SECTION EM
ENGINE MECHANICAL

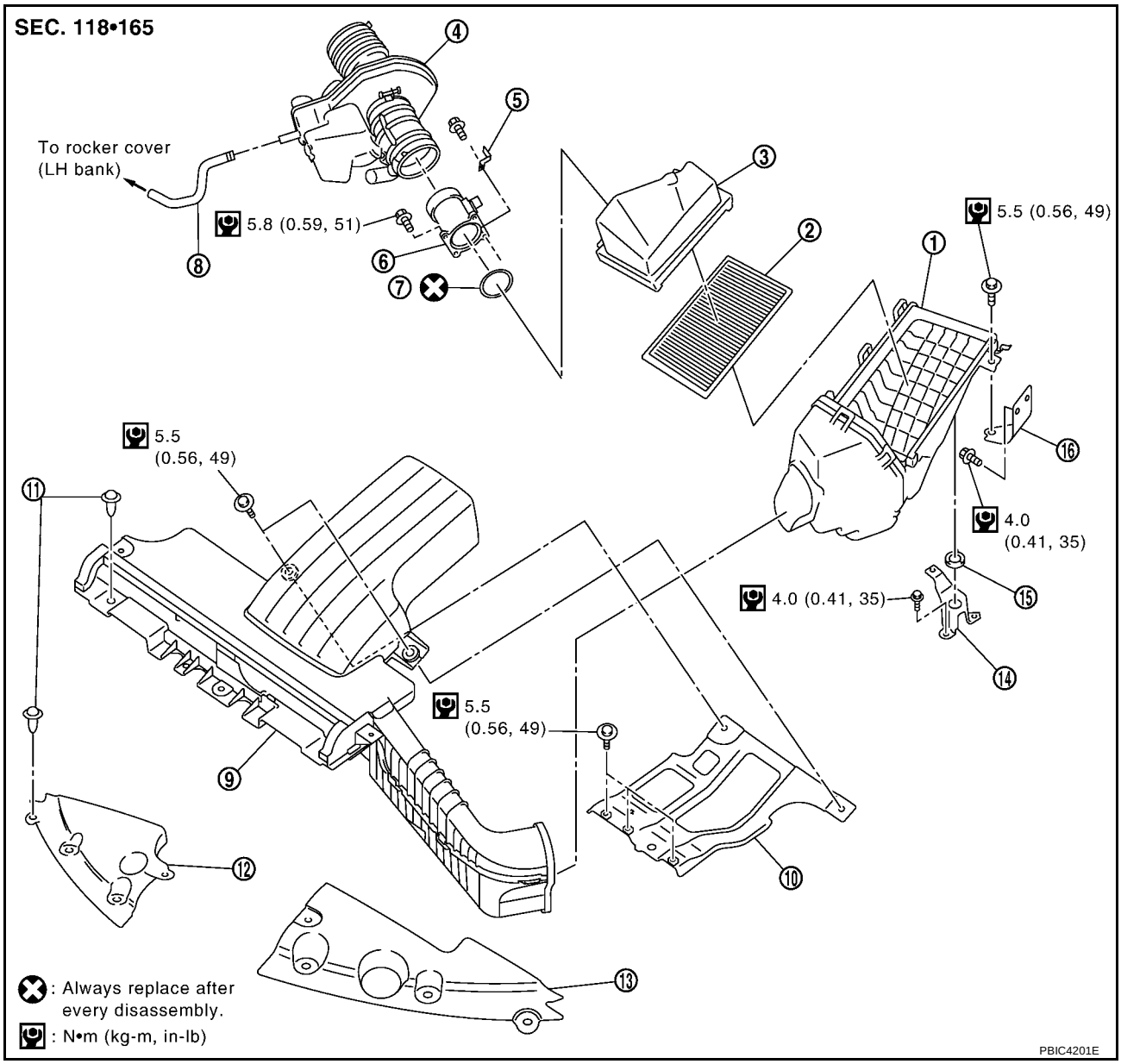
CONTENTS

AIR CLEANER AND AIR DUCT

PFP:16500

Components

ABS008IM



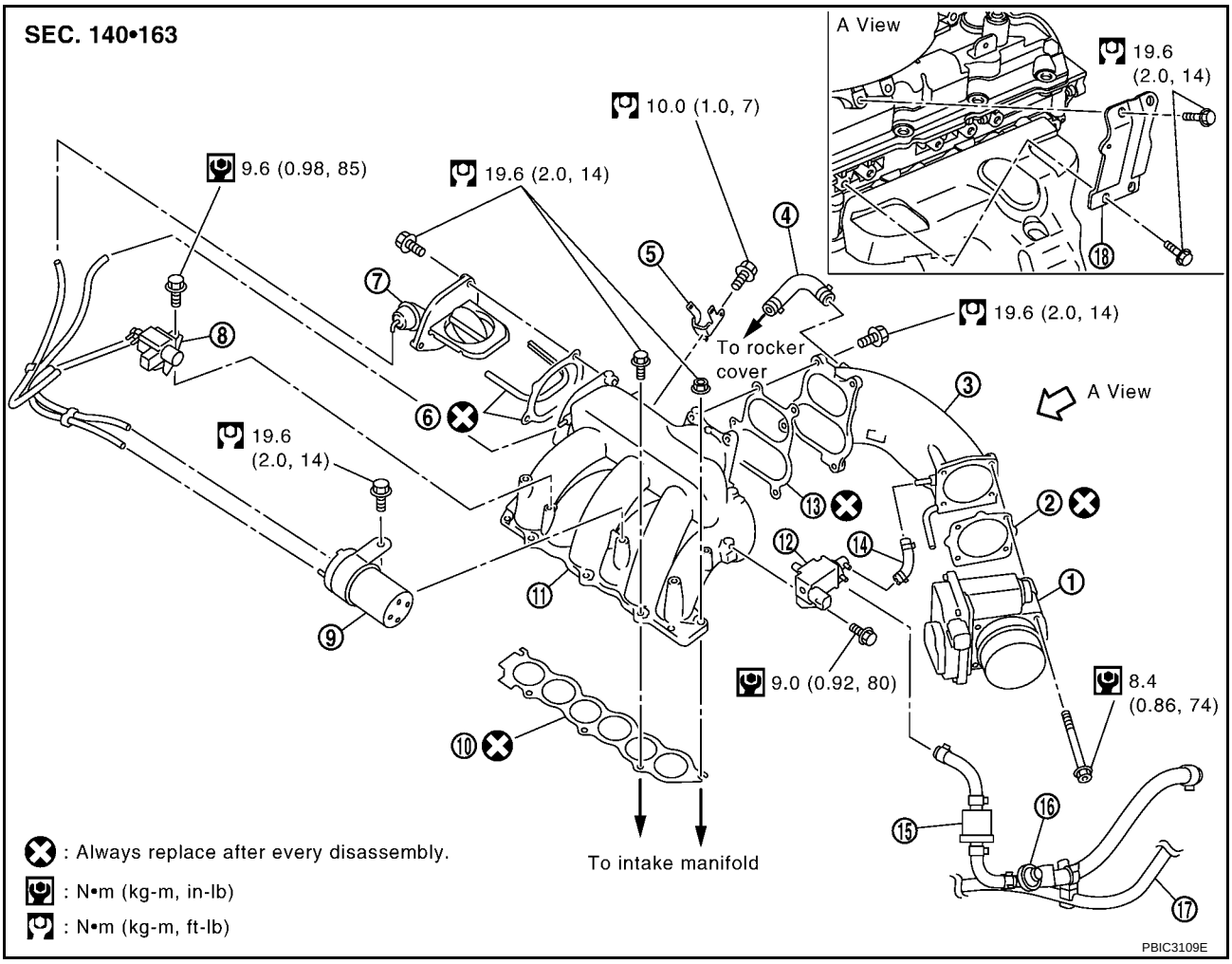
1. Air cleaner case (lower)
2. Air cleaner filter
3. Air cleaner case (upper)
4. Air duct assembly
5. Harness bracket
6. Mass air flow sensor
7. O-ring
8. PCV hose
9. Air duct (inlet)
10. Bracket
11. Clip
12. Radiator cover grill (right side)
13. Radiator cover grill (left side)
14. Bracket
15. Grommet
16. Bracket

INTAKE MANIFOLD COLLECTOR

PFP:14003

Components

ABS008IN



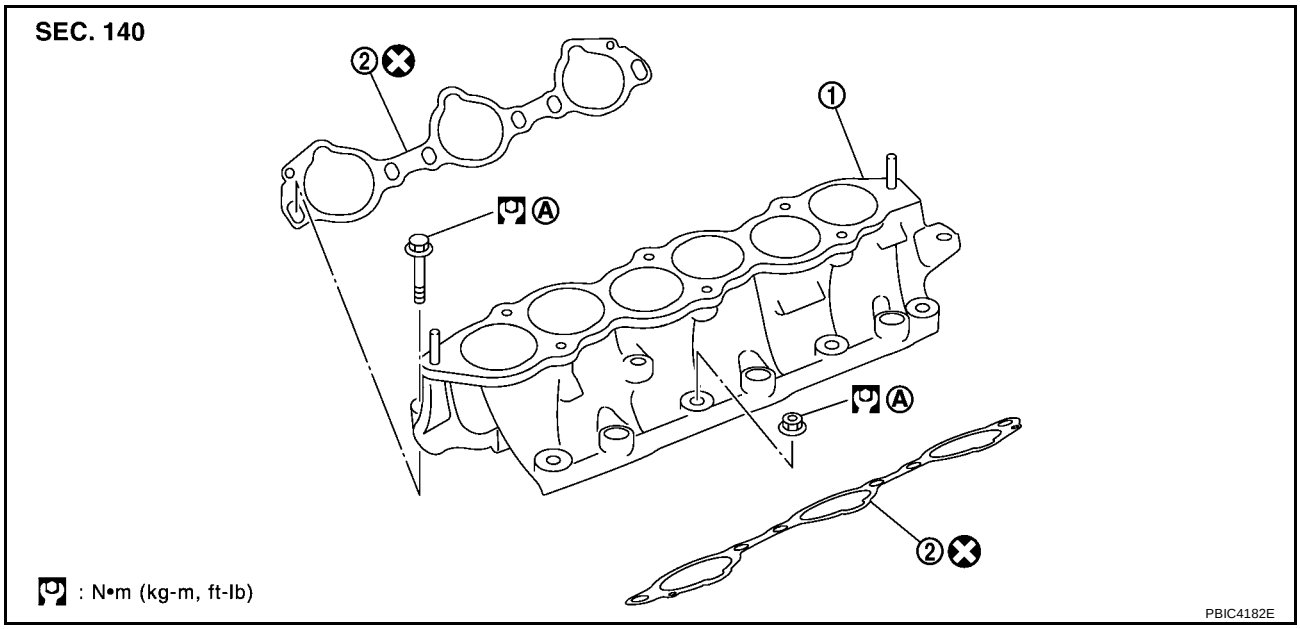
1. Electric throttle control actuator	2. Gasket	3. Intake manifold collector (upper)
4. PCV hose	5. Harness bracket	6. Gasket
7. Power valve	8. VIAS control solenoid valve	9. Vacuum tank
10. Gasket	11. Intake manifold collector (lower)	12. EVAP canister purge volume control solenoid valve
13. Gasket	14. EVAP hose	15. Purge resonator
16. Service port	17. Fuel hose	18. Intake manifold collector support

INTAKE MANIFOLD

PFP:14003

Components

ABS008IO



1. Intake manifold
2. Gasket

A. Refer to EM-40

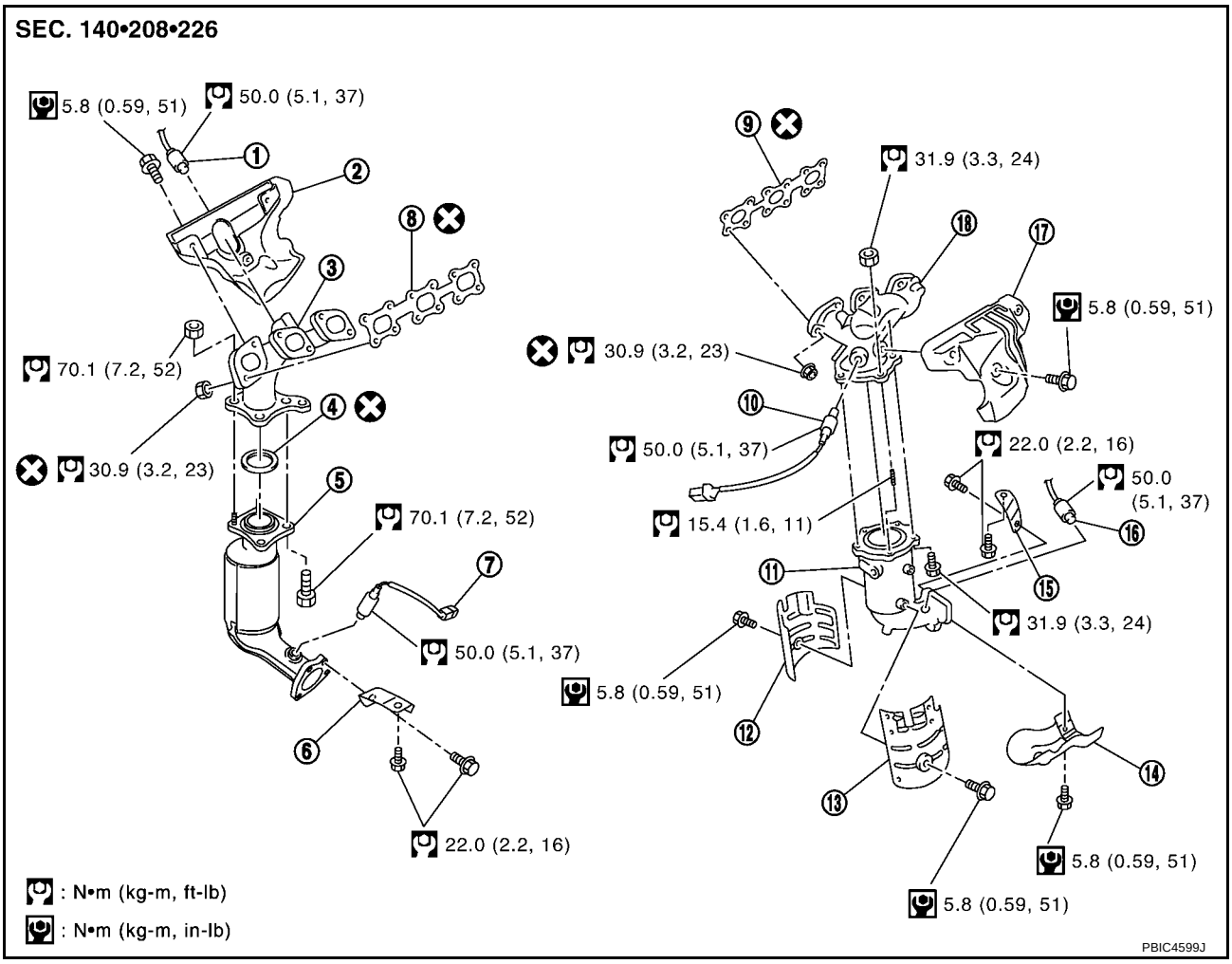
- Refer to GI-8, "Components" for symbol marks in the figure.

EXHAUST MANIFOLD AND THREE WAY CATALYST

PFP:14004

Components

ABS008IP



1. Air fuel ratio sensor 1 (bank 1)	2. Exhaust manifold cover (right bank)	3. Exhaust manifold (right bank)
4. Ring gasket	5. Three way catalyst (right bank)	6. Three way catalyst support (right bank)
7. Heated oxygen sensor 2 (bank 1)	8. Gasket	9. Gasket
10. Air fuel ratio sensor 1 (bank 2)	11. Three way catalyst (left bank)	12. Three way catalyst cover
13. Three way catalyst cover	14. Three way catalyst cover	15. Three way catalyst support (left bank)
16. Heated oxygen sensor 2 (bank 2)	17. Exhaust manifold cover (left bank)	18. Exhaust manifold (left bank)

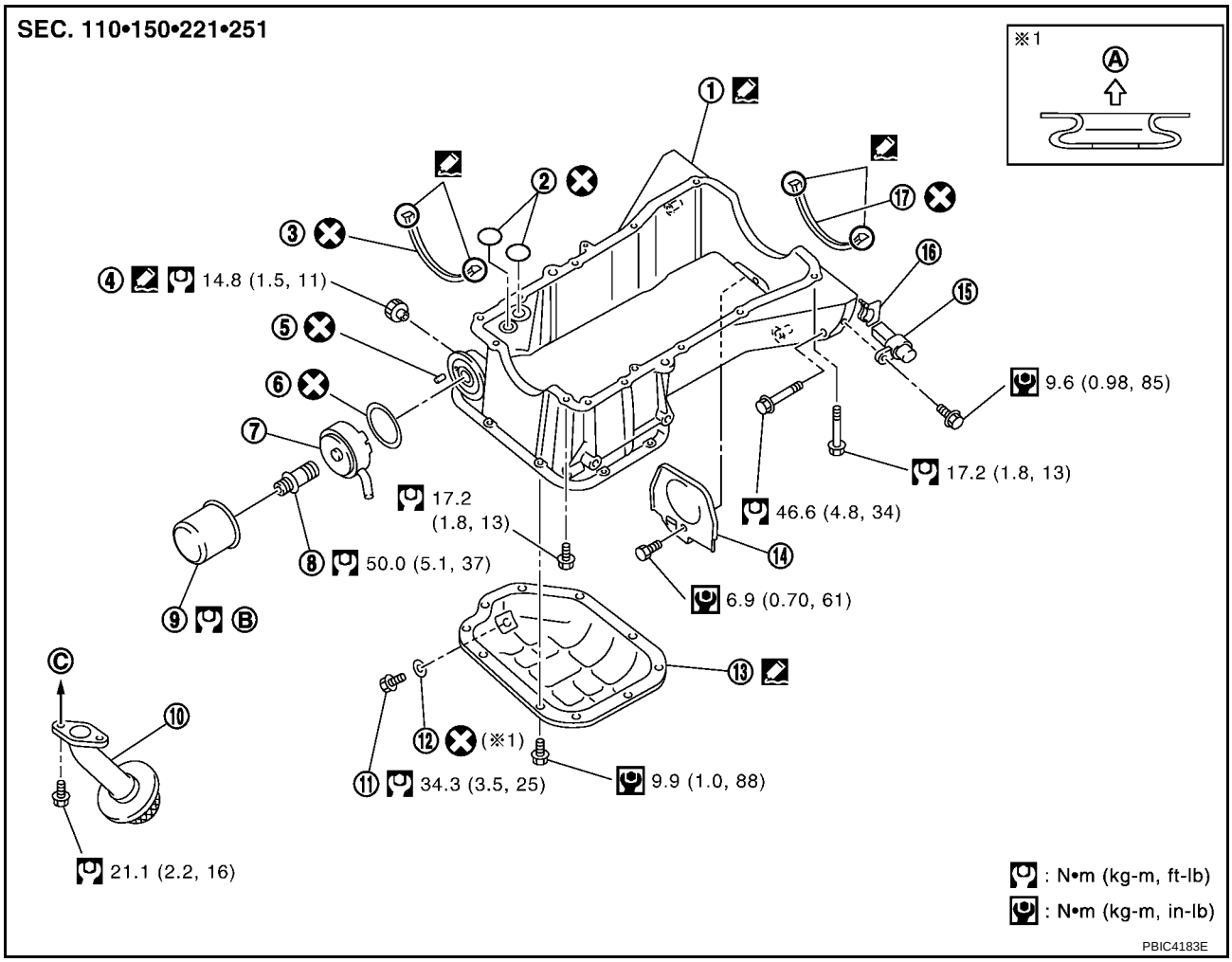
- Refer to GI-8, "Components" for symbol marks in the figure.

OIL PAN AND OIL STRAINER

PFP:11110

Components

ABS008IQ



1.	Oil pan (upper)	2.	O-ring	3.	Oil pan gasket (front)
4.	Oil pressure switch	5.	Relief valve	6.	O-ring
7.	Oil cooler	8.	Connector bolt	9.	Oil filter
10.	Oil strainer	11.	Drain plug	12.	Drain plug washer
13.	Oil pan (lower)	14.	Rear plate cover	15.	Crankshaft position sensor (POS)
16.	Seal rubber	17.	Oil pan gasket (rear)		
A.	Oil pan side	B.	Refer to LU-6	C.	To oil pump

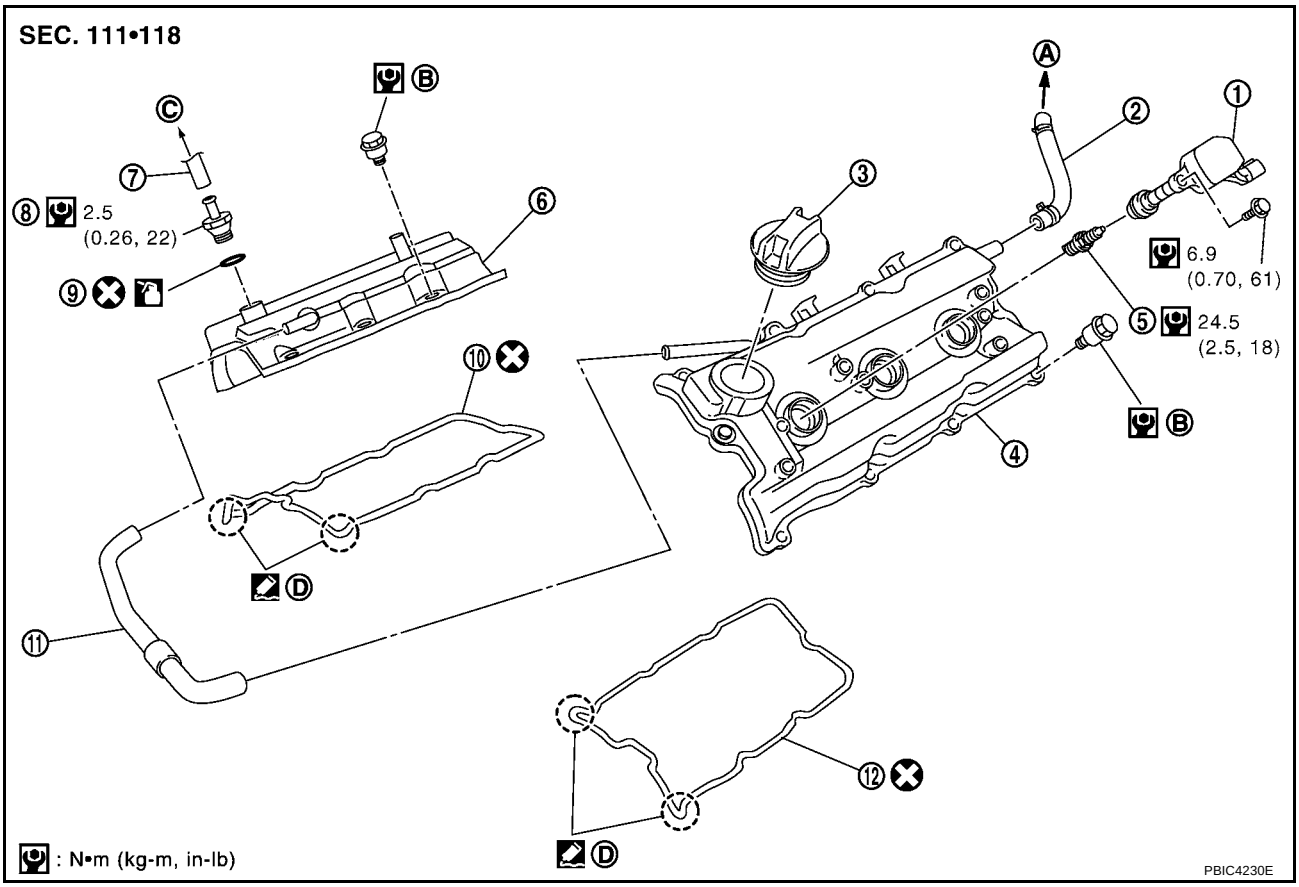
- Refer to GI-8, "Components" for symbol marks in the figure.

IGNITION COIL, SPARK PLUG AND ROCKER COVER

PFP:22448

Components

ABS008IU



1. Ignition coil	2. PCV hose	3. Oil filler cap
4. Rocker cover (left bank)	5. Spark plug	6. Rocker cover (right bank)
7. PCV hose	8. PCV valve	9. O-ring
10. Rocker cover gasket (right bank)	11. PCV hose	12. Rocker cover gasket (left bank)
A. To air duct assembly	B. Refer to EM-40	C. To intake manifold collector (upper)
D. Camshaft bracket side		

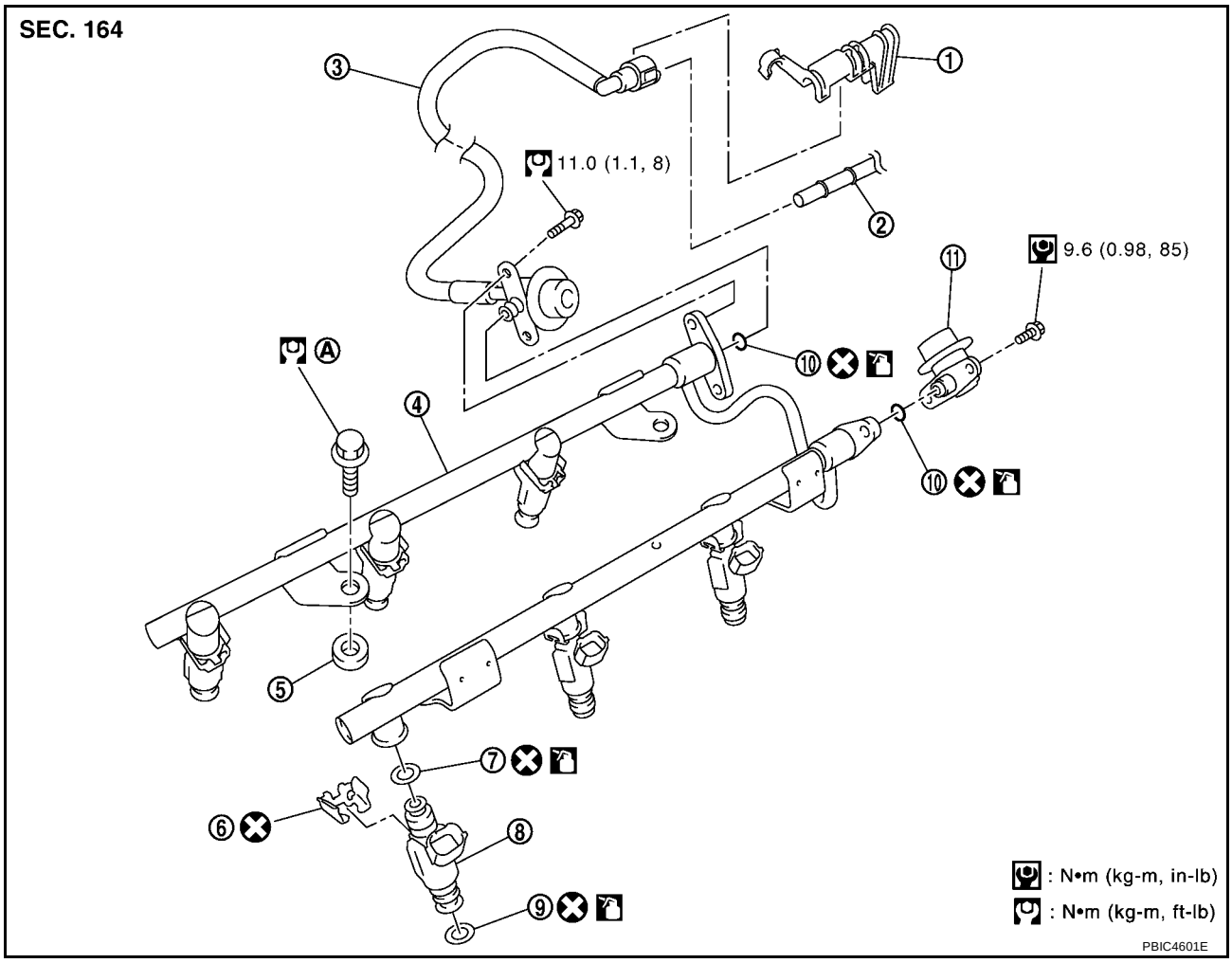
- Refer to GI-8, "Components" for symbol marks in the figure.

FUEL INJECTOR AND FUEL TUBE

PFP:16600

Components

ABS008IT



1. Quick connector cap
2. Centralized under-floor piping
3. Fuel feed hose (with damper)
4. Fuel tube
5. Spacer
6. Clip
7. O-ring (blue)
8. Fuel injector
9. O-ring (brown)
10. O-ring
11. Fuel damper
A. Refer to EM-40

CAUTION:

Do not remove or disassemble parts unless instructed as shown in the figure.

- Refer to GI-8, "Components" for symbol marks in the figure.

FRONT TIMING CHAIN CASE

PFP:13599

Removal and Installation

ABS00H3C

NOTE:

- This section describes removal/installation procedure of front timing chain case and timing chain related parts without removing oil pan (upper) on vehicle.
- When upper oil pan needs to be removed or installed, or when rear timing chain case is removed or installed, remove oil pans (lower and upper) first. Then remove front timing chain case, timing chain related parts, and rear timing chain case in this order, and install in reverse order of removal. Refer to EM-19, "TIMING CHAIN" .
- Refer to EM-19, "TIMING CHAIN" for component parts location.

REMOVAL

1. Remove engine cover. Refer to EM-3, "INTAKE MANIFOLD COLLECTOR" .
2. Remove air duct (inlet), air cleaner case (upper) with mass air flow sensor and air duct assembly. Refer to EM-2, "AIR CLEANER AND AIR DUCT" .
3. Remove undercover and splash guard (RH).
4. Remove right side front road wheel and tire.
5. Drain engine oil.

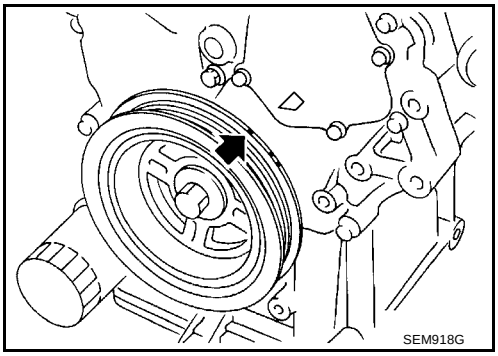
   CAUTION:
   - **Perform this step when the engine is cold.**
   - **Do not spill engine oil on drive belts.**
6. Drain engine coolant from radiator.

   CAUTION:
   - **Perform this step when the engine is cold.**
   - **Do not spill engine coolant on drive belts.**
7. Remove intake manifold collectors (upper and lower). Refer to EM-3, "INTAKE MANIFOLD COLLECTOR" .
8. Remove drive belts.
9. Remove alternator. Refer to SC-19, "Removal and Installation" .
10. Remove power steering oil pump from bracket with piping connected, and temporarily secure it to aside. Refer to PS-8, "POWER STEERING OIL PUMP" .
11. Remove power steering oil pump bracket. Refer to PS-8, "POWER STEERING OIL PUMP" .
12. Remove idler pulley and bracket. Refer to EM-19, "TIMING CHAIN" .
13. Separate engine harnesses removing their brackets from front timing chain case.
14. Remove rocker covers (right and left banks). Refer to EM-7, "IGNITION COIL, SPARK PLUG AND ROCKER COVER" .

    NOTE:
    When only timing chain (primary) is removed, rocker cover does not need to be removed.
15. Obtain No. 1 cylinder at TDC of its compression stroke as follows:

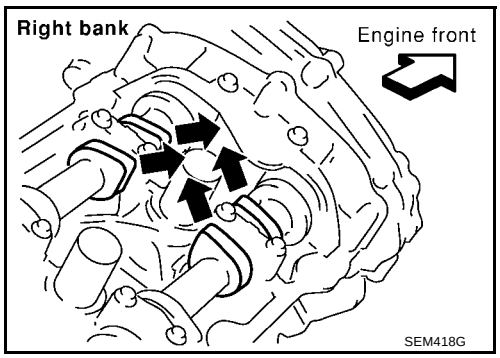
    NOTE:
    When timing chain is not removed/installed, this step is not required.

a. Rotate crankshaft pulley clockwise to align timing mark (grooved line without color) with timing indicator.



b. Make sure that intake and exhaust cam noses on No. 1 cylinder (engine front side of right bank) are located as shown in the figure.
   - If not, turn crankshaft one revolution (360 degrees) and align as shown in the figure.

   NOTE:
   When only timing chain (primary) is removed, rocker cover does not need to be removed. To make sure that No. 1 cylinder is at its compression TDC, remove front timing chain case first. Then check mating marks on camshaft sprockets. Refer to “TIMING CHAIN” in NISSAN VQ engine SERVICE MANUAL.

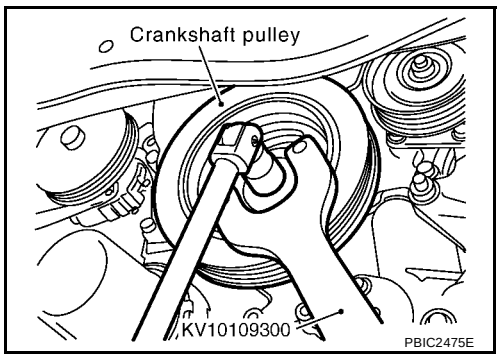


16. Remove crankshaft pulley as follows:

a. Fix crankshaft with the pulley holder [SST].

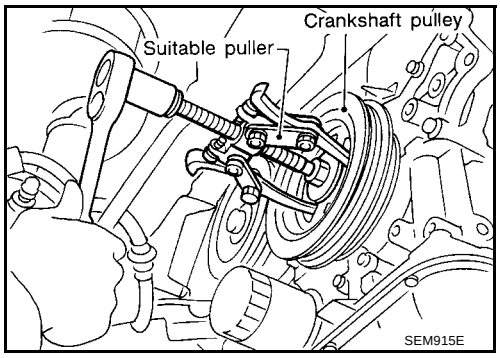
b. Loosen crankshaft pulley bolt and locate bolt seating surface at 10 mm (0.39 in) from its original position.

   CAUTION:
   Do not remove crankshaft pulley bolt as it will be used as a supporting point for suitable puller.



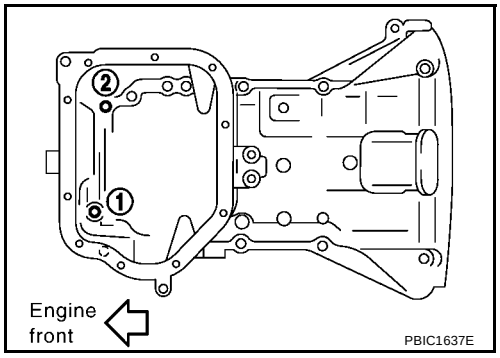
c. Place suitable puller tab on holes of crankshaft pulley, and pull crankshaft pulley through.

   CAUTION:
   Do not put suitable puller tab on crankshaft pulley periphery, as this will damage internal damper.



17. Remove oil pan (lower). Refer to EM-6, "OIL PAN AND OIL STRAINER" .

18. Loosen two mounting bolts in front of oil pan (upper) in reverse order as shown in the figure.



19. Install oil pan (lower) temporarily.
   - Applying liquid gasket is unnecessary.

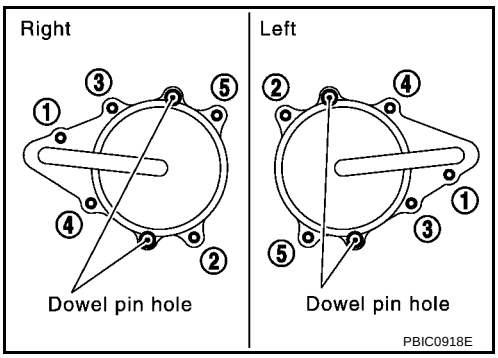
20. Support the oil pan (lower) bottom with jack.
   - Perform following operations with engine front-side supported with jack.

   CAUTION:
   Put a piece of wood or something similar as the supporting surface, be careful not to damage oil pan (lower).

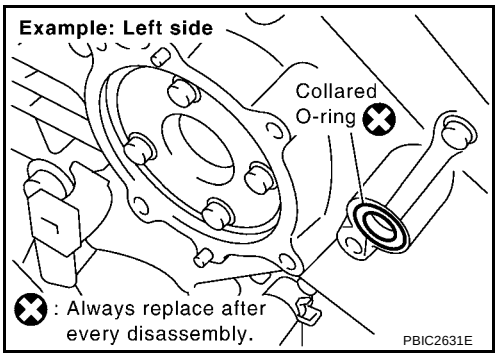
21. Remove intake valve timing control covers.

- Loosen mounting bolts in reverse order as shown in the figure.
- Use the seal cutter [SST: KV10111100] to cut liquid gasket for removal.

CAUTION:
Shaft is internally jointed with camshaft sprocket (INT) center hole. When removing, keep it horizontal until it is completely disconnected.

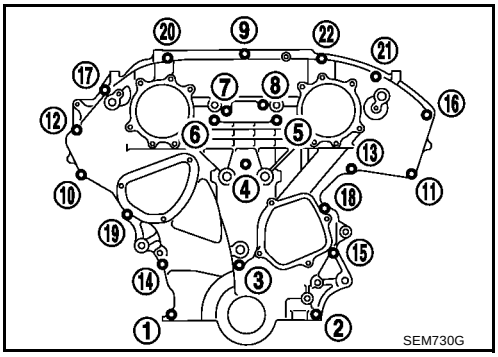


22. Remove collared O-rings from front timing chain case oil holes (left and right sides).



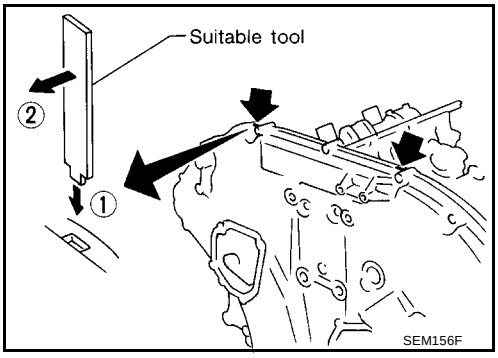
23. Remove RH engine mounting insulator and RH engine mounting bracket. Refer to EM-25, "ENGINE ASSEMBLY" .
24. Raise engine front-side with jack. (This secures workspace to remove front timing chain case.)
25. Remove front timing chain case as follows:

a. Loosen mounting bolts in reverse order as shown in the figure.



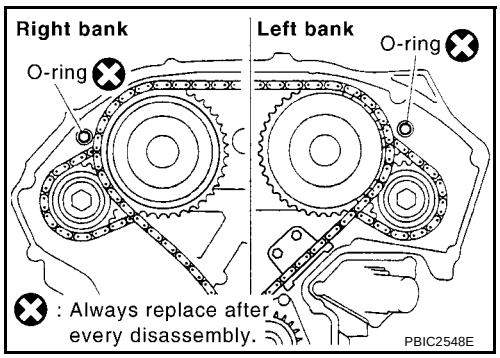
b. Insert a suitable tool into the notch at the top of front timing chain case as shown (1).
c. Pry off case by moving the tool as shown (2).
   - Use the seal cutter [SST: KV10111100] to cut liquid gasket for removal.

CAUTION:
- **Do not use a screwdriver or something similar.**
- **After removal, handle front timing chain case carefully so it does not tilt, cant, or warp under a load.**



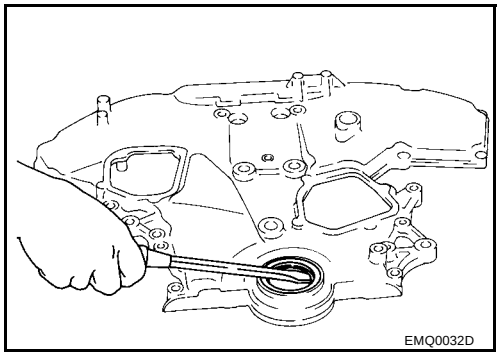
26. Remove oil pan gasket (front). Refer to EM-6, "OIL PAN AND OIL STRAINER" .

27. Remove O-rings from rear timing chain case.



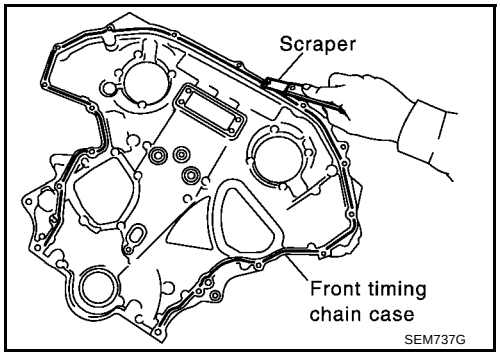
28. Remove water pump cover and chain tensioner cover from front timing chain case, if necessary.
    - Use the seal cutter [SST: KV10111100] to cut liquid gasket for removal.
29. Remove front oil seal from front timing chain case using a suitable tool.
    - Use a screwdriver for removal.

    CAUTION:
    Be careful not to damage front timing chain case.

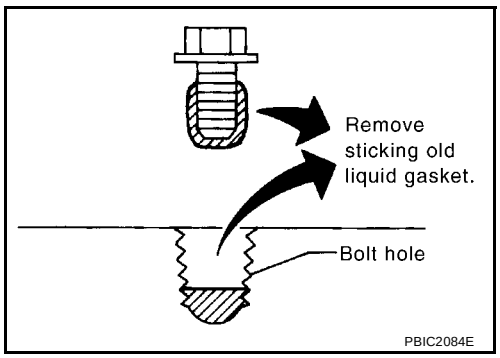


30. Remove timing chain and related parts. Refer to EM-19, "TIMING CHAIN" .
31. Use a scraper to remove all traces of old liquid gasket from front and rear timing chain cases and oil pan (upper), and liquid gasket mating surfaces.

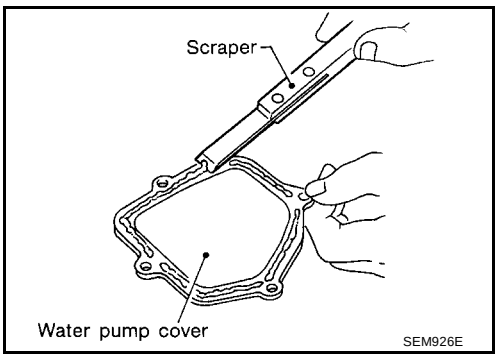
    CAUTION:
    Be careful not to allow gasket fragments to enter oil pan.



    - Remove old liquid gasket from bolt hole and thread.

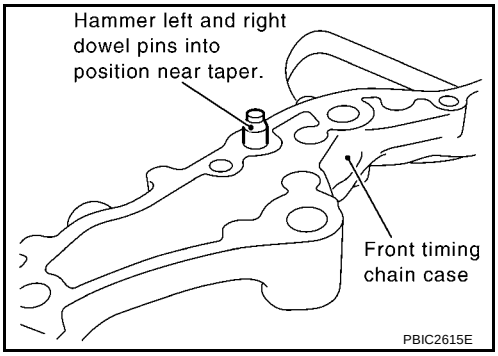


32. Use a scraper to remove all traces of liquid gasket from water pump cover, chain tensioner cover and intake valve timing control covers.

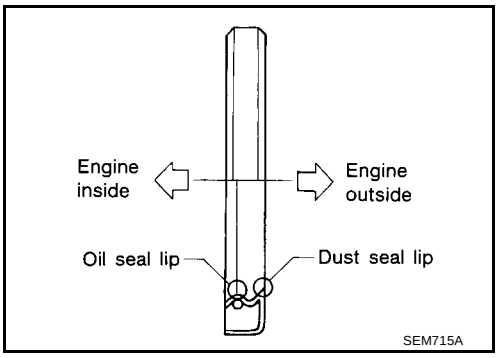


INSTALLATION

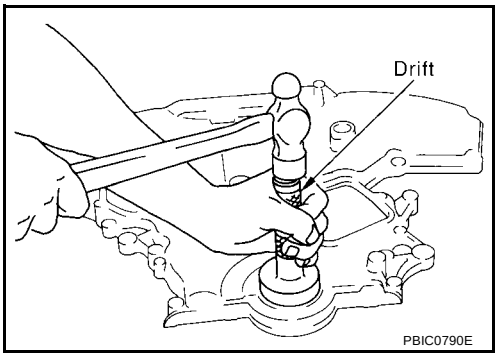
1. Install timing chain and related parts. Refer to EM-19, "TIMING CHAIN" .
2. Hammer dowel pins (right and left) into front timing chain case up to a point close to taper in order to shorten protrusion length.



3. Install new front oil seal on front timing chain case.
   - Apply new engine oil to both oil seal lip and dust seal lip.
   - Install it so that each seal lip is oriented as shown in the figure.

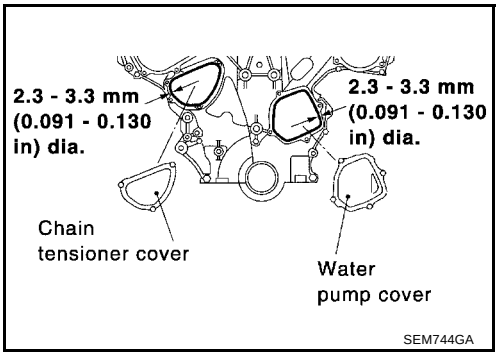


   - Using a suitable drift [outer diameter: 60 mm (2.36 in)], press-fit oil seal until it becomes flush with front timing chain case end face.
   - Make sure the garter spring is in position and seal lip is not inverted.



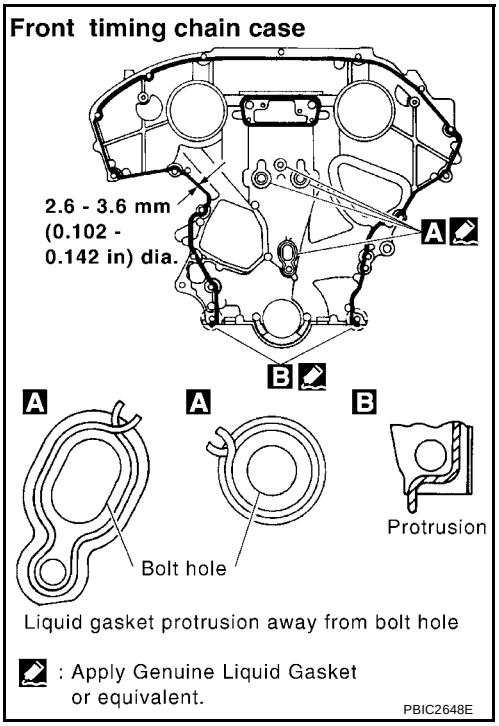
4. Install water pump cover and chain tensioner cover to front timing chain case, if removed.

- Apply a continuous bead of liquid gasket with the tube presser [SST: WS39930000] to front timing chain case as shown in the figure.
  Use Genuine Liquid Gasket or equivalent.

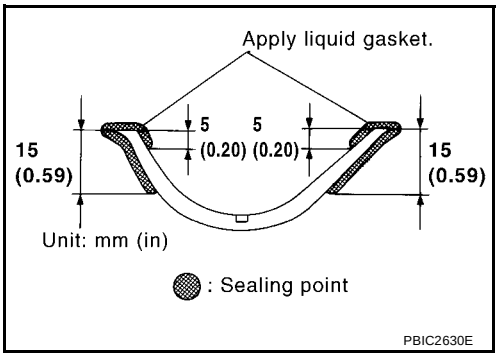


5. Install front timing chain case as follows:

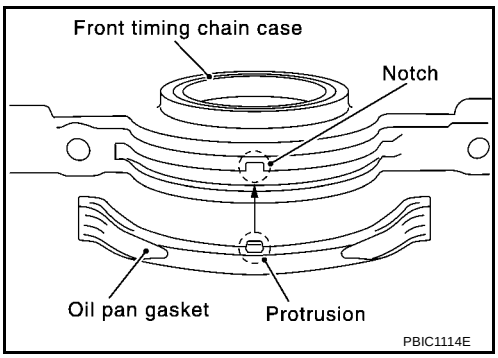
a. Apply a continuous bead of liquid gasket with the tube presser [SST: WS39930000] to front timing chain case back side as shown in the figure.
Use Genuine Liquid Gasket or equivalent.



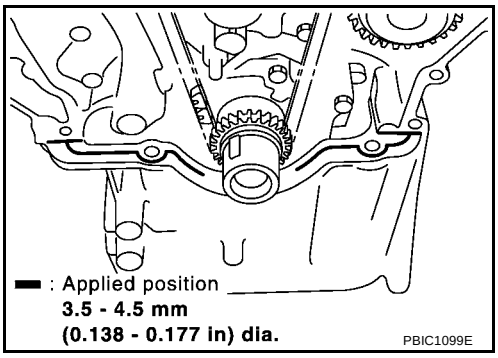
b. Install new oil pan gasket (front).
- Apply liquid gasket to oil pan gasket as shown in the figure.
  Use Genuine Liquid Gasket or equivalent.



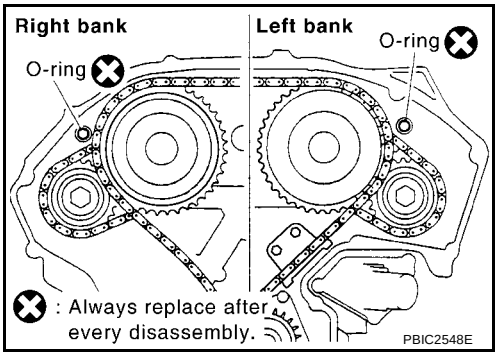
- Align notch of front timing chain case with protrusion of oil pan gasket.



- Apply liquid gasket with the tube presser [SST: WS39930000] to top surface of oil pan (upper) as shown in the figure.
  Use Genuine Liquid Gasket or equivalent.



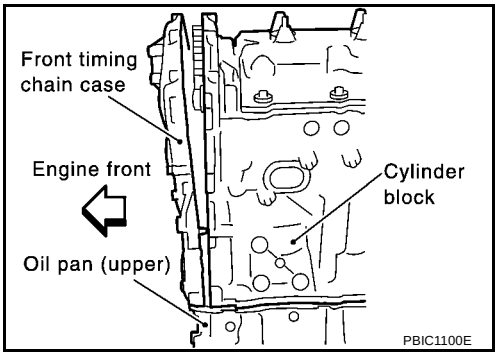
c. Install new O-rings on rear timing chain case.



d. Assemble front timing chain case as follows:

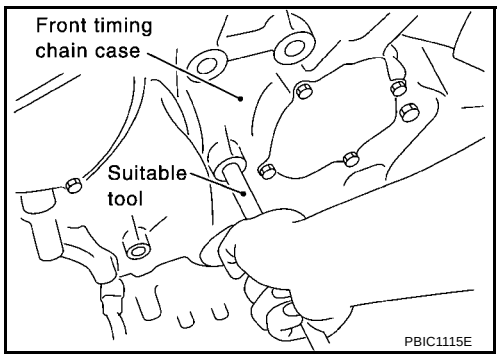
i. Fit lower end of front timing chain case tightly onto top face of oil pan (upper). From the fitting point, make entire front timing chain case contact rear timing chain case completely.

CAUTION:
Be careful that oil pan gasket is in place.



ii. Since front timing chain case is offset for difference of bolt holes, tighten bolts temporarily with holding front timing chain case from front and top as shown in the figure.
For bolt length and positions, refer to step e.

iii. Same as the step ii, insert dowel pin with holding front timing chain case from front and top completely.



e. Tighten mounting bolts to the specified torque in numerical order as shown in the figure.

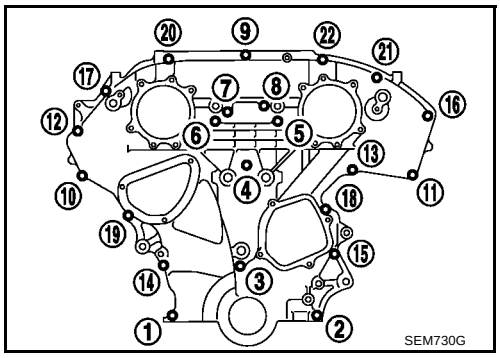
- There are two types of mounting bolt. Refer to the following for locating bolts.

M8 bolts : 1, 2

: 28.4 N·m (2.9 kg-m, 21 ft-lb)

M6 bolts : Except the above

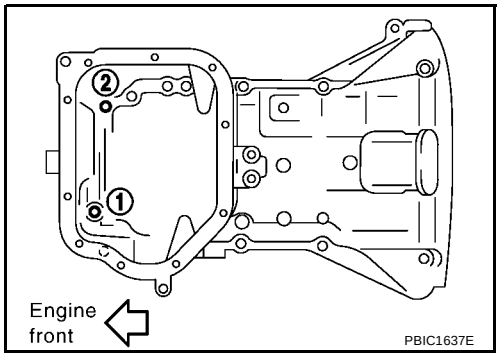
: 12.7 N·m (1.3 kg-m, 9 ft-lb)



f. After all bolts tightening, retighten them to the specified torque in numerical order as shown in the figure.

6. Install RH engine mounting bracket and RH engine mounting insulator. Refer to EM-25, "ENGINE ASSEMBLY" .
7. Remove jack which supports the oil pan (lower) bottom.
8. Remove oil pan (lower).
9. Install two mounting bolts in front of oil pan (upper) in numerical order as shown in the figure.

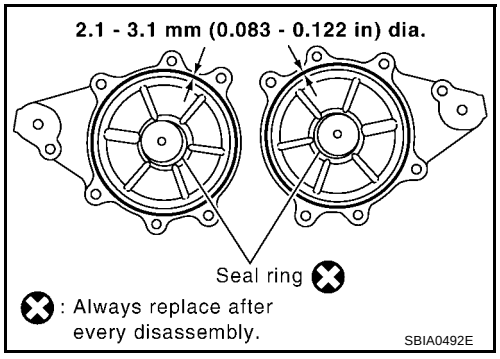
: 17.2 N·m (1.8 kg-m, 13 ft-lb)



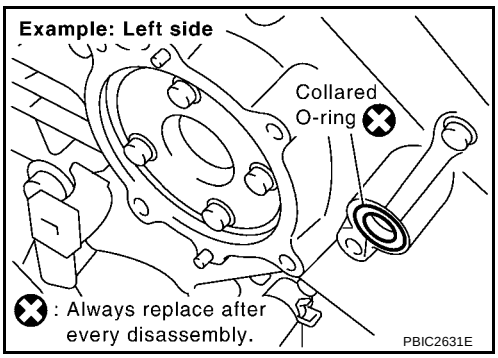
10. Install oil pan (lower). Refer to EM-6, "OIL PAN AND OIL STRAINER" .
11. Install intake valve timing control covers as follows:

a. Install new seal rings in shaft grooves.

b. Apply a continuous bead of liquid gasket with the tube presser [SST: WS39930000] to intake valve timing control covers as shown in the figure.
Use Genuine Liquid Gasket or equivalent.

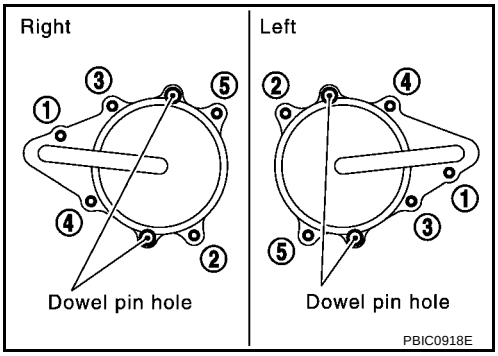


c. Install new collared O-rings in front timing chain case oil holes (left and right sides).



d. Being careful not to move seal rings from the installation grooves, align dowel pins on front timing chain case with the holes to install intake valve timing control covers.

e. Tighten mounting bolts in numerical order as shown in the figure.



12. Install crankshaft pulley as follows:

a. Install crankshaft pulley, taking care not to damage front oil seal.
- When press-fitting crankshaft pulley with plastic hammer, tap on its center portion (not circumference).

b. Fix crankshaft with the pulley holder [SST: KV10109300].

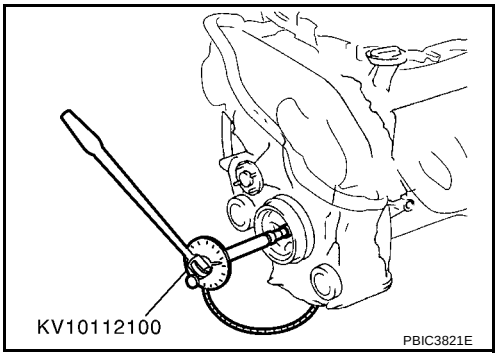
c. Tighten crankshaft pulley bolt.

: 44.1 N·m (4.5 kg-m, 33 ft-lb)

d. Turn crankshaft pulley bolt 90 degrees clockwise (angle tightening).

CAUTION:

Check the tightening angle by using the angle wrench [SST]. Avoid judgment by visual inspection without SST.
- Check tightening angle indicated on the angle wrench indicator plate.



13. Rotate crankshaft pulley in normal direction (clockwise when viewed from engine front) to confirm it turns smoothly.
14. Install in the reverse order of removal after this step.

INSPECTION AFTER INSTALLATION

Inspection for Leaks

The following are procedures for checking fluid leak, lubricates leak and exhaust gases leak.
- Before starting engine, check oil/fluid levels including engine coolant and engine oil. If less than required quantity, fill to the specified level. Refer to MA-12, "RECOMMENDED FLUIDS AND LUBRICANTS" .
- Run engine to check for unusual noise and vibration.

NOTE:
If hydraulic pressure inside timing chain tensioner drops after removal/installation, slack in the guide may generate a pounding noise during and just after engine start. However, this is normal. Noise will stop after hydraulic pressure rises.

- Warm up engine thoroughly to make sure there is no leakage of exhaust gases, or any oil/fluids including engine oil and engine coolant.
- Bleed air from lines and hoses of applicable lines, such as in cooling system.
- After cooling down engine, again check oil/fluid levels including engine oil and engine coolant. Refill to the specified level, if necessary.

Summary of the inspection items:

Item	Before starting engine	Engine running	After engine stopped
Engine coolant	Level	Leakage	Level
Engine oil	Level	Leakage	Level
Other oils and fluid*	Level	Leakage	Level

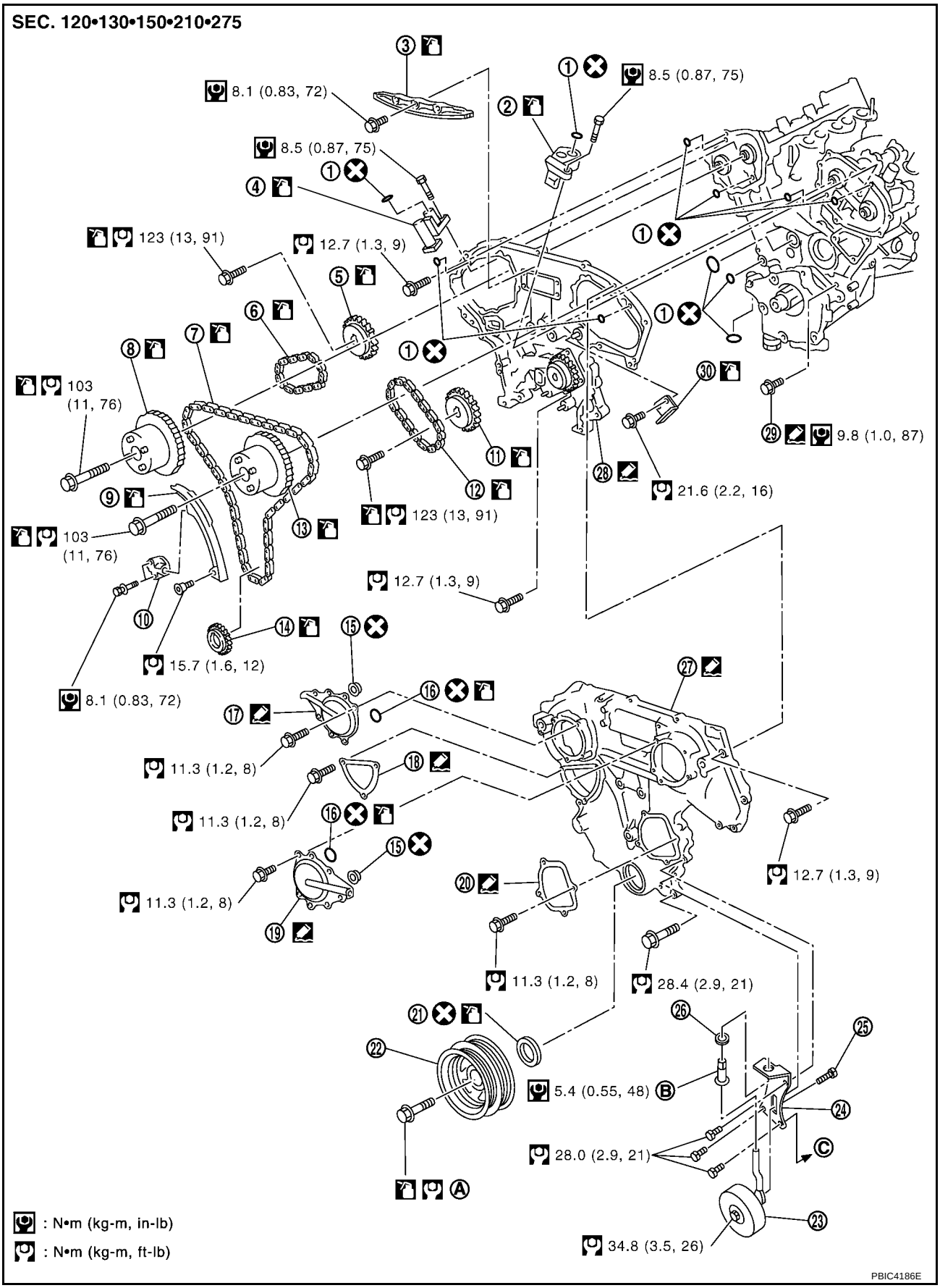
* Transmission/transaxle/CVT fluid. power steering fluid, brake fluid, etc.

TIMING CHAIN

PFP:13028

Components

ABS008IW



1.	O-ring	2.	Timing chain tensioner (secondary) (left bank)	3.	Internal chain guide
4.	Timing chain tensioner (secondary) (right bank)	5.	Camshaft sprocket (EXH)	6.	Timing chain (secondary)
7.	Timing chain (primary)	8.	Camshaft sprocket (INT)	9.	Slack guide
10.	Timing chain tensioner (primary)	11.	Camshaft sprocket (EXH)	12.	Timing chain (secondary)
13.	Camshaft sprocket (INT)	14.	Crankshaft sprocket	15.	Collared O-ring
16.	Seal ring	17.	Intake valve timing control cover	18.	Chain tensioner cover
19.	Intake valve timing control cover	20.	Water pump cover	21.	Front oil seal
22.	Crankshaft pulley	23.	Idler pulley	24.	Idler pulley bracket
25.	Center shaft	26.	Washer	27.	Front timing chain case
28.	Rear timing chain case	29.	Water drain plug (front)	30.	Tension guide
A.	Refer to EM-40	B.	Tighten after adjusting the belt tension.	C.	To A/C compressor

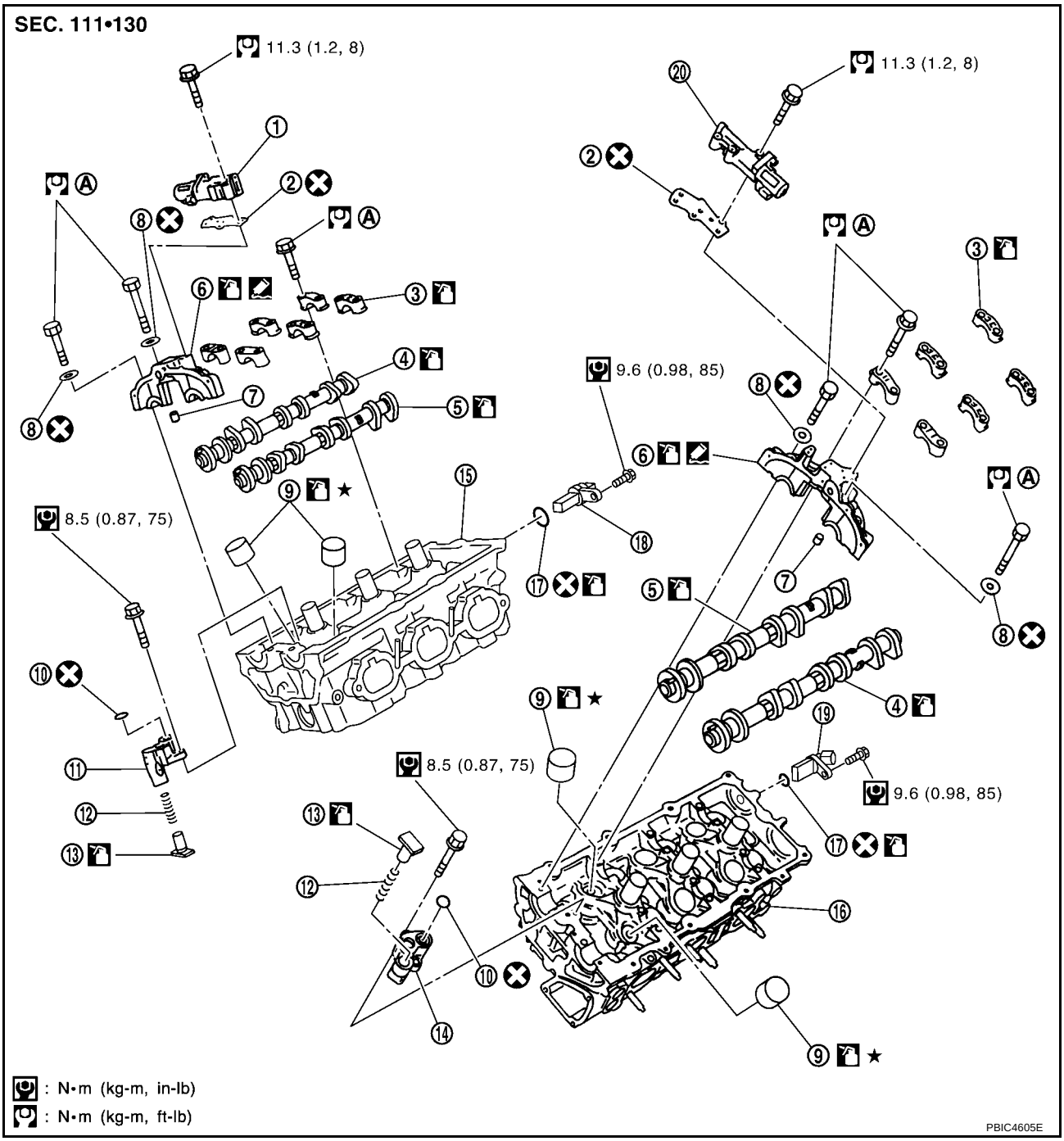
- Refer to GI-8, "Components" for symbol marks in the figure.
- For further details, refer to VQ engine Unit Manual (Publication No. UM5E - VQENG0).

CAMSHAFT

PFP:13001

Components

ABS008IX



1.	Intake valve timing control solenoid valve (right bank)	2.	Gasket	3.	Camshaft bracket (No. 2 to 4)
4.	Camshaft (EXH)	5.	Camshaft (INT)	6.	Camshaft bracket (No. 1)
7.	Dowel pin	8.	Washer	9.	Valve lifter
10.	O-ring	11.	Timing chain tensioner (secondary) (right bank)	12.	Spring
13.	Plunger	14.	Timing chain tensioner (secondary) (left bank)	15.	Cylinder head (right bank)
16.	Cylinder head (left bank)	17.	O-ring	18.	Camshaft position sensor (PHASE) (right bank)

19.	Camshaft position sensor (PHASE) (left bank)	20.	Intake valve timing control solenoid valve (left bank)

A. Refer to EM-40

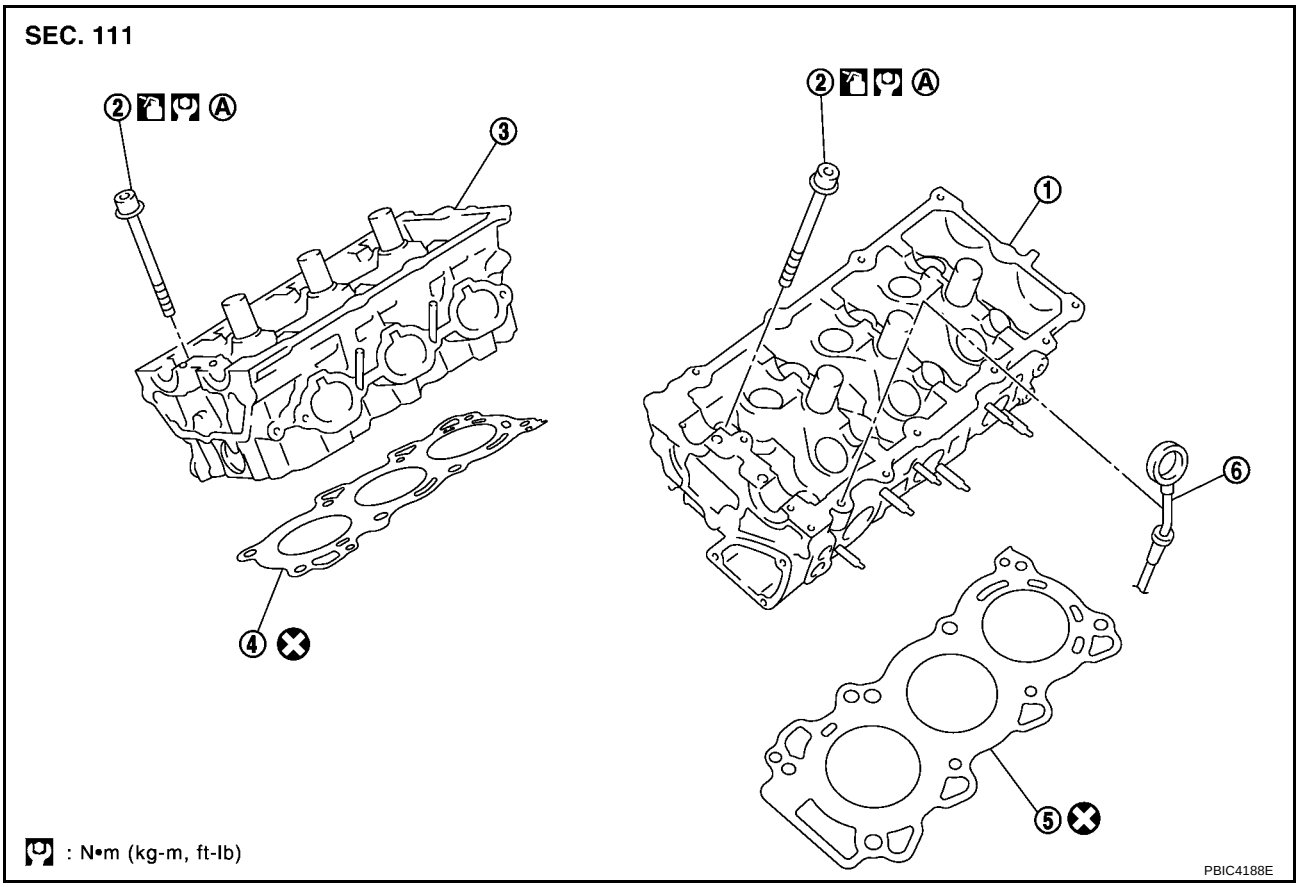
- Refer to GI-8, "Components" for symbol marks in the figure.
- For further details, refer to VQ engine Unit Manual (Publication No. UM5E - VQENG0).

CYLINDER HEAD

PFP:11041

Components (Removal and Installation)

ABS00E8G



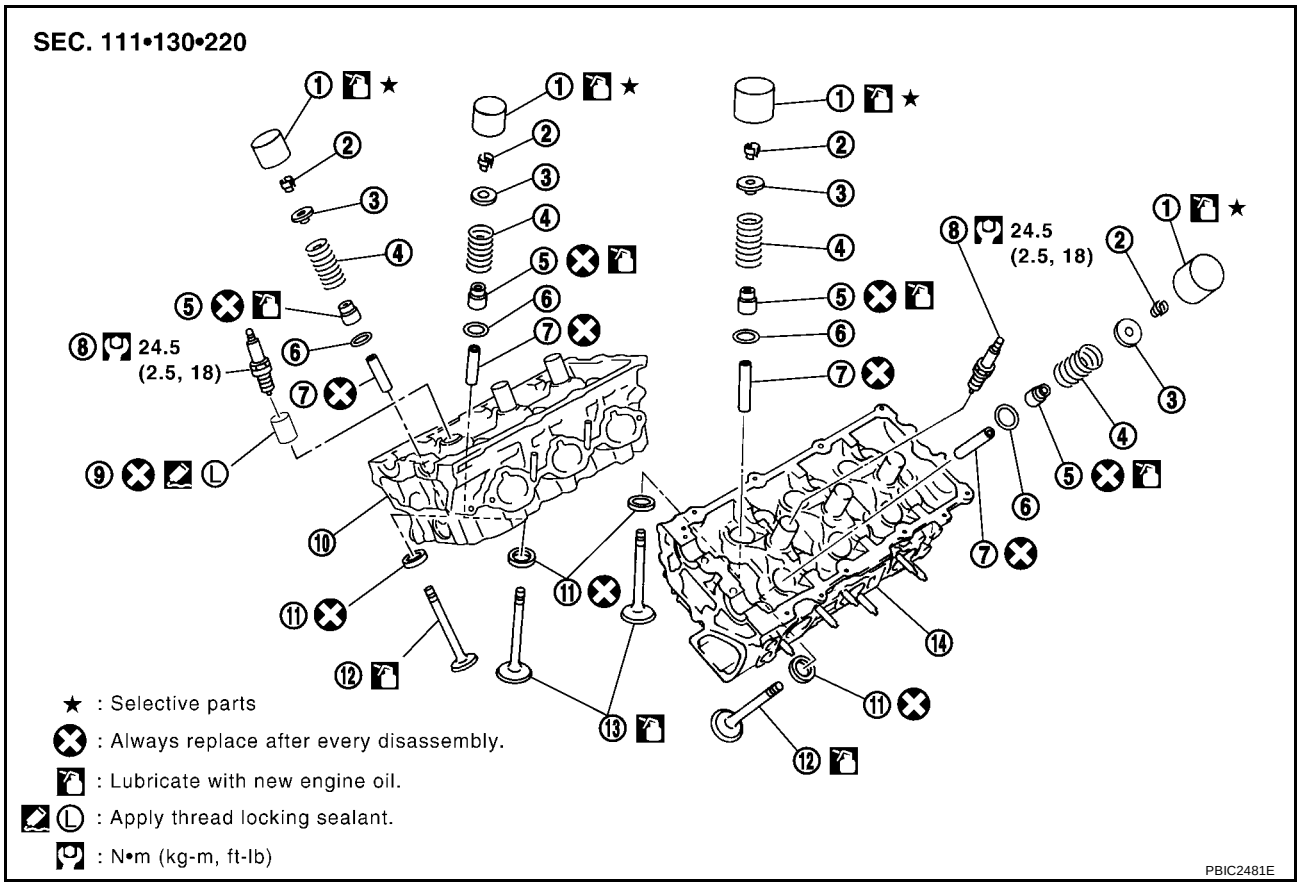
1. Cylinder head (left bank)
2. Cylinder head bolt
3. Cylinder head (right bank)
4. Cylinder head gasket (right bank)
5. Cylinder head gasket (left bank)
6. Oil level gauge

A. Refer to EM-40

- Refer to GI-8, "Components" for symbol marks in the figure.
- For further details, refer to VQ engine Unit Manual (Publication No. UM5E - VQENG0).

Components (Disassembly and Assembly)

ABS00E8P



1. Valve lifter	2. Valve collet	3. Valve spring retainer
4. Valve spring	5. Valve oil seal	6. Valve spring seat
7. Valve guide	8. Spark plug	9. Spark plug tube
10. Cylinder head (right bank)	11. Valve seat	12. Valve (EXH)
13. Valve (INT)	14. Cylinder head (left bank)	

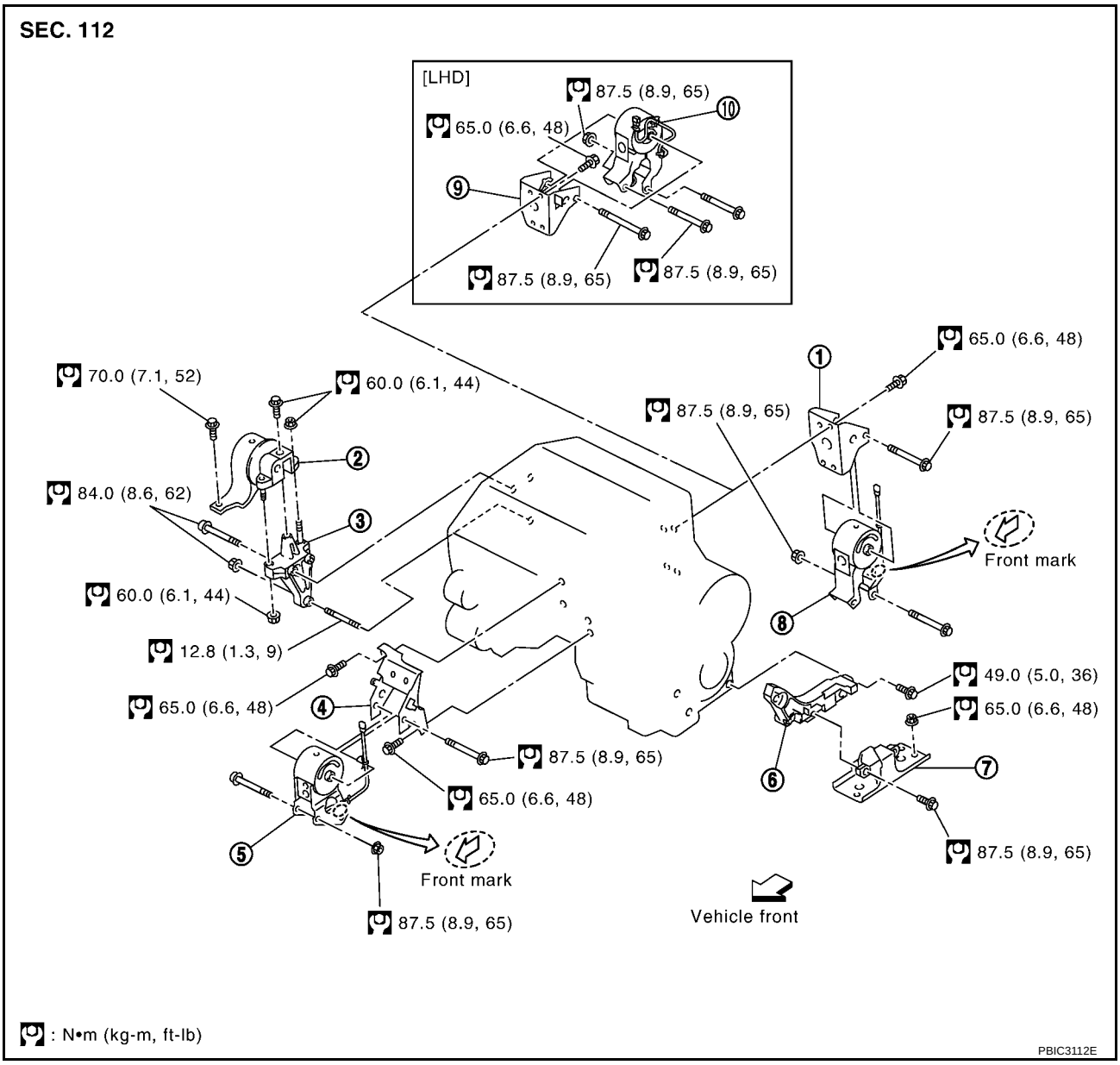
- For further details, refer to VQ engine Unit Manual (Publication No. UM5E - VQENG0).

ENGINE ASSEMBLY

PFP:10001

Components

ABS008J6



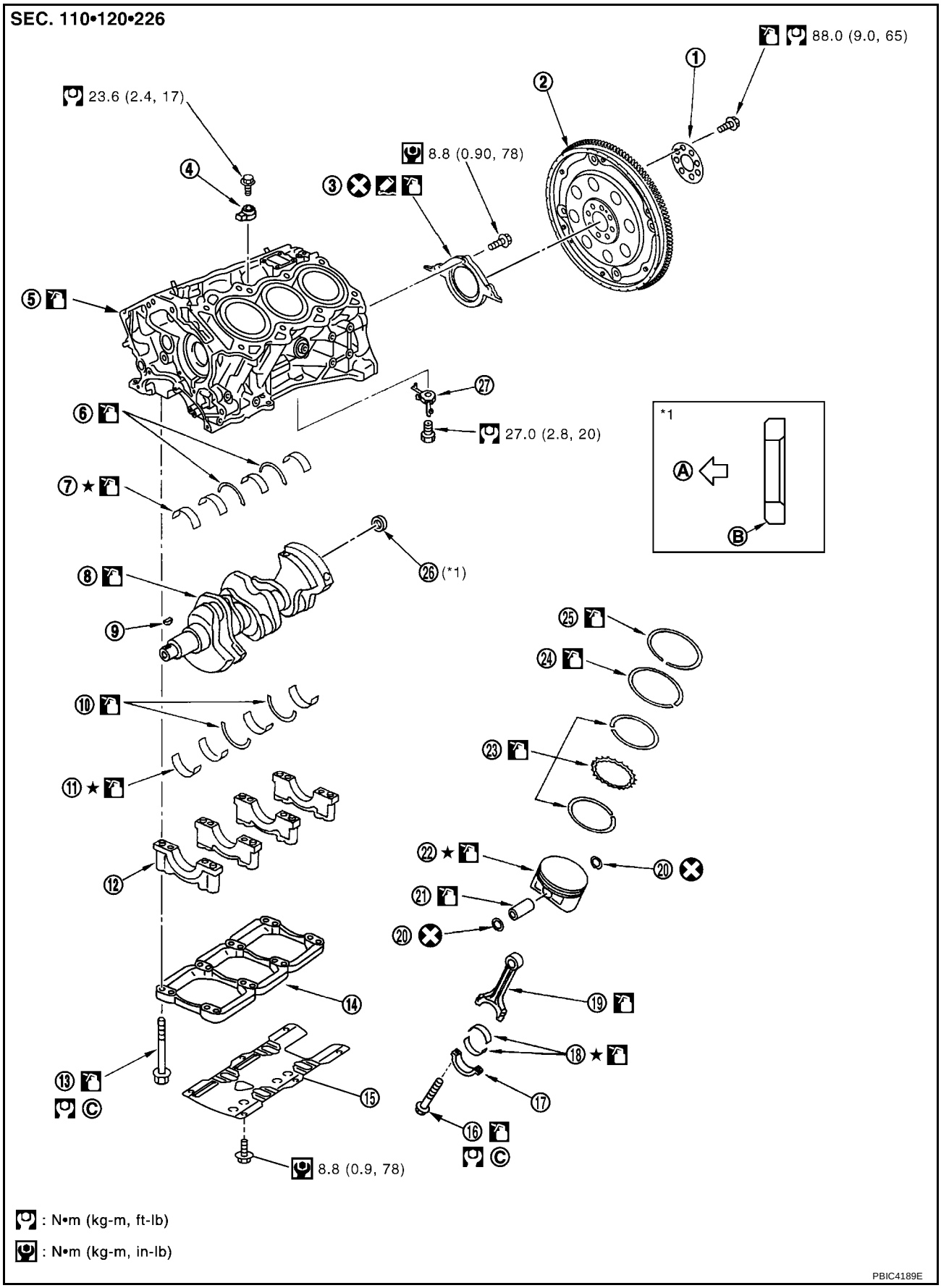
1. Rear engine mounting bracket
2. RH engine mounting insulator
3. RH engine mounting bracket
4. Front engine mounting bracket
5. Front engine mounting insulator
6. LH engine mounting bracket
7. LH engine mounting insulator
8. Rear engine mounting insulator
9. Rear engine mounting bracket
10. Rear engine mounting insulator

CYLINDER BLOCK

PFP:11010

Components

ABS008J7



1. Reinforcement plate	2. Drive plate	3. Rear oil seal retainer
4. Knock sensor	5. Cylinder block	6. Thrust bearing (upper)
7. Main bearing (upper)	8. Crankshaft	9. Crankshaft key
10. Thrust bearing (lower)	11. Main bearing (lower)	12. Main bearing cap
13. Main bearing cap bolt	14. Main bearing beam	15. Baffle plate
16. Connecting rod bolt	17. Connecting rod bearing cap	18. Connecting rod bearing
19. Connecting rod	20. Snap ring	21. Piston pin
22. Piston	23. Oil ring	24. Second ring
25. Top ring	26. Pilot converter	27. Oil jet
A. Crankshaft side	B. Chamfered	C. Refer to EM-40

- Refer to GI-8, "Components" for symbol marks in the figure.
- For further details, refer to VQ engine Unit Manual (Publication No. UM5E - VQENG0).

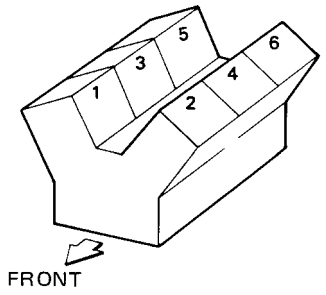
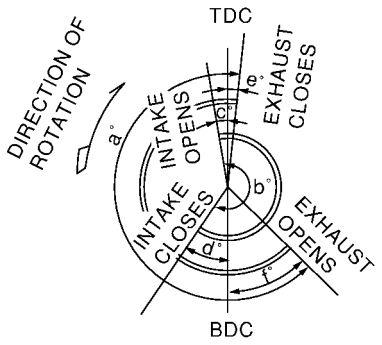
SERVICE DATA AND SPECIFICATIONS (SDS)

PFP:00100

Standard and Limit

ABS008JA

GENERAL SPECIFICATIONS

Cylinder arrangement		V-6
Displacement cm^3 (cu in)		3,498 (213.45)
Bore and stroke mm (in)		95.5 x 81.4 (3.76 x 3.205)
Valve arrangement		DOHC
Firing order		1-2-3-4-5-6
Number of piston rings	Compression	2
	Oil	1
Number of main bearings		4
Compression ratio		10.3
Compression pressure kPa (bar, kg/cm^2 , psi)/300 rpm	Standard	1,275 (12.75, 13.0, 185)
	Minimum	981 (9.81, 10.0, 142)
	Differential limit between cylinders	98 (0.98, 1.0, 14)
Cylinder number	 SEM713A	
Valve timing (Intake valve timing control - “OFF”)	 PBIC0187E	

Unit: degree

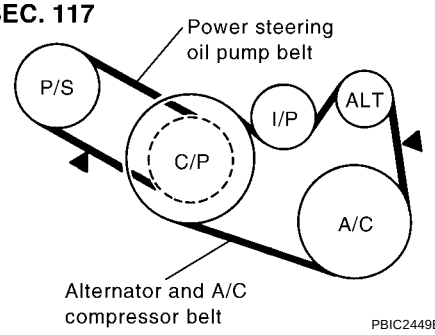
a	b	c	d	e	f
240	238	–6	64	8	52

DRIVE BELT

Unit: mm (in)

	Deflection adjustment		
	Used belt		New belt
	Limit	After adjustment	
Alternator and A/C compressor belt	7 (0.28)	4.2 - 4.6 (0.17 - 0.18)	3.7 - 4.1 (0.15 - 0.16)
Power steering oil pump belt	11 (0.43)	7.3 - 8.0 (0.29 - 0.30)	6.5 - 7.2 (0.26 - 0.28)
Applied pushing force	98 N (10 kg, 22 lb)		

SEC. 117



INTAKE MANIFOLD COLLECTOR, INTAKE MANIFOLD AND EXHAUST MANIFOLD

Unit: mm (in)

Items		Limit
Surface distortion	Intake manifold collector (lower)	0.1 (0.004)
	Intake manifold	0.1 (0.004)
	Exhaust manifold	0.3 (0.012)

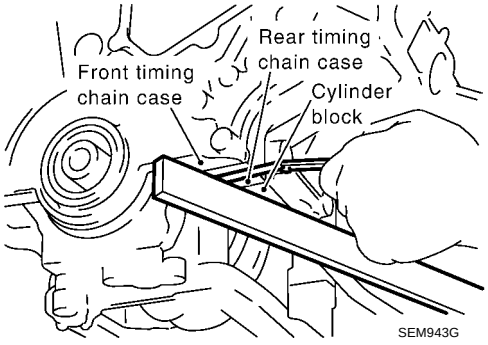
SPARK PLUG

Make	NGK
Standard type	PLFR5A-11
Hot type	PLFR4A-11
Cold type	PLFR6A-11
Gap (Nominal)	1.1 mm (0.043 in)

FRONT TIMING CHAIN CASE

Unit: mm (in)

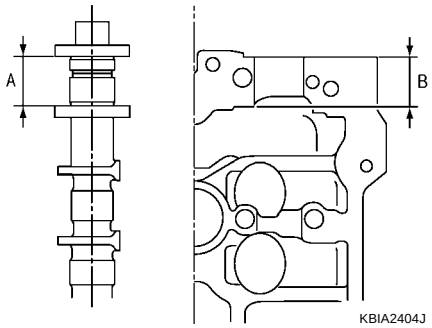
Items	Standard
Surface difference between front timing chain case and rear timing chain case	–0.14 to 0.14 (–0.006 to 0.006)



CAMSHAFT AND CAMSHAFT BEARING

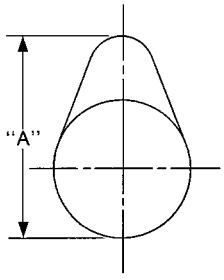
Unit: mm (in)

Items		Standard	Limit
Camshaft journal oil clearance	No. 1	0.045 - 0.086 (0.0018 - 0.0034)	0.15 (0.0059)
	No. 2, 3, 4	0.035 - 0.076 (0.0014 - 0.0030)	
Camshaft bracket inner diameter	No. 1	26.000 - 26.021 (1.0236 - 1.0244)	—
	No. 2, 3, 4	23.500 - 23.521 (0.9252 - 0.9260)	—
Camshaft journal diameter	No. 1	25.935 - 25.955 (1.0211 - 1.0218)	—
	No. 2, 3, 4	23.445 - 23.465 (0.9230 - 0.9238)	—



KBIA2404J

Dimension A for camshaft No.1 journal	27.500 - 27.548 (1.0827 - 1.0846)	—
Dimension B for cylinder head No.1 journal bearing	27.360 - 27.385 (1.0772 - 1.0781)	—
Camshaft end play	0.115 - 0.188 (0.0045 - 0.0074)	0.24 (0.0094)



SEM671

Camshaft cam height "A"	Intake and exhaust	44.865 - 45.055 (1.7663 - 1.7738)	0.2 (0.008)*1
Camshaft runout [TIR*2]		Less than 0.02 mm (0.001)	0.05 (0.002)
Camshaft sprocket runout [TIR*2]		—	0.15 (0.0059)

*1 : Cam wear limit

*2 : Total indicator reading

Valve Lifter

Unit: mm (in)

Items	Standard
Valve lifter outer diameter	33.977 - 33.987 (1.3377 - 1.3381)
Valve lifter hole diameter	34.000 - 34.016 (1.3386 - 1.3392)
Valve lifter clearance	0.013 - 0.039 (0.0005 - 0.0015)

Valve Clearance

Unit: mm (in)

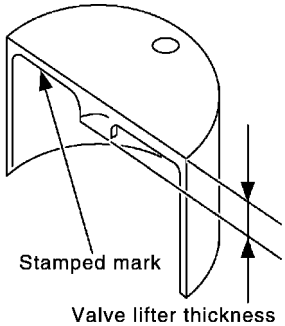
Items	Cold	Hot* (reference data)
Intake	0.26 - 0.34 (0.010 - 0.013)	0.304 - 0.416 (0.012 - 0.016)
Exhaust	0.29 - 0.37 (0.011 - 0.015)	0.308 - 0.432 (0.012 - 0.017)

*: Approximately 80°C (176°F)

Available Valve Lifter

Unit: mm (in)

Identification (stamped) mark		Thickness
Intake	Exhaust	
788U	788R	7.88 (0.3102)
790U	790R	7.90 (0.3110)
792U	792R	7.92 (0.3118)
794U	794R	7.94 (0.3126)
796U	796R	7.96 (0.3134)
798U	798R	7.98 (0.3142)
800U	800R	8.00 (0.3150)
802U	802R	8.02 (0.3157)
804U	804R	8.04 (0.3165)
806U	806R	8.06 (0.3173)
808U	808R	8.08 (0.3181)
810U	810R	8.10 (0.3189)
812U	812R	8.12 (0.3197)
814U	814R	8.14 (0.3205)
816U	816R	8.16 (0.3213)
818U	818R	8.18 (0.3220)
820U	820R	8.20 (0.3228)
822U	822R	8.22 (0.3236)
824U	824R	8.24 (0.3244)
826U	826R	8.26 (0.3252)
828U	828R	8.28 (0.3260)
830U	830R	8.30 (0.3268)
832U	832R	8.32 (0.3276)
834U	834R	8.34 (0.3283)
836U	836R	8.36 (0.3291)
838U	838R	8.38 (0.3299)
840U	840R	8.40 (0.3307)

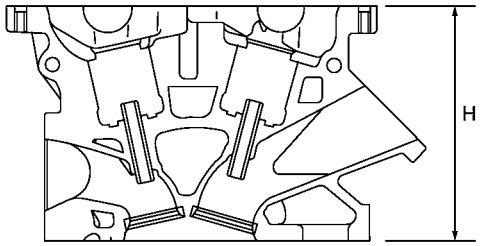


SEM758G

CYLINDER HEAD

Unit: mm (in)

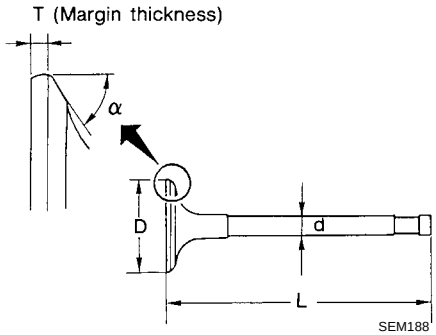
Items	Standard	Limit
Head surface distortion	Less than 0.03 (0.0012)	0.1 (0.004)
Normal cylinder head height “H”	126.3 - 126.5 (4.972 - 4.980)	—



PBIC0924E

Valve Dimensions

Unit: mm (in)

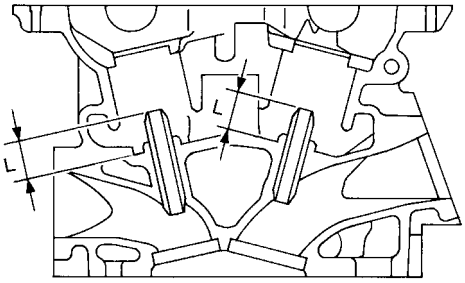


SEM188

Valve head diameter “D”	Intake	37.0 - 37.3 (1.4567 - 1.4685)
	Exhaust	31.2 - 31.5 (1.228 - 1.240)
Valve length “L”	Intake	96.46 (3.798)
	Exhaust	93.99 (3.700)
Valve stem diameter “d”	Intake	5.965 - 5.980 (0.2348 - 0.2354)
	Exhaust	5.955 - 5.970 (0.2344 - 0.2350)
Valve seat angle “α”	Intake	45°15′ - 45°45′
	Exhaust	
Valve margin “T”	Intake	1.1 (0.043)
	Exhaust	1.3 (0.051)
Valve margin “T” limit		0.5 (0.020)
Valve stem end surface grinding limit		0.2 (0.008)

Valve Guide

Unit: mm (in)

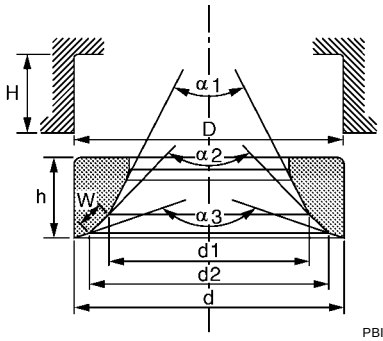


SEM950E

Items		Standard	Over size (Service) [0.2 (0.008)]
Valve guide	Outer diameter	10.023 - 10.034 (0.3946 - 0.3950)	10.223 - 10.234 (0.4025 - 0.4029)
	Inner diameter (Finished size)	6.000 - 6.018 (0.2362 - 0.2369)	
Cylinder head valve guide hole diameter		9.975 - 9.996 (0.3927 - 0.3935)	10.175 - 10.196 (0.4006 - 0.4014)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
Items		Standard	Limit
Valve guide clearance	Intake	0.020 - 0.053 (0.0008 - 0.0021)	0.08 (0.003)
	Exhaust	0.030 - 0.063 (0.0012 - 0.0025)	0.09 (0.004)
Projection length “L”		12.6 - 12.8 (0.496 - 0.504)	

Valve Seat

Unit: mm (in)



PBIC2745E

Items		Standard	Over size (Service) [0.5 (0.02)]
Cylinder head seat recess diameter “D”	Intake	38.000 - 38.016 (1.4961 - 1.4967)	38.500 - 38.516 (1.5157 - 1.5164)
	Exhaust	32.200 - 32.216 (1.2677 - 1.2683)	32.700 - 32.716 (1.2874 - 1.2880)
Valve seat outer diameter “d”	Intake	38.097 - 38.113 (1.4999 - 1.5005)	38.597 - 38.613 (1.5196 - 1.5202)
	Exhaust	32.280 - 32.296 (1.2709 - 1.2715)	32.780 - 32.796 (1.2905 - 1.2912)
Valve seat interference fit	Intake	0.081 - 0.113 (0.0032 - 0.0044)	
	Exhaust	0.064 - 0.096 (0.0025 - 0.0038)	
Diameter “d1”*1	Intake	35 (1.38)	
	Exhaust	28.7 (1.130)	
Diameter “d2”*2	Intake	36.3 - 36.8 (1.429 - 1.449)	
	Exhaust	30.3 - 30.8 (1.193 - 1.213)	
Angle “α1”	Intake	60°	
	Exhaust	60°	
Angle “α2”	Intake	88°45′ - 90°15′	
	Exhaust	88°45′ - 90°15′	
Angle “α3”	Intake	120°	
	Exhaust	120°	
Contacting width “W”*3	Intake	1.0 - 1.4 (0.039 - 0.055)	
	Exhaust	1.2 - 1.6 (0.047 - 0.063)	
Height “h”	Intake	5.9 - 6.0 (0.232 - 0.236)	5.05 - 5.15 (0.1988 - 0.2028)
	Exhaust	5.9 - 6.0 (0.232 - 0.236)	4.95 - 5.05 (0.1949 - 0.1988)
Depth “H”		6.0 (0.236)	

*1 : Diameter made by intersection point of conic angles “α1” and “α2”

*2 : Diameter made by intersection point of conic angles “α2” and “α3”

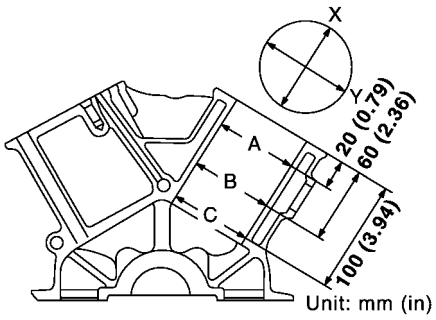
*3 : Machining data

Valve Spring

Free height mm (in)		47.07 (1.8531)
Pressure N (kg, lb) at height mm (in)	Installation	166 - 188 (16.9 - 19.2, 37.3 - 42.3) at 37.00 (1.4567)
	Valve open	373 - 421 (38.0 - 42.9, 83.9 - 94.6) at 27.20 (1.0709)
Out-of-square mm (in)	Limit	2.1 (0.083)

CYLINDER BLOCK

Unit: mm (in)



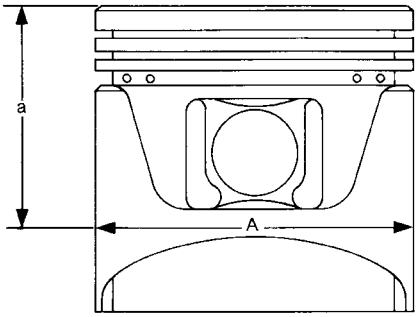
PBIC0923E

Surface flatness		Standard		Less than 0.03 (0.0012)
		Limit		0.1 (0.004)
Main bearing housing inner diameter		Standard		63.993 - 64.017 (2.5194 - 2.5203)
Cylinder bore	Inner diameter	Standard	Grade No. 1	95.500 - 95.510 (3.7598 - 3.7602)
			Grade No. 2	95.510 - 95.520 (3.7602 - 3.7606)
			Grade No. 3	95.520 - 95.530 (3.7606 - 3.7610)
		Wear limit		0.2 (0.008)
Out-of-round (Difference between “X” and “Y”)		Limit		0.015 (0.0006)
Taper (Difference between “A” and “C”)				0.01 (0.0004)
Main bearing housing inner diameter (Without bearing)			Grade No. A	63.993 - 63.994 (2.5194 - 2.5194)
			Grade No. B	63.994 - 63.995 (2.5194 - 2.5195)
			Grade No. C	63.995 - 63.996 (2.5195 - 2.5195)
			Grade No. D	63.996 - 63.997 (2.5195 - 2.5196)
			Grade No. E	63.997 - 63.998 (2.5196 - 2.5196)
			Grade No. F	63.998 - 63.999 (2.5196 - 2.5196)
			Grade No. G	63.999 - 64.000 (2.5196 - 2.5197)
			Grade No. H	64.000 - 64.001 (2.5197 - 2.5197)
			Grade No. J	64.001 - 64.002 (2.5197 - 2.5198)
			Grade No. K	64.002 - 64.003 (2.5198 - 2.5198)
			Grade No. L	64.003 - 64.004 (2.5198 - 2.5198)
			Grade No. M	64.004 - 64.005 (2.5198 - 2.5199)
			Grade No. N	64.005 - 64.006 (2.5199 - 2.5199)
			Grade No. P	64.006 - 64.007 (2.5199 - 2.5200)
			Grade No. R	64.007 - 64.008 (2.5200 - 2.5200)
			Grade No. S	64.008 - 64.009 (2.5200 - 2.5200)
			Grade No. T	64.009 - 64.010 (2.5200 - 2.5201)
			Grade No. U	64.010 - 64.011 (2.5201 - 2.5201)
			Grade No. V	64.011 - 64.012 (2.5201 - 2.5202)
			Grade No. W	64.012 - 64.013 (2.5202 - 2.5202)
			Grade No. X	64.013 - 64.014 (2.5202 - 2.5202)
			Grade No. Y	64.014 - 64.015 (2.5202 - 2.5203)
			Grade No. 4	64.015 - 64.016 (2.5203 - 2.5203)
			Grade No. 7	64.016 - 64.017 (2.5203 - 2.5203)
Difference in inner diameter between cylinders		Standard		Less than 0.03 (0.0012)

PISTON, PISTON RING AND PISTON PIN

Available Piston

Unit: mm (in)



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Items		Standard	Over size (Service) [0.20 (0.0079)]
Piston skirt diameter “A”	Grade No. 1	95.480 - 95.490 (3.7590 - 3.7594)	—
	Grade No. 2	95.490 - 95.500 (3.7594 - 3.7598)	—
	Grade No. 3	95.500 - 95.510 (3.7598 - 3.7602)	—
	Service	—	95.680 - 95.710 (3.7669 - 3.7681)
Items		Standard	Limit
“a” dimension		41.0 (1.614)	—
Piston pin hole diameter	Grade No. 0	21.993 - 21.999 (0.8659 - 0.8661)	—
	Grade No. 1	21.999 - 22.005 (0.8661 - 0.8663)	—
Piston to cylinder bore clearance		0.010 - 0.030 (0.0004 - 0.0012)	0.08 (0.0031)

Piston Ring

Unit: mm (in)

Items		Standard	Limit
Side clearance	Top	0.045 - 0.080 (0.0018 - 0.0031)	0.11 (0.0043)
	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.10 (0.0039)
	Oil ring	0.065 - 0.135 (0.0026 - 0.0053)	—
End gap	Top	0.23 - 0.33 (0.0091 - 0.0130)	0.54 (0.0213)
	2nd	0.33 - 0.48 (0.0130 - 0.0189)	0.80 (0.0315)
	Oil (rail ring)	0.20 - 0.50 (0.0079 - 0.0197)	0.95 (0.0374)

Piston Pin

Unit: mm (in)

Items		Standard	Limit
Piston pin outer diameter	Grade No. 0	21.989 - 21.995 (0.8657 - 0.8659)	—
	Grade No. 1	21.995 - 22.001 (0.8659 - 0.8662)	—
Piston to piston pin oil clearance		0.002 - 0.006 (0.0001 - 0.0002)	—
Connecting rod bushing oil clearance		0.005 - 0.017 (0.0002 - 0.0007)	0.030 (0.0012)

CONNECTING ROD

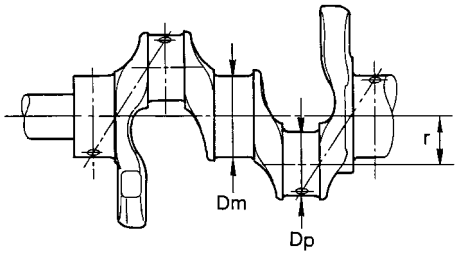
Unit: mm (in)

Items		Standard	Limit
Center distance		144.15 - 144.25 (5.6752 - 5.6791)	—
Bend [per 100 (3.94)]		—	0.15 (0.0059)
Torsion [per 100 (3.94)]		—	0.30 (0.0118)
Connecting rod bushing inner diameter*	Grade No. 0	22.000 - 22.006 (0.8661 - 0.8664)	—
	Grade No. 1	22.006 - 22.012 (0.8664 - 0.8666)	—
Connecting rod big end diameter (Without bearing)		55.000 - 55.013 (2.1654 - 2.1659)	—
Side clearance		0.20 - 0.35 (0.0079 - 0.0138)	0.40 (0.0157)

*: After installing in connecting rod

CRANKSHAFT

Unit: mm (in)



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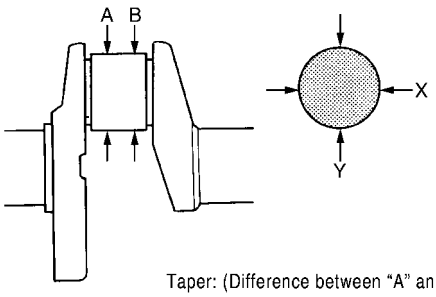

Taper: (Difference between “A” and “B”)
Out-of-round: (Difference between “X” and “Y”)

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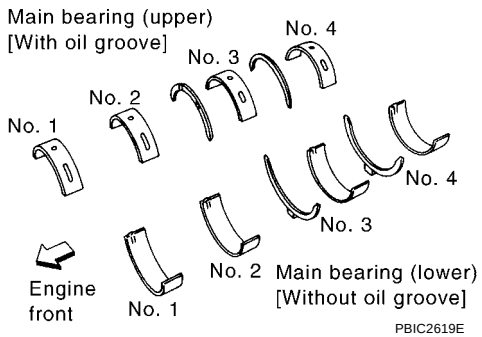
Main journal diameter. “Dm” grade	Standard	Grade No. A	59.974 - 59.975 (2.3612 - 2.3612)
		Grade No. B	59.973 - 59.974 (2.3611 - 2.3612)
		Grade No. C	59.972 - 59.973 (2.3611 - 2.3611)
		Grade No. D	59.971 - 59.972 (2.3611 - 2.3611)
		Grade No. E	59.970 - 59.971 (2.3610 - 2.3611)
		Grade No. F	59.969 - 59.970 (2.3610 - 2.3610)
		Grade No. G	59.968 - 59.969 (2.3609 - 2.3610)
		Grade No. H	59.967 - 59.968 (2.3609 - 2.3609)
		Grade No. J	59.966 - 59.967 (2.3609 - 2.3609)
		Grade No. K	59.965 - 59.966 (2.3608 - 2.3609)
		Grade No. L	59.964 - 59.965 (2.3608 - 2.3608)
		Grade No. M	59.963 - 59.964 (2.3607 - 2.3608)
		Grade No. N	59.962 - 59.963 (2.3607 - 2.3607)
		Grade No. P	59.961 - 59.962 (2.3607 - 2.3607)
		Grade No. R	59.960 - 59.961 (2.3606 - 2.3607)
		Grade No. S	59.959 - 59.960 (2.3606 - 2.3606)
		Grade No. T	59.958 - 59.959 (2.3605 - 2.3606)
		Grade No. U	59.957 - 59.958 (2.3605 - 2.3605)
		Grade No. V	59.956 - 59.957 (2.3605 - 2.3605)
		Grade No. W	59.955 - 59.956 (2.3604 - 2.3605)
		Grade No. X	59.954 - 59.955 (2.3604 - 2.3604)
		Grade No. Y	59.953 - 59.954 (2.3603 - 2.3604)
		Grade No. 4	59.952 - 59.953 (2.3603 - 2.3603)
		Grade No. 7	59.951 - 59.952 (2.3603 - 2.3603)
Pin journal diameter. “Dp”	Standard	Grade No. 0	51.968 - 51.974 (2.0460 - 2.0462)
		Grade No. 1	51.962 - 51.968 (2.0457 - 2.0460)
		Grade No. 2	51.956 - 51.962 (2.0455 - 2.0457)
Center distance “r”			40.66 - 40.74 (1.6008 - 1.6039)
Taper (Difference between “A” and “B”)	Limit		0.002 (0.0001)
Out-of-round (Difference between “X” and “Y”)			0.002 (0.0001)
Crankshaft runout [TIR*]	Standard		Less than 0.05 (0.002)
	Limit		0.10 (0.0039)
Crankshaft end play	Standard		0.10 - 0.25 (0.0039 - 0.0098)
	Limit		0.30 (0.0118)

*: Total indicator reading

MAIN BEARING



Grade number	UPR/LWR	Thickness "T" mm (in)	Width "W" mm (in)	Identification color	Remarks
0	—	2.000 - 2.003 (0.0787 - 0.0789)	19.9 - 20.1 (0.783 - 0.791)	Black	Grade is the same for upper and lower bearings.
1	—	2.003 - 2.006 (0.0789 - 0.0790)		Brown	
2	—	2.006 - 2.009 (0.0790 - 0.0791)		Green	
3	—	2.009 - 2.012 (0.0791 - 0.0792)		Yellow	
4	—	2.012 - 2.015 (0.0792 - 0.0793)		Blue	
5	—	2.015 - 2.018 (0.0793 - 0.0794)		Pink	
6	—	2.018 - 2.021 (0.0794 - 0.0796)		Purple	
7	—	2.021 - 2.024 (0.0796 - 0.0797)		White	
01	UPR	2.003 - 2.006 (0.0789 - 0.0790)		Brown	Grade is different for upper and lower bearings.
	LWR	2.000 - 2.003 (0.0787 - 0.0789)		Black	
12	UPR	2.006 - 2.009 (0.0790 - 0.0791)		Green	
	LWR	2.003 - 2.006 (0.0789 - 0.0790)		Brown	
23	UPR	2.009 - 2.012 (0.0791 - 0.0792)		Yellow	
	LWR	2.006 - 2.009 (0.0790 - 0.0791)		Green	
34	UPR	2.012 - 2.015 (0.0792 - 0.0793)		Blue	
	LWR	2.009 - 2.012 (0.0791 - 0.0792)		Yellow	
45	UPR	2.015 - 2.018 (0.0793 - 0.0794)		Pink	
	LWR	2.012 - 2.015 (0.0792 - 0.0793)		Blue	
56	UPR	2.018 - 2.021 (0.0794 - 0.0796)		Purple	
	LWR	2.015 - 2.018 (0.0793 - 0.0794)		Pink	
67	UPR	2.021 - 2.024 (0.0796 - 0.0797)		White	
	LWR	2.018 - 2.021 (0.0794 - 0.0796)		Purple	

Undersize

Unit: mm (in)

Items	Thickness	Main journal diameter
0.25 (0.0098)	2.132 - 2.140 (0.0839 - 0.0843)	Grind so that bearing clearance is the specified value.

Main Bearing Oil Clearance

Unit: mm (in)

Items	Standard	Limit
Main bearing oil clearance	0.035 - 0.045 (0.0014 - 0.0018)*	0.065 (0.0026)

*: Actual clearance

CONNECTING ROD BEARING

Grade number	Thickness mm (in)	Identification color (mark)
0	1.500 - 1.503 (0.0591 - 0.0592)	Black
1	1.503 - 1.506 (0.0592 - 0.0593)	Brown
2	1.506 - 1.509 (0.0593 - 0.0594)	Green

Undersize

Unit: mm (in)

Items	Thickness	Crank pin journal diameter
0.25 (0.0098)	1.626 - 1.634 (0.0640 - 0.0643)	Grind so that bearing clearance is the specified value.

Connecting Rod Bearing Oil Clearance

Unit: mm (in)

Items	Standard	Limit
Connecting rod bearing oil clearance	0.034 - 0.059 (0.0013 - 0.0023)*	0.070 (0.0028)

*: Actual clearance

Tightening Torque

ABS008JB

*1: Parts to be tightened in particular orders.
1)-: Order of tightening when tightening two or more times separately.

Unit: N·m (kg-m, ft-lb)
Unit: N·m (kg-m, in-lb)*2

*1	Intake manifold		1)	7.4 (0.8, 5)
			2)	29.0 (3.0, 21)
*1	Fuel tube		1)	10.1 (1.0, 7)
			2)	23.6 (2.4, 17)
*1	Rocker cover		1)	1.96 (0.20, 17)*2
			2)	8.33 (0.85, 74)*2
	Crankshaft pulley		1)	44.1 (4.5, 33)
			2)	90° (angle tightening)
*1	Camshaft bracket	(No. 1)	1)	1.96 (0.20, 1)
		(No. 2, 3 and 4)	2)	1.96 (0.20, 1)
		(All)	3)	5.88 (0.60, 4)
		(No. 2, 3 and 4)	4)	10.4 (1.1, 8)
		(No. 1)	5)	9.3 (0.95, 7)
*1	Cylinder head		1)	98.1 (10, 72)
			2)	0 (0, 0)
			3)	39.2 (4.0, 29)
			4)	90° (angle tightening)
			5)	90° (angle tightening)
*1	Main bearing cap		1)	35.3 (3.6, 26)
			2)	90° (angle tightening)
	Connecting rod		1)	19.6 (2.0, 14)
			2)	90° (angle tightening)