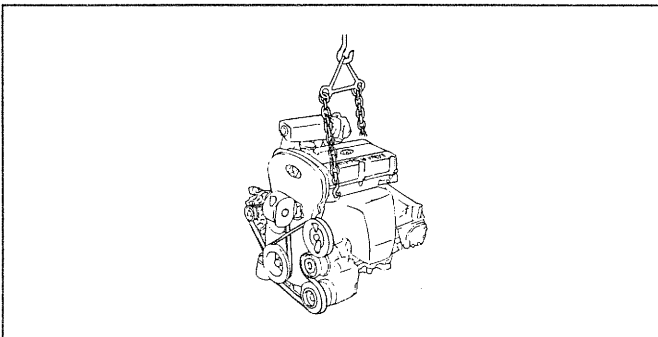


ECHA052A



EDHA006I

25. After removing the drive shaft and hang the engine and transaxle assembly on the hoist and then remove the front roll stopper and the rear roll stopper.



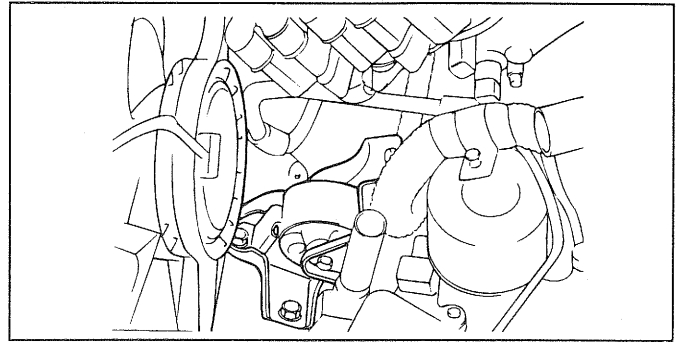
ECA9021A

INSTALLATION ECHA2400

1. While checking the connections of harnesses, pipes, hoses, etc., make sure that none of them is being caught, damaged, etc.
2. Install the front roll stopper to the bracket roughly.

Tightening torque

Service standard : 50-65 Nm (500-650kg.cm, 36-47 lb.ft)

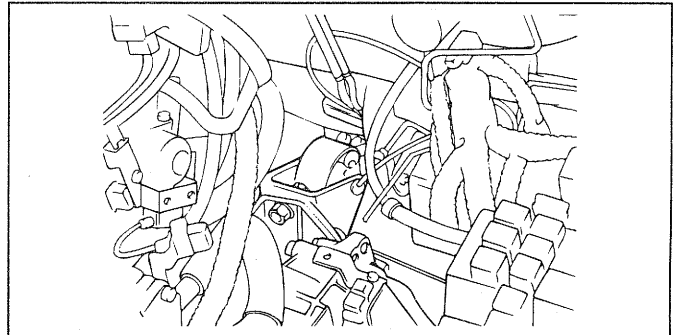


ECHA005A

3. Install the rear roll stopper to the bracket.

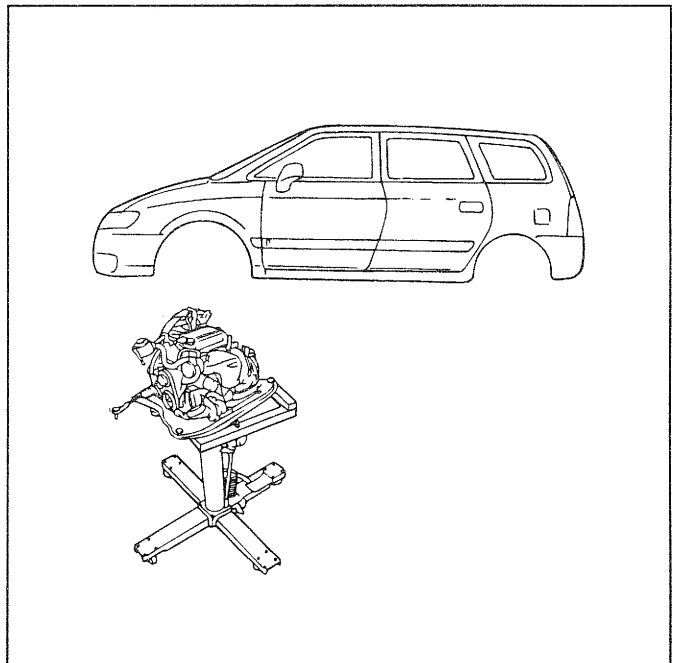
Tightening torque

Service standard : 50-65Nm(500-650kg.cm, 36-47 lb.ft)



ECHA005B

4. Put on the engine, transaxle sub-frame assembly by using the T/M jack and then adjust it to the vehicle body slowly.

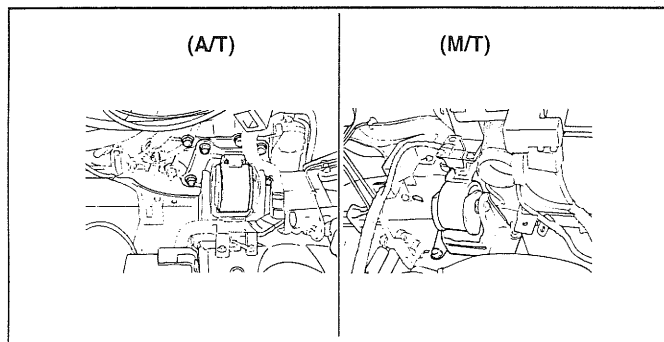


EDHA006I

5. Install the transaxle mounting bracket.

Tightening torque

Service standard : 90-110Nm(900-1100kg.cm, 65-80 lb.ft)



EDHA004C

6. Install the engine bracket (right side).
-

Tightening torque

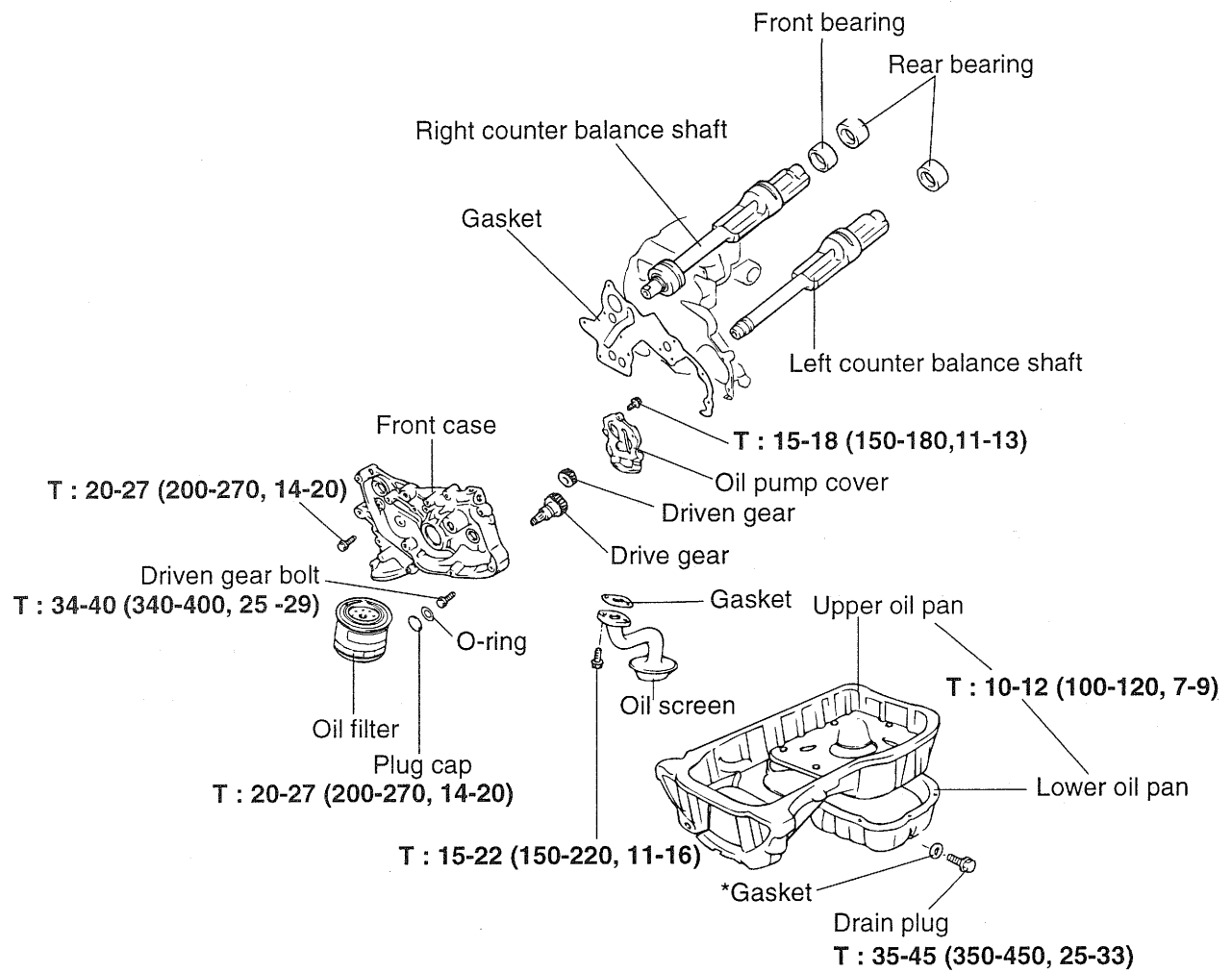
Service standard : 60-80Nm(600-800kg.cm, 43-58 lb.ft)

7. To install all of parts follow the removal procedures in the reverse order.
8. Refill the coolant and then check for leak.
9. Refill the transaxle oil and check for leak, test it's operation.
10. Check for the operation of the transaxle control cable and accelerator cable.
11. Check for proper operation of each gauge.

FRONT CASE

OIL PUMP CASE, OIL PUMP AND
COUNTER BALANCE SHAFT

ECHA2500

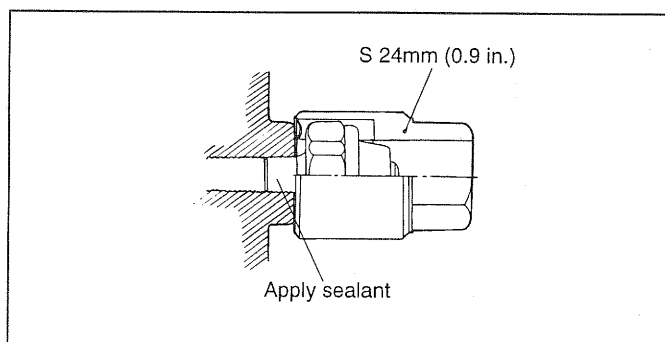


TORQUE : Nm (kg.cm, lb.ft)

*Drain plug gasket
should not be used
again.

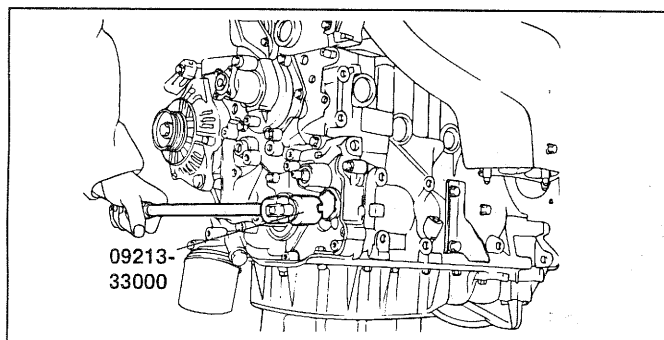
DISASSEMBLY ECHA2600

1. Remove the timing belt. Refer to "Timing Belt."
2. Remove all the oil pan bolts.
3. Tap the oil pan by rubber hammer and remove the cylinder block and oil pan.
4. Remove the oil screen and gasket.
5. Remove the front case assembly.
6. Remove the oil pressure switch.



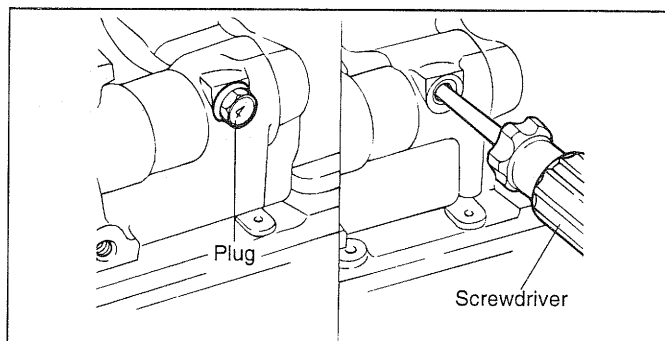
ECHA260A

7. Remove the oil filter bracket and gasket.
8. Using the special tool (09213-33000) remove the plug cap from the oil pump portion of the front case.



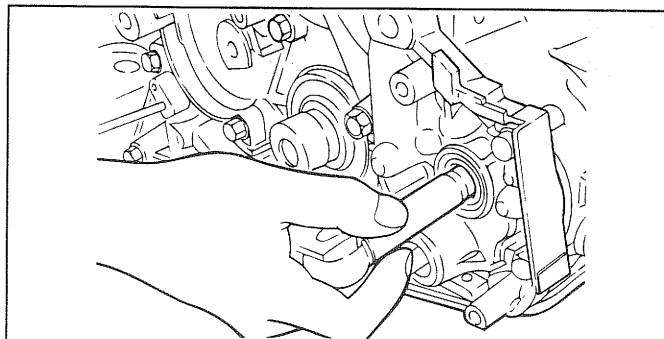
ECA9040A

9. Remove the left side of cylinder block plug and insert a screw driver with an 8 mm (0.32 in.) diameter into plug hole. The screwdriver must be inserted more than 60 mm (2.4 in.)



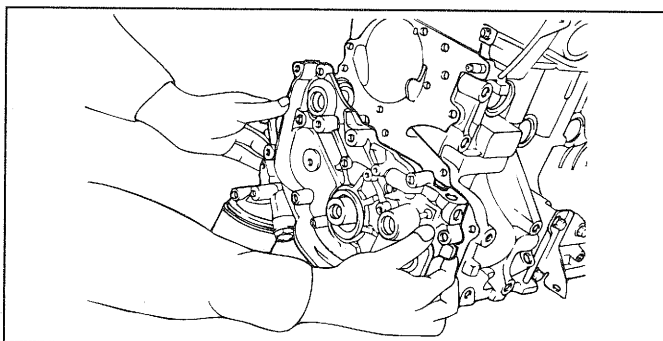
ECA9310C

10. Remove the oil pump driven gear and the left counter balance shaft retaining bolt.



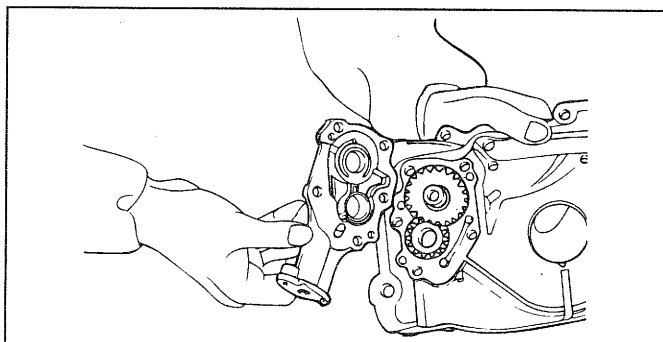
ECA9310D

11. Remove the front case mounting bolts and remove the front case assembly and gasket and then remove the two counter balance shafts from the cylinder block.



ECA9041A

12. Remove the oil pump cover from the front case.
13. Remove the oil pump gears from the front case.



ECA9042A

INSPECTION

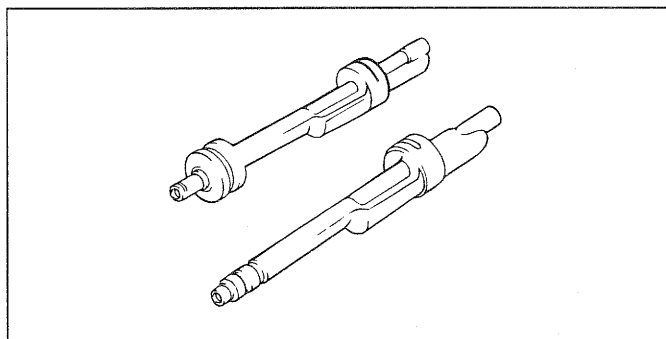
ECHA2700

FRONT CASE

1. Check oil holes for clogging. Clean holes if necessary.
2. Check the counter balance shaft front bearing section for wear, damage and seizure. If there is anything wrong with the section, replace the front case.
3. Check the front case for crack and other damage.
4. Replace the cracked or damaged front case.

COUNTER BALANCE SHAFT

1. Check journals for wear or seizure.
2. If excessive wear or seizure is evident, check the bearing carefully.
3. If necessary, replace the counter balance shaft bearing or both.



ECA9043A

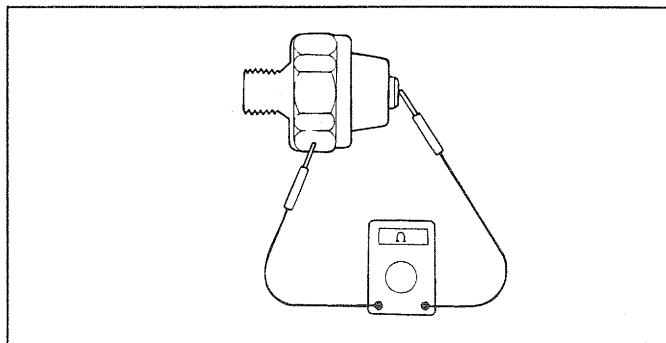
OIL SEAL

1. Check the oil seal lip for wear and damage. Replace the oil seal if necessary.
2. Check the oil seal lip for deterioration. Replace the oil seal if necessary.

OIL PRESSURE SWITCH

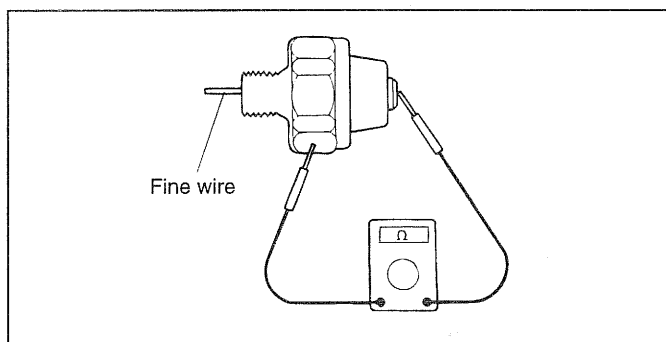
1. Check the continuity between the terminal and the body with an ohmmeter.

If there is noncontinuity, replace the oil pressure switch.



ECA9320D

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 it.
3. If there is noncontinuity when a 50 kPa (7 psi) vacuum is applied through the oil hole, the switch is operating properly. Check the leakage of air. If air leaks, the diaphragm is broken. Replace the switch.



ECA9320E

OIL PUMP

1. Assemble the oil pump gear to the front case and rotate it to ensure smooth rotation with no looseness.
2. Make sure that there is no ridge wear on the contact surface between the front case and gear surface of the oil pump cover.
3. Install the drive and driven gears to the front case, measure the tip clearance of the gears.

[Standard value]

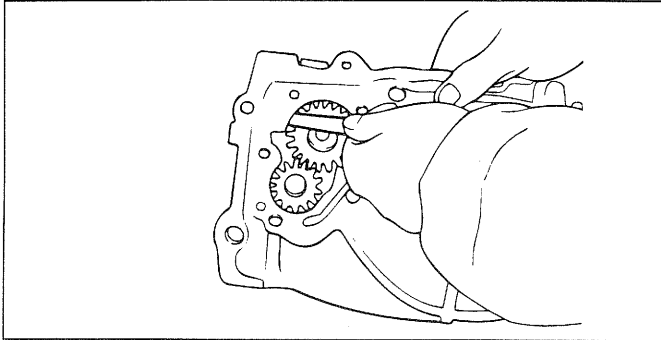
Drive gear : 0.16-0.21mm(0.0063-0.0083 in.)

Driven gear : 0.18-0.21mm(0.0071-0.0083 in.)

[Limit]

Drive gear : 0.25mm(0.0098 in.)

Driven gear : 0.25mm(0.0098 in.)



ECA9044A

4. Check the side clearance.

[Standard value]

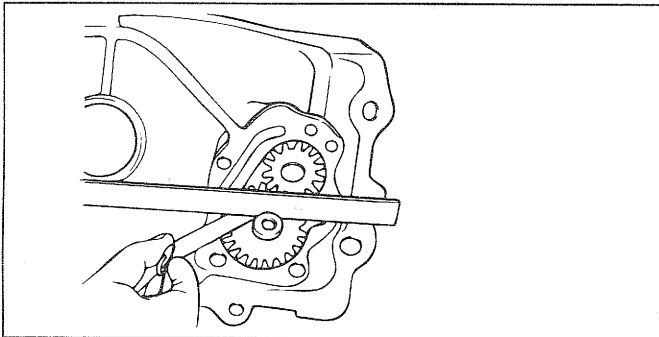
Drive gear : 0.08-0.14mm(0.0031-0.0055in.)

Driven gear : 0.06-0.12mm(0.0024-0.0047in.)

[Limit]

Drive gear : 0.25mm(0.0098 in)

Driven gear : 0.25mm(0.0098 in.)



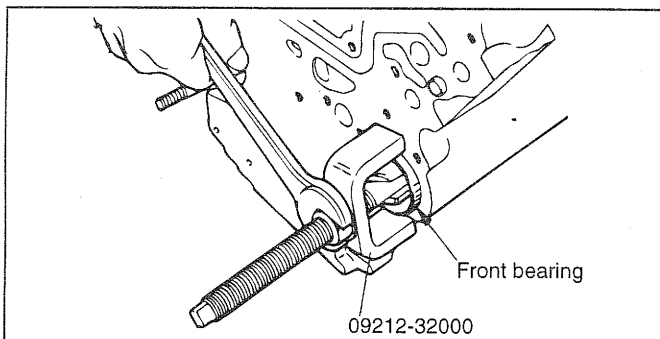
ECA9045A

COUNTER BALANCE SHAFT BEARING

ECHA2800

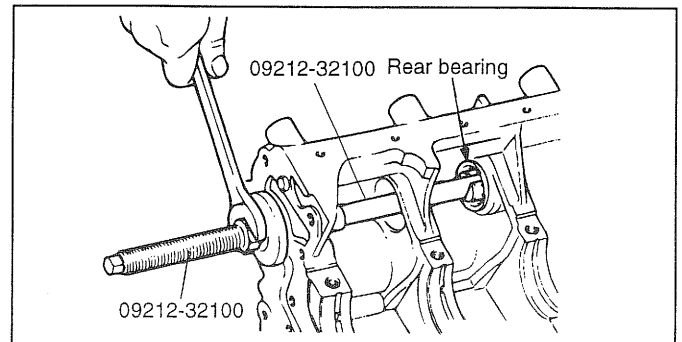
REPLACEMENT

1. Using a special tool, remove the front bearing of the right counter balance shaft from the cylinder block.



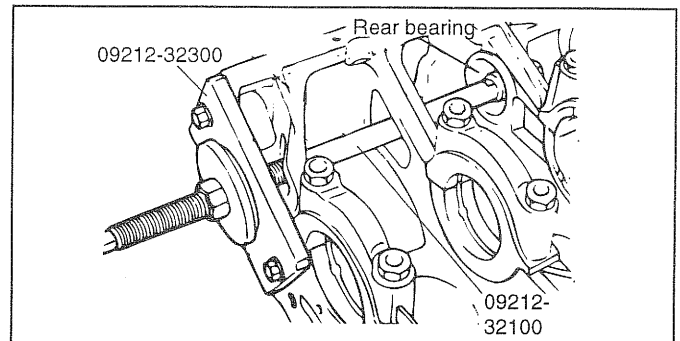
ECA9330A

2. Using a special tool, remove the rear bearing of the right counter balance shaft from the cylinder block.



ECHA280A

3. Using a special tool, remove the rear bearing of the left counter balance shaft from the cylinder block. At this time, install a special tool on the front surface of cylinder block to hold the bearing puller.

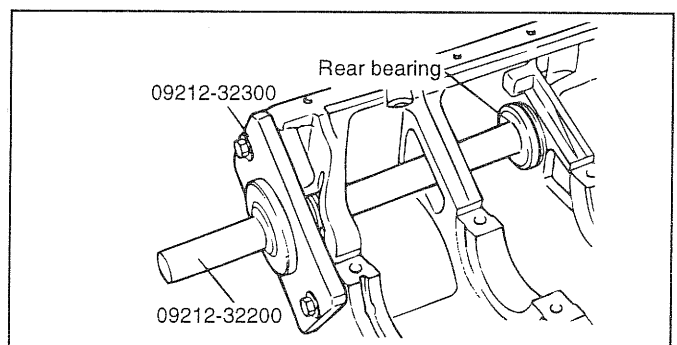


ECHA280B

4. Using a special tool, install the rear bearing of the left counter balance shaft to the cylinder block.

NOTE

1. Apply engine oil to the outside of rear bearing and bearing hole in cylinder block.
2. The left rear bearing has no oil holes.



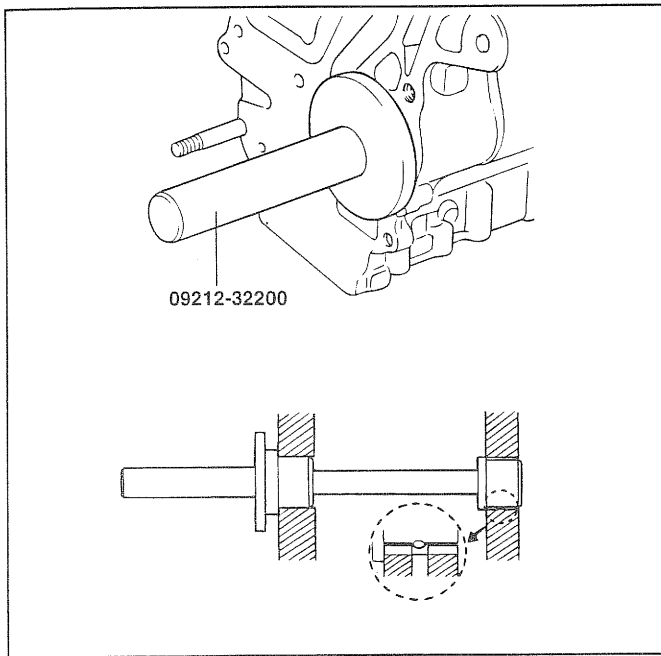
ECA9330D

5. Using a special tool, install the rear bearing of the right counter balance shaft to the cylinder block.

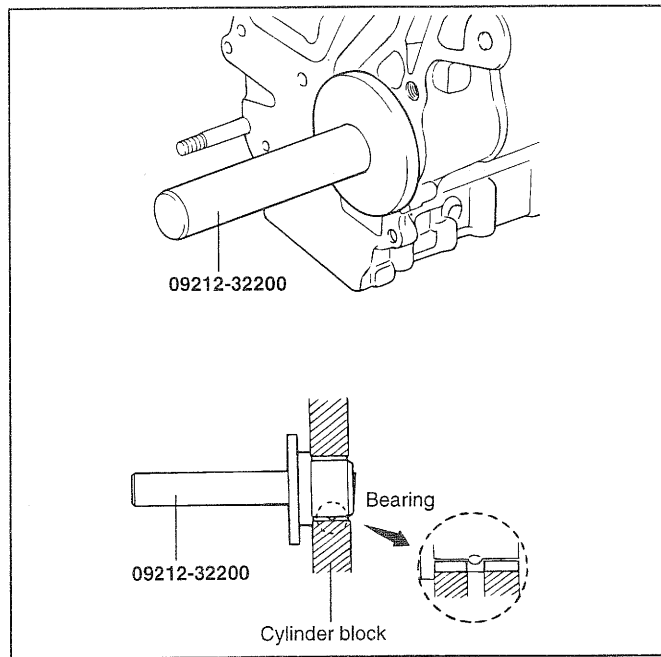
NOTE

1. Apply engine oil to the outside surface of bearing.

2. Make sure that the bearing oil hole is aligned with the oil hole of cylinder block.

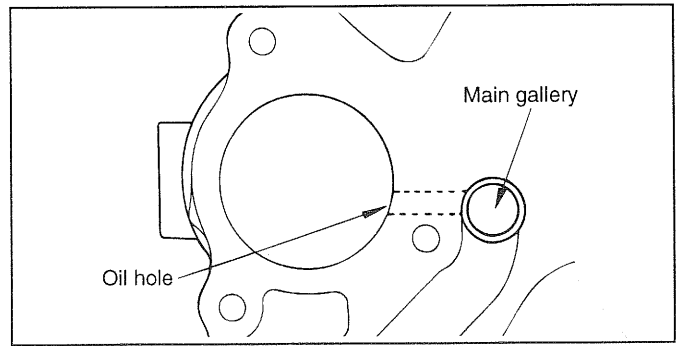


6. Using a special tool, install the front bearing of the right counter balance shaft to the cylinder block.



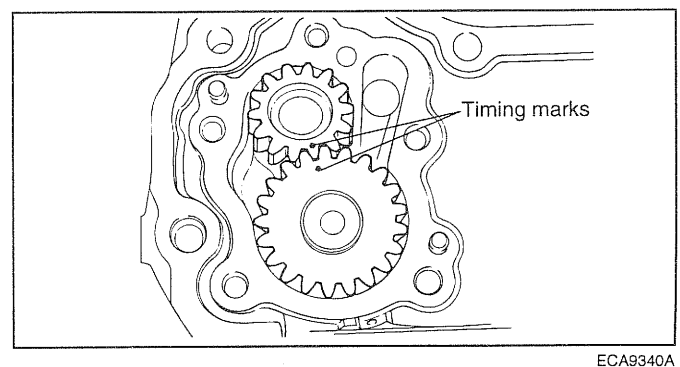
NOTE

Make sure that the bearing oil hole is aligned with the oil hole cylinder block.

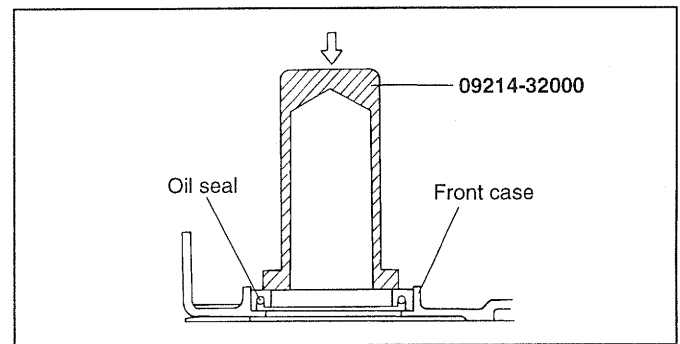


REASSEMBLY ECHA2900

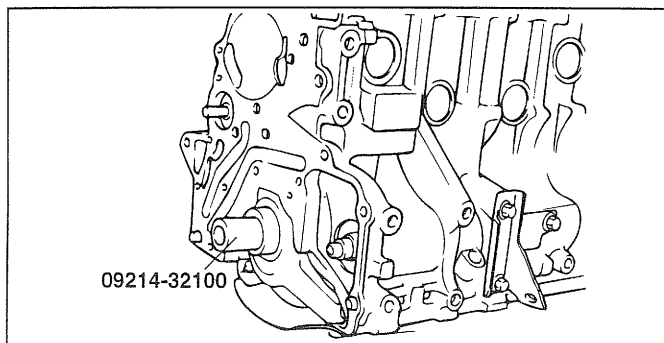
1. Apply engine oil to the gear and align the two timing marks.



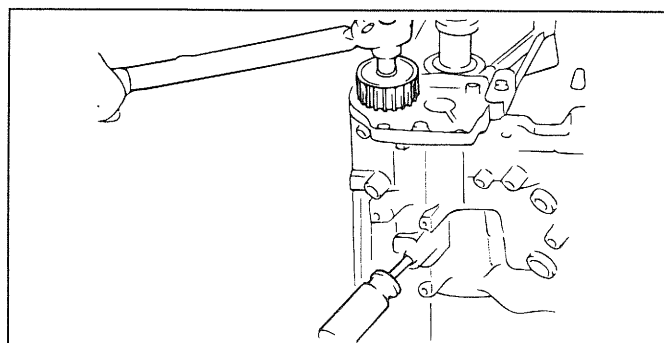
2. Using the special tool, crankshaft front oil seal installer (09214-32000), install the crankshaft front oil seal into the front case.



3. Set the special tool (09214-32100) on the front end of crankshaft and apply a thin coat of engine oil to the outer circumference of the special tool to install the front case.

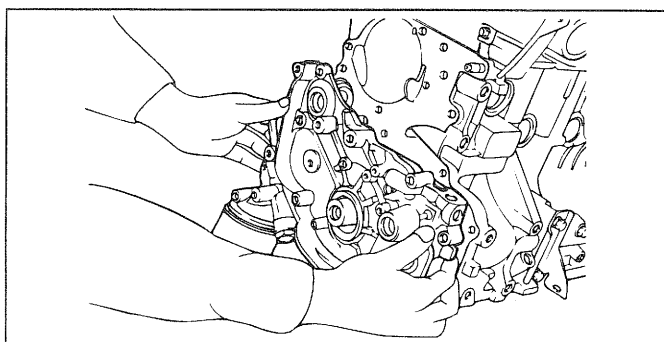


ECA9046A



ECA9340F

4. Install a new front case gasket to the front case assembly and tighten the flange bolts temporarily.



ECA9041A

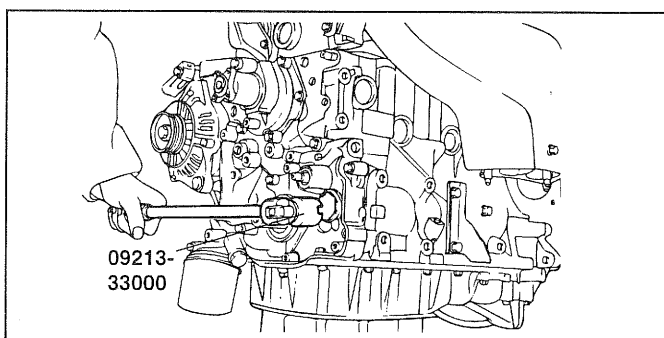
5. Install the front case assembly with a new gasket. Tighten bolts to the specified torque.

Front case assembly

Tightening torque :

20-27Nm(200-270kg.cm, 14-20 lb.ft)

7. Install a new O-ring to the groove of the front case.
8. Using a special tool, install the plug case and tighten to the specified torque.

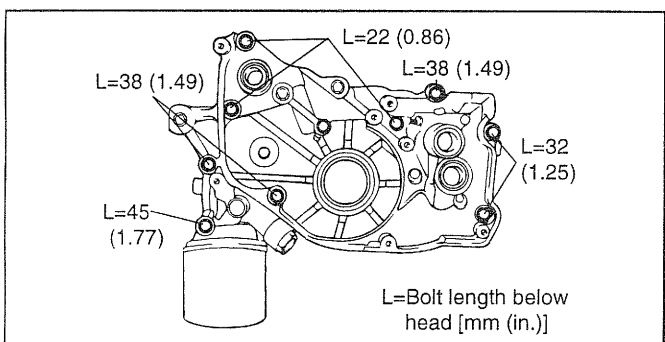


ECA9040A

Plug cap

Tightening torque :

20-27 N.m (200-270 kg.cm, 14-20 lb.ft)



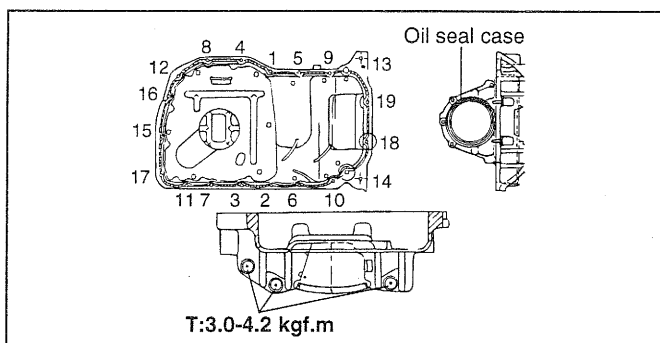
ECJA290B

6. Insert a screwdriver into the plug hole in left side of cylinder block. After checking that the shaft is in a proper position, tighten.

9. Apply sealant to the groove of the pan flange as shown.

NOTE

1. Apply sealant approximately 4 mm (0.16 in.) in thickness.
2. After application of sealant, install oil pan within 15 minutes before installing the oil pan.



ECJA290A

10. Note the difference in bolt lengths at the location shown.

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

Tightening torque

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

11. Using 24 mm deep socket, install the oil pressure switch after applying sealant to the threaded area.

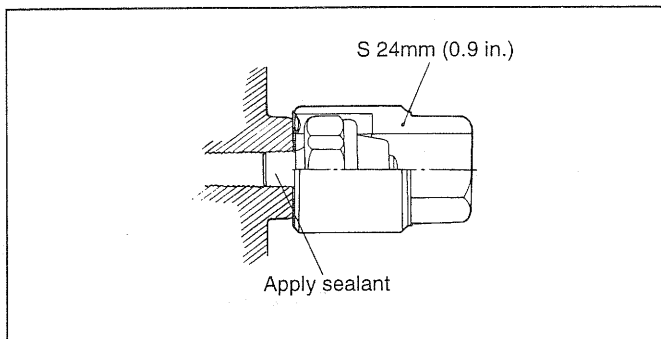
Sealant : Threebond 1104 or equivalent

NOTE

Do not torque the oil pressure switch excessively.

Tightening torque

Oil pressure switch : 8-12Nm(80-120kg.cm, 6-9 lb.ft)



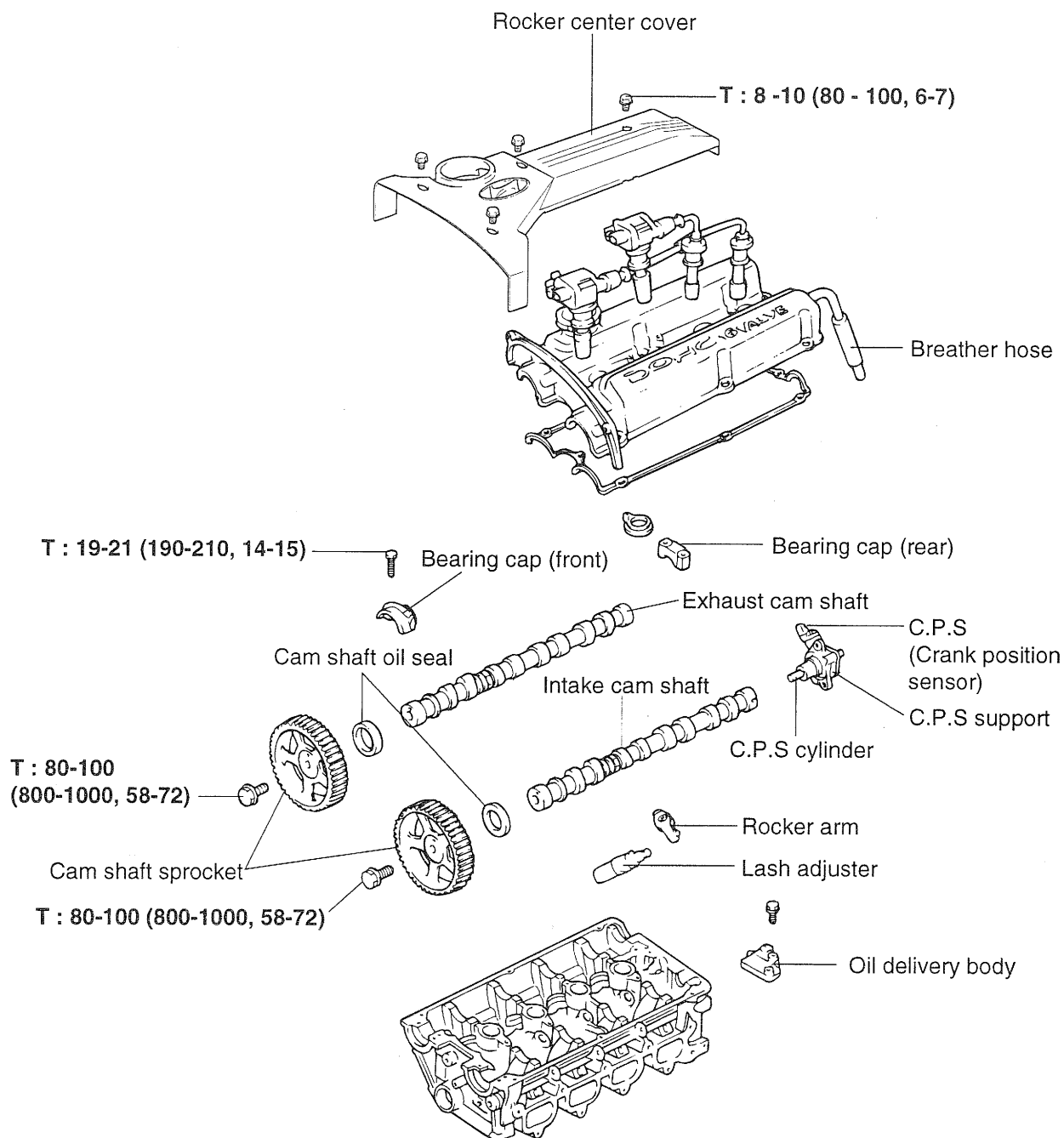
ECHA260A

MAIN MOVING SYSTEM

CAM SHAFT

CAMSHAFTS AND ROCKER ARMS

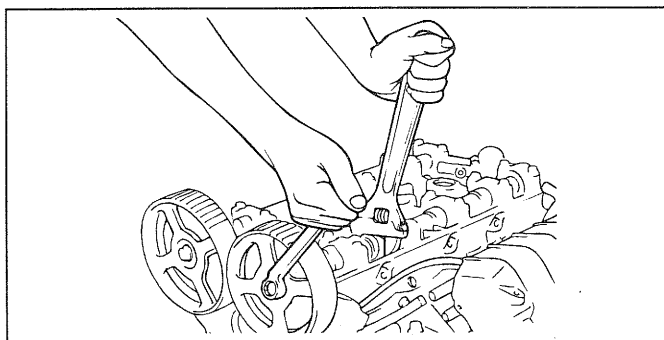
ECHA3000



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

DISASSEMBLY ECHA3100

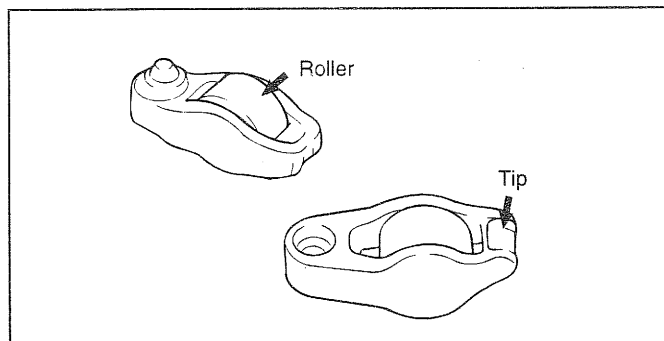
1. Disconnect the negative terminal from the battery.
2. Drain the engine coolant.
3. Remove the breather hose between the air cleaner and the rocker cover.
4. Remove the air cleaner.
5. Remove the timing belt cover.
6. Remove the rocker cover, crank position sensor.
7. Loosen the camshaft sprocket bolts then remove the camshaft sprockets.
8. Loosen the bearing cap bolts and remove the bearing caps, camshafts, rocker arms and lash adjusters.



ECA9170C

INSPECTION ECHA3200**ROCKER ARMS**

1. Check rotation of the roller. If it does not rotate smoothly or loose, replace it.
2. Check the roller surface. Replace if there are any dent, damage or seizure.
3. Check the valve contact surface for possible damage or seizure. Replace if necessary.



ECA9240A

CAMSHAFTS

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.

Cam height

[Standard]

Intake : 35.493 mm (1.3974 in.)

Exhaust :

M/T : 35.204 mm (1.3860 in.)

A/T : 35.204 mm (1.3866 in.)

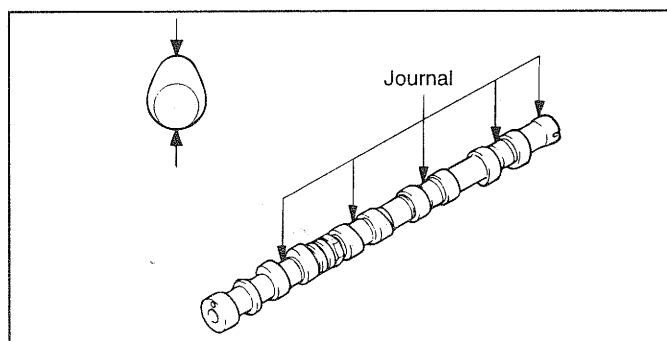
[Limit]

Intake : 35.993 mm (1.4170 in.)

Exhaust :

M/T : 34.704 mm (1.3663 in.)

34.704 mm (1.3663 in.)



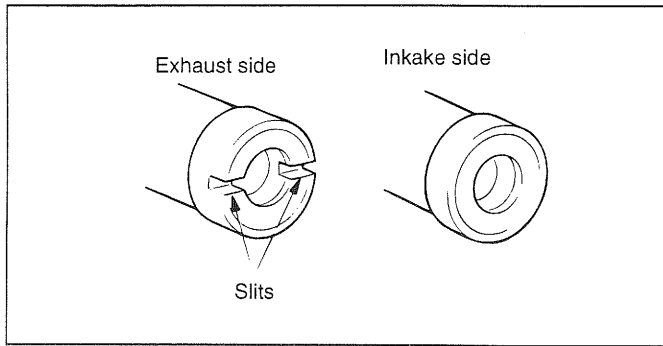
ECA9240B

REASSEMBLY ECHA3300

1. Install the camshafts on the cylinder head.

NOTE

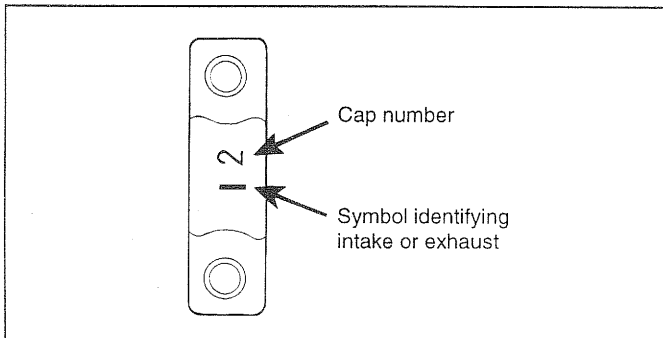
1. Apply engine oil to journals and cams of the camshafts.
2. The exhaust camshaft has a slit on its rear end for driving the crankshaft position sensor.



ECA9250A

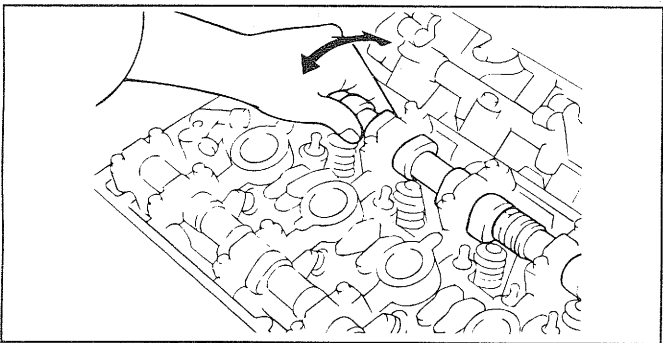
2. Install the bearing caps. Check the markings on the caps for intake/exhaust identification symbol.

I : Intake camshaft. E : Exhaust camshaft



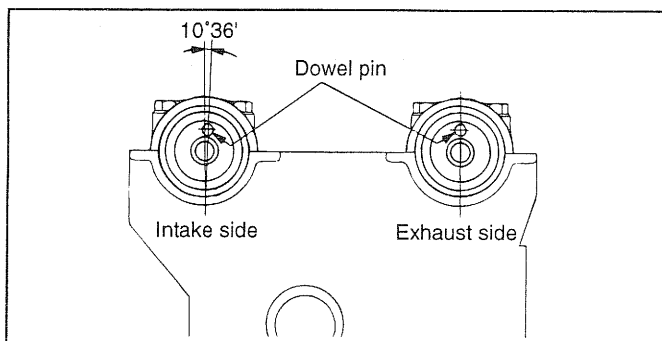
ECA9250B

3. Check that the camshaft can be easily turned by hand. After checking, remove the bearing caps and the camshafts, and then install the rocker arms.



ECA9250C

4. Make sure that the dowel pins on the camshaft sprocket end are located on the top.



ECHA330A

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

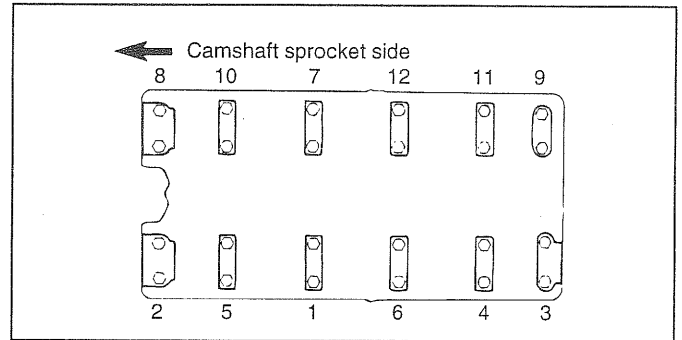
NOTE

Tighten the rocker arms uniformly.

Tightening torque

Bearing cap bolts:

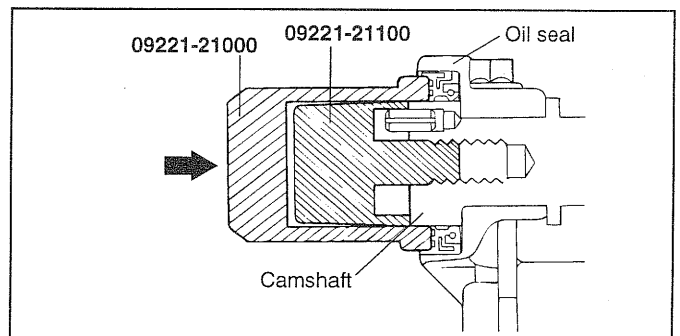
19-21 Nm (190-210 kg.cm, 14-15 lb.ft)



ECHA330B

6. Using a special tools, camshaft oil seal Installer and guide (09221-21000, 09221-21100), press and fit the camshaft oil seal. Be sure to apply engine oil to the external surface of the oil seal.

Insert the oil seal along the camshaft front end and install it by driving the installer with a hammer until the oil seal is fully seated.



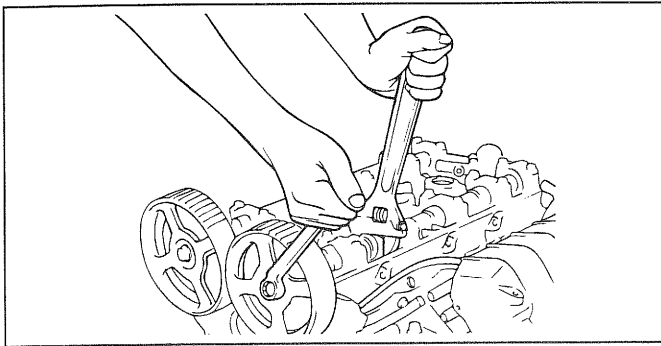
ECHA330C

7. Install the camshaft sprockets to the specified torque.

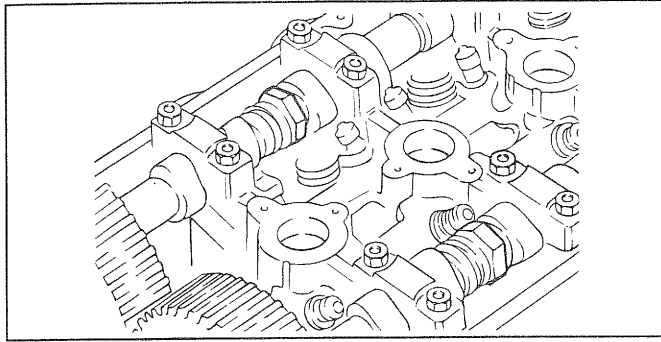
Tightening torque

Camshaft sprocket bolts :

80-100 Nm (800-1000 kg.cm, 58-72lb.ft)



ECA9170C



ECA9210J

8. Install the rocker cover. Apply sealant as shown.

Tightening torque

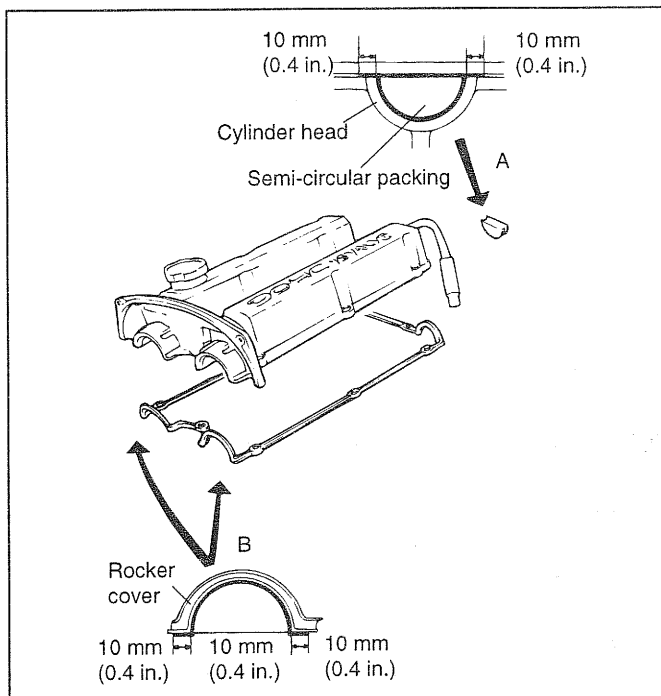
Rocker cover bolts : 8-10 Nm (80-100 kg.cm, 6-7 lb.ft)

Center cover bolts : 4-5 Nm (40-50 kg.cm, 3-4 lb.ft)

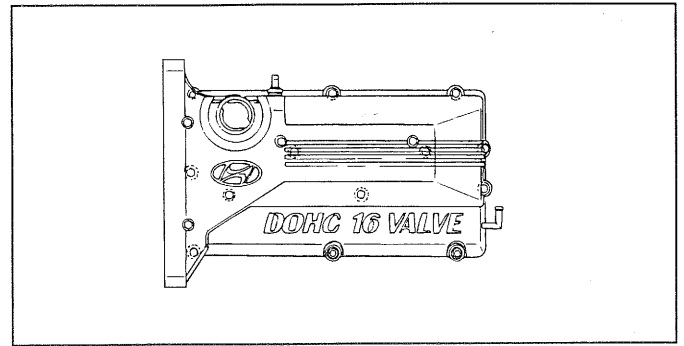
Sealant

A Portion : Threebond No. 10 or equivalent

B Portion : Threebond No. 1212D or equivalent

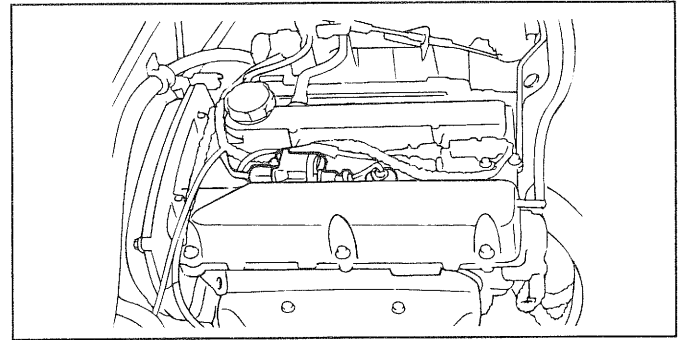


ECA9034A



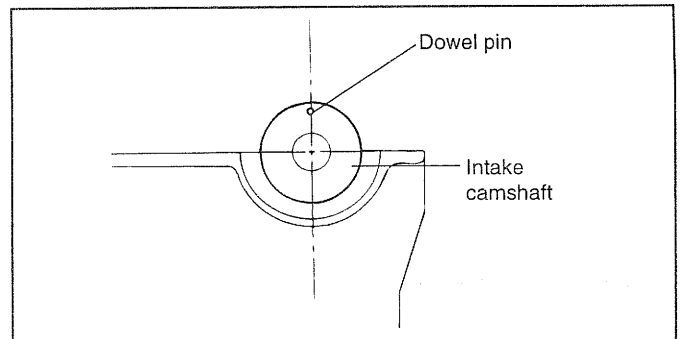
ECA9035A

9. Install the spark plugs, ignition coil and connect the connector and then install the center cover.



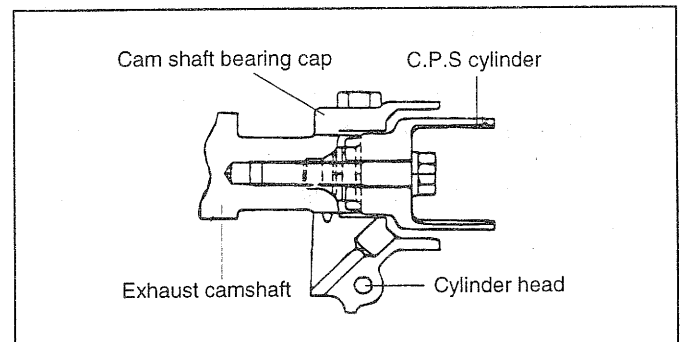
ECHA008A

10. Install the dowel pin on the sprocket side of the intake cam shaft.



ECA9250L

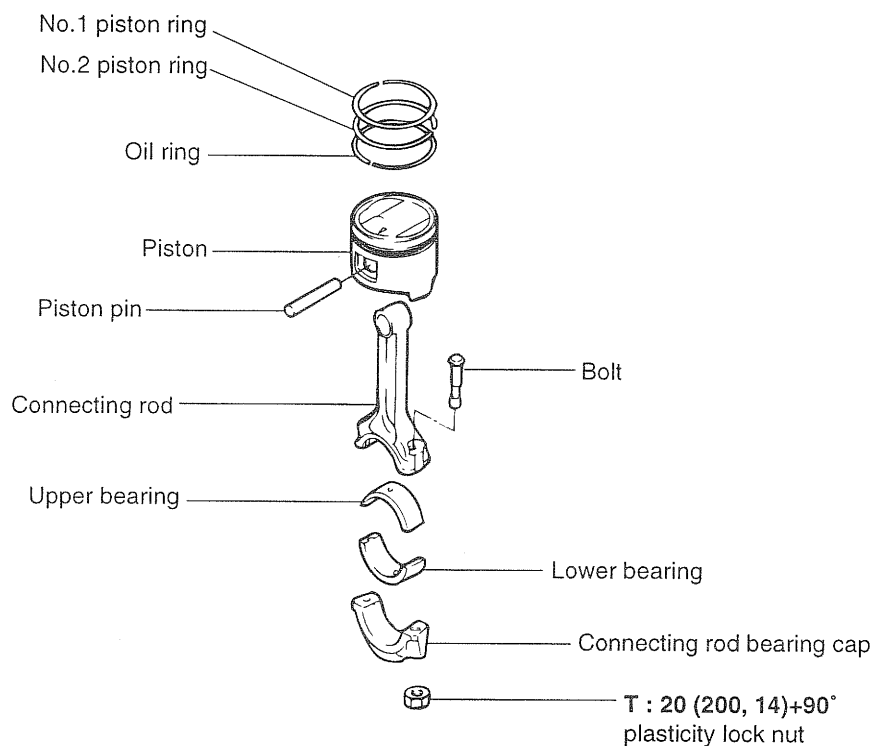
11. Install the crank position sensor support assembly after installing the crank position sensor cylinder on the camshaft (Ex).



ECHA008B

CONNECTING ROD

PISTON AND CONNECTING ROD ECHA3500



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

ECHA350A

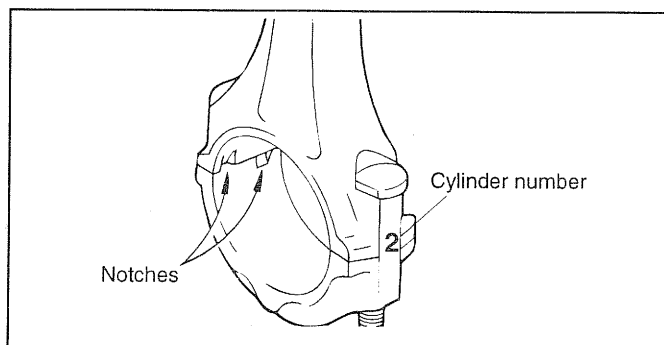
DISASSEMBLY ECHA3600

CONNECTING ROD CAP

NOTE

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

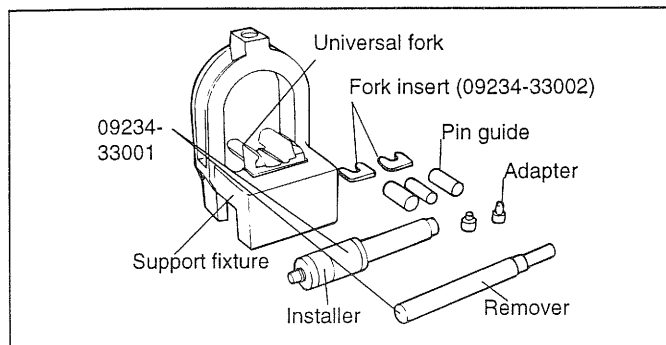
1. Remove the connecting rod cap nuts and then remove the caps and the big end lower bearing.
2. Push each piston-connecting rod assembly toward the top of the cylinder.



ECA9360A

DISASSEMBLY AND REASSEMBLY OF

1. Use the special tools (09234-33001, 09234-33002) disassemble and reassemble the piston and connecting rod.
2. Place the proper insert (09234-33002) in the fork of the tool. Position the insert between the connecting rod and the piston.



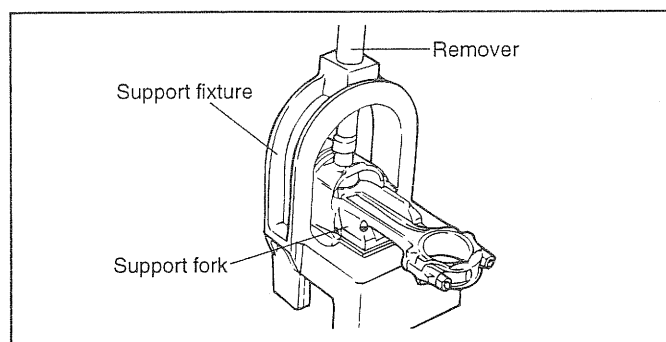
ECA9361A

3. Insert the proper tool for removal through the hole in the arch of the tool.

NOTE

Center the piston, rod and pin assembly with the removal arbor.

4. Press the piston pin out of the connecting rod.

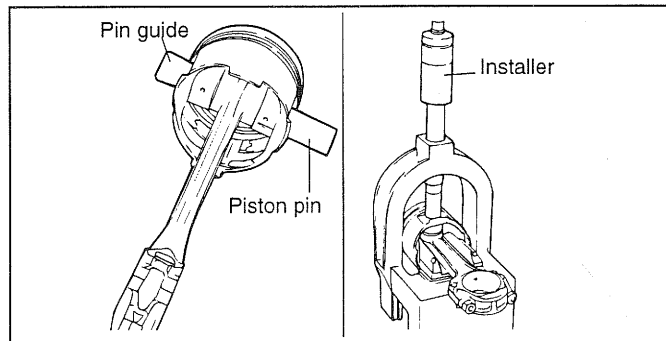


ECA9361B

5. Install the proper pin guide through the piston and into the connecting rod. Hand tap the pin guide into the piston for proper retention. Drop the piston pin into the other side of the piston.

NOTE

The pin guide should be centered on the connecting rod through the piston. If the piston, connecting rod, piston pin and pin guide assembly are accurately positioned on the fork of the tool, pin guide will also be placed on the center of assembly line without fail. If a pin guide which is too small is used, damage may occur to the fork or insert of the tool because piston assembly is not centered on the tool.

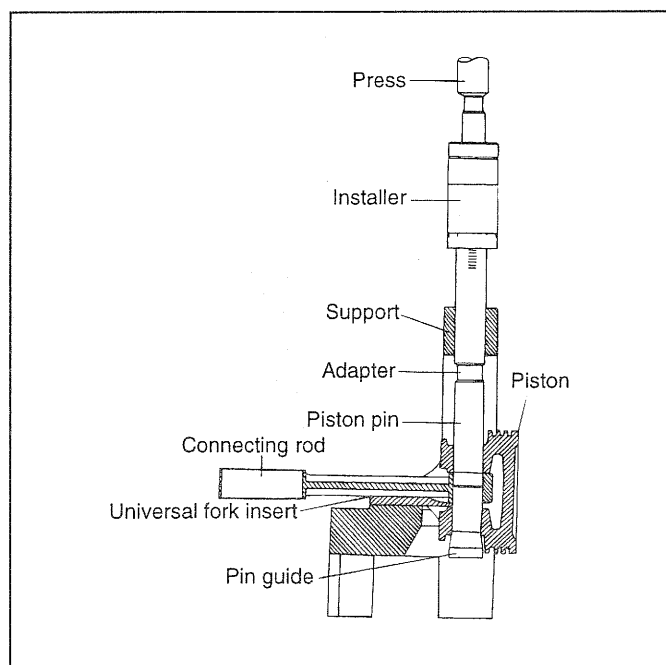


ECA9361C

6. Install the piston assembly onto the fork assembly of the tool. The tool will support the connecting rod. Be sure that the piston assembly slide down onto the fork until the pin guide contacts the fork insert.
7. Insert the installing arbor through the hole in the arch of the tool. Press the piston pin into the connecting rod until the sleeve on the installing arbor contacts the top of the tool arch. The pin guide will fall out of the connecting rod as the piston pin is pressed in.

CAUTION

Do not exceed 1250 ± 500 kg (2756 ± 1102 lb) of force when stopping the installing arbor sleeve against the arch.



EOY055C

INSPECTION ECHA3700**PISTON 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 a 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 only the piston ring only.

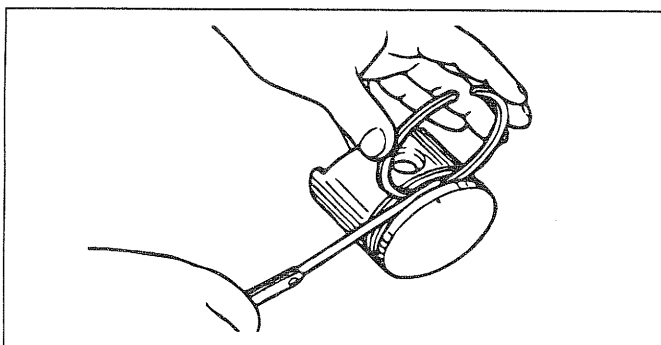
Standard value

Piston ring side clearance :

No. 1 : 0.03-0.07mm(0.0012-0.0028 in.)

No. 2 : 0.02-0.06mm(0.0008-0.0024 in.)

Oil ring : 0.06-0.15 mm (0.0024-0.0059 in.)



ECA9370A

2. To measure the piston ring end gap, insert a piston ring into the cylinder bore. Position the ring at right angles to 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 : 0.25-0.35mm(0.0098-0.0138 in.)

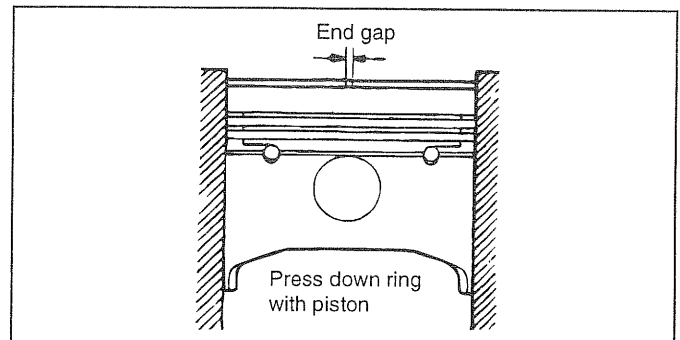
No.2 : 0.40-0.55mm(0.0157-0.0216 in.)

Oil ring side rail : 0.10-0.40mm(0.0039-0.0157 in.)

[Limit]

No.1, No.2 : 0.8mm(0.031 in.)

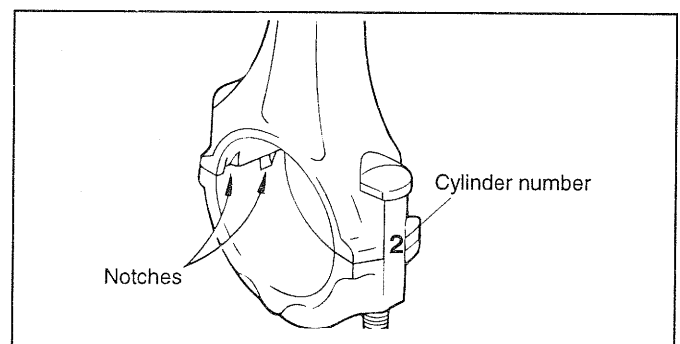
Oil ring side rail : 1.0mm(0.039 in.)



ECA9370B

CONNECTING RODS

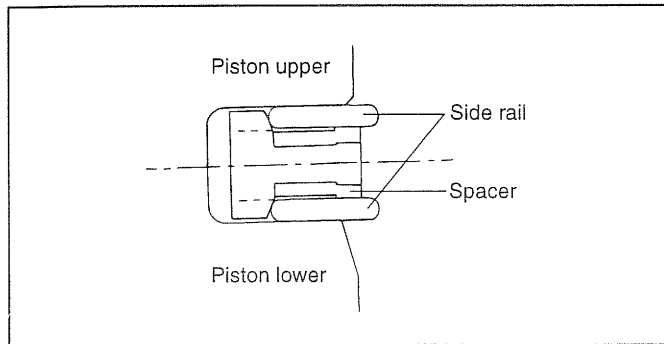
1. When the connecting rod cap is installed, make sure that cylinder numbers marked on rod end cap at disassembly match. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.
2. Replace the connecting rod if it is damaged at either end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



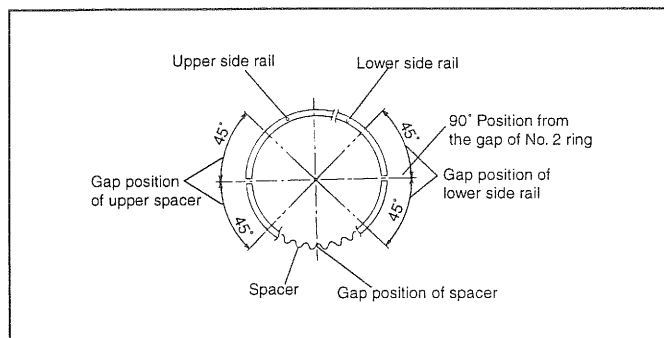
ECA9360A

REASSEMBLY ECHA3800

1. Install the spacer.



ECA9082A



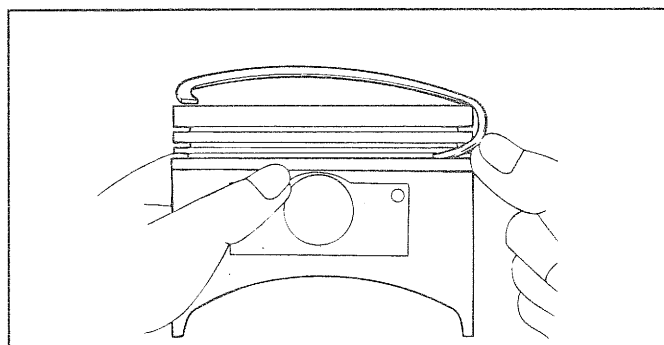
EDJA490A

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, then press down with your finger the portion to be inserted into groove as illustrated.

NOTE

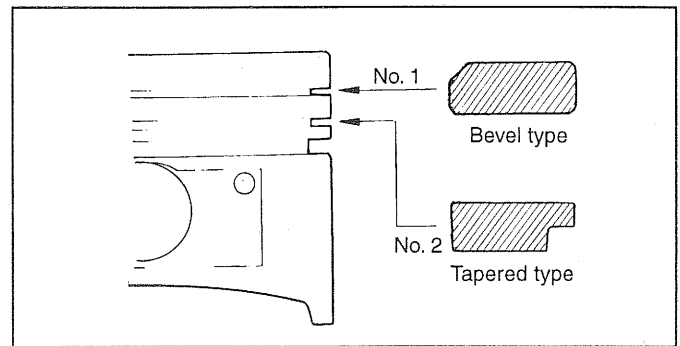
Do not use a piston ring expander when installing the side rail.

3. Install the lower side rail by the same procedure as described in Step No. 2.



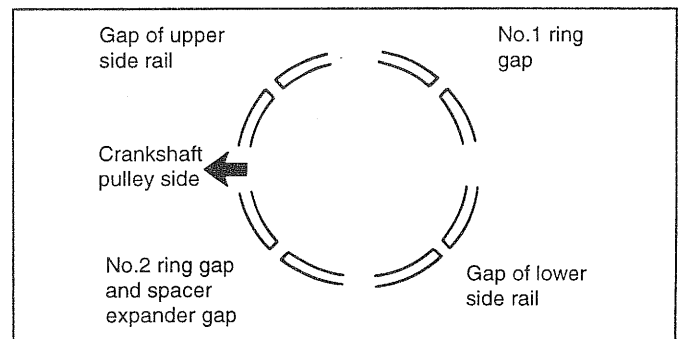
ECA9380B

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



EDJA490B

7. Position each piston ring end gap as apart from neighboring gaps as possible. Make sure that gaps are not positioned in the thrust and pin directions.
8. Hold piston rings firmly with a piston ring compressor as they are inserted into cylinder.



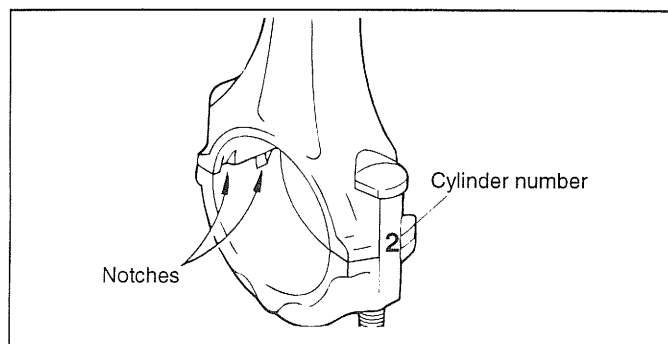
ECA9380D

9. 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.
10. When the connecting rod cap is installed, make sure that the cylinder numbers put on the rod and cap at disassembly match.
11. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.
12. Tighten the connecting rod cap nuts.

Tightening torque

Connecting rod cap nuts :

20Nm(200kg.cm, 14 lb.ft)+90°



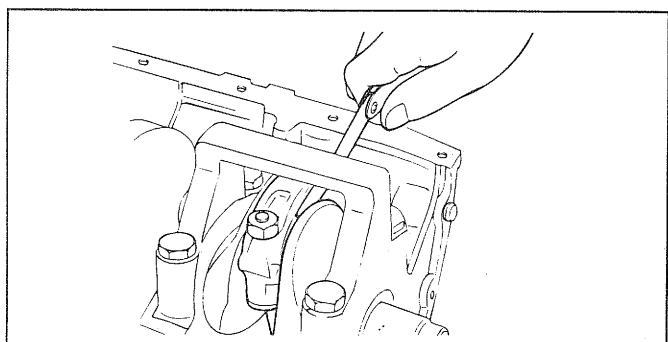
ECA9360A

13. Check connecting rod side clearance.

Connecting rod side clearance

standard : 0.10-0.25mm(0.004-0.0098 in.)

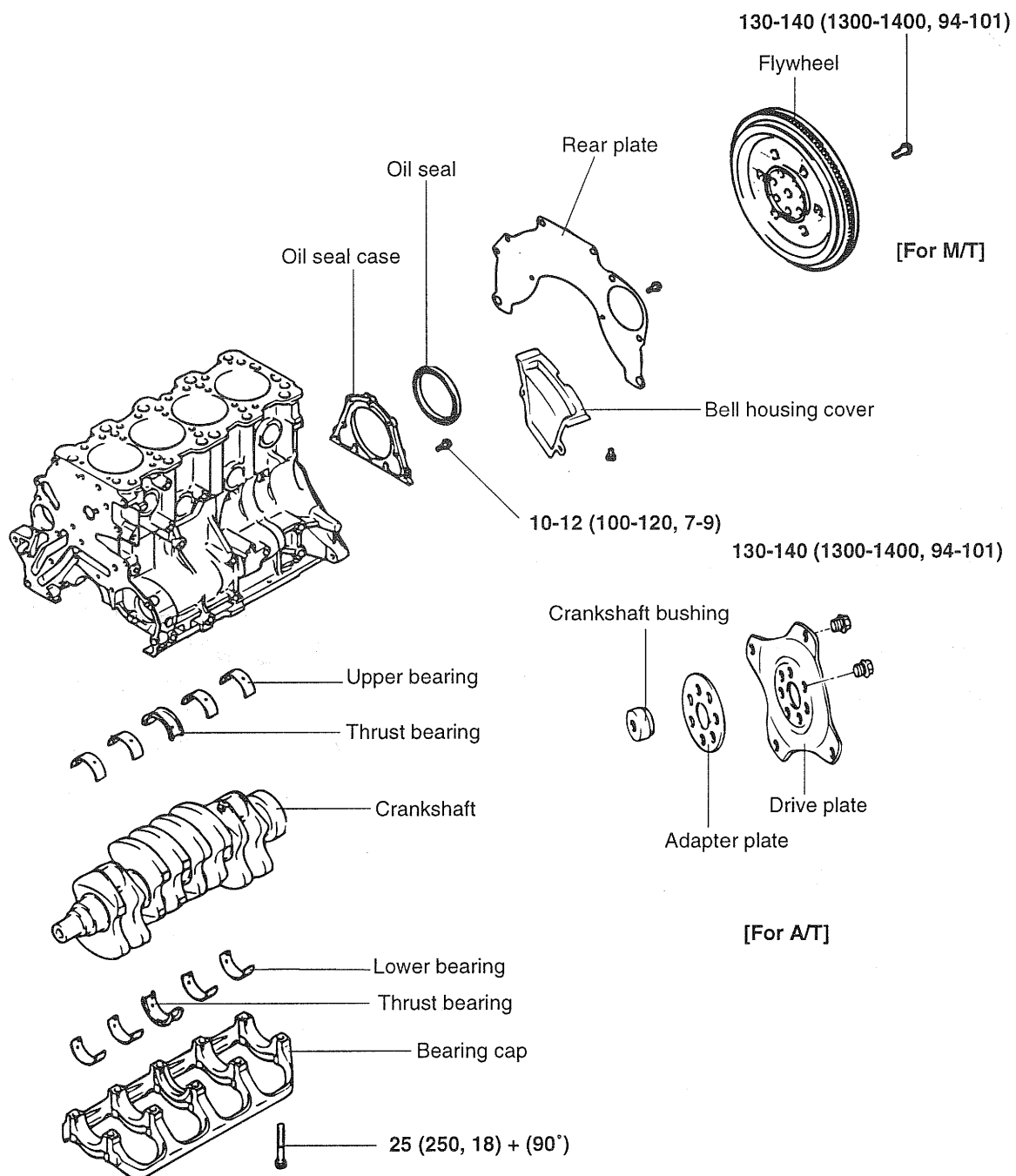
Limit : 0.4 mm (0.0157 in.)



ECA9380F

CRANK SHAFT

CRANKSHAFT, FLYWHEEL ECHA4000



TORQUE : Nm (kg·cm, lb·ft)

DISASSEMBLY ECHA4100

1. Remove the timing belt train, front case, flywheel cylinder head assembly and oil pan. For details, refer to respective chapters.
2. Remove the rear plate and the rear oil seal.
3. Remove the connecting rod caps.

NOTE

Mark the main bearing caps to be able to reassemble in the original position and direction.

4. Remove the main bearing caps and remove the crankshaft. Keep the bearings in order according to the cap number.

INSPECTION ECHA4200**CRANKSHAFT**

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

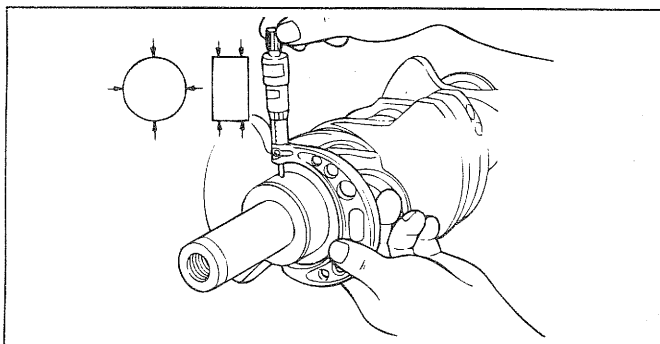
Standard value

Crankshaft journal O.D :

56.982-57.000mm(2.2434-2.2441 in.)

Crankshaft pin O.D :

44.980-45.000mm(1.7709-1.7717 in.)



ECA9410A

MAIN BEARINGS AND CONNECTING ROD BEARINGS

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

MEASURING OIL CLEARANCE

To check the oil clearance by measuring the outside diameter of the crankshaft journal and the inside diameter of the bearing. The clearance can be obtained by calculating the difference between the measured outside diameters.

Standard value

Oil clearance

Crankshaft main bearing

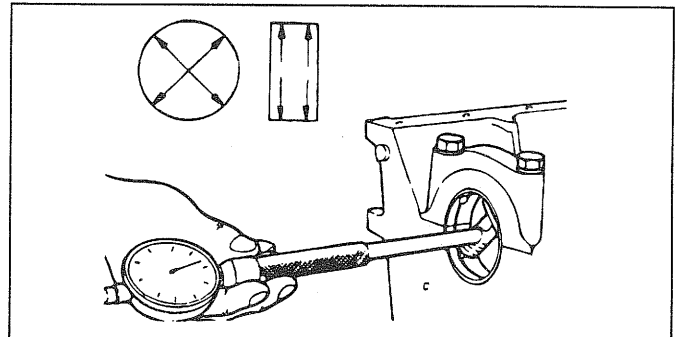
No.1,2,4,5 : 0.018-0.036 mm (0.0007-0.0014 in.)

No.3 : 0.024-0.042 mm (0.0009-0.0017 in.)

Connecting rod bearing :

0.015-0.048 mm (0.0006-0.0019 in.)

Limit : 0.1 mm (0.0039 in.)

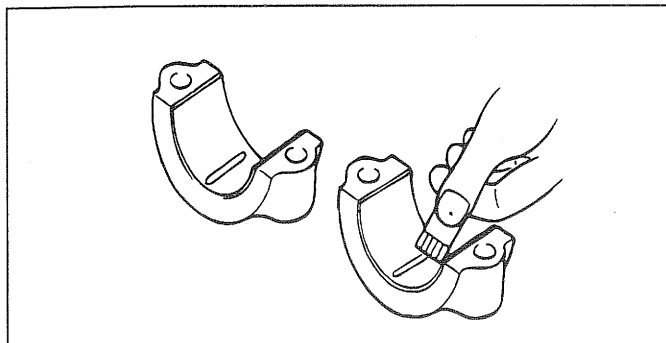


ECA9410B

HOW TO USE PLASTIC GAUGE

Plastic gauge may be used to measure the clearance.

1. Remove oil, grease and any other dirt from the bearings and journals.
2. Cut the plastic gauge to the same length as the width of the bearing and place it in parallel with the journal, avoiding the oil holes.
3. Install the crankshaft, bearings and caps and tighten them to the specified torques. During this operation, do not turn the crankshaft. Remove the caps. Measure the width of the plastic gauge at the widest part by using the scale printed on the gauge package. If the clearance exceeds the service limit, the bearing should be replaced or an undersize bearing should be used. When installing a new crankshaft, be sure to use standard size bearings. The standard clearance not be obtained even after replacing the bearing, the journal and pin should be ground to the undersize and a bearing of the corresponding size should be installed.



ECA9410C

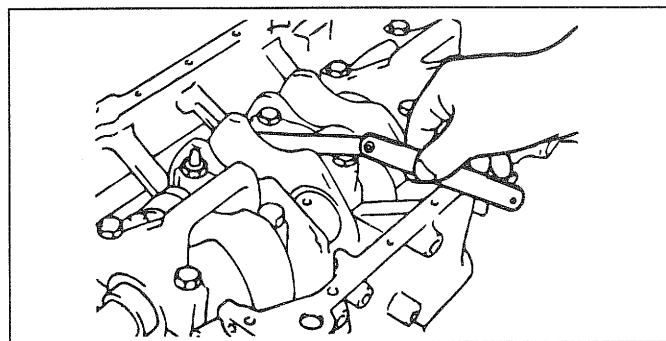
OIL SEAL

Check the front and rear oil seals for damage or worn surfaces. Replace any seat that is defective.

BEARING CAPS

After installing the bearing caps, make sure the crankshaft turns smoothly and the end play is correct. If the end play exceeds the limit, replace crankshaft bearings.

Standard value : 0.05-0.25mm(0.0020-0.0098 in.)



ECA9410D

DRIVE PLATE

Replace distorted, damaged, or cracked drive plates.

FLYWHEEL

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 run-out.

Limit

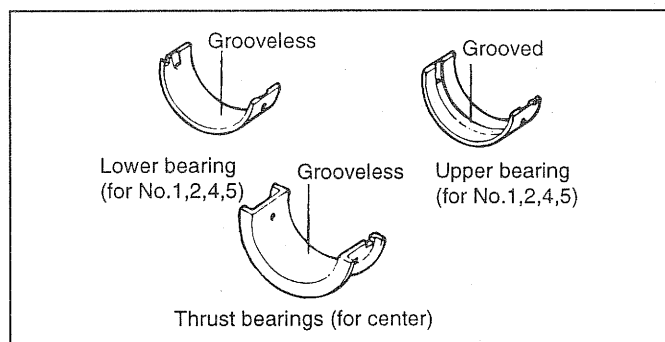
Flywheel run-out : 0.13mm(0.0051 in.)

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

REASSEMBLY

ECHA4300

1. Install grooved main bearing (upper bearing) on cylinder block side.
2. Install grooveless main bearing (lower bearing) on main bearing cap side.
3. Both upper and lower bearings for center are grooveless.



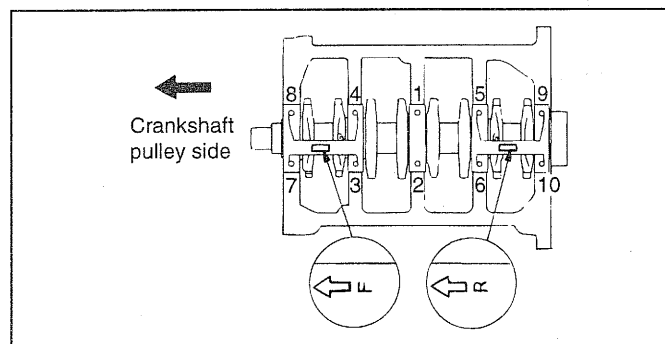
ECA9420A

4. Install the crankshaft. Apply engine oil to journals and pins.
5. Install caps with the arrow mark directed toward front of engine. Cap number must be correct.
6. Tighten cap bolts to specified torque.

Tightening torque

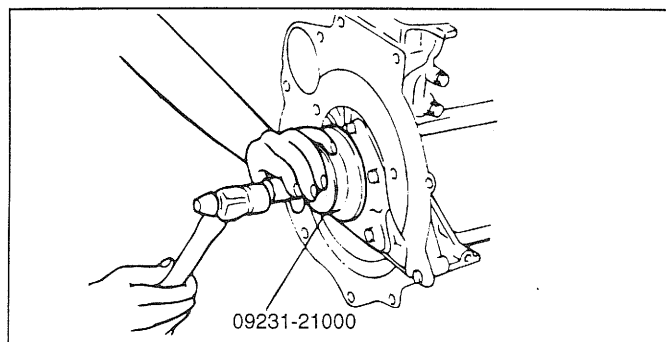
Main bearing cap bolts : 25 Nm (250, 18lb.ft) + (90°)

7. Cap bolts should be tightened evenly in from 4 to 5 stages before they are tightened to the specified torque.
8. Make sure that the crankshaft turns freely to check end play of the crankshaft.



EOY062B

9. Using a special tool (09231-21000). Install the rear and the new oil seal should be used. Oil seal in the oil seal case.



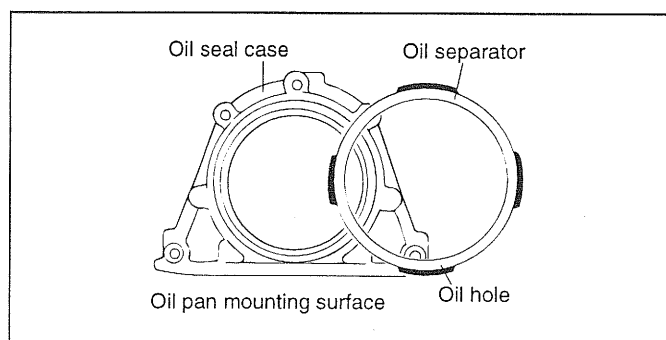
ECA9420C

Tightening torque

Drive plate :

130-140 Nm (1300-1400kg.cm,94-101lb.ft)

10. Install the oil seal into the oil seal case so that the oil hole in the separator may be directed downward (arrow in illustration)



ECA9053A

11. Install the new oil seal case gasket and oil seal case assembly.

Tightening torque

oil seal case :

10-12N.m (100-120kg.cm, 7-9 lb.ft)

<For M/T>

12. Install the rear plate to the cylinder block.
13. Install the flywheel assembly and tighten the bolts to the specified torque.

Tightening torque

Flywheel bolt :

130-140 Nm (1300-1400kg.cm,94-101lb.ft)

<For A/T>

14. Install the adapter plate to the cylinder block.
15. Install the drive plate and tighten the bolts to the specified torque.

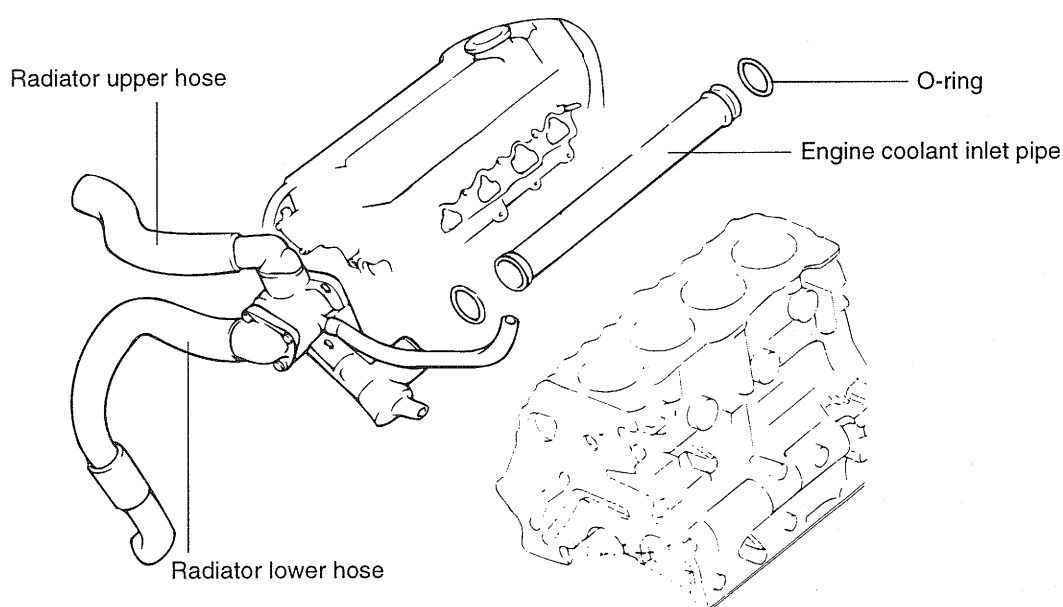
COOLING SYSTEM

ENGINE COOLANT HOSE/PIPES

ENGINE COOLANT HOSE AND
PIPE

ECHA4500

[DOHC ENGINE]



ECA9081B

INSPECTION

ECHA4600

Check the engine coolant pipe and hose for cracks, damage and restrictions. Replace if necessary.

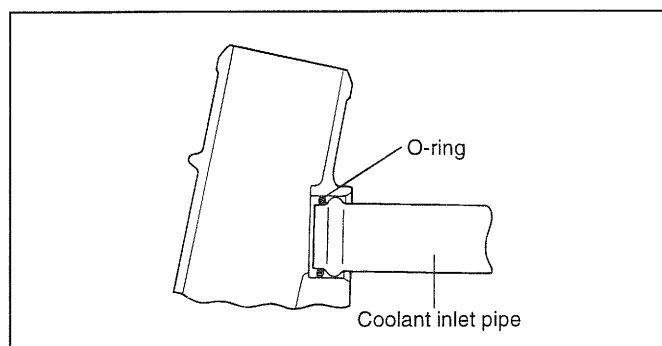
REASSEMBLY

ECHA4700

Fit O-ring in the groove provided at the engine coolant inlet pipe end. Wet the periphery of the O-ring with water and insert the engine coolant inlet pipe.

NOTE

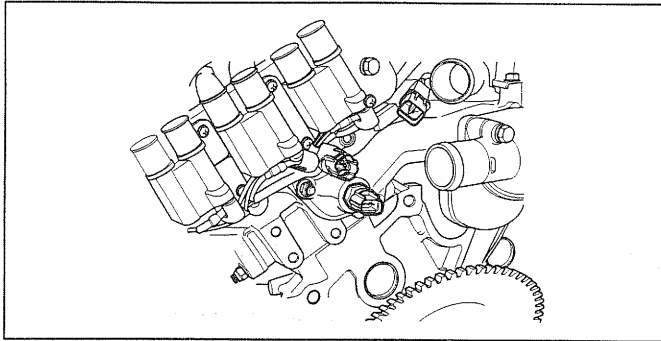
1. Do not apply oil or grease to engine coolant pipe O-ring.
2. Keep the engine coolant pipe connections free of sand, dust, etc.
3. Insert the engine coolant pipe to the end of engine coolant pump inlet.
4. whenever installing the engine coolant inlet pipe, always replace the O-ring with a new one.



ECA9570A

THE COOLANT SENSOR ECHA4800**REMOVAL**

1. Drain the coolant to the bottom of the sensor.
2. Disconnect the ground cable from the battery and then remove the engine harness.
3. Remove the coolant sensor.



KFW5012A

INSTALLATION ECHA4900

1. Tighten the coolant temperature sensor to the specified torque after applying the sealant to the screw area.

Recommended sealant :

Threebond No. 1324 or LOCTITE 262

Tightening torque

The coolant temperature sensor :

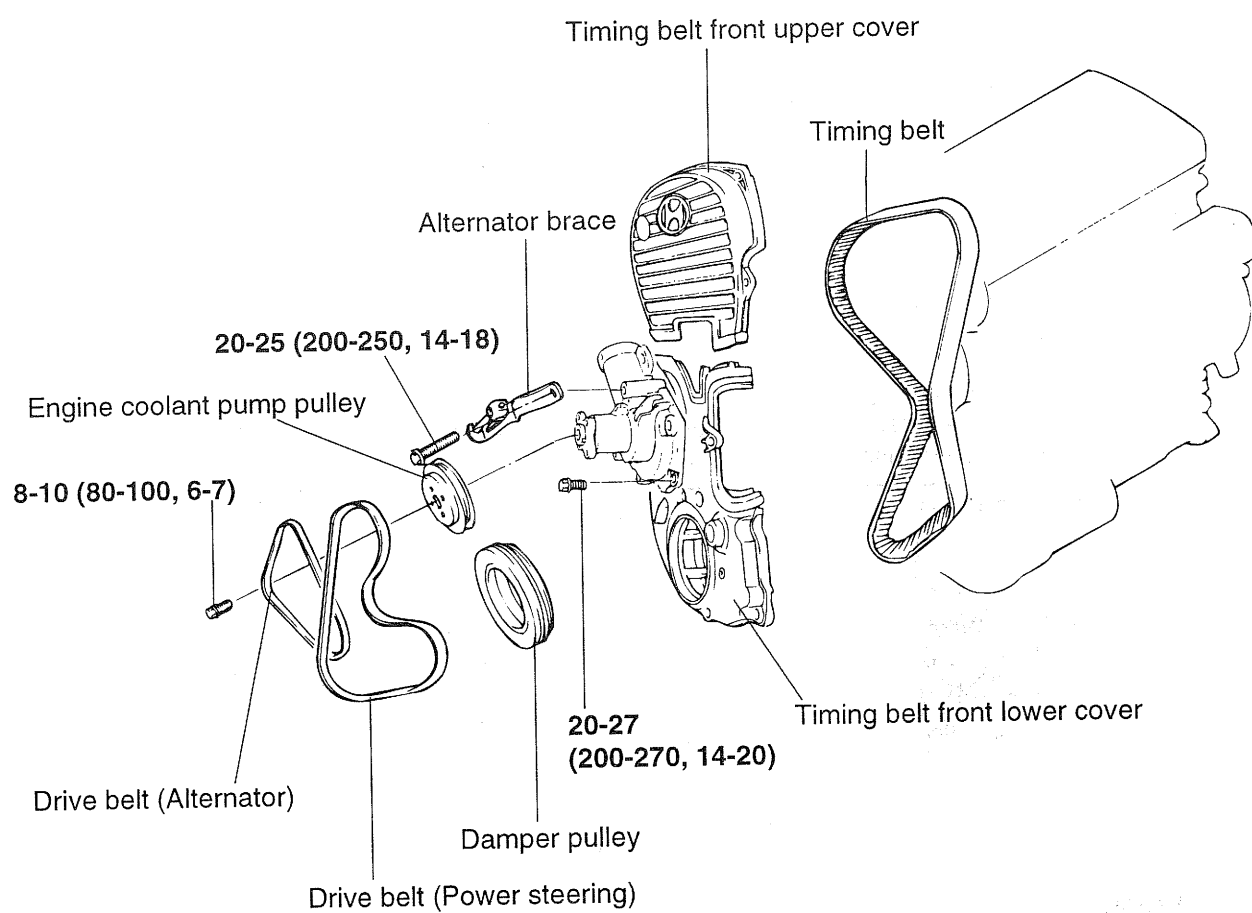
20-40Nm (200-400 kg.cm, 14-29 lb.ft)

2. Connect sensor to the harness.
3. Connect the ground cable to the battery.
4. Refill the engine coolant.

ENGINE COOLANT PUMP

ENGINE COOLANT PUMP [FOR DOHC
ENGINE]

ECHA5000



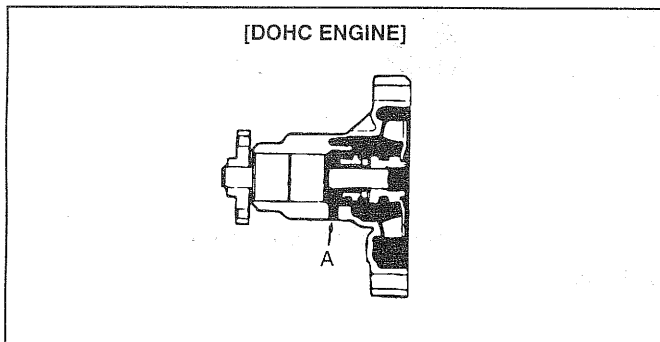
TORQUE : Nm (kg·cm, lb·ft)

REMOVAL ECHA5100

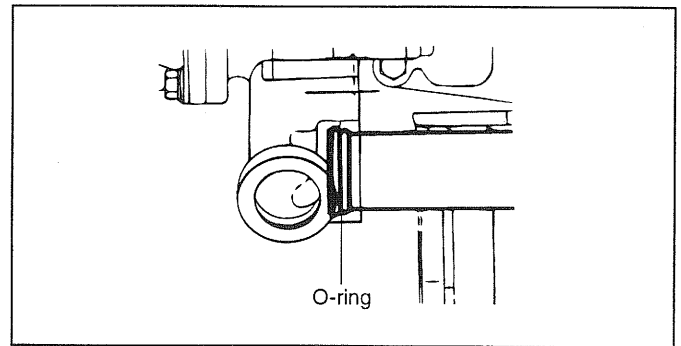
1. Drain the coolant and disconnect the coolant pump inlet pipe.
2. Remove the drive belt and engine coolant pump pulley.
3. Remove the timing belt covers and the timing belt tensioner.
4. Remove the engine coolant pump mounting bolts, then remove the alternator brace.
5. Remove the engine coolant pump assembly from the cylinder block.

INSPECTION ECHA5200

1. Check the engine coolant pump for cracks, damage or wear. Replace the engine coolant pump assembly if necessary.
2. Check the bearing for damage, abnormal noise, and sluggish rotation. Replace the engine coolant pump assembly if necessary.
3. Check the seal unit for leaks. Replace the engine coolant pump assembly if necessary.
4. Check for engine coolant leakage. If the engine coolant leaks from hole "A", seal unit is defective. Replace engine coolant pump assembly.



ECA9560A



ECHA013A

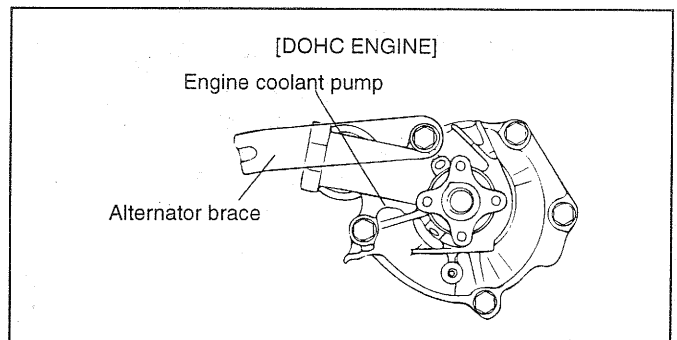
3. Install a new engine coolant pump gasket and engine coolant pump assembly. Tighten the bolts to specified torque.

Tightening torque

Engine coolant pump bolt :

20-27Nm(200-270kg.cm, 14-20lb.ft)

4. Install the timing belt tensioner and timing belt. Adjust timing belt tension, then install timing belt covers.
5. Install the engine coolant pump pulley and drive belt, then adjust the belt tension.
6. Refill the coolant.
7. Run the engine and check for leak.



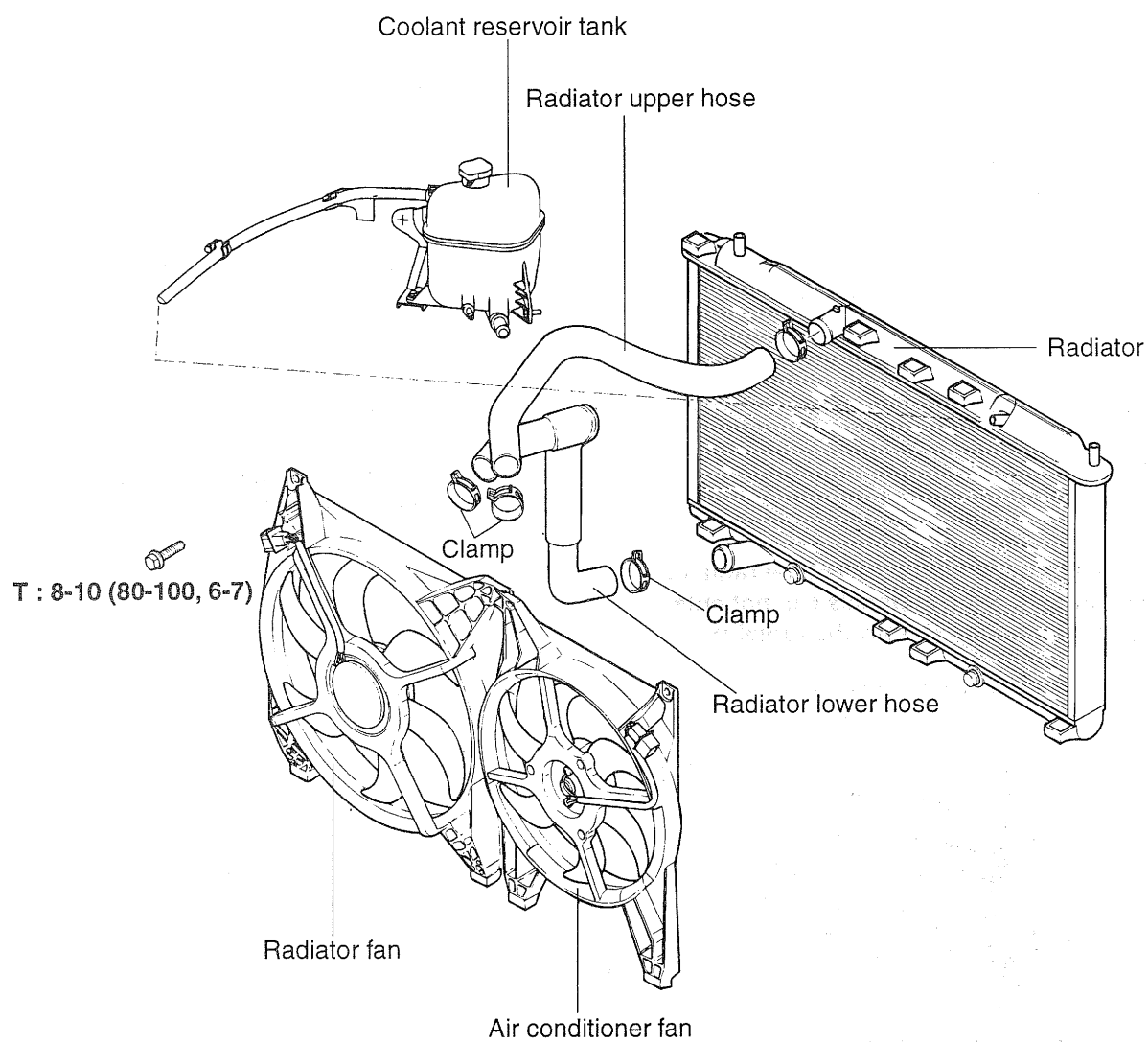
ECHA530A

INSTALLATION ECHA5300

1. Clean the gasket surfaces of the engine coolant pump body and the cylinder block.
2. Install the new O-ring onto the groove on the front end of the engine coolant pipe, then wet the O-ring with water. Do not apply oil or grease.

RADIATOR

RADIATOR ECHA5500

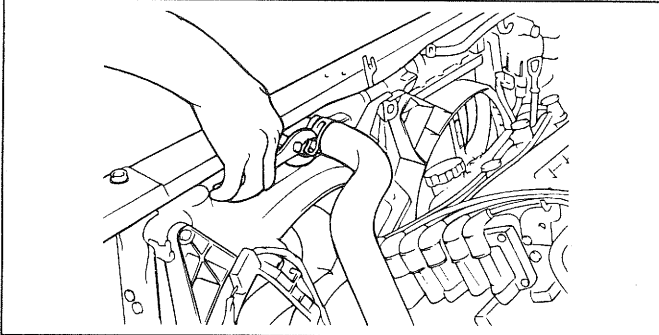


TORQUE : Nm (kg·cm, lb·ft)

REMOVAL

ECHA5600

1. Disconnect the ground cable from the battery terminal.
2. Disconnect the fan motor connector.
3. Loosen the radiator drain plug to drain the coolant.
4. Disconnect the upper and lower hoses and overflow tube after making marks on the radiator hose and the hose clamp.



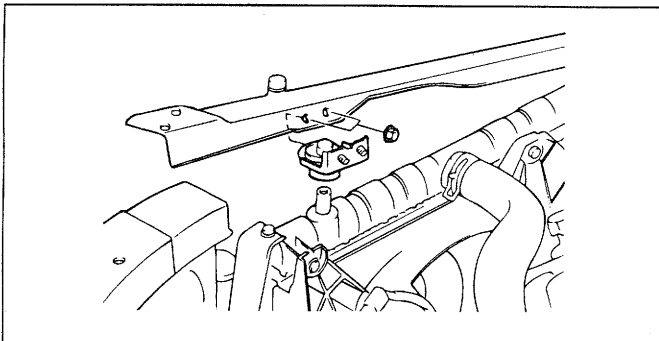
EDHA004D

5. For vehicles with automatic transaxles, disconnect the return oil cooler hoses from the automatic transaxle.

CAUTION

Cover or plug the hose and nipple part of the radiator so that dust and other foreign materials can not enter after the hose is disconnected from the radiator.

6. Remove the radiator upper mounting bolt.



EDHA001C

7. Remove the radiator together with the fan motor.
8. Remove the radiator fan motor and condenser fan motor from the radiator.

INSPECTION

ECHA5700

1. Check for foreign material between radiator fins.

2. Check the radiator fins for damage and straighten if necessary.
3. Check the radiator for corrosion, damage, rust or scale.
4. Check the radiator hoses for cracks, damage or deterioration.
5. Check the reservoir tank for damage.
6. Check the automatic transaxle oil cooler hoses for cracking, damage or deterioration. (only A/T)

INSTALLATION

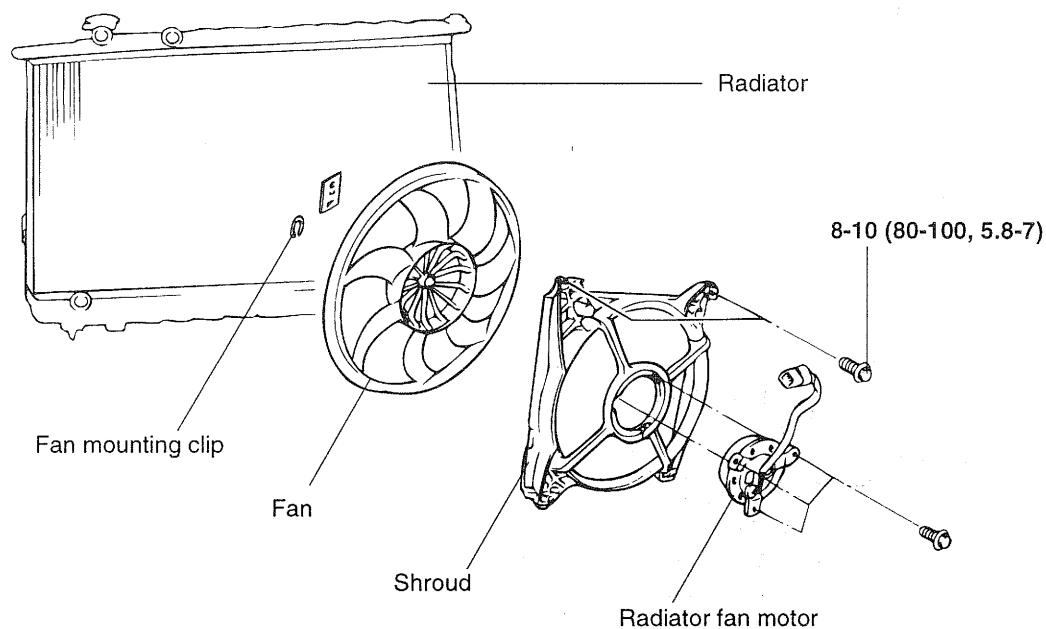
ECHA5800

1. Fill the radiator and reservoir tank with clean coolant mixture.
2. Run the engine until the coolant has warmed up enough so that the thermostat valve may open and then stop the engine.
3. Remove the radiator cap and pour the coolant to the filler neck of the radiator. Fill the reservoir tank with the coolant to the upper level.
4. Check that there is no leakage from the radiator, hoses or connections.

RADIATOR PAN MOTOR

RADIATOR FAN MOTOR
ASSEMBLY

ECHA6200

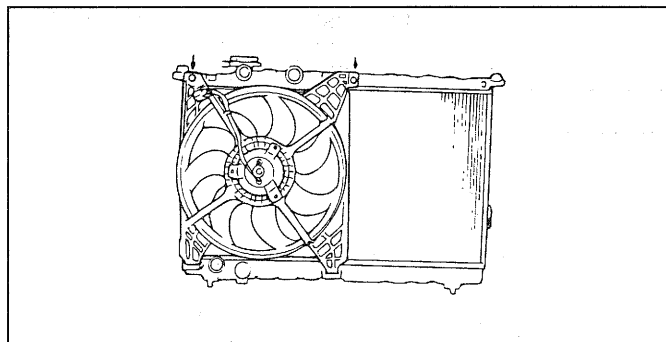
**TORQUE : Nm (kg·cm, lb·ft)**

ECA9059A

REMOVAL

ECHA6300

1. Disconnect the ground cable from the battery cable.
2. Disconnect the connectors from the fan motor and the harness from shroud.
3. For vehicles with automatic transaxle, remove the oil cooler hose from the shroud.
4. Remove the four bolts fixing shroud.
5. Remove the shroud with the fan motor.
6. Remove the fan mounting clip and detach the fan from fan motor.
7. Remove three screws and detach the fan motor.

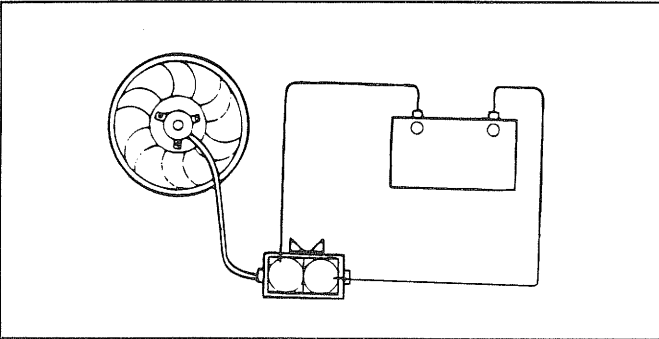


ECA9060A

INSPECTION**RADIATOR FAN MOTOR**

1. Check that the radiator fan rotates when battery voltage is applied between the terminals (as shown table below).

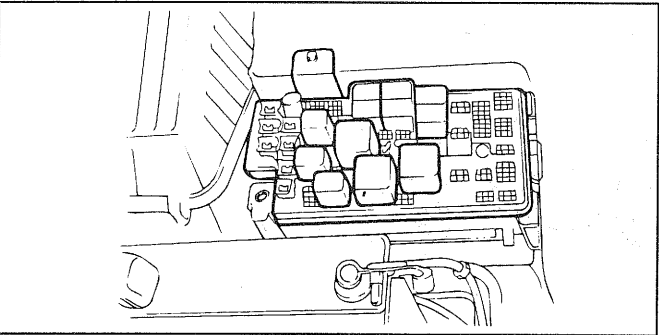
2. Check that abnormal noise is not produced while the motor is turning.



ECHA011C

RADIATOR FAN MOTOR RELAY

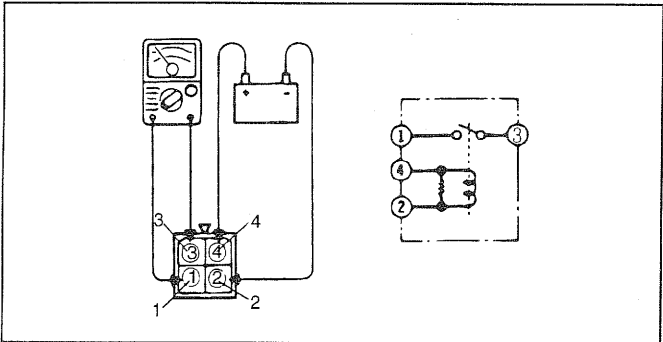
1. Remove the radiator fan motor relay (High and Low) from the relay box in engine room.



EDAA094A

2. Check the continuity of the terminals “2” and “4” with an ohmmeter.

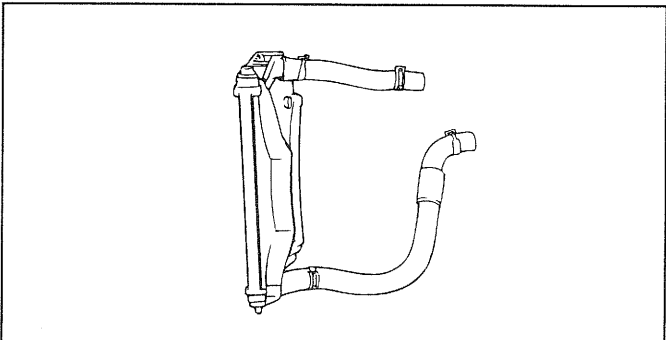
Item	Terminal NO.	Yes or not
ON	Terminal 1-3	Continuity
OFF	Terminal 1-3	Non continuity
	Terminal 2-4	Continuity



HFR25016

NOTE

- Make sure the cooling fan does not come into contact with the shroud when installed.
- After installation, make sure there is no unusual noise or vibration when the fan is rotated.



ECA9061A

INSTALLATION

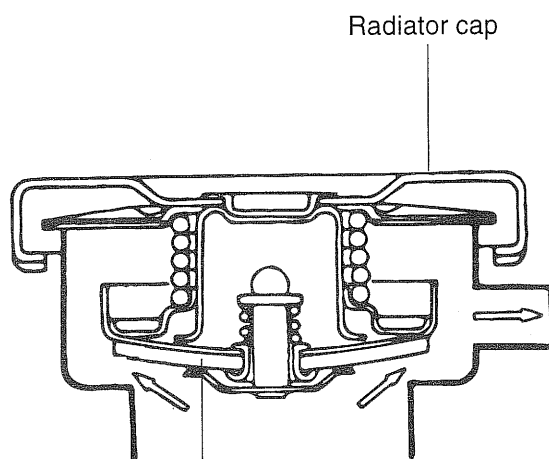
ECHA6400

Installation is in the reverse order of removal procedures.

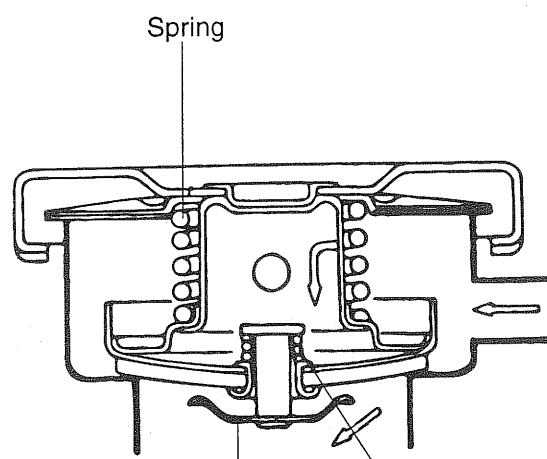
RADIATOR CAP

RADIATOR CAP

ECHA5900



High pressure valve

Pressure : 107.9 ± 14.7 (1.1 ± 0.15 , 15.64 ± 2.13)

Bent valve

Vacuum spring

Pressure : 83.4 (0.85, 12.1)

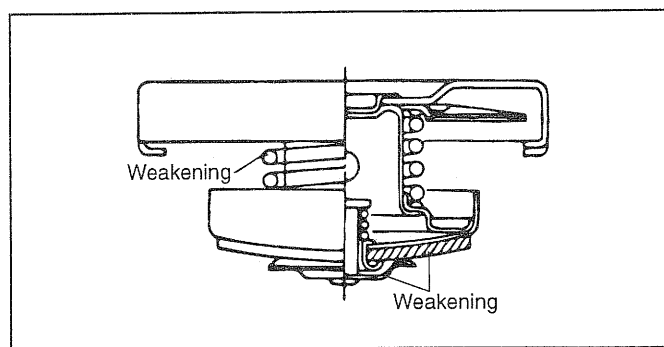
PRESSURE : Kpa (kg/cm², psi)

ECHA014A

INSPECTION

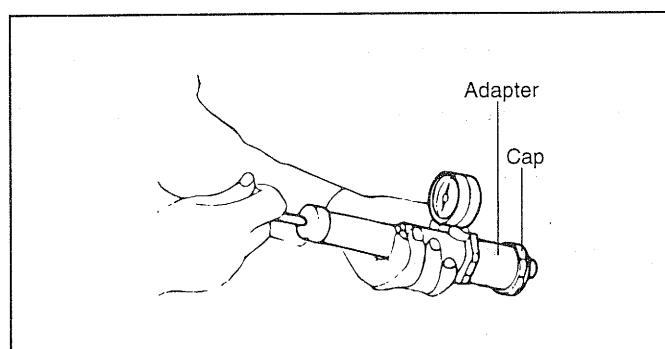
ECHA6000

1. Check the radiator cap for damage, crack or weakening.



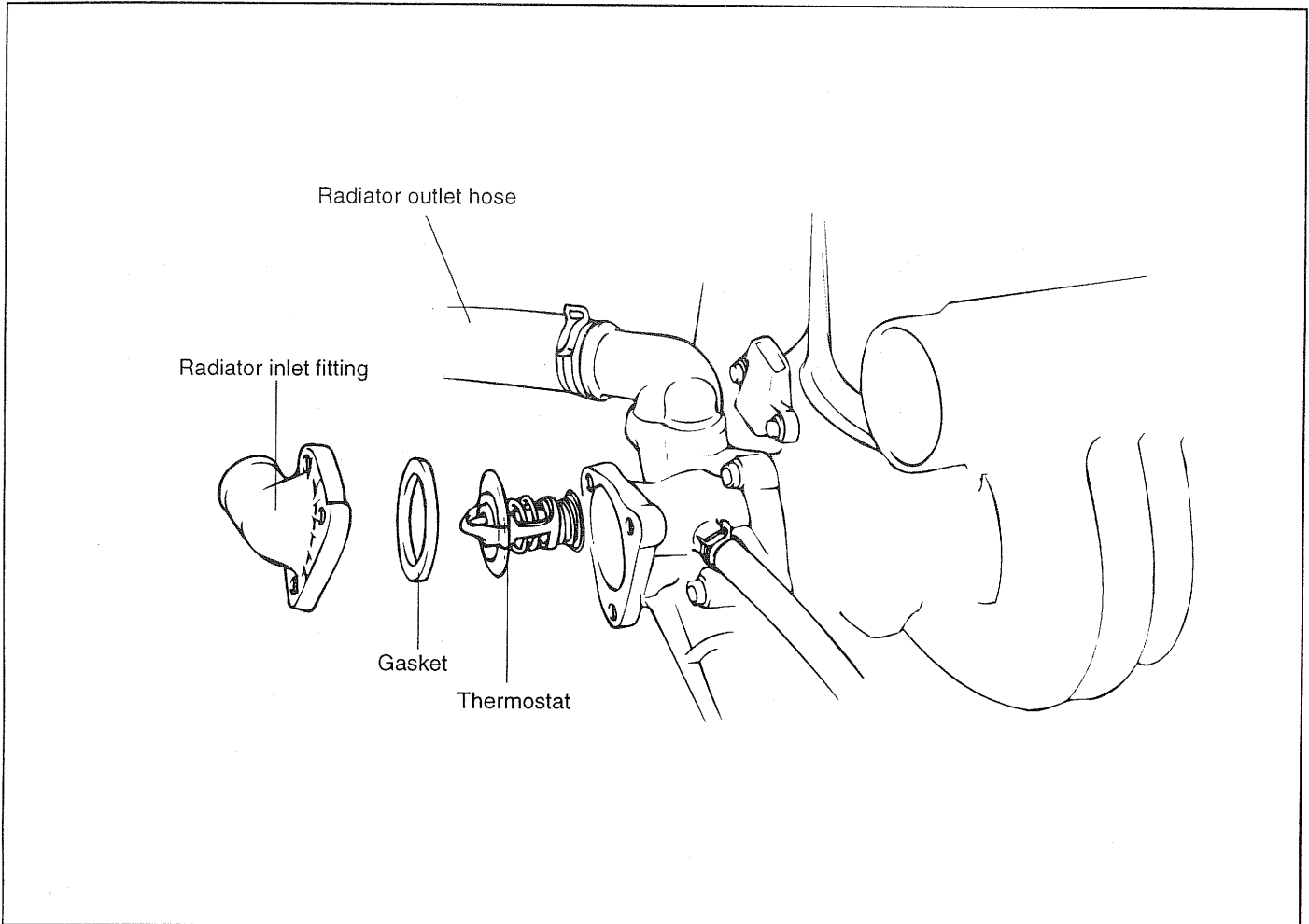
ECHA014B

4. Replace the radiator cap if the reading does not remain about 10 seconds.



ECHA014C

2. Connect the tester to the radiator cap.
3. Increase the pressure until the indicator stops moving.

THERMOSTAT**THERMOSTAT** ECHA6600

ECHA660A

REMOVAL ECHA6700

1. Drain the coolant to the thermostat level or below.
2. Remove the engine coolant inlet fitting and gasket.
3. Remove the thermostat.

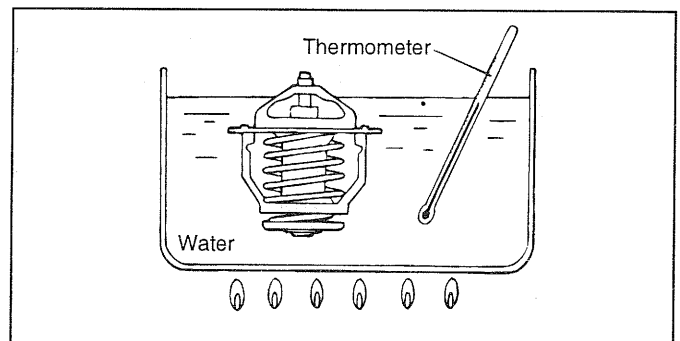
INSPECTION ECHA6800

1. Heat the thermostat as shown in the illustration.
2. Check that the valve operates properly.
3. Check to determine the temperature at which the valve begins to open.

Valve opening temperature :

80-84°C(176-183.2°F)

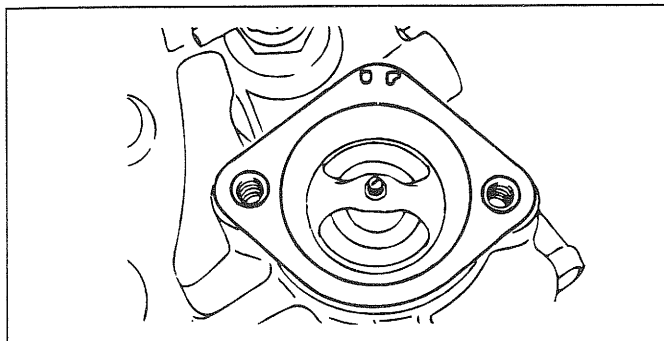
Full opening temperature : 95°C(203°F)



ECA9600A

INSTALLATION ECHA6900

1. Check that the flange of the thermostat is correctly seated in the socket of the thermostat housing.
2. Install the engine coolant inlet fitting.



ECHA013B

Tightening torque

Engine coolant inlet fitting bolt :

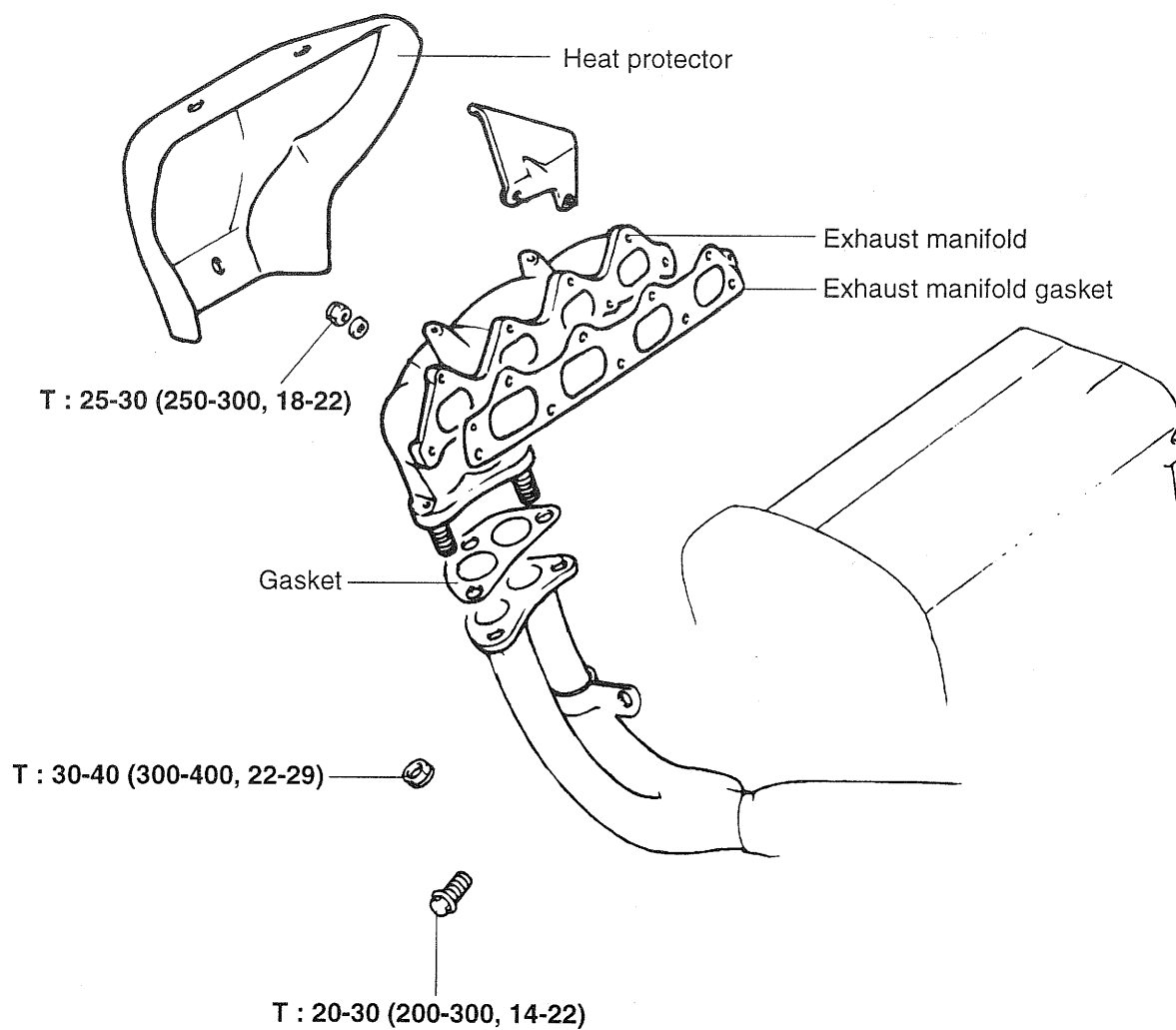
10-15Nm(100-150kg.cm, 7-11lb.ft)

3. Refill the coolant

INTAKE AND EXHAUST SYSTEM

EXHAUST PIPE

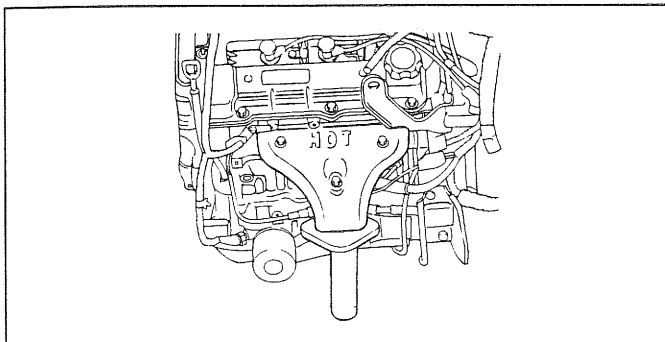
EXHAUST MANIFOLD ECHA7000



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

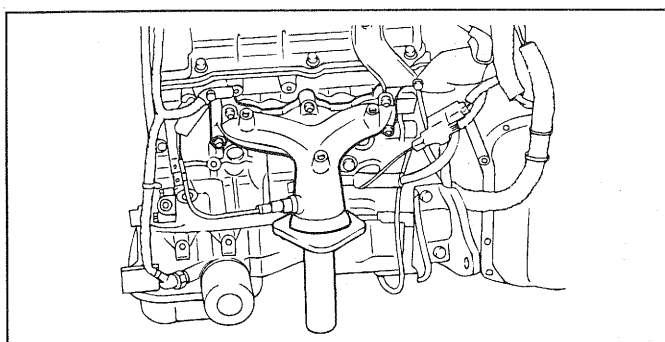
REMOVAL ECHA7100

1. Remove the heat protector.



EDHA011A

2. Remove the exhaust manifold.



EDHA011B

3. Remove the exhaust manifold gasket.

INSPECTION

1. Check for damage or cracking.
2. Using a straight edge and feeler gauge, check for distortion on the cylinder head matching surface.

Standard value : 0.15 mm (0.006 in.)

Service limit : 0.3 mm (0.012 in.)

3. Check the exhaust manifold for damage crack.

INSTALLATION ECHA7200

1. Install the exhaust manifold with gasket

Tightening torque

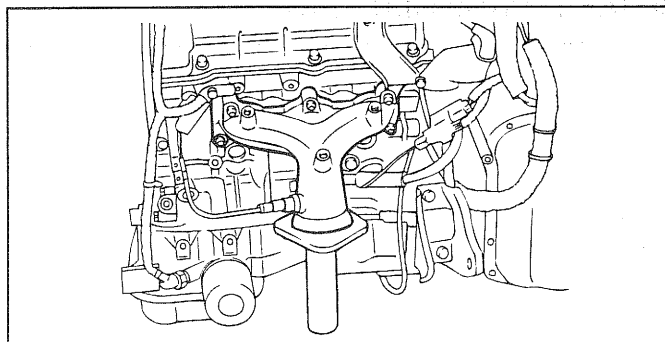
Exhaust manifold

M8 : 25-30 N.m (250-300 kg.cm, 18-22 lb.ft)

M10 : 35-55 N.m (350-550 kg.cm, 25-40 lb.ft)

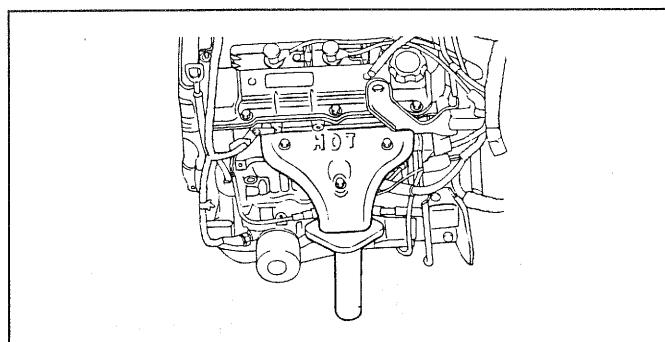
NOTE

Do not use the used exhaust manifold gasket.



EDHA011B

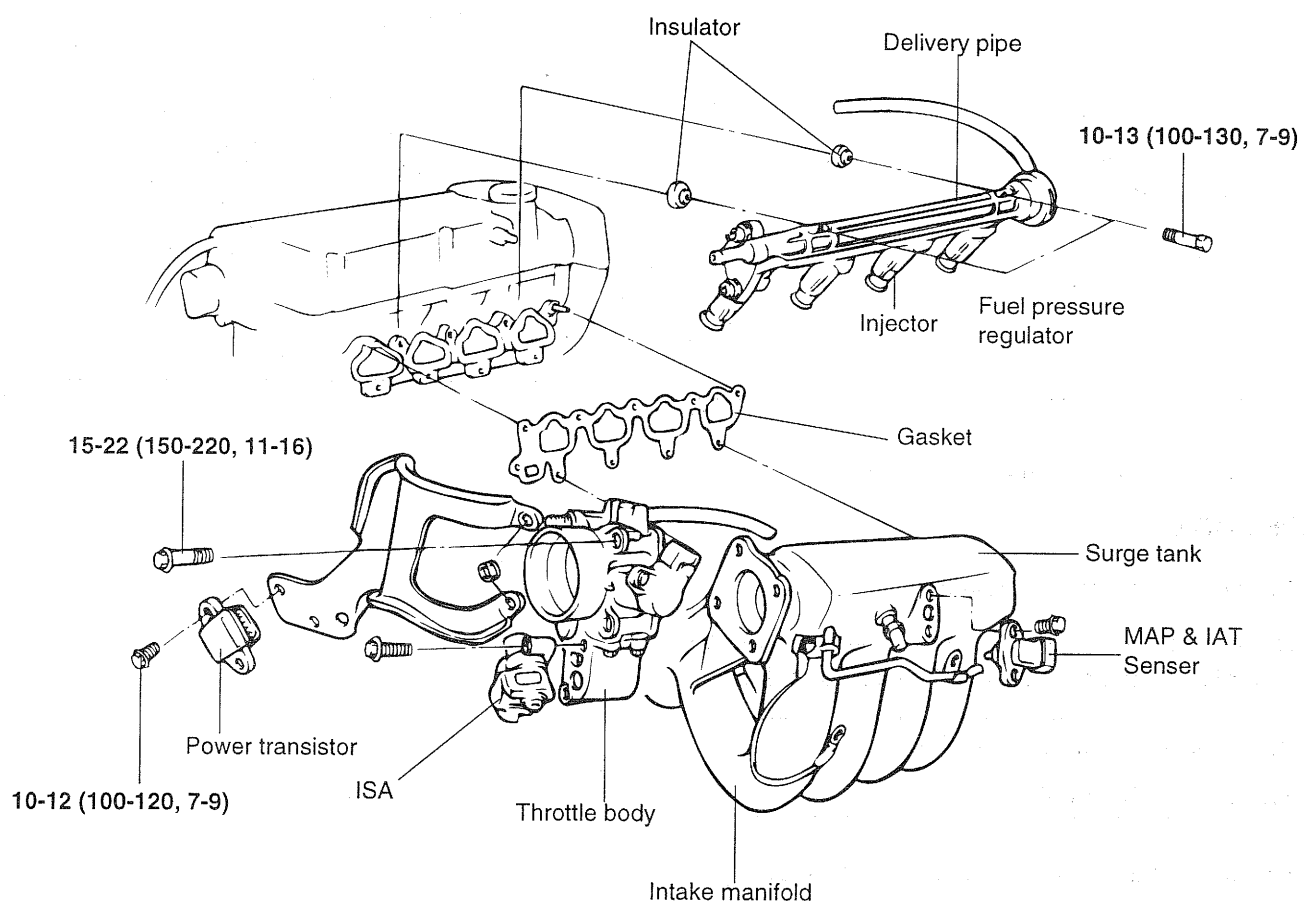
2. Install the heat protector.



EDHA011A

INTAKE MANIFOLD

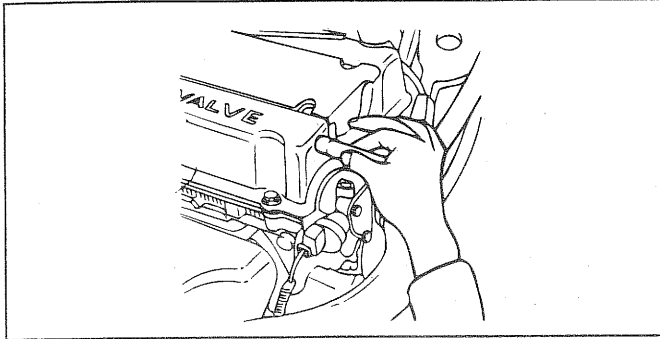
INTAKE MANIFOLD ECHA7500



TORQUE : Nm (kg·cm, lb·ft)

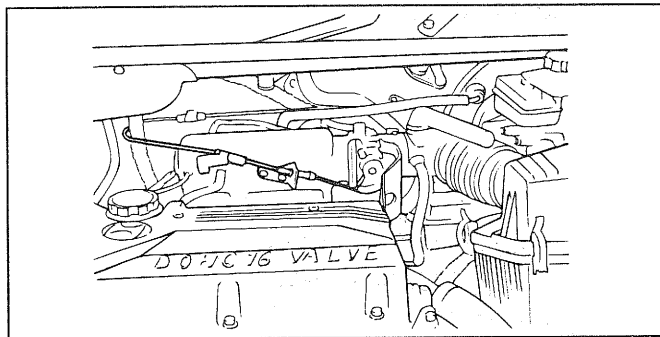
REMOVAL ECHA7600

1. Remove the air breather hose connected on the throttle body.



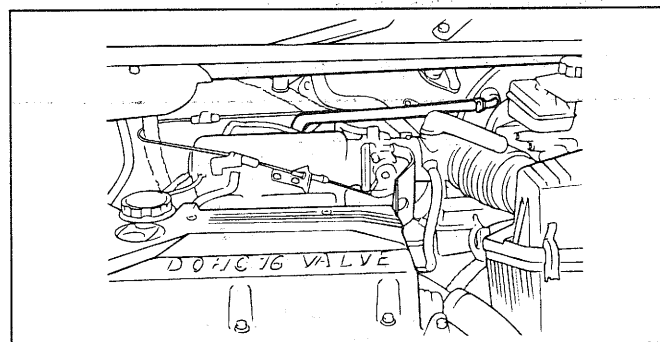
ECHA016A

2. Remove the accelerator cable.



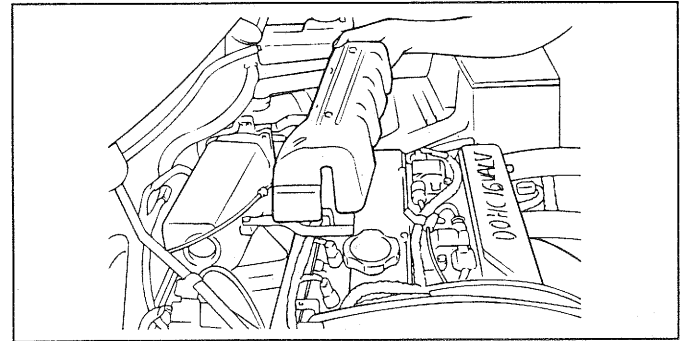
EDHA006E

3. Remove the engine coolant hose and throttle body.
4. Remove the P.C.V valve and brake boost vacuum hose.
5. Disconnect the vacuum hose connector.



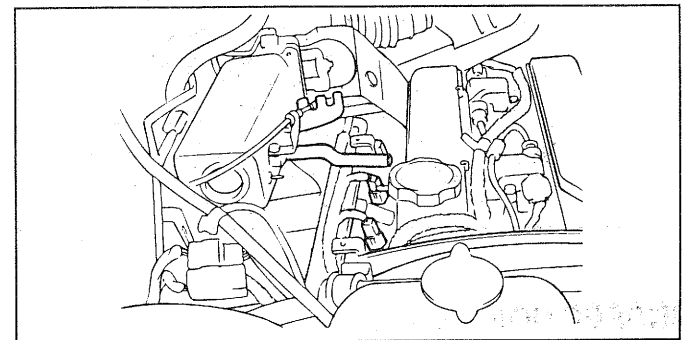
EDHA006B

6. Remove the injector cover.



ECHA016I

7. Decrease the pressure in the fuel pipe line to prevent fuel from flowing over and then disconnect the connector of high pressure hose.
8. Disconnect the fuel injector harness connector.

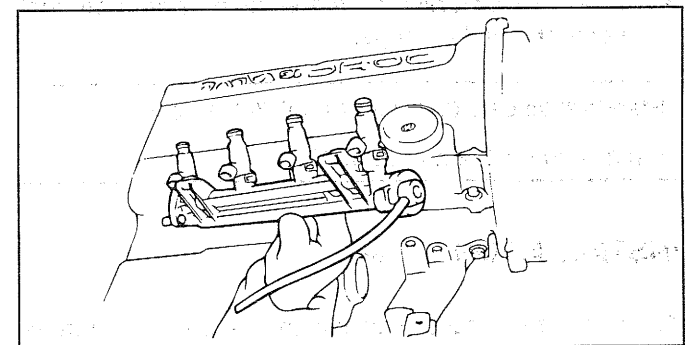


ECHA055A

9. Remove the delivery pipe with fuel injector and pressure regulator.

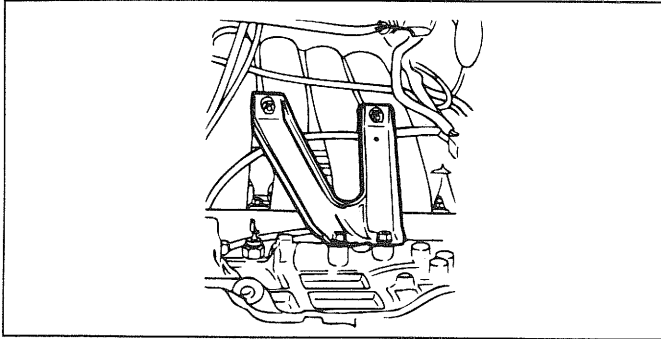
NOTE

When the delivery pipe is removed, notice not to drop the injector.



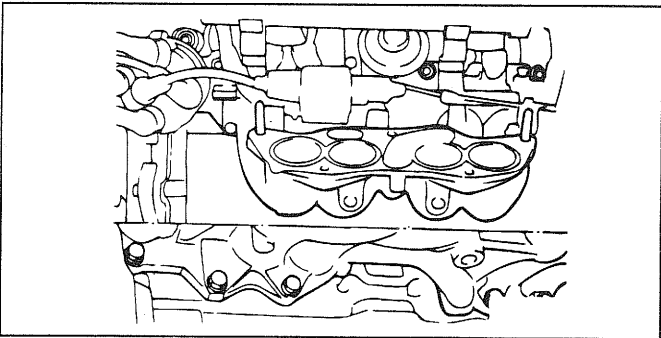
ECA9070A

10. Remove the intake manifold stay.



ECHA016C

11. Remove the intake manifold.



ECHA016J

INSPECTION

ECHA7700

INTAKE MANIFOLD AND SURGE TANK

1. Check for damage or cracking of any part.
2. Check for restriction of the vacuum outlet port, water or gas passage.
3. Check for distortion on the surface using a straight edge and feeler gauge.

Standard value : 0.15 mm (0.06 in.) or less

Service limit : 0.2 mm (0.0078 in.)

INSTALLATION

ECHA7800

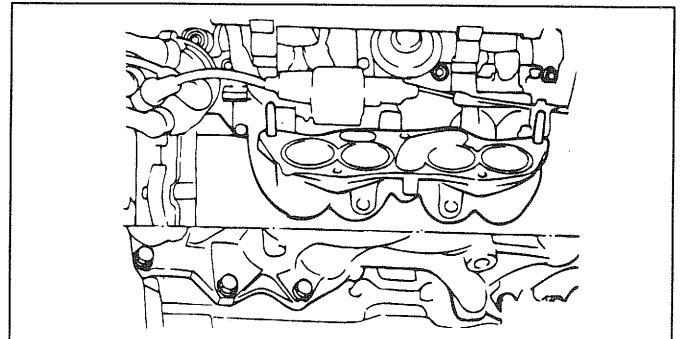
1. Install the intake manifold to the specified torque with new gasket.

Tightening torque

Intake manifold

Bolt : 15-20Nm (150-120 kg.cm, 11-14 lb.ft)

Nut : 30-42Nm (300-420 kg.cm, 22-30 lb.ft)

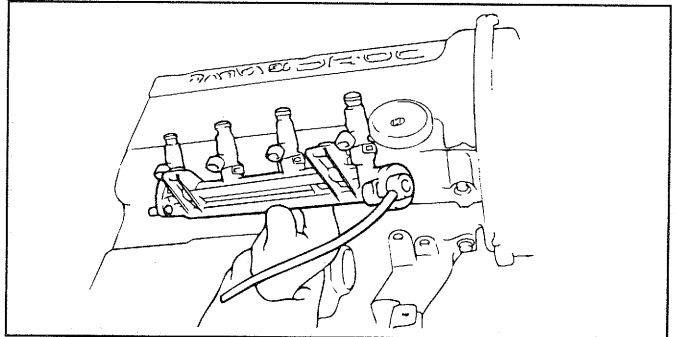


ECHA016I

2. Install the delivery pipe and injector assembly to the intake manifold.

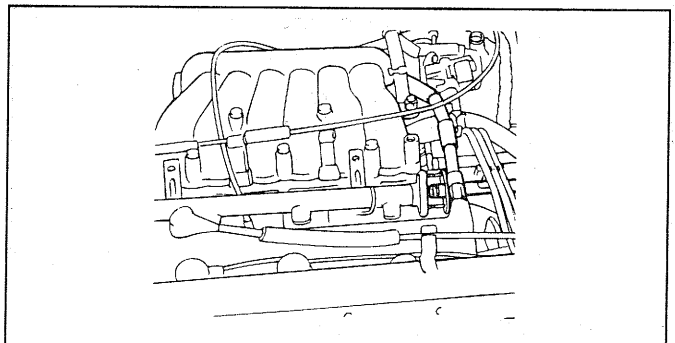
NOTE

Make certain that there is any interference between the injectors and injector holes on the intake manifold.



ECA9070A

3. Install the surge tank stay.
4. Connect the fuel injector connector and wiring harness and then install the cover.
5. Connect the high pressure hose.



ECHA016B

6. Connect the vacuum hoses.

Tightening torque

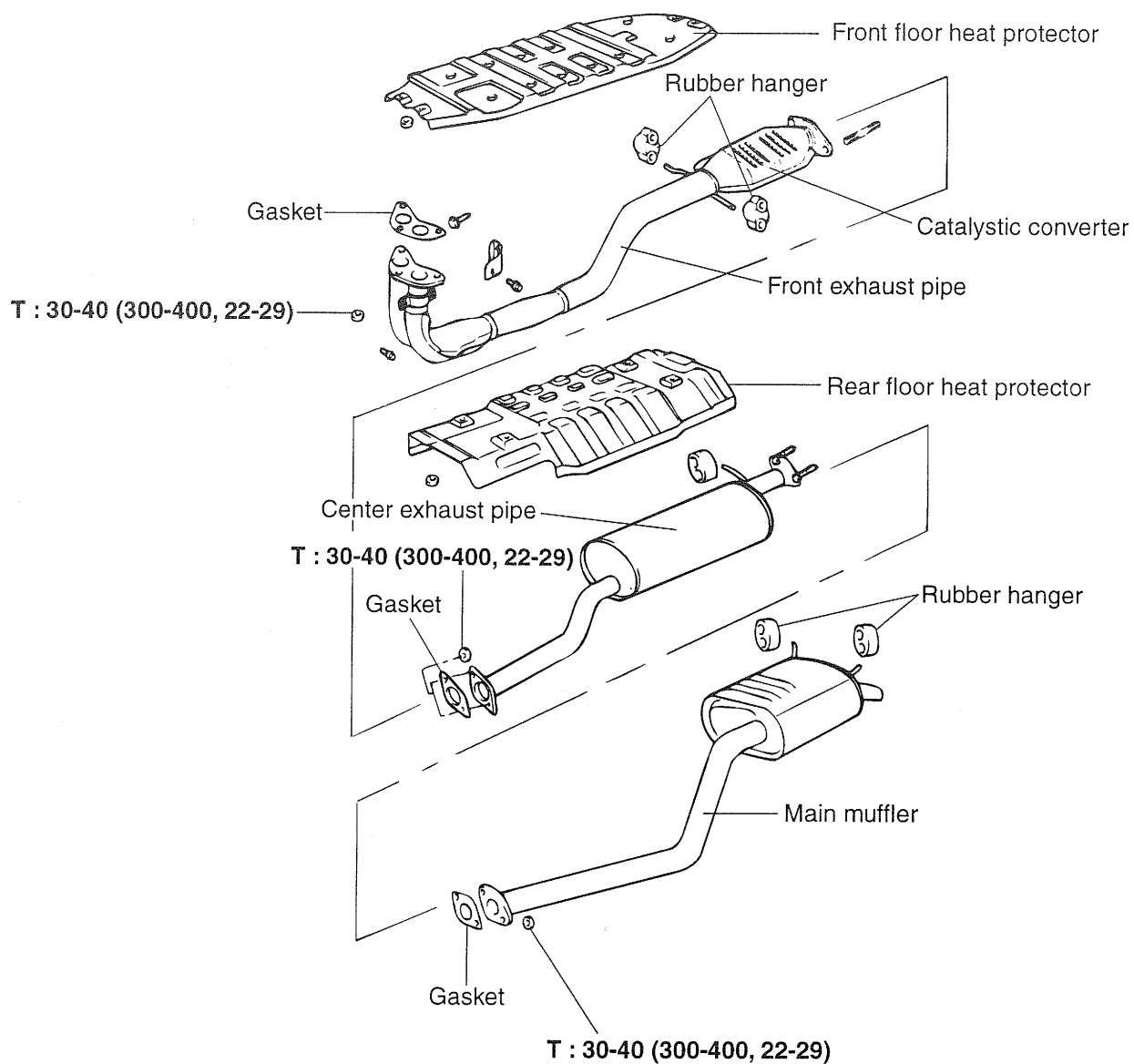
Intake manifold stay and cylinder block :

18-251Nm (180-250 kg.cm, 13-18 lb.ft)

7. Connect the PCV valve and brake boost hose.
8. Install the air breather hose.
9. Install the accelerator cable.

MUFFLER

MUFFLERS ECHA8000



TOR QUE : Nm (kg·cm, lb·ft)

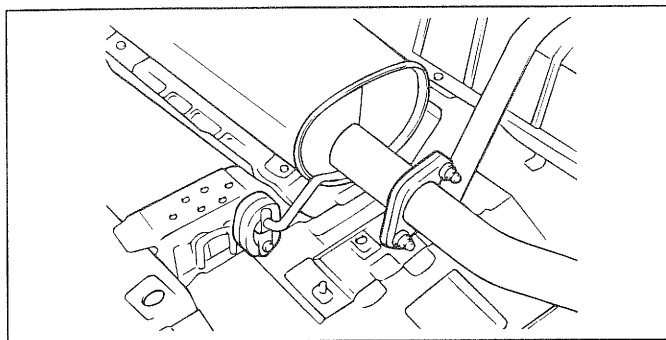
REMOVAL ECHA8100

MAIN MUFFLER

CAUTION

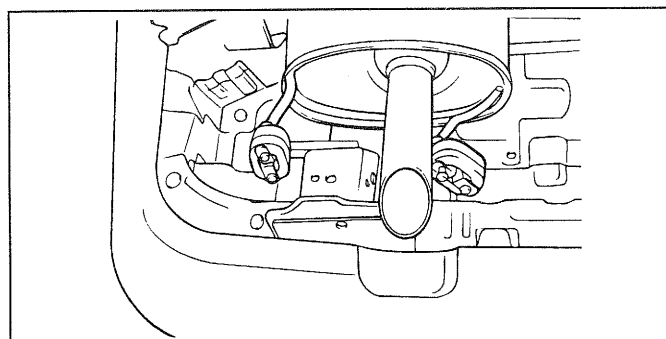
Before removing or inspecting the exhaust system, ensure that the exhaust system is cool enough.

1. Disconnect the main muffler from the center exhaust pipe.



ECHA019E

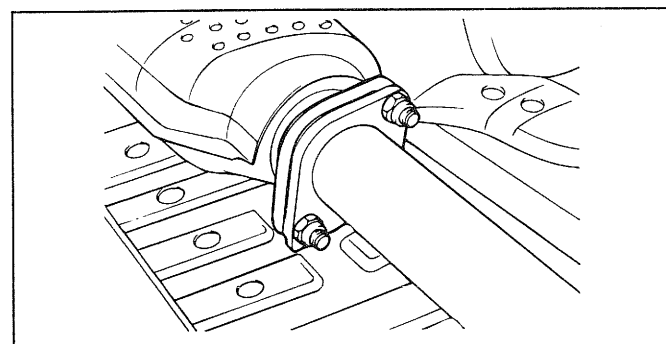
2. Remove the rubber hangers and take out the main muffler.



ECHA019B

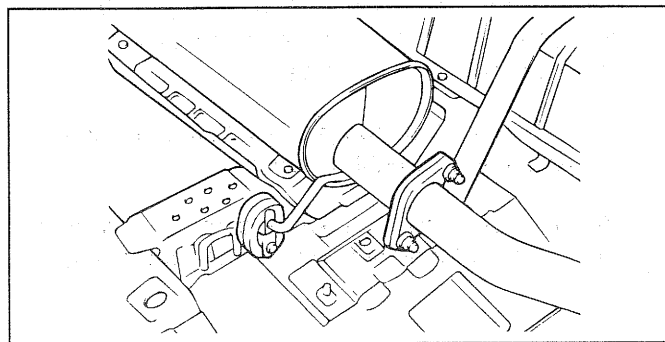
CENTER EXHAUST PIPE

1. Disconnect the center exhaust pipe from the main muffler.
2. Remove the center exhaust pipe from the front exhaust pipe.



ECHA019D

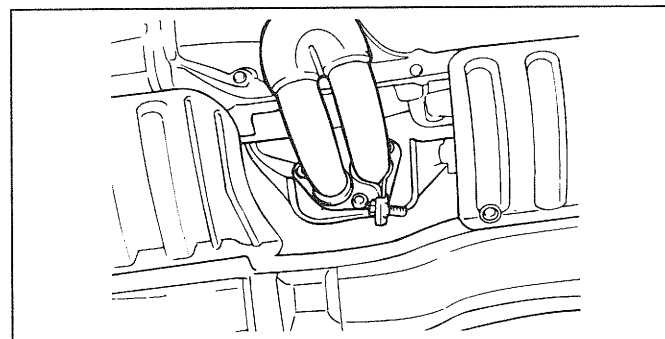
3. Remove the rubber hangers and take out the center exhaust pipe.



ECHA019E

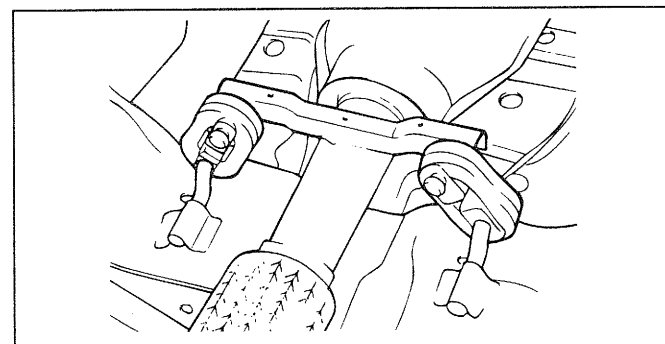
FRONT EXHAUST PIPE (INCLUDING CATALYTIC CONVERTER)

1. Remove the front exhaust pipe from the center exhaust pipe.
2. Remove the front exhaust pipe bolts and exhaust manifold pipe mounting nuts.



ECHA004M

3. Remove the front exhaust pipe from the rubber hanger.



ECHA019H

INSPECTION ECHA8200

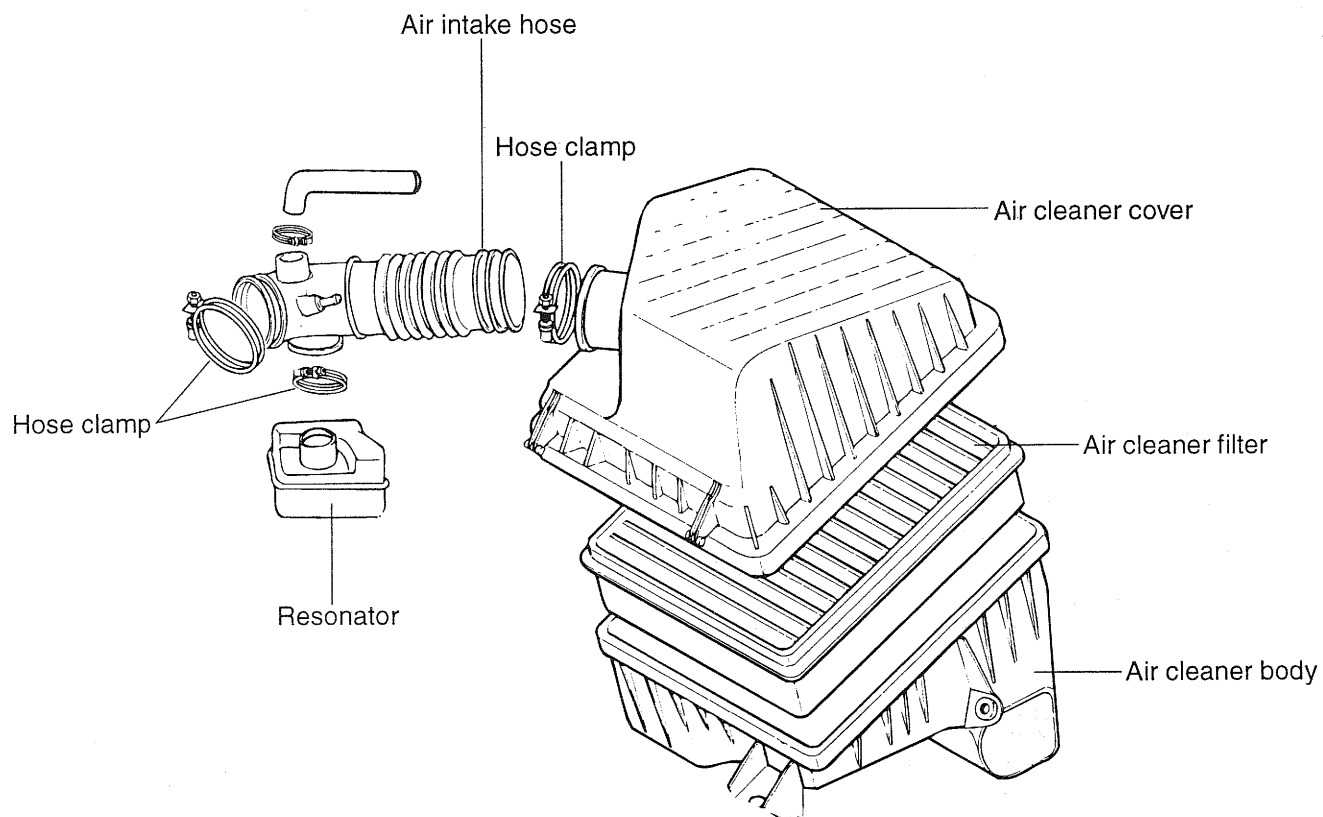
1. Check the mufflers and pipes for corrosion and damage.
2. Check the rubber hangers for deterioration and cracks.

INSTALLATION ECHA8300

1. Temporarily, install the front exhaust pipe (catalytic converter assembly), the center exhaust pipe and the main muffler in this order.
2. Install the rubber hangers so that they can be identical (left and right) in length.
3. Tighten the parts securely and then confirm that there is no interference with any of components.

AIR CLEANER (ACL)

AIR CLEANER ECHA8500

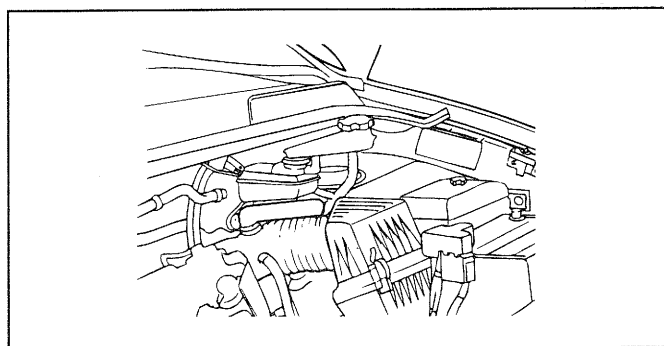


TOR QUE : Nm (kg·cm, lb·ft)

ECHA015A

REMOVAL ECHA8600

1. Disconnect the air flow sensor connector.
2. Remove the air intake hose connected to the air cleaner and the resonator.
3. Remove the three bolts attaching the air cleaner mounting brackets.
4. Detach the air cleaner.



ECHA004A

5. Remove the air flow sensor from the air intake hose.

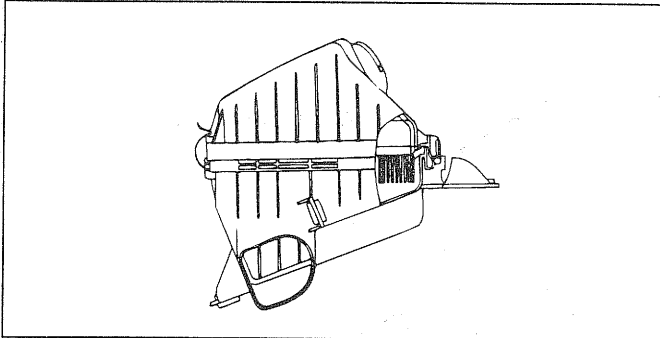
CAUTION

Donot pull the air flow sensor harness.

INSPECTION

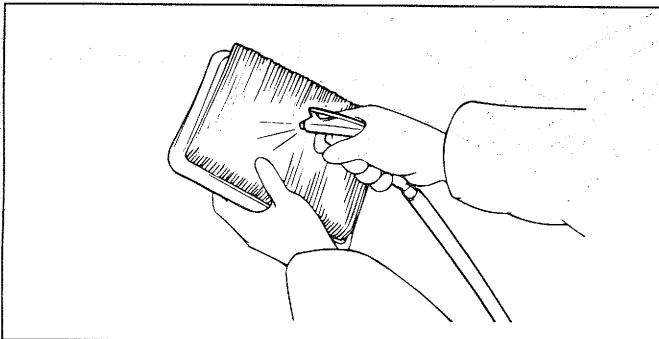
ECHA8700

1. Check the air cleaner body, cover, or packing for distortion, corrosion or damage.
2. Check the air duct for damage.



ECHA015C

3. Check the air cleaner element for restriction, contamination or damage. If the element is slightly restricted, remove the dust and debris by blowing the inside of the element.



ECA9066A

INSTALLATION

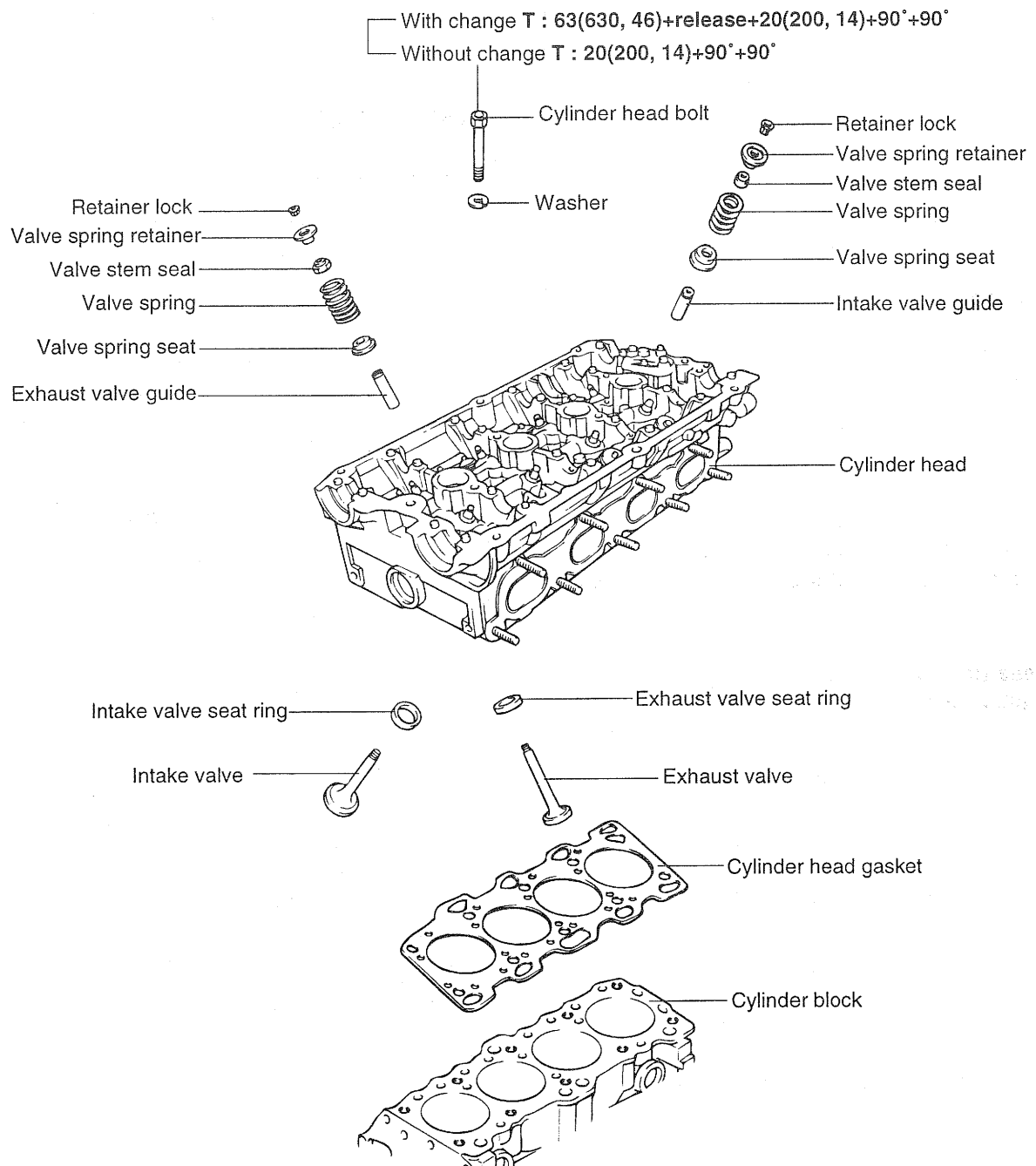
ECHA8800

Install the air cleaner according to the reverse order of removal.

CYLINDER HEAD ASSEMBLY

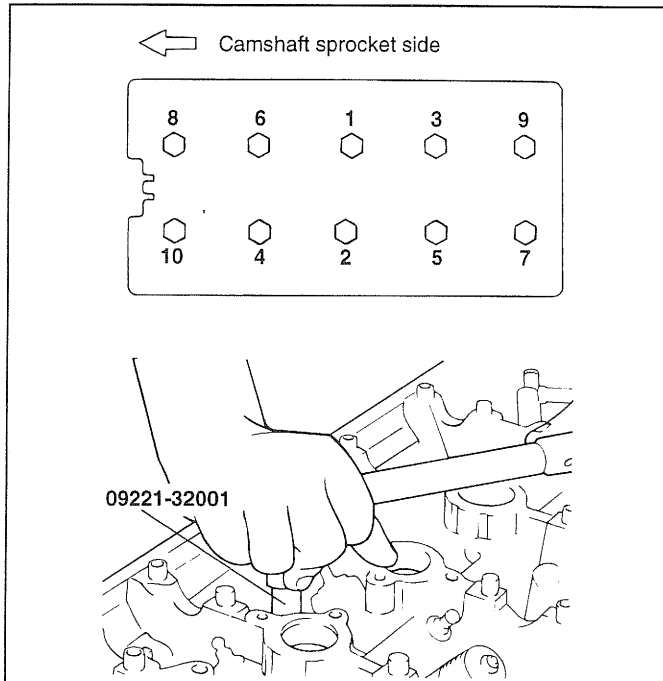
CYLINDER HEAD

CYLINDER HEAD AND VALVES ECHA9000



DISASSEMBLY ECHA9100

1. Using a special tool (09221-32001), remove the cylinder head bolts as shown in the illustration.

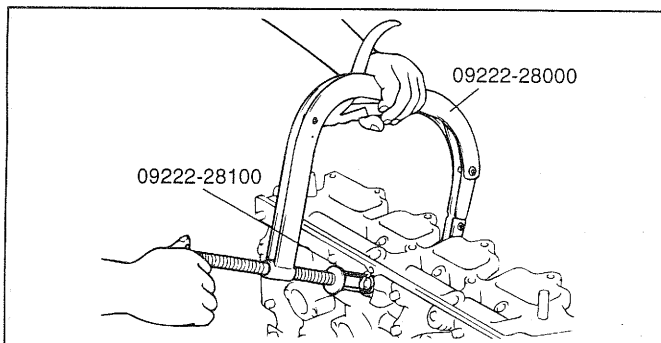


ECHA910A

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

NOTE

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

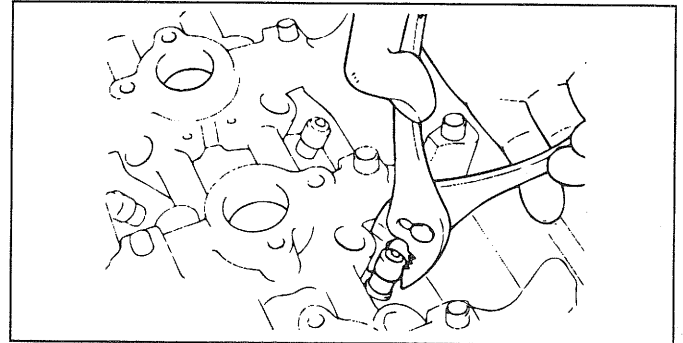


ECHA910B

3. Remove the valve stem seals with pliers.

NOTE

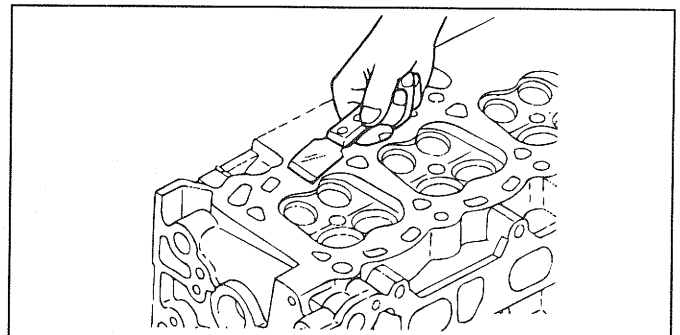
Do not reuse the valve stem seals.



ECA9270C

INSPECTION ECHA9200**CYLINDER HEAD**

1. Check the cylinder head for crack, damage and coolant leakage. If cracked, replace the cylinder head.
2. Remove scale, sealing compound and carbon deposit completely. After cleaning oil passages, apply compressed air to make certain that the passages are not clogged.



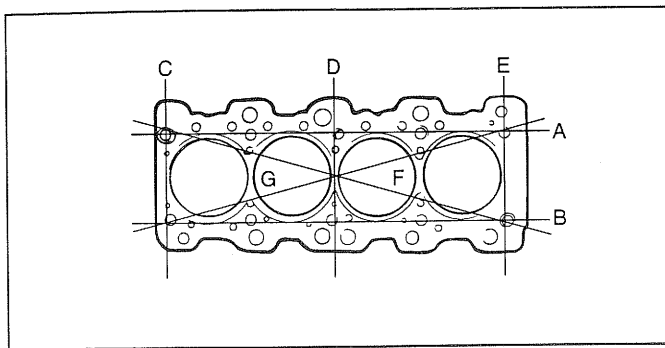
ECA9280A

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

Flatness of cylinder head gasket surface

Standard : Less than 0.03mm(0.0012 in.)

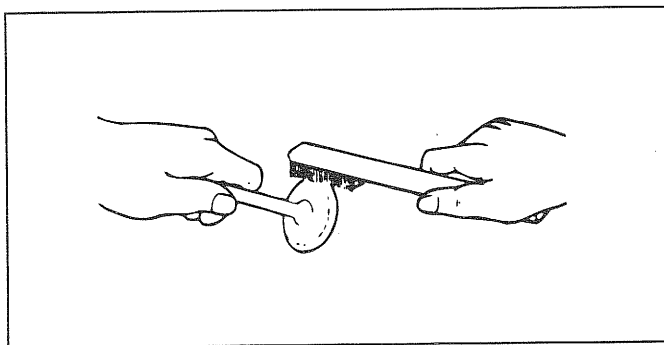
Limit : 0.2 mm (0.008 in.)



ECA920A

VALVES

1. Using a wire brush, clean the valve thoroughly.



ECA9281A

2. Check each valve for wear, damage and distortion of head and stem at B Position. Repair or correct, 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]

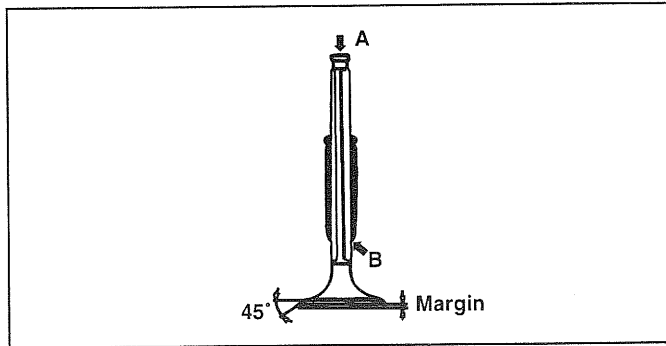
Intake : 1.0mm(0.040 in.)

Exhaust : 1.5mm(0.059 in.)

[Limit]

Intake : 0.7mm(0.028 in.)

Exhaust : 1.0mm(0.040 in.)



ECA9281B

VALVE SPRINGS

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

Valve spring

[Standard]

Free height : 45.82mm(1.804 in.)

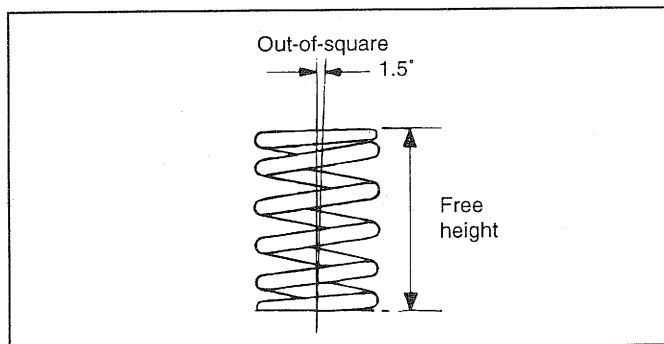
Load : 25.3kg/40mm (55.8 lb/1.57 in.)

Out of square : 1.5° or less

[Limit]

Free height : 44.82mm(1.7646in.)

Out of square : 4°



ECA9281C

VALVE GUIDES

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-guide clearance

[Standard]

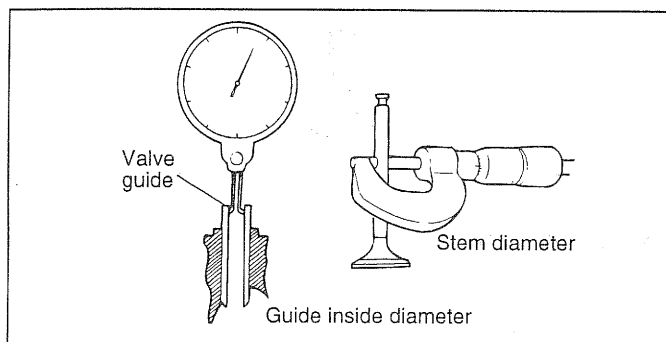
Intake : 0.020-0.047mm(0.0008-0.0020 in.)

Exhaust : 0.050-0.085mm(0.0020-0.0033 in.)

[Limit]

Intake : 0.1mm(0.0040 in.)

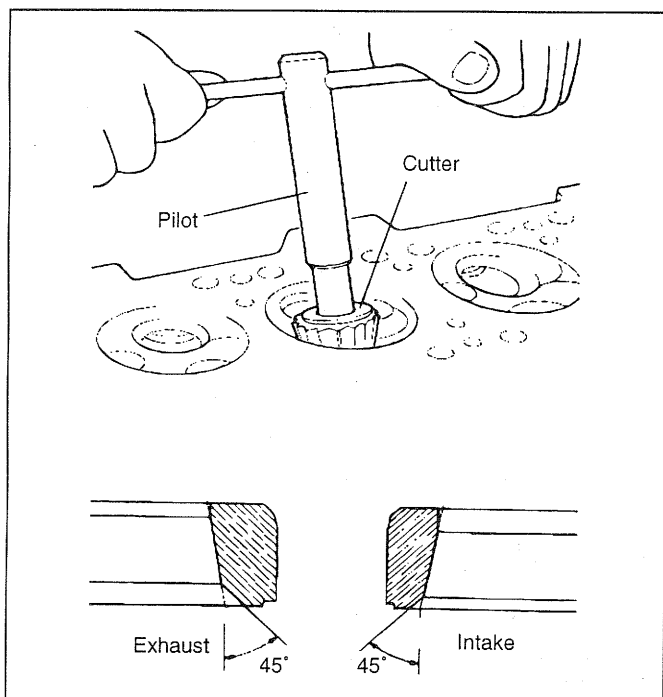
Exhaust : 0.15mm(0.0059 in.)



ECA9281D

RECONDITIONING VALVE SEAT

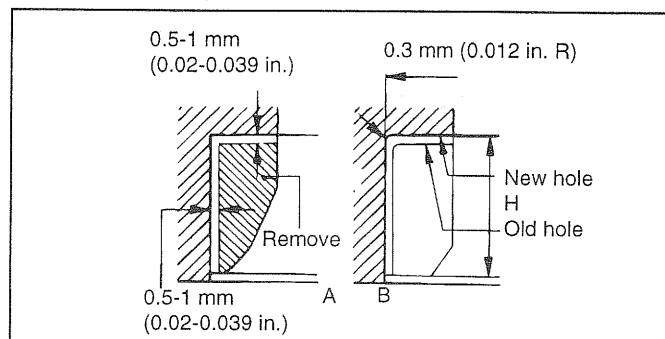
Check the valve seat for overheating and improper contact with the valve face. Recondition or replace the seat if necessary. Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace it and then recondition the seat. Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within specifications and centered on the valve face. After reconditioning, the valve and valve seat should be lapped lightly with a lapping compound.



ECHA920B

REPLACING VALVE SEAT RING

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



ECA9281F

2. Adjust diameter of the valve seat on the cylinder head side so that it can match the diameter of the oversize 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 at normal temperature.
4. Using the lapping compound, lap the valve.

Valve seat contact width :

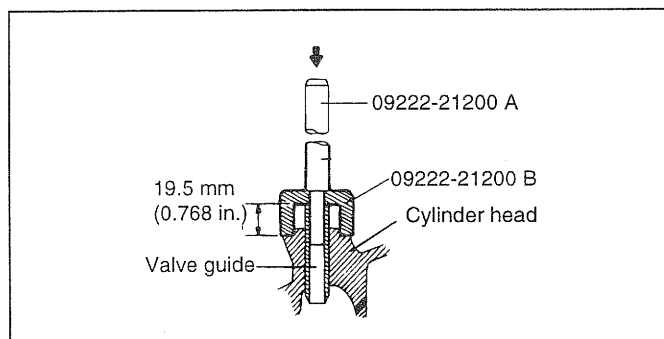
0.9 -1.3 mm (0.035-0.051 in.)

VALVE SEAT INSERT OVERSIZES

Description	Size mm (in.)	Size mark	Seat ring height H mm(in.)	Oversize hole diameter I.D. mm(in.)
Intake valve	0.3 (0.012) O.S.	30	7.9-8.1 (0.311-0.319)	35.300-35.325 (1.3898-1.3907)
Seat ring	0.6 (0.024) O.S.	60	8.2-8.4 (0.323-0.331)	35.600-35.625 (1.4016-1.4026)
Exhaust valve	0.3 (0.012) O.S.	30	7.9-8.1 (0.311-0.319)	33.300-33.325 (1.3110-1.3120)
Seat ring	0.6 (0.024) O.S	60	8.2-8.4 (0.323-0.331)	33.600-33.625 (1.3228-1.3238)

REPLACING VALVE GUIDE

- Using the special tool (09222-21200A), press down the old valve guide toward the bottom of cylinder head.
- Recondition the valve guide hole so that it can match the newly press-fitted oversize valve guide..

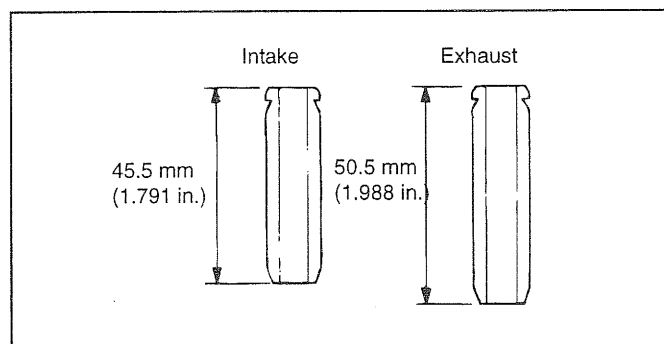


ECA9281G

- Using the special tool (09222-21200 A, B), press-fit the valve guide. The valve guide must be press-fitted from the upper side of the cylinder head. Keep in mind that the valve guides are different in length.

NOTE

Do not install a valve guide of the same size again.



ECA9281H

- After the valve guide is replaced, check that the valve is seated in contact with them and recondition the valve seats as necessary.

VALVE GUIDE OVERSIZES

Size mm (in.)	Size mark	Oversize valve guide hole size mm (in.)
0.05(0.002) O.S.	5	12.050-12.068 (0.4744-0.4751)
0.25 (0.010) O.S.	25	12.250-12.268 (0.4823-0.4830)
0.50 (0.020) O.S.	50	12.500-12.518 (0.4921-0.4928)

REASSEMBLY

ECHA9300

NOTE

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

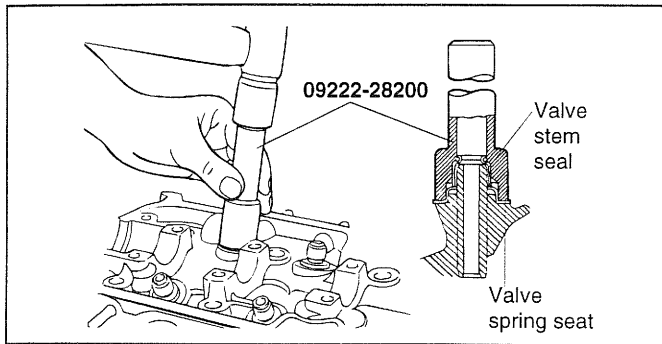
- Install the spring seats.

Using a special tool (09222-28200), tap the seal in position lightly.

NOTE

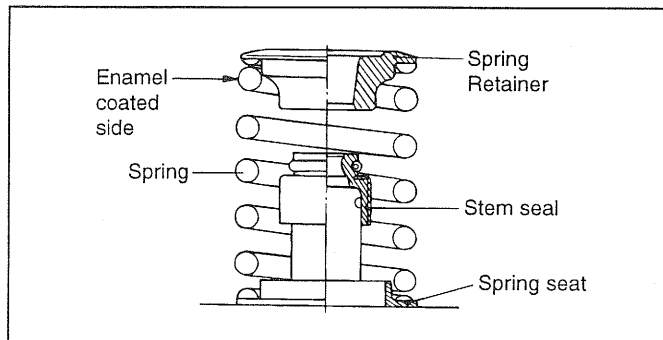
- Do not reuse old valve stem seals.
 - Incorrect installation of the seal could result in oil leakage of the valve guides.
- Apply engine oil to each valve. Insert the valves into the valve guides. Avoid pushing the valve into the seal by force. After inserting the valve, check that it moves smoothly.

- After the valve guide is press-fitted, insert a new valve and check for proper the clearance.



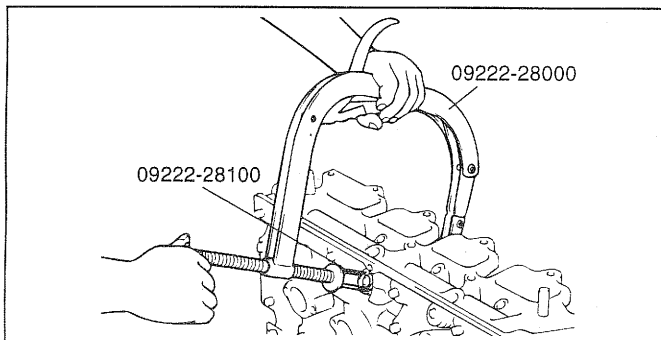
ECHA930A

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



ECHA9290B

4. Using the special tool (09222-28000, 09222-28100), push 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.



ECHA910B

NOTE

When the spring is compressed, Check that the valve stem sea 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.

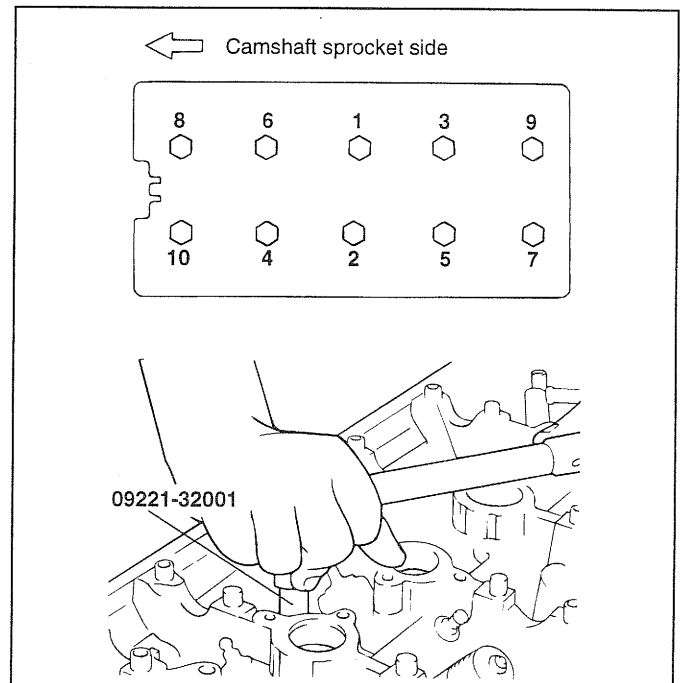
7. Install the gasket so that the surface with the identification mark may face toward the cylinder head.

NOTE

Check and measure the length of bolt.

Maximum length : 99.4 mm (3.9 in.)

8. Tighten the bolts to the specified torque.



ECHA910A

Tightening torque

Without replacement (head bolt, head gasket, cylinder head, cylinder block) :

20Nm (200 kg.cm, 14 lb.ft)+90°+90°

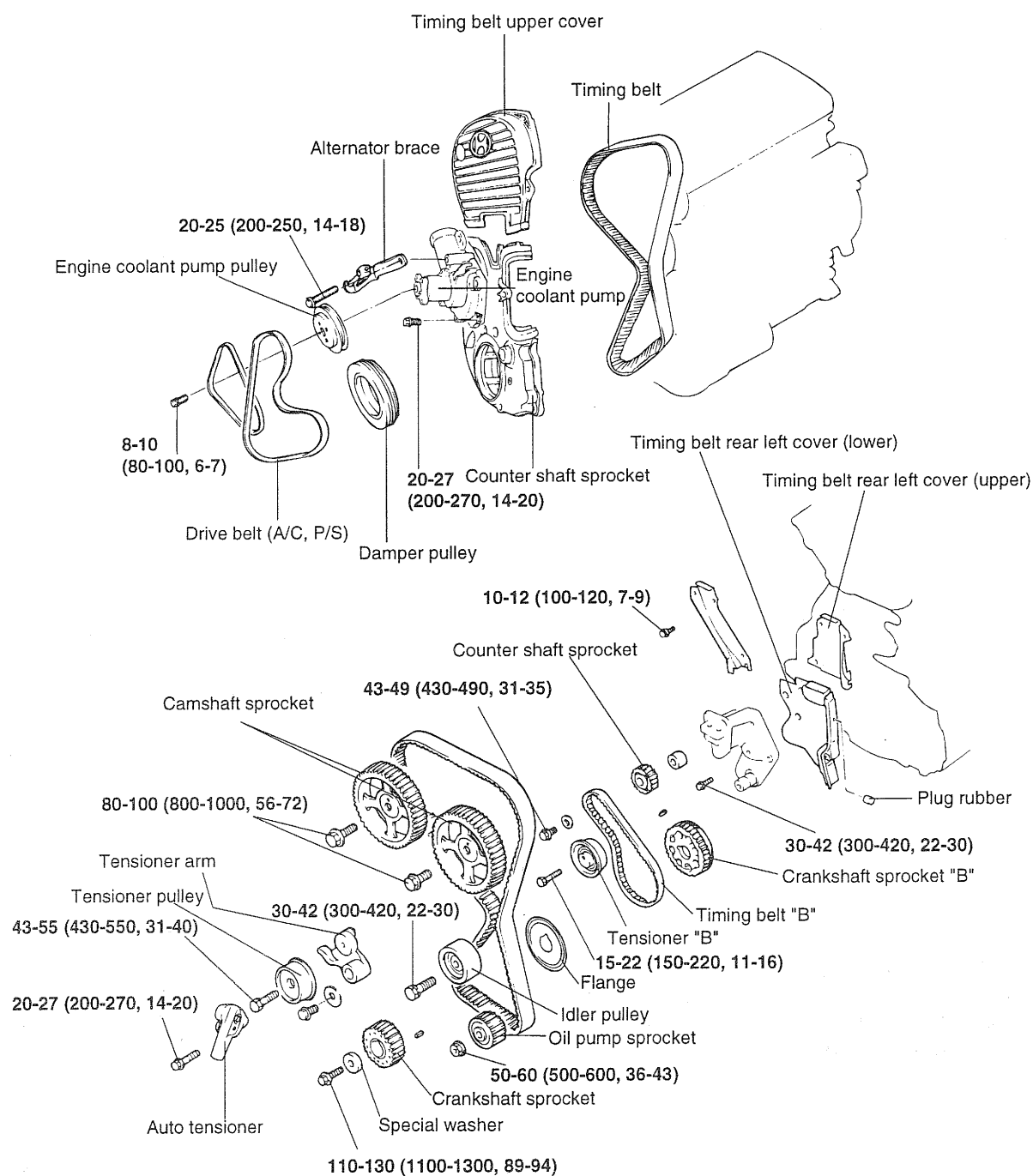
With replacement (even if one thing is replaced) :

64Nm (640 kg.cm, 46 lb.ft)+release+20Nm (200 kg.cm, 14 lb.ft)+90°+90°

TIMING SYSTEM

TIMMING BELT

TIMING BELT ECHA9500



TORQUE : Nm (kg-cm, lb-ft)

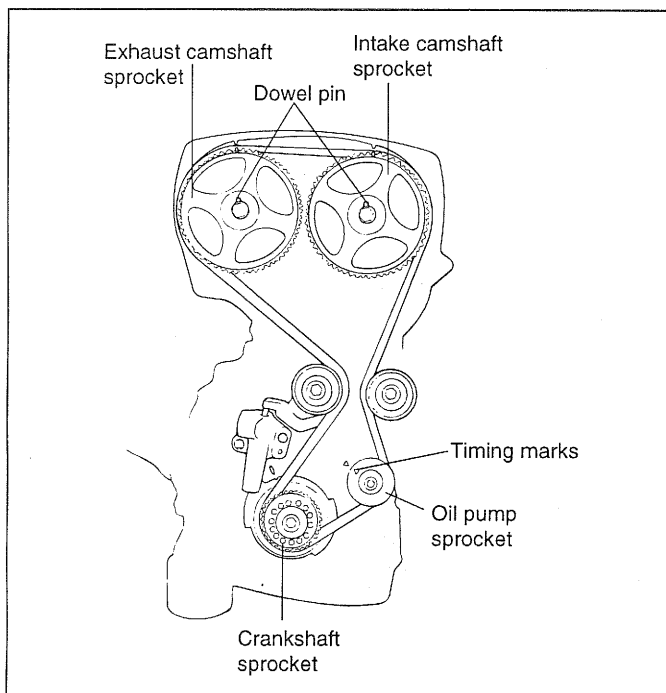
REMOVAL ECHA9600

1. Remove the crankshaft pulley, engine coolant pump pulley and drive belt.
2. Remove the timing belt cover.
3. Remove the auto tensioner.

CAUTION

Rotate the crankshaft clockwise and align the timing marks to set the No. 1 cylinder's piston to TDC.

At this time, the timing marks of the camshaft sprocket and cylinder head cover should coincide with each other and the dowel pin of the camshaft sprocket should be at the upper side.

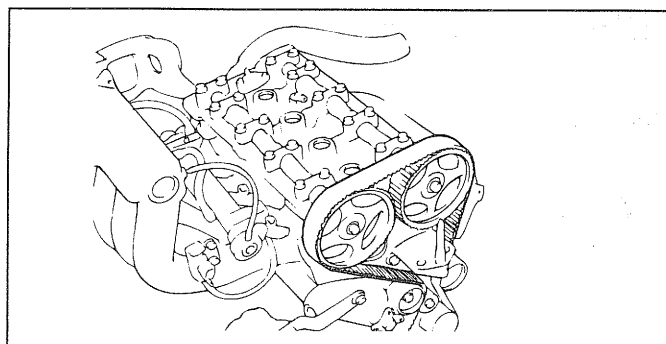


ECA9023A

4. Remove the timing belt.

NOTE

If the timing belt is reused, make an arrow mark indicating the turning direction (or the front of the engine) to make sure that the belt is reinstalled in the same direction as before.

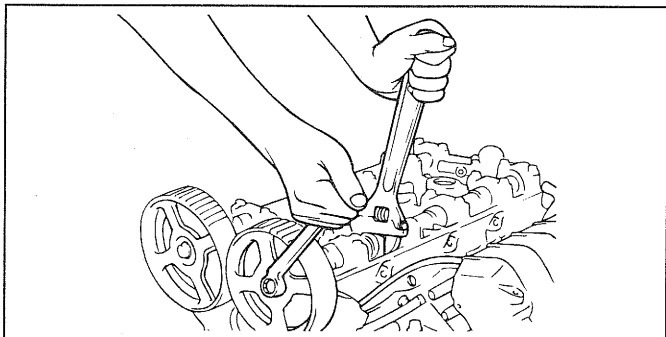


ECA9024A

5. Remove the camshaft sprockets.

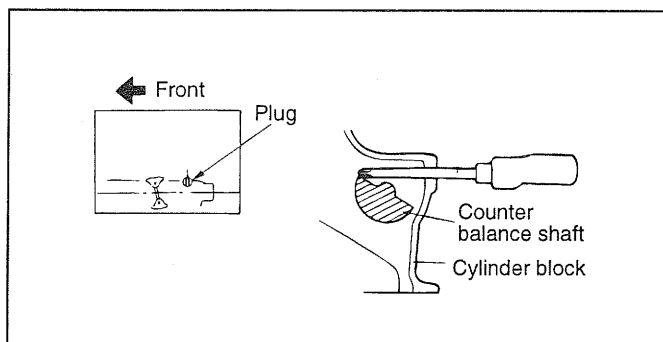
NOTE

Be careful not to damage the cylinder head and camshaft sprocket with a wrench.



ECA9170C

6. When the oil pump sprocket nut is removed, first remove the plug at the left side of the cylinder block and insert a screwdriver to keep the left counter balance shaft in position. Use a screwdriver with a shaft measuring 8 mm (0.3in.) in diameter which can be inserted being more than 60 mm (2.36 in.)
7. Remove the oil pump sprocket retaining nut and the oil pump sprocket.



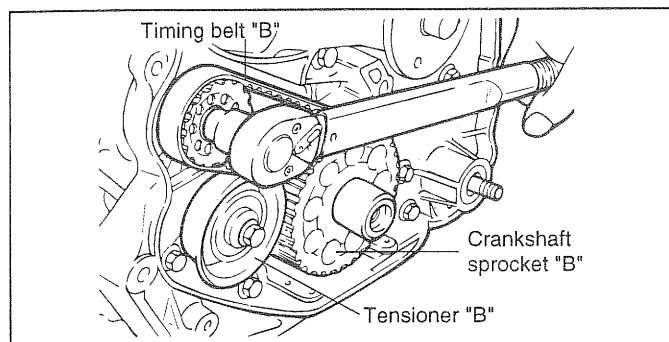
ECA9170D

8. Loosen the right counter balance shaft sprocket mounting bolt until it can be loosened by hand.
9. Next, remove the tensioner "B" and then the timing belt "B."

CAUTION

After the timing belt "B" is removed, do not attempt to loosen bolts while holding the sprocket with pliers, etc.

10. Remove the crankshaft sprocket "B" from the crankshaft.



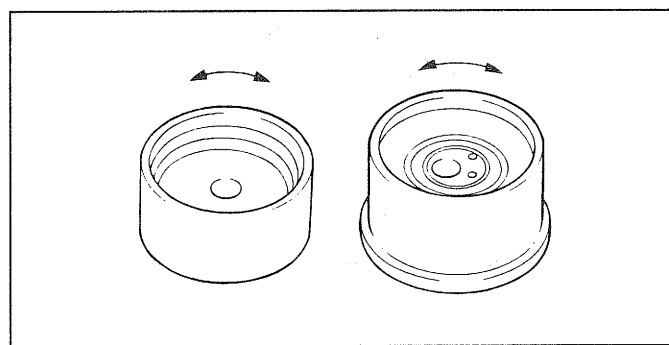
ECA9025A

INSPECTION

ECHA9700

SPROCKETS, TENSIONER PULLEY AND IDLER PULLEY

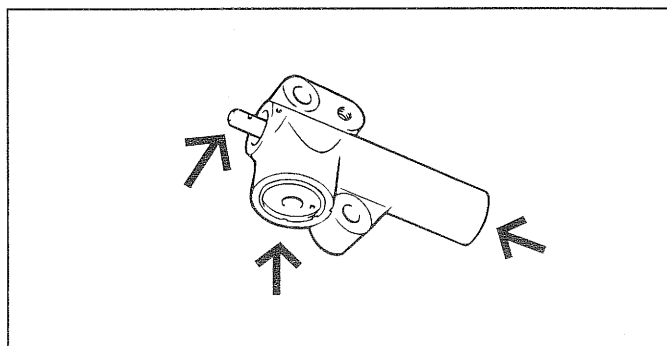
1. Check the camshaft sprocket, crankshaft sprocket, tensioner pulley and idler pulley for abnormal wear, cracks or damage. Replace if necessary.
2. Inspect the tensioner pulley and the idler pulley for easy and smooth rotation and check for play or noise. Replace if necessary.
3. Replace if there is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



EOY025A

AUTO TENSIONER

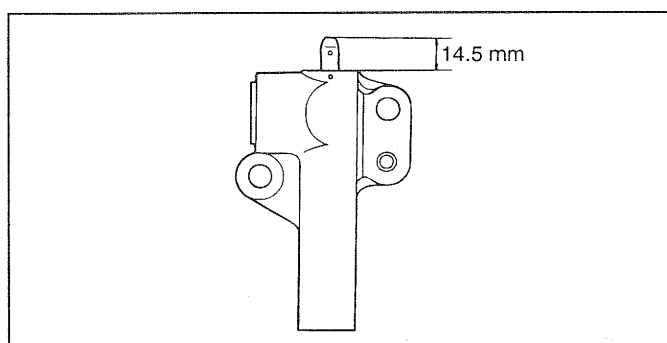
1. Check the auto tensioner for leak and replace if necessary.
2. Check the rod end for wear or damage and replace if necessary.



ECA9026A

3. Measure the rod protrusion. If it is out of specification, replace the auto tensioner.

Standard value : 14.5 mm (0.39-0.43 in)

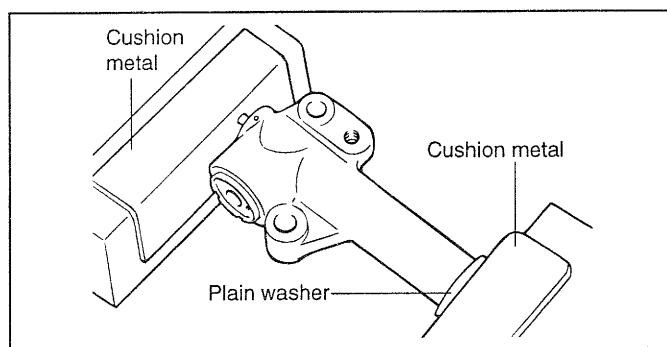


ECHA970A

4. Using a vise soft jaw, push the auto tensioner rod. If the rod can be easily retracted, replace the auto tensioner. You should feel a lot of resistance when pushing the rod in.

NOTE

Clamp the auto tensioner in the vise so that it can be level. Use soft jaws in the vise to avoid damaging the auto tensioner.

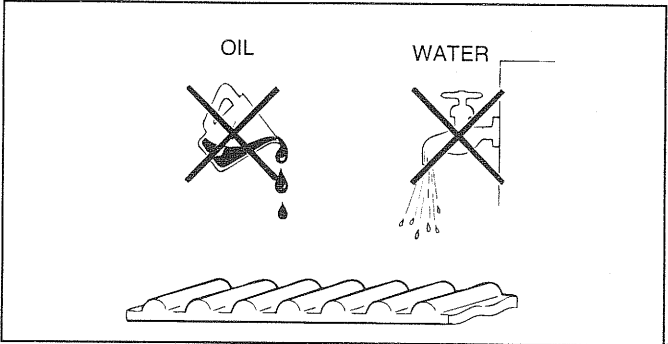


ECA9028A

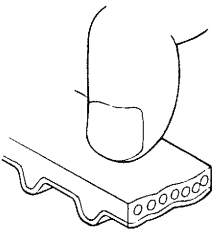
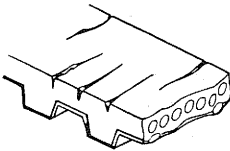
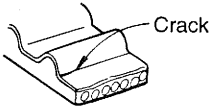
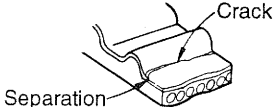
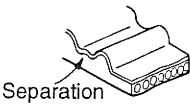
TIMING BELT

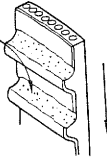
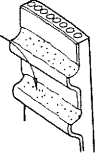
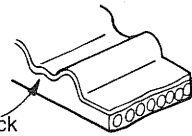
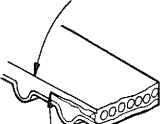
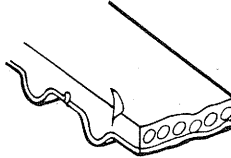
1. Check the belt for oil or dust deposit. Replace if necessary. Small deposit should be wiped away with a dry cloth or paper. Do not clean with solvent.

2. When the engine is overhauled or belt tension is adjusted, check the belt in detail. If any of the following flaws are evident, replace the belt with a new one.



ECA9200A

Description	Flaw conditions
1. Hardened back surface of rubber	Back surface is glossy. Non-elastic and so hard that, when your fingernail is pressed into it, no mark is produced.  ECA9200B
2. Cracked back surface of rubber	 ECA9200Y
3. Cracked or separating canvas	 Crack ECA9200I  Crack Separation ECA9200J  Separation ECA9200K
4. Badly worn teeth (initial stage)	Tooth flank worn of canvas on load side (Fluffy canvas fibers, rubber changed into white color and unclear canvas texture)

Description	Flaw conditions
5. Badly worn teeth (last stage)	Flank worn (On load side)  ECA9200C Tooth flank worn and rubber exposed of canvas on load side (tooth width reduced)
6. Cracked tooth bottom	Rubber exposed  ECA9200D
7. Missing tooth	Crack  ECA9200E
8. Badly worn side of belt	Tooth missing and canvas fiber exposed  ECA9200F
9. Cracked side of belt	Rounded belt side  Abnormal wear (Fluffy canvas fiber) ECA9200G
9. Cracked side of belt	 ECA9200H

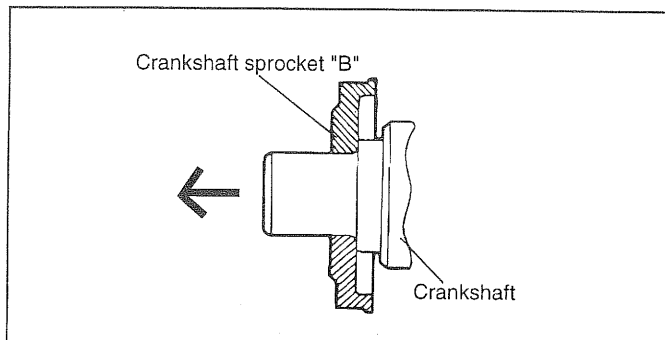
INSTALLATION

ECHA9800

1. Install the crankshaft sprocket "B" into the crankshaft.

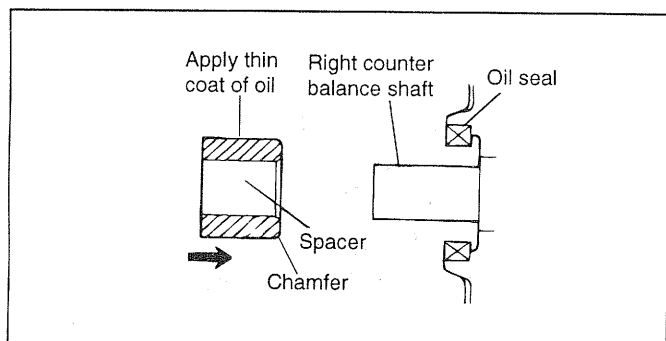
CAUTION

Pay attention to the direction of the flange. If it is installed in the wrong direction, a broken belt could result from it.



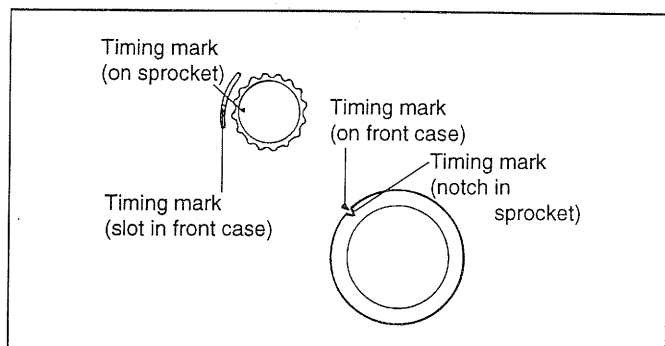
ECA9210A

2. Apply engine oil to the outer surface of spacer lightly and then install the spacer to the right counter balance shaft. Be sure to install as the direction shown in illustration.
3. Install the counter balance shaft sprocket onto the right counterbalance shaft and then tighten a flange bolt by hand tightly.



ECA9210B

4. Align the timing mark on each sprocket with the corresponding timing mark on the front case.

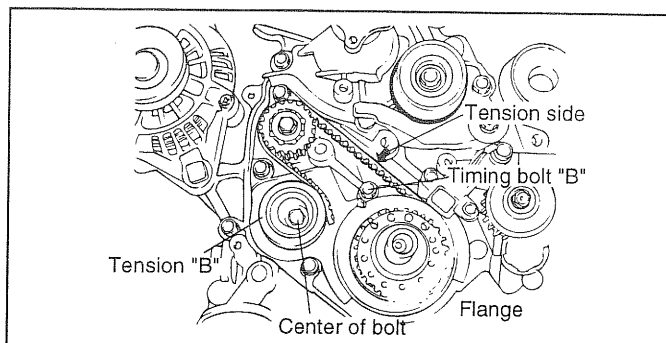


ECA9210C

5. When the timing belt "B" is installed, make certain that tension side has no slack.

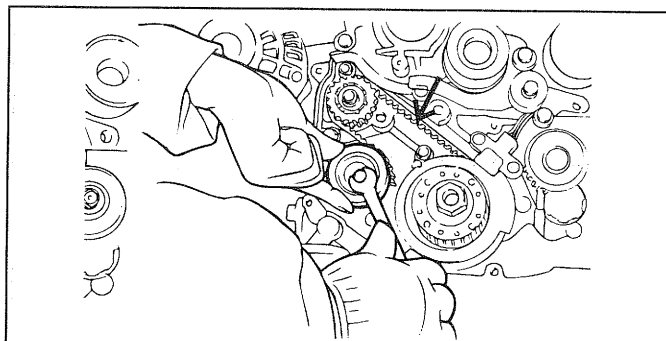
Install the tensioner "B" in the center of pulley located on the left side of mounting bolt and in the pulley flange directed toward front of engine.

Align the timing mark on the right counter balance shaft sprocket with the timing mark on the front case.



ECA9084A

6. Lift the tensioner "B" to tighten the timing belt "B" so that its tension side will be pulled tight. In this condition, tighten a bolt to secure tensioner "B". When a bolt is tightened, be careful to prevent shaft from turning together. If the shaft is turned together, the belt will be tightened excessively.



ECA9083A

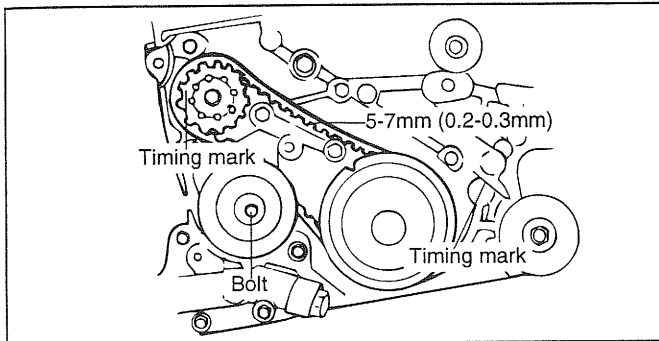
7. Check to ensure that timing marks are in alignment.
8. Check the tension of the timing belt.

Method 1 : Check to ensure that when the center of span on the tension side is depressed with an index finger in direction of arrow, deflection of belt is within specification.

Belt deflection : 5-7 mm (0.20-0.28 in)

Method 2 : Measure the tension of the timing belt by using the frequency instrument.

Span length	Pressure	Torque
139mm (5.47 in.)	0.42 kg/cm ² (42 kPa)	50-100Nm (500-1000kg.cm, 36-72 lb.ft)

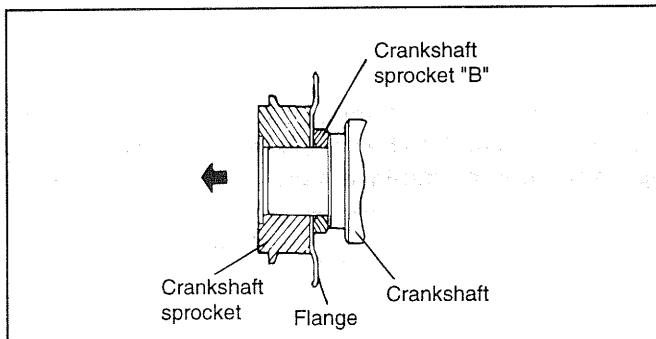


ECA9210F

9. Install the flange and crankshaft sprocket onto the crankshaft. Be sure to install as the direction shown in illustration.

CAUTION

Pay attention to direction of flange. If it is installed in wrong direction, a broken belt could result from it.



ECA9210G

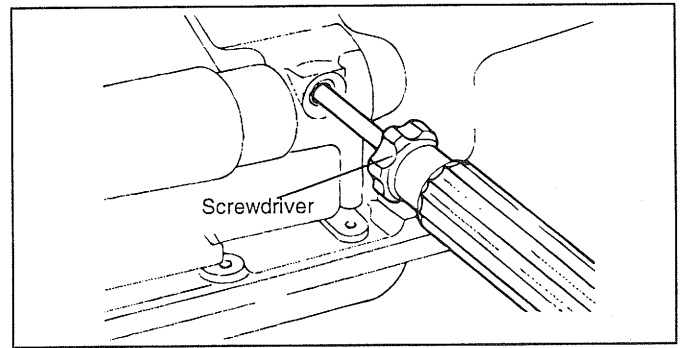
10. Install the special washer and sprocket bolt to the crankshaft and then tighten the sprocket bolt.

Tightening torque

Crankshaft sprocket bolt :

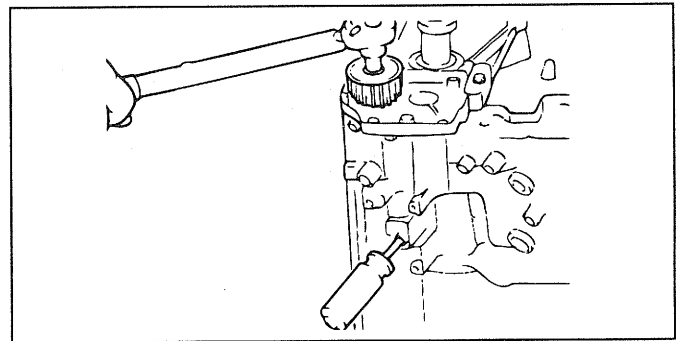
110-130 Nm (1100-1300 kg.cm, 80-94 lb.ft)

11. Insert a screwdriver through the plug hole in left side of cylinder block to keep the shaft in position.



ECA9210H

12. Install the oil pump sprocket and tighten the nut to the specified torque.



ECA9210I

Tightening torque

Oil pump sprocket :

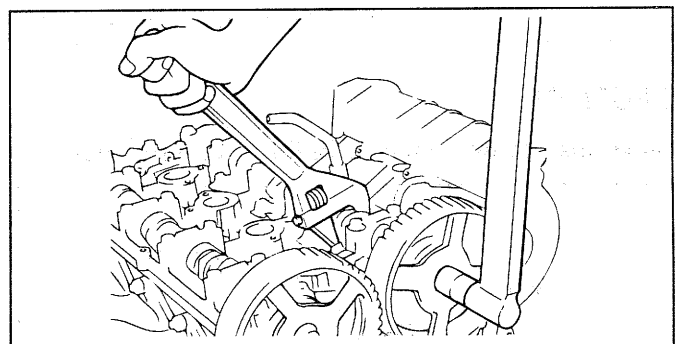
50-60 Nm (500-600 kg.cm, 36-43 lb.ft)

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

Tightening torque

Camshaft sprocket bolt :

80-100 Nm (800-1000 kg.cm, 58-72 lb.ft)

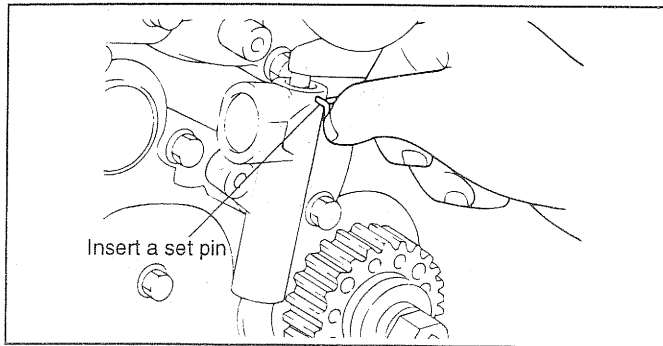


ECA9210K

14. Install the auto tensioner.

CAUTION

Leave the set pin installed in the auto tensioner.

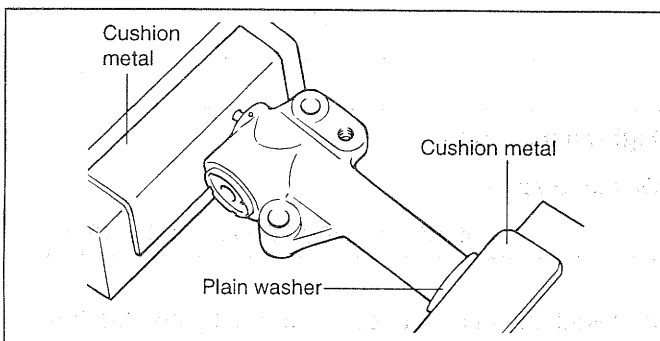


ECHA980A

NOTE

If the auto tensioner rod is in its fully extended position, reset it as follows.

1. Clamp it in a vise equipped with soft jaws in a level position. Apply a plain washer if there is a plug at the bottom of the auto tensioner.
2. Push the rod slowly with the vise until the set hole in the rod is aligned with set hole in the cylinder.



ECA9028A

15. Install the tensioner pulley onto the tensioner arm.

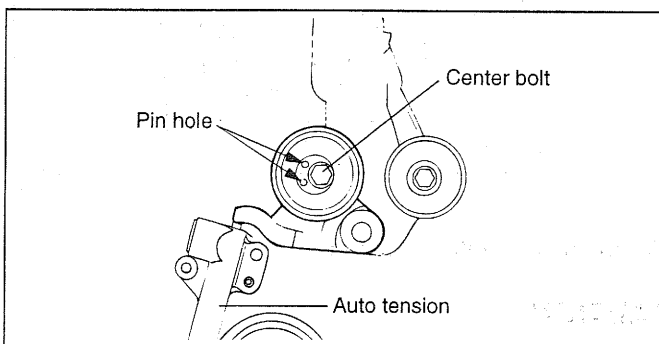
Tightening torque

Tensioner pulley

43-55 N.m (430-550 kg.cm, 31-40 lb.ft)

CAUTION

Leave the set pin installed in the auto tensioner.

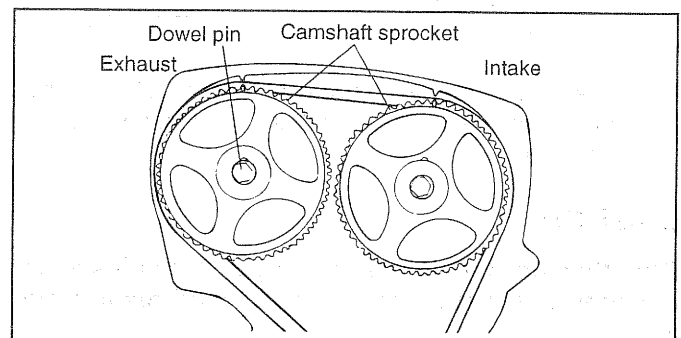


ECA9210N

16. Rotate the camshaft sprockets so that the dowel pin of camshaft sprocket may be at the upper side, set the timing mark of sprocket correctly.

NOTE

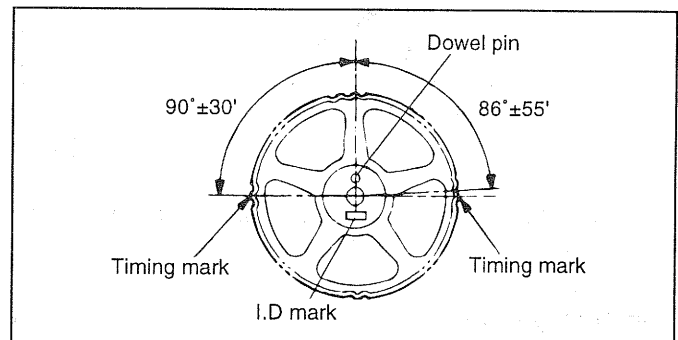
1. Before installing the timing belt, if the timing mark of camsprocket doesn't coincide with that of rocker cover, do not rotate the cam sprocket more than 2 teeth of sprocket in any direction. Rotating sprocket more than 2 teeth might make valve and piston be touched each other.
2. In case of rotating the cam sprocket unavoidably more than 2 teeth, rotate the cam sprocket after rotating 2 teeth in the side of crank sprocket counterclockwise on basis of timing mark.



ECA9029A

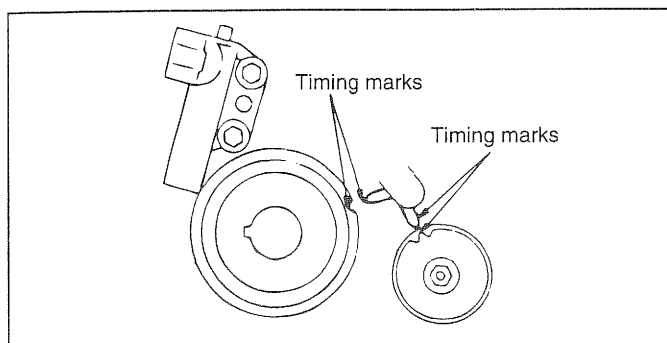
NOTE

Same thing as exhaust and intake camshaft sprocket is used and install it after checking I.D mark depending on the engine displacement.



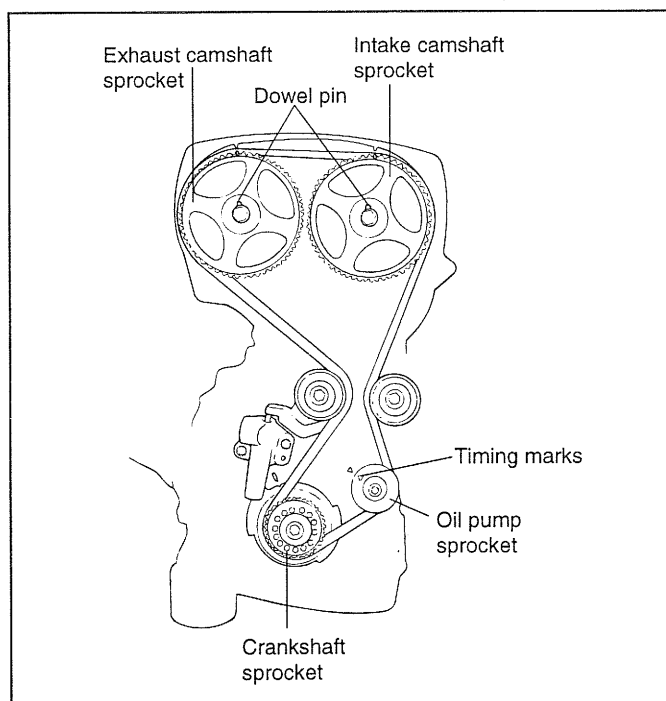
ECHA007C

17. Align the crankshaft sprocket timing marks.
18. Align the oil pump sprocket timing marks.



ECHA007D

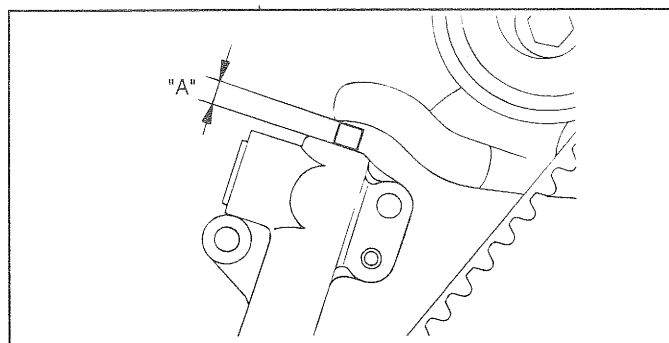
19. Install the timing belt around the tensioner pulley and crankshaft sprocket. Then secure the timing belt onto the tensioner pulley with your left hand.
20. Pulling the belt with your right hand, install it around the oil pump sprocket.
21. Install the belt around the idler pulley.
22. Install the belt around the intake camshaft sprocket.
23. Turn the exhaust camshaft sprocket one tooth clockwise to align its timing mark with the cylinder head top surface [see illustration in step 16]. Then, pulling the belt with both hands, it around the exhaust camshaft sprocket.
24. Gently raise the tensioner pulley so that the belt can't sag and tighten the center bolt temporarily.
25. Check again whether the timing mark of each sprocket is correct or not.



ECA9023A

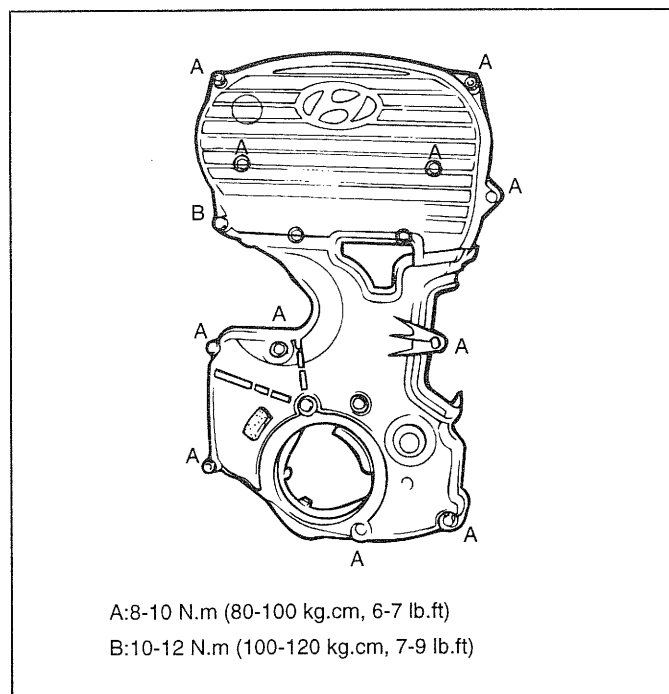
26. Remove the set pin that is attached to auto tensioner.
27. Rotate the crankshaft two revolutions turns clockwise and leave it for about 15 minutes. Then, measure the auto tensioner protrusion "A" (Distance between the tensioner arm and auto tensioner body) to ensure that it is within the specification.

Standard value : 6-9 mm (0.24-0.35 in)



ECA9210R

28. Install the timing belt lower cover and the timing belt upper cover.



ECHA980B

