CO/HC INSPECTION

HINT:

This check is used only to determine whether or not the idle CO/ HC complies with regulations.

- 1. INITIAL CONDITIONS
- (a) Engine at normal operating temperature
- (b) Air cleaner installed
- (c) All pipes and hoses of air induction system connected
- (d) All accessories switched OFF
- (e) All vacuum lines properly connected

HINT:

All vacuum hoses should be properly connected.

- (f) SFI system wiring connectors fully plugged
- (g) Ignition timing set correctly
- (h) Transmission in neutral range
- (i) Tachometer and CO/HC meter calibrated by hand
- 2. START ENGINE
- 3. RACE ENGINE AT 2,500 RPM FOR APPROX. 180 SE-CONDS



4. INSERT CO/HC METER TESTING PROBE AT LEAST 40 cm (1.3 ft) INTO TAILPIPE DURING IDLING

5. IMMEDIATELY CHECK CO/HC CONCENTRATION AT IDLE AND/OR 2,500 RPM

HINT:

When performing the 2 mode (2,500 rpm and idle) test, follow the measurement order prescribed by the applicable local regulations.

EM09G-02

6. TROUBLESHOOTING

If the CO/HC concentration does not comply with regulations, perform troubleshooting in the order given below.

See the table below for possible causes, and then inspect and correct the applicable causes if necessary.

со	нс	Problems	Causes
Normal	High	Rough idle	1. Faulty ignitions:
			♦Incorrect timing
			Fouled, shorted or improperly gapped plugs
			2. Incorrect valve clearance
			3. Leaky intake and exhaust valves
			4. Leaky cylinders
Low	High	Rough idle	1. Vacuum leaks:
		(fluctuating HC reading)	♦PCV hoses
			Intake manifold
			◆Throttle body
			◆Brake booster line
			2. Lean mixture causing misfire
High	High	Rough idle	1. Restricted air filter
		(Black smoke from exhaust)	2.Faulty SFI systems:
			◆Faulty pressure regulator
			◆Defective ECT sensor
			◆Faulty ECM
			◆Faulty injectors
			◆Faulty throttle position sensor
			◆Faulty MAF meter

COMPRESSION INSPECTION

HINT:

If there is lack of power, excessive oil consumption or poor fuel economy, measure the compression pressure.

1. WARM UP AND STOP ENGINE

Allow the engine to warm up to normal operating temperature.

2. REMOVE SPARK PLUGS (See page IG-1)

3. CHECK CYLINDER COMPRESSION PRESSURE

- (a) Insert a compression gauge into the spark plug hole.
- (b) Fully open the throttle.
- (c) While cranking the engine, measure the compression pressure.

HINT:

Always use a fully charged battery to obtain engine speed of 250 rpm or more.

(d) Repeat steps (a) through (c) for each cylinder.

NOTICE:

This measurement must be done in as short a time as possible.

Compression pressure:

1,226 kPa (12.5 kgf/cm², 178 psi) or more Minimum pressure: 981 kPa (10.0 kgf/cm², 142 psi) Difference between each cylinder: 98 kPa (1.0 kgf/cm², 14 psi) or less

- (e) If the cylinder compression in one or more cylinders is low, pour a small amount of engine oil into the cylinder through the spark plug hole and repeat steps (a) through (c) for cylinders with low compression.
 - If adding oil helps the compression, chances are that the piston rings and/or cylinder bore are worn or damage.
 - If pressure stays low, a valve may be sticking or seating is improper, or there may be leakage past the gasket.
- 4. REINSTALL SPARK PLUGS (See page IG-1)



EM09H-02

VALVE CLEARANCE

HINT:

Inspect and adjust the valve clearance when the engine is cold.

EM09I-02

- 1. DRAIN ENGINE COOLANT
- 2. REMOVE BATTERY CLAMP COVER
- 3. REMOVE AIR CLEANER INLET
- 4. REMOVE V-BANK COVER
- 5. REMOVE AIR CLEANER AND INTAKE AIR CONNEC-TOR ASSEMBLY
- 6. REMOVE NO.3 TIMING BELT COVERS (See page EM-15)
- 7. REMOVE IGNITION COILS (See page IG-7)
- 8. REMOVE RH CYLINDER HEAD COVER

Remove the 9 bolts, 9 seal washers and cylinder head cover.

- 9. REMOVE LH CYLINDER HEAD COVER
- (a) Remove the oil dipstick for the transmission.
- (b) Disconnect the PCV hose.
- (c) Disconnect the engine wire clamp from the wire bracket on the delivery pipe.
- (d) Remove the 9 bolts, 9 seal washers and cylinder head cover.



10. SET NO.1 CYLINDER TO TDC/COMPRESSION

(a) Turn the crankshaft pulley, and align its groove with timing mark "0" of the No.1 timing belt cover.



(b) Check that the timing marks of the camshaft timing pulleys and timing belt rear plates are aligned.

If not, turn the crankshaft 1 revolution (360°) and align the mark as above.

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11. INSPECT VALVE CLEARANCE

- (a) Check only the valves indicated.
 - Using a feeler gauge, measure the clearance between the valve lifter and camshaft.
 - Record the out-of-specification valve clearance measurements. They will be used later to determine the required replacement adjusting shim.

Valve clearance (Cold):

Intake	0.15 – 0.25 mm (0.006 – 0.010 in.)
Exhaust	0.25 – 0.35 mm (0.010 – 0.014 in.)

- (b) Turn the crankshaft 1 revolution (360°) and align the mark as above. (See procedure in step 10)
- (c) Check only the valves indicated as shown. Measure the valve clearance. (See procedure in step (a))
- 12. ADJUST VALVE CLEARANCE
- (a) Remove the timing belt. (See page EM-15)
- (b) Remove the camshafts. (See page EM-34)
- (c) Remove the valve lifter and adjusting shim.

- (d) Determine the replacement adjusting shim size according to these Formula or Charts:
 - Using a micrometer, measure the thickness of the removed shim.
 - Calculate the thickness of a new shim so that the valve clearance comes within the specified value.
 - T Thickness of removed shim
 - A Measured valve clearance
 - N Thickness of new shim

EM-6

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Intake:
```

```
N = T + (A – 0.20 mm (0.008 in.))
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```
Exhaust:
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```
N = T + (A - 0.30 \text{ mm} (0.012 \text{ in.}))
```

 Select a new shim with a thickness as close as possible to the calculated value.

HINT:

Shims are available in 41 increments of 0.020 mm (0.0008 in.), from 2.00 mm (0.0787 in.) to 2.80 mm (0.1102 in.).

- (e) Place a new adjusting shim on the valve.
- (f) Place the valve lifter.
- (g) Reinstall the camshafts. (See page EM-58)
- (h) Reinstall the timing belt. (See page EM-22)
- (i) Recheck the valve clearance.
- 13. REINSTALL CYLINDER HEAD COVERS
- 14. REINSTALL IGNITION COILS
- 15. REINSTALL NO.3 TIMING BELT COVERS (See page EM-22)
- 16. REINSTALL AIR CLEANER AND INTAKE AIR CON-NECTOR ASSEMBLY
- 17. REFILL WITH ENGINE COOLANT
- 18. START ENGINE AND CHECK FOR LEAKS
- **19. RECHECK ENGINE COOLANT LEVEL**
- 20. REINSTALL V-BANK COVER
- 21. REINSTALL AIR CLEANER INLET
- 22. REINSTALL BATTERY CLAMP COVER

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Adjusting Shim Selection Chart (Intake)																											
Installed shim thickness	87) 95)	03)	19) 27)	35)	50) 53	66)	74)	82)	()06	68)	(90)	13)	21)	29) 33)	37) 41)	45) 49)	53) 57)	61) 65)	72)	80) 88) 88)	92)	04)	12) 16)	24) 31)	39) 47) 55)	63) 71)	79) 87) 94)
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0.051-0.070 (0.0020-0.0028)			00 00	000	0 02 04	06 08	8 08 10	0 10 12	2 12 1	4 14 16	6 16 18	3 18 20	20 22	22 24	24 26	26 28	28 30	30 32 32	34 34	4 36 36 38	38 40 4	0 42 4	2 44 44 46	3 46 48	50 52 54	56 58	60 62 64
0.071-0.090 (0.0028-0.0035)		00	00 00	00 00	2 04 06	08 10	0 10 12	2 12 14	14 1	6 16 18	8 18 20	20 22	2 22 24	24 26	26 28	28 30	30 32	32 34 34	36 36	6 38 38 40	40 42 4	2 44 4	4 46 46 48	3 48 50	52 54 56	58 60	62 64 66
0.091 - 0.110 (0.0036 - 0.0043)		00 00	00 00		4 06 08	10 12	2 12 14	4 14 16	5 16 1	8 18 20		2 22 24	1 24 26	26 28	28 30	30 32	32 34	34 36 36	38 38	8 40 40 42	42 44 4	4 46 4	6 48 48 50	0 50 52	54 56 58	60 62	64 66 68
0.131 - 0.149 (0.0052 - 0.0059)	100	00 00	02 04	1 06 0	8 10 12	14 16	6 16 18	3 18 20) 20 2	2 22 24	4 24 26	6 26 28	3 28 30	30 32	32 34	34 36	36 38	38 40 40	40 40	2 44 44 46	46 48 4	8 50 5	0 52 52 54	4 54 56	58 60 62	64 66	68 70 72
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0.271-0.290 (0.0107-0.0114)	08 10	12 14	16 18	3 20 2	2 24 26	28 30	30 32	2 32 34	1 34 3	6 36 38	8 38 40	0 40 42	2 42 44	44 46	46 48	48 50	50 52	52 54 54	56 50	6 58 58 60	60 62 6	64 6	4 66 66 68	3 68 70	72 74 76	78 80	80 80
0.291 - 0.310(0.0115 - 0.0122) 0.311 - 0.330(0.0122 - 0.0130)	12 14	16 18	20 22	22 2	4 26 28	30 32	134 36	3 36 38	30 30 3		2 40 44	1 44 46	44 40	48 50	48 50	52 54	54 56	56 58 58	60 60	62 62 64	64 66 6	6 68 6		2 72 74	76 78 80	80 80	80
0.331 - 0.350 (0.0122 - 0.0130)	14 16	18 20	22 24	1 26 2	8 30 32	34 36	36 38	3 38 40) 40 4	2 42 44	4 44 46	5 46 48	3 48 50	50 52	52 54	54 56	56 58	58 60 60	62 62	2 64 64 66	66 68 6	8 70 7	0 72 72 74	4 74 76	78 80 80	80	
0.351-0.370 (0.0138-0.0146)	16 18	20 22	24 26	3 28 3	0 32 34	36 38	3 38 40	0 40 42	2 42 4	4 44 46	6 46 48	3 48 50	50 52	52 54	54 56	56 58	58 60	60 62 62	64 64	4 66 66 68	68 70 7	0 72 7	2 74 74 76	3 76 78	80 80 80		
0.371-0.390 (0.0146-0.0154)	18 20	22 24	26 28	3 30 3	2 34 36	38 40	40 42	2 42 44	44 4	6 46 48	8 48 50	50 52	2 52 54	54 56	56 58	58 60	60 62	62 64 64	66 66	6 68 68 70	70 72 7	2 74 7	4 76 76 78	3 78 80	80 80		
0.391-0.410 (0.0154-0.0161)	20 22	24 26	28 30	32 3	4 36 38	40 42	2 42 44	4 44 46	6 46 4	8 48 50	0 50 52	2 52 54	1 54 56	56 58	58 60	60 62	62 64	64 66 66	68 68	8 70 70 72	72 74 7	4 76 7	6 78 78 80	08 08 0	80		
0.411 - 0.430 (0.0162 - 0.0169)	22 24	26 28	30 32	2 34 3	6 38 40	42 44	44 4		48 5	0 50 52	2 52 54	1 54 56	56 56	58 60	60 62	62 64	64 66	66 68 68	70 70	0 72 72 74	76 76 7	6 /8 /	8 80 80 80	08080]		
0.431 - 0.450 (0.0170 - 0.0177)	26 28	30 32	34 36	3 38 4	0 42 44	44 40	40 40	0 50 52	52 5	2 52 54 4 54 5f	6 56 58	3 58 60	0 60 62	62 64	64 66	66 68	68 70	70 72 72	74 74	4 76 76 78	78 80 8	80808					
0.471 - 0.490 (0.0185 - 0.0193)	28 30	32 34	36 38	3 40 4	2 44 46	48 50	50 52	2 52 54	54 5	6 56 58	8 58 60	0 60 62	2 62 64	64 66	66 68	68 70	70 72	72 74 74	76 70	6 78 78 80	80 80 8	80808	0 80	-			
0.491-0.510 (0.0193-0.0201)	30 32	34 36	38 40) 42 4	4 46 48	50 52	2 52 54	4 54 56	56 5	8 58 60	0 60 62	2 62 64	1 64 66	66 68	68 70	70 72	72 74	74 76 76	78 78	8 80 80 80	80 80 8	80 80					
0.511-0.530 (0.0201-0.0209)	32 34	36 38	40 42	2 44 4	6 48 50	52 54	54 56	5 56 58	3 58 6	0 60 62	2 62 64	4 64 66	66 68	68 70	70 72	72 74	74 76	76 78 78	80 80	0 80 80 80	80 80						
0.531-0.550 (0.0209-0.0217)	34 36	38 40	42 44	1 46 4	8 50 52	2 54 56	6 56 58	3 58 60	60 6	2 62 64	4 64 66	66 68	3 68 70	70 72	72 74	74 76	76 78	78 80 80	80 80	0 80 80 80							
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0.571 - 0.590 (0.0225 - 0.0232)	40 42	42 44	40 40	525	4 56 58	0000	00 02	1 64 66	66 6	8 68 70		2 72 74	1 74 76	76 78	78 80	80 80	80 80	80 80 80	100								
0.611-0.630 (0.0241-0.0248)	42 44	46 48	50 52	2 54 5	6 58 60	62 64	64 66	5 66 68	3 68 7	0 70 72	2 72 74	4 74 76	5 76 78	78 80	80 80	80 80	80 80	00 00									
0.631-0.650 (0.0248-0.0256)	44 46	48 50	52 54	1 56 5	8 60 62	64 66	66 68	3 68 70	0 70 7:	2 72 74	4 74 76	6 76 78	3 78 80	80 80	80 80	80 80											
0.651-0.670 (0.0256-0.0264)	46 48	50 52	54 56	5 58 6	62 64	66 68	8 68 70	0 70 72	2 72 7	4 74 76	6 76 78	3 78 80	80 80	80 80	80 80	1	-										
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$\begin{array}{c} 0.731-0.750 & (0.0288-0.0295)\\ 0.751-0.770 & (0.0296-0.0303)\\ 0.771-0.790 & (0.0304-0.0311)\\ 0.791-0.810 & (0.0311-0.0319)\\ 0.811-0.830 & (0.0319-0.0327)\\ 0.831-0.850 & (0.0327-0.0335)\\ 0.851-0.870 & (0.0335-0.0343)\\ 0.871-0.890 & (0.034-0.0356)\\ 0.891-0.910 & (0.0351-0.0358)\\ \end{array}$	54 56 56 58 58 60 62 64 64 66 66 68 68 70 70 72	58 60 60 62 62 64 64 66 66 68 68 70 70 72 74 76	62 64 64 66 66 68 70 72 72 74 74 76 76 78 78 80	4 66 6 5 68 7 3 70 7 0 72 7 2 74 7 4 76 7 5 78 8 3 80 8 0 80 8	10 72 10 72 10 72 12 74 12 74 12 74 12 74 12 74 14 76 16 78 16 78 10 80 10 80 10 80 10 80	76 78 78 80 80 80 80 80 80 80	3 78 80 3 80 80 3 80	0 80 80 0 80 80 0 80 80 0 80 80 0 80 80) 80 8) 80 8)	0 80 80 0								Shim No 00 02 04	o. 2 2 2	Thickness .000 (0.078 .020 (0.079 .040 (0.080	N Shi 7) 5) 3)	New sh m No. 28 30 32	im thickne Thickne 2.280 (0 2.300 (0 2.320 (0	ss .0898) .0906) .0913)	Shim No 56 58 60	Th 2.56 2.58 2.60	mm iickness 60 (0.100 30 (0.101 00 (0.102
$\begin{array}{c} 0.731-0.750 & (0.0288-0.0295)\\ 0.751-0.770 & (0.0296-0.0303)\\ 0.771-0.790 & (0.0304-0.0311)\\ 0.791-0.810 & (0.0311-0.0319)\\ 0.811-0.830 & (0.0319-0.0327)\\ 0.831-0.850 & (0.0327-0.0335)\\ 0.851-0.870 & (0.0355-0.0343)\\ 0.871-0.890 & (0.0343-0.0350)\\ 0.891-0.910 & (0.0359-0.0366)\\ 0.911-0.930 & (0.0359-0.0366)\\ \end{array}$	54 56 56 58 60 62 62 64 64 66 66 68 68 70 70 72 72 74	58 60 62 64 64 66 66 68 70 72 72 74 76 78	62 64 64 66 66 68 70 72 74 76 78 80 80 80	4 66 6 5 68 7 3 70 7 0 72 7 2 74 7 4 76 7 5 78 8 3 80 8 0 80 80	10 72 0 72 74 2 74 76 4 76 78 6 78 80 8 80 80 10 80 80 10 80 80	76 78 78 80 80 80 80 80 80 80	3 78 80 0 80 80 0 8	0 80 80 0 80 80 0 80 80 0 80 80) 80 8 80 8)	0 80 80 0	<u>0</u>							Shim No 00 02 04 06	0. 2 2 2 2	Thickness .000 (0.078 .020 (0.079 .040 (0.080 .060 (0.081	N 7) 5) 3) 1)	New sh m No. 28 30 32 34	im thickne Thickne 2.280 (0 2.300 (0 2.320 (0 2.340 (0	ss .0898) .0906) .0913) .0921)	Shim No 56 58 60 62	Th 2.56 2.58 2.60 2.60	mm ickness 50 (0.100 30 (0.101 00 (0.102 20 (0.103
0.731-0.750 (0.0288-0.0295) 0.751-0.770 (0.0296-0.0303) 0.771-0.790 (0.0304-0.0311) 0.791-0.810 (0.0311-0.0319) 0.811-0.830 (0.0319-0.0327) 0.831-0.850 (0.0327-0.0335) 0.851-0.870 (0.0345-0.0343) 0.871-0.890 (0.0343-0.0350) 0.891-0.910 (0.0351-0.0358) 0.911-0.930 (0.0359-0.0366) 0.931-0.950 (0.0367-0.0374)	54 56 56 58 58 60 62 64 64 66 66 68 70 72 72 74 74 70	58 60 60 62 62 64 64 66 68 70 70 72 74 76 78 80	62 64 64 66 66 68 70 72 72 74 74 76 76 78 80 80 80 80 80 80 80	4 66 6 5 68 7 3 70 7 0 72 7 2 74 7 4 76 7 5 78 8 3 80 8 0 80 8 0 80 8 0 80 8 0 80 8	10 72 10 72 10 72 12 74 12 74 12 74 14 76 16 78 16 78 16 78 17 80 18 80 10 80	76 78 78 80 80 80 80 80 80 80	3 78 80 0 80 80 0 80 80 0 80 80	80 80 80 80 80 80 80 80 80 80 80 80 9) 80 80 80 80 9	0 80 80 0	ט							Shim No 00 02 04 06 08	0. 2 2 2 2 2	Thickness .000 (0.078 .020 (0.079 .040 (0.080 .060 (0.081	Shi 7) 5) 3) 1) 9) 1	New sh m No. 28 30 32 34 36	im thickne Thickne 2.280 (0 2.300 (0 2.320 (0 2.340 (0 2.360 (0	ss .0898) .0906) .0913) .0921)	Shim No 56 58 60 62 64	Th 2.56 2.58 2.60 2.62	mm iickness 60 (0.100 30 (0.101 00 (0.102 20 (0.103 40 (0.103
$\begin{array}{c} 0.731-0.750 & (0.0288-0.0295)\\ 0.751-0.770 & (0.0296-0.0303)\\ 0.771-0.790 & (0.0304-0.0311)\\ 0.791-0.810 & (0.0311-0.0319)\\ 0.811-0.830 & (0.0319-0.0327)\\ 0.831-0.850 & (0.0327-0.0335)\\ 0.851-0.870 & (0.0355-0.0343)\\ 0.871-0.890 & (0.0343-0.0350)\\ 0.891-0.910 & (0.0351-0.0358)\\ 0.911-0.930 & (0.0367-0.0374)\\ 0.931-0.950 & (0.0374-0.0382)\\ 0.971-0.90 & (0.0372-0.038)\\ 0.971-0.90 & (0.0372-0.038)\\ 0.971-0.90 & (0.037-$	54 56 56 58 60 60 62 64 64 66 68 68 70 72 74 76 78 80	58 60 60 62 64 66 68 70 70 72 74 76 78 80 80 80	62 64 66 68 66 70 70 72 72 74 74 76 76 78 80 80 80 80 80	4 66 68 7 5 68 7 7 0 72 7 7 2 74 76 7 4 76 7 7 5 78 8 8 0 80 8 8 0 80 8 8 0 80 8 8 0 80 8 8	8 70 72 0 72 74 2 74 76 4 76 78 6 78 80 8 80 80 00 80 80 00 80 80 00 80 80	76 78 78 80 80 80 80 80 80 80	3 78 80 80 80 80 80 80 80 80 80 9 80 80	80 80 80 80 80 80 80 80 80 80 9	0 80 80 80 80 9	0 80 80	<u>0</u>							Shim No 00 02 04 06 08	0. 2 2 2 2 2 2	Thickness .000 (0.078 .020 (0.079 .040 (0.080 .060 (0.081 .080 (0.081	Shi 7) - 5) - 3) - 1) - 9) - 7) -	New sh m No. 28 30 32 34 36	im thickne Thickne 2.280 (0 2.300 (0 2.320 (0 2.340 (0 2.360 (0 2.360 (0	ss .0898) .0906) .0913) .0921) .0929)	Shim No 56 58 60 62 64	Th 2.56 2.58 2.60 2.62 2.62	mm (iickness 60 (0.100) 80 (0.101) 90 (0.102) 20 (0.103) 10 (0.103) 10 (0.103)
$\begin{array}{c} 0.731-0.750 & (0.0288-0.0295)\\ 0.751-0.770 & (0.0296-0.0303)\\ 0.771-0.790 & (0.0304-0.0311)\\ 0.791-0.810 & (0.0311-0.0319)\\ 0.811-0.830 & (0.0319-0.0327)\\ 0.831-0.850 & (0.0327-0.0335)\\ 0.851-0.870 & (0.0335-0.0343)\\ 0.871-0.890 & (0.035-0.0343)\\ 0.891-0.910 & (0.035-0.0368)\\ 0.911-0.930 & (0.035-0.0368)\\ 0.931-0.950 & (0.0367-0.0374)\\ 0.951-0.970 & (0.0374-0.0382)\\ 0.991-0.10 & (0.0380-0.0390)\\ 0.991-0.10 & (0.0380-0.0390)\\ 0.991-0.10 & (0.0380-0.0390)\\ 0.991-0.10 & (0.0390-0.0389)\\ 0.991-0.10 & (0.0390-0.0389)\\ 0.991-0.10 & (0.0390-0.0389)\\ 0.991-0.0380 & (0.0380-0.0380)\\ 0.991-0.00 & (0.000000)\\ 0.991-0.000 & (0.0000000000)\\ 0.991-0.000000000000\\ 0$	54 56 56 58 58 60 62 64 64 66 66 68 70 72 72 74 74 76 78 80 80 80	58 60 60 62 62 64 66 68 68 70 72 74 76 78 80 80 80 80	62 64 66 68 68 70 70 72 72 74 74 76 76 78 78 80 80 80 80 80	4 66 68 7 3 70 7 7 0 72 7 7 2 74 7 7 3 80 8 8 80 3 80 80 8 0 0 80 80 8 0 0 80 8 0 80	8 70 72 0 72 74 '2 74 76 '4 76 78 '6 78 80 '8 80 80 00 80 80 10 80	76 78 78 80 80 80 80 80 80 80	78 80 80 80 80 80 80 80 80 80 9				urano	ce (C	cold)	:				Shim No 00 02 04 06 08 10	0. 2 2 2 2 2 2 2 2 2	Thickness .000 (0.078 .020 (0.079 .040 (0.080 .060 (0.081 .080 (0.081	Shi 7) 5 3) 1 9) 7	New sh m No. 28 30 32 34 36 38	im thickne Thickne 2.280 (0 2.300 (0 2.320 (0 2.340 (0 2.360 (0 2.380 (0	ss .0898) .0906) .0913) .0921) .0929) .0937)	Shim No 56 58 60 62 64 66	Th 2.56 2.58 2.60 2.62 2.64 2.64	mm iickness 60 (0.100 80 (0.101 90 (0.102 20 (0.103 10 (0.103 60 (0.104
$\begin{array}{c} 0.731-0.750 & (0.0288-0.0295)\\ 0.751-0.770 & (0.0296-0.0303)\\ 0.771-0.790 & (0.0304-0.0311)\\ 0.791-0.810 & (0.0311-0.0319)\\ 0.811-0.830 & (0.0319-0.0327)\\ 0.831-0.850 & (0.0327-0.0335)\\ 0.851-0.870 & (0.0335-0.0343)\\ 0.871-0.890 & (0.0351-0.0356)\\ 0.891-0.910 & (0.0351-0.0356)\\ 0.911-0.930 & (0.0359-0.0366)\\ 0.931-0.950 & (0.0367-0.0374)\\ 0.951-0.970 & (0.0374-0.0382)\\ 0.991-1.010 & (0.0390-0.0398)\\ 1.011-1.030 & (0.0390-0.0466)\\ \end{array}$	54 56 56 58 58 60 62 64 64 66 68 70 72 74 76 78 80 80 80 80	58 60 60 62 62 64 66 68 68 70 72 74 76 78 80 80 80 80	62 64 64 66 66 68 70 72 72 74 74 76 76 78 80 80 80 80 80 80	4 66 6 5 68 7 3 70 7 0 72 7 2 74 7 4 76 7 5 78 8 3 80 8 0 80 8 0 80 9 0 80 9	10 72 74 12 74 76 14 76 78 16 78 80 16 88 80 10 80 80	76 78 78 80 80 80 80 80 80 80	ntak	xe va - 0.2	alve 25 m	clea	uranc 0.000	ce (C 6 – 0	cold)	: in.)				Shim No 00 02 04 06 08 10 12	0. 22 22 22 22 22 22 22 22 22	Thickness .000 (0.078 .020 (0.079 .040 (0.080 .060 (0.081 .080 (0.081 .100 (0.082 .120 (0.083	Shi 7) 5 3) 1 1) 9 7) 5	New sh m No. 28 30 32 34 36 38 40	im thickne 2.280 (0 2.300 (0 2.320 (0 2.320 (0 2.340 (0 2.360 (0 2.380 (0 2.400 (0	SS .0898) .0906) .0913) .0921) .0929) .0937) .0945)	Shim No 56 58 60 62 64 66 68	Th 2.56 2.62 2.62 2.62 2.66 2.66	mm iickness 60 (0.100 30 (0.101 20 (0.102 20 (0.103 40 (0.103 50 (0.104 30 (0.105
$\begin{array}{c} 0.731-0.750 & (0.0288-0.0295)\\ 0.751-0.770 & (0.0296-0.0303)\\ 0.771-0.790 & (0.0304-0.0311)\\ 0.791-0.810 & (0.0311-0.0319)\\ 0.811-0.830 & (0.0319-0.0327)\\ 0.831-0.850 & (0.0327-0.0335)\\ 0.851-0.870 & (0.0335-0.0343)\\ 0.871-0.890 & (0.0343-0.0350)\\ 0.891-0.910 & (0.0351-0.0358)\\ 0.911-0.930 & (0.0359-0.0366)\\ 0.931-0.970 & (0.0367-0.0374)\\ 0.951-0.970 & (0.0382-0.0390)\\ 0.991-1.010 & (0.0390-0.0398)\\ 1.041-1.050 & (0.0406-0.0413)\\ \end{array}$	54 56 56 58 58 60 60 62 64 66 68 70 72 74 76 78 80 80	58 60 60 62 62 64 66 68 68 70 72 74 76 78 80 80 80 80	62 64 64 66 66 68 70 72 72 74 74 76 76 78 80 80 80 80 80	4 66 66 5 68 7 3 70 7 0 72 7 2 74 76 4 76 7 5 78 8 3 80 8 0 80 8 0 80 8 0 80 8	18 70 72 74 0 72 74 76 4 76 78 6 78 80 78 80 80 10 80 80 10 80 10	76 78 78 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 8	ntak	(e va - 0.2	alve 25 m	clea	uranc 0.000	ce (C 6 – 0	old) .010	: in.)				Shim No 00 02 04 06 08 10 12 14	0. 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Thickness .000 (0.078 .020 (0.079 .040 (0.080 .060 (0.081 .080 (0.081 .100 (0.082 .120 (0.083 .140 (0.084	Shi 7)	New sh m No. 28 30 32 34 36 38 40 42	im thickne Thickne 2.280 (0 2.300 (0 2.320 (0 2.340 (0 2.360 (0 2.380 (0 2.400 (0 2.420 (0	ss .0898) .0906) .0913) .0921) .0929) .0937) .0945) .0953)	Shim No 56 58 60 62 64 66 68 70	Th 2.56 2.62 2.62 2.62 2.62 2.62 2.66 2.68 2.70	mm (iickness 30 (0.100) 30 (0.101) 20 (0.103) 40 (0.103) 30 (0.104) 30 (0.104) 30 (0.105) 30 (0.106)
$\begin{array}{c} 0.731-0.750 & (0.0288-0.0295)\\ 0.751-0.770 & (0.0296-0.0303)\\ 0.771-0.790 & (0.0304-0.0311)\\ 0.791-0.810 & (0.0311-0.0319)\\ 0.811-0.830 & (0.0319-0.0327)\\ 0.831-0.850 & (0.0327-0.0335)\\ 0.851-0.870 & (0.0335-0.0343)\\ 0.871-0.890 & (0.0343-0.0350)\\ 0.891-0.910 & (0.0351-0.0358)\\ 0.931-0.950 & (0.0367-0.0374)\\ 0.951-0.970 & (0.0382-0.0390)\\ 0.991-1.010 & (0.0398-0.0406)\\ 1.031-1.050 & (0.0406-0.0413)\\ \end{array}$	54 56 56 58 58 60 60 62 64 66 68 70 72 74 74 76 76 78 80 80	58 60 60 62 62 64 64 66 68 70 72 74 74 76 78 80 80 80	62 64 64 66 66 68 70 72 72 74 74 76 76 78 80 80 80 80 80	4 66 6 5 68 7 3 70 7 0 72 7 2 74 7 4 76 7 5 78 8 3 80 8 0 80 8 0 80 8 0 80 8	8 70 72 74 0 72 74 76 4 76 78 6 78 80 8 80 80 0 80 80 10 80	76 78 78 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 8	ntak).15	xe va - 0.2	alve 25 m	clea	uranc 0.000	ce (C 6 – 0	cold) .010	: in.)				Shim No 00 02 04 06 08 10 12 14 14	D. 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Thickness .000 (0.078 .020 (0.079 .040 (0.080 .060 (0.081 .080 (0.081 .100 (0.082 .120 (0.083 .140 (0.084 .160 (0.085	Shi 7) - 5) - 3) - 1) - 9) - 7) - 5) - 3) - 3) - 0) -	New sh m No. 28 30 32 34 36 38 40 42 44	im thickne 2.280 (0 2.300 (0 2.320 (0 2.320 (0 2.340 (0 2.360 (0 2.380 (0 2.400 (0 2.420 (0 2.420 (0 2.440 (0	ss .0898) .0906) .0913) .0921) .0929) .0937) .0945) .0953) .0961)	Shim No 56 58 60 62 64 66 68 70 72	Th 2.56 2.62 2.62 2.62 2.62 2.62 2.62 2.62	mm (iickness 30 (0.100) 30 (0.101) 30 (0.102) 20 (0.103) 30 (0.103) 30 (0.104) 30 (0.105) 30 (0.106) 20 (0.107)
$\begin{array}{c} 0.731-0.750 & (0.0288-0.0295)\\ 0.751-0.770 & (0.0296-0.0303)\\ 0.771-0.790 & (0.0304-0.0311)\\ 0.791-0.810 & (0.0311-0.0319)\\ 0.811-0.830 & (0.0319-0.0327)\\ 0.831-0.850 & (0.0327-0.0335)\\ 0.851-0.870 & (0.0335-0.0343)\\ 0.871-0.890 & (0.0343-0.0350)\\ 0.891-0.910 & (0.0351-0.0358)\\ 0.911-0.930 & (0.0367-0.0374)\\ 0.951-0.970 & (0.0374-0.0382)\\ 0.951-0.970 & (0.0382-0.0390)\\ 0.991-1.010 & (0.0390-0.0398)\\ 1.011-1.030 & (0.0398-0.0406)\\ 1.031-1.050 & (0.0406-0.0413)\\ \end{array}$	54 56 56 58 58 60 60 62 64 66 66 68 67 70 70 72 74 76 78 80 80 80	58 60 60 62 62 64 64 66 68 70 72 74 74 76 78 80 80 80	62 64 64 66 66 68 70 72 72 74 74 76 76 78 80 80 80 80 80 80	4 66 6 5 68 7 3 70 7 0 72 7 2 74 7 4 76 7 5 78 8 3 80 8 0 80 8 0 80 8 0 80 8 0 80 8	8 70 72 74 0 72 74 76 4 76 78 80 6 78 80 80 0 80 80 80 0 80 80 80 10 80 80 80	76 78 78 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 8	ntak).15 ().15 ().16	ke va – 0.2 .MPI 2.30	alve 25 m _E:)0 m	clea 1m ((uranc 0.000	ce (C 6 – 0 06 ir	Cold) 0.010	: in.) nim i	s ins	stalle	ed,	Shim No 00 02 04 06 08 10 12 14 16 18	D. 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Thickness .000 (0.078 .020 (0.079 .040 (0.080 .060 (0.081 .100 (0.082 .120 (0.083 .140 (0.084 .160 (0.085 .180 (0.085	Shi 7) 5 3) 1 9) 7 7) 5 33) 0 0) 8	New sh m No. 28 30 32 34 36 38 40 42 44 44	im thickne Thickne 2.280 (0 2.300 (0 2.320 (0 2.340 (0 2.360 (0 2.360 (0 2.400 (0 2.420 (0 2.420 (0 2.440 (0 2.460 (0	SS .0898) .0906) .0913) .0921) .0929) .0937) .0945) .0953) .0961) .0969)	Shim No 56 58 60 62 64 66 68 70 72 74	Th 2.56 2.55 2.60 2.62 2.62 2.66 2.68 2.70 2.72 2.72	mm (iickness 50 (0.100) 30 (0.101) 20 (0.102) 20 (0.103) 30 (0.104) 30 (0.104) 30 (0.105) 30 (0.106) 20 (0.107) 40 (0.107)
$\begin{array}{c} 0.731-0.750 & (0.0288-0.0295)\\ 0.751-0.770 & (0.0296-0.0303)\\ 0.771-0.790 & (0.0304-0.0311)\\ 0.791-0.810 & (0.0311-0.0319)\\ 0.811-0.830 & (0.0319-0.0327)\\ 0.831-0.850 & (0.0327-0.0335)\\ 0.851-0.870 & (0.0335-0.0343)\\ 0.871-0.890 & (0.0343-0.0356)\\ 0.891-0.910 & (0.0359-0.0366)\\ 0.931-0.950 & (0.0367-0.0374)\\ 0.951-0.970 & (0.0374-0.0382)\\ 0.991-1.010 & (0.0392-0.0398)\\ 1.011-1.030 & (0.0398-0.0406)\\ 1.031-1.050 & (0.0406-0.0413)\\ \end{array}$	54 56 56 58 58 60 60 62 64 66 66 68 68 70 70 72 74 76 76 78 80 80 80 80	58 60 60 62 62 64 64 66 68 70 72 74 74 76 78 80 80 80	62 64 64 66 66 68 70 72 72 74 74 76 76 78 80 80 80 80 80	4 66 6 5 68 7 3 70 7 0 72 7 2 74 7 3 80 8 0 80 8 0 80 8 0 80 8 0 80 8 0 80 8 0 80 8 0 80 8	8 70 72 74 0 72 74 76 4 76 78 80 6 78 80 80 10 80 80 80	76 78 78 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 8	ntak 3.78 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 8	xe va – 0. 2 .MPI 2.30	alve 25 m _E:)0 m	clea mm ((asur	uranc 0.000 0.09 red c	ce (C 6 – 0 06 ir	cold) 0.010 n.) sl	: in.) nim i e is	s in:	stalle	ed,	Shim No 00 02 04 06 08 10 12 14 16 18 20	D. 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Thickness .000 (0.078 .020 (0.079 .040 (0.080 .060 (0.081 .100 (0.082 .120 (0.083 .140 (0.084 .160 (0.085 .180 (0.085 .200 (0.086	Shi 7) 5 5) 3 1) 9 5) 3 7) 5 33) - 6) -	New sh m No. 28 30 32 34 36 38 40 42 44 46 48	im thickne Thickne 2.280 (0 2.300 (0 2.320 (0 2.340 (0 2.360 (0 2.400 (0 2.420 (0 2.420 (0 2.440 (0 2.460	SS .0898) .0906) .0913) .0921) .0929) .0937) .0945) .0953) .0961) .0969) .0976)	Shim No 56 58 60 62 64 66 68 70 72 74	Th 2.56 2.55 2.60 2.62 2.66 2.66 2.66 2.70 2.72 2.72 2.74	mm ickness 60 (0.100 30 (0.101) 20 (0.102 20 (0.103) 40 (0.103) 50 (0.104) 50 (0.105) 50 (0.107) 40 (0.107) 50 (0.108)
$\begin{array}{c} 0.731-0.750 & (0.0288-0.0295)\\ 0.751-0.770 & (0.0296-0.0303)\\ 0.771-0.790 & (0.0304-0.0311)\\ 0.791-0.810 & (0.0311-0.0319)\\ 0.811-0.830 & (0.0319-0.0327)\\ 0.831-0.850 & (0.0327-0.0335)\\ 0.851-0.870 & (0.0355-0.0343)\\ 0.871-0.890 & (0.0343-0.0350)\\ 0.891-0.910 & (0.0351-0.0368)\\ 0.911-0.930 & (0.0359-0.0366)\\ 0.931-0.950 & (0.0374-0.0382)\\ 0.951-0.970 & (0.0374-0.0382)\\ 0.971-0.990 & (0.0382-0.0398)\\ 1.011-1.030 & (0.0390-0.0398)\\ 1.031-1.050 & (0.0406-0.0413)\\ \end{array}$	54 56 56 58 58 60 62 64 64 66 68 70 72 74 74 76 78 80 80 80 80 80	58 60 60 62 62 64 64 66 68 70 72 74 74 76 78 80 80 80	62 64 64 66 66 68 68 70 70 72 72 74 74 76 76 78 80 80 80 80 80 80	4 66 6 5 68 7 3 70 7 7 2 7 7 7 7 7 7 7 7 7 7 7 7 7	8 70 72 74 7 74 76 78 2 74 76 78 4 76 78 80 6 78 80 80 0 80 80 80 0 80 80 80 0 80 80 80 0 80 80 80 0 80 80 80 0 80 80 80 0 80 80 80 0 80 80 80 0 80 80 80		ntak 30 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 8	xe va = 0.2 MPI 2.30 the	alve 25 m _E:)0 m in \	clea mm ((asur	urano 0.000 0.09 red (ce (C 6 – 0 06 ir	cold) .010	: in.) nim i e is	s ins 0.44	stalle	ed, im	Shim No 00 02 04 06 08 10 12 14 16 18 20 22). 22 22 22 22 22 22 22 22 22 22 22 22 22	Thickness .000 (0.078 .020 (0.079 .040 (0.080 .060 (0.081 .100 (0.082 .120 (0.083 .140 (0.084 .160 (0.085 .180 (0.085 .200 (0.086	Shi 7) 5 5) 3 1) 9 5) 3 7) 5 33) - 6) - 4) -	New sh m No. 28 30 32 34 36 38 40 42 44 46 48 50	im thickne Thickne 2.280 (0 2.300 (0 2.320 (0 2.340 (0 2.340 (0 2.400	SS .0898) .0906) .0913) .0921) .0929) .0937) .0945) .0953) .0961) .0969) .0976) .09264	Shim No 56 58 60 62 64 66 68 70 74 76 79	Th 2.56 2.62 2.62 2.62 2.62 2.62 2.62 2.62	mm (iickness 30 (0.100) 30 (0.101) 20 (0.102) 20 (0.103) 30 (0.104) 30 (0.104) 30 (0.104) 30 (0.104) 30 (0.104) 30 (0.107) 30 (0.108) 30 (0.108)
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$\begin{array}{c} 0.731 - 0.750 & (0.0288 - 0.0295) \\ 0.751 - 0.770 & (0.0296 - 0.0303) \\ 0.771 - 0.790 & (0.0304 - 0.0311) \\ 0.791 - 0.810 & (0.0311 - 0.0319) \\ 0.811 - 0.830 & (0.0319 - 0.0327) \\ 0.831 - 0.850 & (0.0327 - 0.0335) \\ 0.851 - 0.870 & (0.0335 - 0.0343) \\ 0.871 - 0.890 & (0.0343 - 0.0350) \\ 0.891 - 0.910 & (0.0351 - 0.0386) \\ 0.931 - 0.950 & (0.0374 - 0.0382) \\ 0.951 - 0.970 & (0.0374 - 0.0382) \\ 0.971 - 0.990 & (0.0382 - 0.0398) \\ 1.011 - 1.030 & (0.0398 - 0.0406) \\ 1.031 - 1.050 & (0.0406 - 0.0413) \\ \end{array}$	54 56 56 58 60 62 64 66 68 70 72 74 76 78 80 80	58 60 62 62 64 66 68 68 70 72 74 76 78 80 80 80 80 80	62 64 64 66 66 68 70 72 74 74 76 78 80 80 80 80 80 80 80	4 66 6 5 68 7 70 72 7 2 74 7 4 76 7 5 78 8 3 80 8 8 80	8 70 72 74 1 76 78 80 6 78 80 80 80 10 80 80 80 80 10 80 80 80 80 10 80 80 80 80	76 78 80 8	ntak 0.15 0.07 0.07 0.07 0.07 0.07	ce va <u>80 80</u> 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 8	alve 25 m _E: 00 m mea in.).	clea mm ((asur Rep h a	orano 0.000 red c blace No.	ce (C 6 – 0 06 ir clear 2 the 54 s	cold) 0.010 anc 2.3 shim	: in.) e is 00 m	s ins 0.44 mm (l	stalle 40 n 0.09	ed, nm 06	Shim No 00 02 04 06 08 10 12 14 16 18 20 22 24	D. 22 22 22 22 22 22 22 22 22 22 22 22 22	Thickness .000 (0.078 .020 (0.079 .040 (0.080 .060 (0.081 .080 (0.081 .100 (0.082 .120 (0.083 .140 (0.084 .160 (0.085 .200 (0.086 .220 (0.087 .240 (0.088	Shi 7) 5 5) 3 1) 9 7) 5 5) 3 7) 5 5) 3 6) - 4) - 2) -	New sh m No. 28 30 32 34 36 38 40 42 44 46 48 50 52	im thickne 2.280 (0 2.300 (0 2.320 (0 2.340 (0 2.340 (0 2.340 (0 2.340 (0 2.420 (0 2.440 (0 2.440 (0 2.440 (0 2.460 (0 2.500 (0 2.520 (0	SS .0898) .0906) .0913) .0921) .0929) .0937) .0945) .0945) .0969) .0969) .0984) .0984) .0992)	Shim No 56 58 60 62 64 66 68 70 72 74 76 78 80	Th 2.56 2.62 2.62 2.64 2.66 2.66 2.70 2.77 2.77 2.77 2.77 2.77 2.77 2.77	mm (iickness 30 (0.100) 30 (0.101) 30 (0.102) 30 (0.103) 30 (0.103) 30 (0.103) 30 (0.103) 30 (0.104) 30 (0.105) 30 (0.106) 30 (0.107) 30 (0.107) 30 (0.108) 30 (0.109) 30 (0.110)
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Author :

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EM-7

2000 LEXUS LS40	
0 (RM717U)	

Installed shim thickness	87)	'95)	() ()	19)	(27)	(35)	143) 50)	58)	(99)	(02	(78)	82)	(98	() ()	(1 86)	02)	(90	(00)	17)	21)	25)	(53)	33)	941)	945)	(46)	57)	61)	(65)	(22)	(020)	84)	88)	96)	() ()	(10)	12)	16)	24)	31)	947)	55) 63)	11	(62)	94)	(2)
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mm (in.)													00				00		4 04					10	10				101								00					40 4		40 4		
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0.071-0.090 (0.0028-0.0035)							10	0 00	000	00 0	00 0	2 02	04	04 0	6 06	608	08	10 1	0 12	2 12	14	14 1	16 16	18	18 2	20 2	0 22	2 22	24 2	4 26	26 2	3 28	30 30) 32	32 3	4 34	36	36 38	3 38	40 42	2 44	46 4	3 50	52 5	4 56	58
0.091-0.110 (0.0036-0.0043)			+		+		00 0	0 00	00 0	02 0	02 0	4 04	06	06 0	8 08	3 10	10	12 1	2 14	14	16	16 1	18 18	20	20 2	22 2	2 24	1 24	26 2	6 28	28 3	0 30	32 32	2 34	34 3	6 36	38	38 40) 40	42 44	1 46	48 5	0 52	54 5	6 58	60
0.111-0.130 (0.0044-0.0051)						00	00 0	0 00	02	04 0	04 0	6 06	08	08 1	0 10) 12	12	14 1	4 16	6 16	18	18 2	20 20	22	22 2	24 2	4 26	6 26	28 2	8 30	30 3	2 32	34 34	1 36	36 3	8 38	40	40 42	2 42	44 46	6 48	50 5	2 54	56 5	8 60	62
0.131-0.150 (0.0052-0.0059)					00	00 0	00 0	0 02	2 04	06 0	06 0	8 08	10	10 1	2 12	2 14	14	16 1	6 18	3 18	20	20 2	22 22	24	24 2	26 2	6 28	3 28	30 3	0 32	32 3	4 34	36 36	5 38	38 4	0 40	42	42 44	44	46 48	3 50	52 5	4 56	58 6	0 62	64
0.151-0.170 (0.0059-0.0067)				00	00	00 (00 0	2 04	1 06	08 0)8 10	0 10	12	12 1	4 14	16	16	18 1	8 20	20	22	22 2	24 24	26	26 2	28 2	8 30) 30	32 3	2 34	34 3	5 36	38 38	3 40	40 4	2 42	44	14 46	6 46	48 50) 52	54 5	6 58	60 6	2 64	66
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0.191-0.210 (0.0075-0.0083)		00			00	02 0	04 0	8 10	3 10	12 1	12 1	4 14	16	16 1	8118	120	20	22 2	2 24	24	26	26 2	28 28	30	30 3	32 3	2 34	34	36 3	8 40	38 4	2 40	42 42	1 44	44 4	8 48	48	18 50	50	52 54	+ 56	58 6	2 64	64 6	8 70	70
0.231-0.249 (0.0091-0.0098)		00		0 00	02	04 0	08 1	0 12	2 14	16 1	6 1	8 18	20	20 2	2 22	22	24	26 2	6 28	20	30	30 3	32 32	34	34 3	36 3	6 38	3 38	40 4	0 40	40 4	1 44	46 4	40	40 4	0 50	52	52 54	1 54	56 58	3 60	62 6	2 66	68 7	0 72	74
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0.371-0.390 (0.0146-0.0154)	08	10	12 1	4 16	18	20 2	22 2	4 26	5 28	30 3	30 33	2 32	34	34 3	6 36	6 38	38	40 4	0 42	2 42	44	44 4	46 46	48	48 5	50 5	0 52	2 52	54 5	4 56	56 5	3 58	60 60	0 62	62 6	4 64	66	66 68	3 68	70 72	2 74	76 7	3 80	80 8	0	,
0.391-0.410 (0.0154-0.0161)	10	12	14 1	6 18	20	22 2	24 2	6 28	3 30	32 3	32 3	4 34	36	36 3	8 38	3 40	40	42 4	2 44	44	46	46 4	48 48	50	50 5	52 5	2 54	1 54	56 5	6 58	58 6	0 60	62 63	2 64	64 6	6 66	68	58 70	70	72 74	1 76	78 8	08 C	80		
0.411-0.430 (0.0162-0.0169)	12	14	16 1	8 20	22	24 2	26 2	8 30) 32	34 3	34 3	6 36	38	38 4	0 40) 42	42	44 4	4 46	6 46	48	48 5	50 50	52	52 5	54 5	4 56	56	58 5	8 60	60 6	2 62	64 64	1 66	66 6	8 68	70	70 72	2 72	74 76	5 78	80 8	08 0			
0.431-0.450 (0.0170-0.0177)	14	16	18 2	20 22	24	26 2	28 3	0 32	2 34	36 3	36 3	8 38	40	40 4	2 42	2 44	44	46 4	6 48	3 48	50	50 5	52 52	54	54 5	56 5	6 58	3 58	60 6	0 62	62 6	1 64	66 6	5 68	68 7	0 70	72	72 74	174	76 78	3 80	80 8	2			
0.451-0.470 (0.0178-0.0185)	10	18	20 2	2 24	20	28	30 3	2 34	+ 30	38 3	10 4	2 40	42	42 4	4 44 6 16	40	40	48 4	0 50	150	52	52 5	54 54	50	50 30	20 00	0 60	00	62 6	2 64	66 6		70 70	3 70	70 7	2 72	74	76 70	70	78 80	180	80				
0.491 - 0.510 (0.0183 - 0.0193)	20	20	24 2	6 28	30	32 (34 3	6 38	3 40	40 4	12 4	4 44	44	44 4	8 48	2 50	50	52 5	2 54	154	56	56 5	58 58	60	60 6	32 6	2 64	1 64	66 6	6 68	68 7	70	72 7	74	74 7	6 76	78	78 80	80	80 80						
0.511-0.530 (0.0201-0.0209)	22	24	26 2	8 30	32	34 3	36 3	8 40) 42	44 4	14 4	6 46	48	48 5	0 50) 52	52	54 5	4 56	5 56	58	58 6	50 60	62	62 6	54 6	4 66	66	68 6	8 70	70 7	2 72	74 74	1 76	76 7	8 78	80	30 80	80	80	1					
0.531-0.550 (0.0209-0.0217)	24	26	28 3	0 32	34	36 3	38 4	0 42	2 44	46 4	16 4	8 48	50	50 5	2 52	2 54	54	56 5	6 58	58	60	60 6	52 62	64	64 6	36 6	6 68	8 68	70 7	0 72	72 7	1 74	76 76	5 78	78 8	0 80	80	30 80	80							
0.551-0.570 (0.0217-0.0224)	26	28	30 3	2 34	36	38 4	40 4	2 44	1 46	48 4	18 5	0 50	52	52 5	4 54	56	56	58 5	8 60	60	62	62 6	54 64	66	66 6	6 86	8 70) 70	72 7	2 74	74 7	3 76	78 78	3 80	80 8	0 80	80	30 80								
0.571-0.590 (0.0225-0.0232)	28	30	32 3	4 36	38	40 4	42 4	4 46	6 48	50 5	50 53	2 52	54	54 5	6 56	58	58	60 6	0 62	2 62	64	64 6	66 66	68	68 7	70 7	0 72	2 72	74 7	4 76	76 7	3 78	80 80	080	80 8	0 80	80		-							
0.591-0.610 (0.0233-0.0240)	30	32	34 3	6 38	40	42 4	44 4	6 48	3 50	52 5	52 5	4 54	56	56 5	8 58	8 60	60	62 6	2 64	64	66	66 6	68 68	70	70 7	72 7	2 74	1 74	76 7	6 78	78 8	080	80 80	0 80	80 8	0										
0.611-0.630 (0.0241-0.0248)	32	34	36 3	8 40	42	44	46 4	8 50) 52	54 5	54 5	6 56	58	58 6	0 60	62	62	64 6	4 66	66	68	68 7	70 70	72	72	74 7	4 76	5 76	78 7	8 80	80 8	0 80	80 80	0 80												
0.631-0.650 (0.0248-0.0256)	34	36	38 4	0 42	44	46 4	48 5	0 52	2 54	56 5	6 5	8 58	60	60 6	2 62	2 64	64	66 6	6 68	8 68	70	70 7	12 72	74	74	76 7	6 78	3 78	80 8	0 80	80 8	01801	80													
0.651 - 0.670(0.0256 - 0.0264)	30	38	40 4	2 44	40	48 3	52 5	2 34	+ 50	58 5		2 62	64	64 6	6 66	60	69	70 7	0 73	70	74	74 7	76 76	70	70 /	20 0	0 80	180	80 8	0 80	8018	2														
0.691 - 0.710 (0.0272 - 0.0272)	40	40	44 4	6 48	50	52 /	54 5	6 58	3 60	62 6	2 6	4 64	66	66 6	8 68	3 70	70	72 7	2 74	74	76	76 7	78 78	80	80 8	30 8	0 80	80	80	0100																
0.711-0.730 (0.0280-0.0287)	42	44	46 4	8 50	52	54 5	56 5	8 60	0 62	64 6	54 6	6 66	68	68 7	0 70) 72	72	74 7	4 76	5 76	78	78 8	30 80	80	80 8	30 8	0 80		00																	
0.731-0.750 (0.0288-0.0295)	44	46	48 5	0 52	54	56 !	58 6	0 62	2 64	66 6	6 6	8 68	70	70 7	2 72	2 74	74	76 7	6 78	3 78	80	80 8	30 80	80	80 8	30	-	-																		
0.751-0.770 (0.0296-0.0303)	46	48	50 5	2 54	56	58 6	60 6	2 64	1 66	68 6	58 70	0 70	72	72 7	4 74	1 76	76	78 7	8 80	80	80	80 8	30 80	80		_																				
0.771-0.790 (0.0304-0.0311)	48	50	52 5	4 56	58	60 6	62 6	4 66	68 6	70 7	70 73	2 72	74	74 7	6 76	5 78	78	80 8	0 80	80	80	80 8	30												New	shin	n thi	ckne	SS					r	mm ((in.)
0.791-0.810 (0.0311-0.0319) 0.811-0.830 (0.0319-0.0327)	50 52	52 54	54 5 56 5	6 58 8 60	60	62 6 64 6	64 6 66 6	6 68	3 70	72 7	72 7	4 74 6 76	76 78	76 7 78 8	8 78	3 80 3 80	80 80	80 8 80 8	0 80	80	80							s	him N	No.	Thi	cknes	s	S	him N	lo.	Th	ickne	SS	s	him I	No.	Tł	nickne	ess	
0.831-0.850 (0.0327-0.0335)	54	56	58 6	0 62	64	66 6	68 7	0 72	2 74	76 7	76 71	8 78	80	80 8	0 80	80	80	80											00		2 00	0 (0 (787		28		2.28	0 0	0898	3)	56		2.5	30 (0	100	8)
0.851-0.870 (0.0335-0.0343)	56	58	60 6	2 64	66	68	70 7	2 74	1 76	78 7	78 8	0 80	80	80 8	0 80	80														+	0.00		705)		00		0.00		0000	<u>,</u>			0.5		101	<u>~</u>
0.871-0.890 (0.0343-0.0350)	58	60	62 6	4 66	68	70	72 7	4 76	5 78	80 E	30 8	0 80	80	80 8	0													-	02		2.02	0 (0.0	1795)		30		2.30	0 (0	.0906	5)	58		2.5	30 (0	. 1010	2)
0.891-0.910 (0.0351-0.0358)	60	62	64 6	6 68	70	72	74 7	6 78	3 80	80 8	30 8	0 80	80																04		2.04	0 (0.0)803)		32		2.32	20 (0	.0913	3)	60		2.6	0) 00	.102	4)
0.911-0.930 (0.0359-0.0366)	62	64	66 6	8 70	72	74	76 7	8 80	0 80	80 8	30 8	0																	06		2.06	0 (0.0	0811)		34		2.34	0) 0	.0921	1)	62		2.6	20 (0	.103	1)
0.931 - 0.950 (0.0367 - 0.0374)	64	60	08 7	0 /2	76	70 0	18 8	0 80	1081	80																			08		2.08	0 (0.0	0819)		36		2.36	60 (0	.0929	3)	64		2.6	40 (0	.1039	9)
0.951 - 0.970(0.0374 - 0.0382)	68	70	72 7	2 74	78	80 8	80 8	0 00	<u>'</u>	_										,	~								10		2 10		1827)	-	28		2.26		0037	7)	88		2.6	30 (0	104	7
0.991-1.010 (0.0390-0.0398)	70	72	74 7	6 78	80	80 8	80	Ĩ.		E	=Xł	าลเ	ıst	va	IVe	e c	iea	irai	nce	e (U0	Id)):					\vdash	10		2.10)021)		40		2.00		0047	\rightarrow	00	+	2.0	20 (0	104	\leq
1.011-1.030 (0.0398-0.0406)	72	74	76 7	8 80	80	80				0).2	5 –	0.	35	m	n (0.0)10) —	0.0)14	l ir	າ.)					\vdash	12		2.12	0 (0.0	1835)		40		2.4(0) 0	.0945))	68	+	2.6	50 (0	.105	<u>)</u>
1.031-1.050 (0.0406-0.0413)	74	76	78 8	0 80	80					Г	=v	٨٨				`							•						14		2.14	0 (0.0)843)		42		2.42	20 (0	.0953	3)	70		2.7	0) 00	.106	3)
1.051-1.070 (0.0414-0.0421)	76	78	80 8	0 80							_^	ΗI	// [•		_						-				_		16		2.16	0 (0.0	0850)		44		2.44	0) 0	.0961	1)	72		2.7	20 (0	.107	1)
1.071-1.090 (0.0422-0.0429)	78	80	80 8	0							Γhe	e 2	2.30	00	mr	n (0.0)90)6	in.) s	hir	n is	s ir	nsta	alle	ed,		18		2.18	0 (0.0	0858		46		2.46	0) 0	.0969	3)	74		2.7	40 (0	.1079	9) T
1.091-1.110 (0.0430-0.0437)	180	δU	6U													`					,						,																			-

Adjusting Shim Selection Chart (Exhaust)

and the measured clearance is 0.440 mm

20

22

24

26

2.200 (0.0866)

2.220 (0.0874)

2.240 (0.0882)

2.260 (0.0890)

48

50

52

54

2.480 (0.0976)

2.500 (0.0984)

2.520 (0.0992)

2.540 (0.1000)

2.760 (0.1087)

2.780 (0.1094)

2.800 (0.1102)

76

78

80

EM-8

A03112

1.111-1.130 (0.0437-0.0445)

1.131-1.150 (0.0445-0.0453) 80

80 80

1.





IGNITION TIMING INSPECTION **REMOVE BATTERY CLAMP COVER**

- 2. **REMOVE AIR CLEANER INLET**
- **REMOVE V–BANK COVER** 3.

Remove the 2 cap nuts, bolt and V-bank cover.

4. WARM UP ENGINE

Allow the engine to warm up to normal operating temperature.

- CONNECT LEXUS HAND-HELD TESTER OR OBD II 5. **SCAN TOOL**
- (a) Connect the hand-held tester or OBD II scan tool to the DLC3.
- Please refer to the hand-held tester or OBD II scan tool (b) operator's manual for further details.

6. CONNECT TIMING LIGHT TO ENGINE

Connect the tester probe of a timing light to the yellow lead wire of the ignition coil connector for No.1 cylinder.

- 7. **CHECK IDLE SPEED**
- Race the engine speed at 2,500 rpm for approx. 90 se-(a) conds.
- (b) Check the idle speed. Idle speed: 750 ± 50 rpm

INSPECT IGNITION TIMING 8.

Using SST, connect terminals TC and E1 of the DLC1. (a) SST 09843-18020



Yellow

Wire



2000 LEXUS LS400 (RM717U)

- (b) Using a timing light, check the ignition timing. Ignition timing: 8 – 12° BTDC @ idle (Transmission in neutral position)
- Remove the SST from the DLC1. (c) SST 09843-18020
- **DISCONNECT TIMING LIGHT FROM ENGINE** 9.
- 10. DISCONNECT LEXUS HAND-HELD TESTER OR OBD **II SCAN TOOL**
- **REINSTALL V-BANK COVER** 11.
- 12. **REINSTALL AIR CLEANER INLET**

EM09J-02

EM-9

13. REINSTALL BATTERY CLAMP COVER

IDLE SPEED

INSPECTION

1. INITIAL CONDITIONS

- (a) Engine at normal operating temperature
- (b) Air cleaner installed
- (c) All pipes and hoses of air induction system connected
- (d) All accessories switched OFF
- (e) All vacuum lines properly connected

HINT:

- All vacuum hoses should be properly connected.
- (f) SFI system wiring connectors fully plugged
- (g) Ignition timing set correctly
- (h) Transmission in neutral position
- (i) Air conditioning switched OFF
- 2. CONNECT LEXUS HAND-HELD TESTER OR OBD II SCAN TOOL (See page EM-9)
- 3. INSPECT IDLE SPEED
- (a) Race the engine speed at 2,500 rpm for approx. 90 seconds.
- (b) Check the idle speed.

Idle speed: 750 ± 50 rpm

If the idle speed is not as specified, check the air intake system.

4. DISCONNECT LEXUS HAND-HELD TESTER OR OBD II SCAN TOOL

2000 LEXUS LS400 (RM717U)

EM09K-02

TIMING BELT COMPONENTS

EM09L-02









2000 LEXUS LS400 (RM717U)

Date :

REMOVAL

- 1. REMOVE OIL PAN PROTECTOR
- 2. REMOVE ENGINE UNDER COVER
- 3. DRAIN ENGINE COOLANT
- 4. REMOVE BATTERY CLAMP COVER
- 5. REMOVE AIR CLEANER INLET
- 6. REMOVE V–BANK COVER

Remove the bolt, 2 cap nuts and V-bank cover.

7. REMOVE AIR CLEANER AND INTAKE AIR CONNEC-TOR ASSEMBLY

A01892





8. REMOVE DRIVE BELT, FAN, FLUID COUPLING AND FAN PULLEY

- (a) Loosen the 4 nuts holding the fluid coupling to the fan bracket.
- (b) Remove the generator drive belt. (See page CH-8)
- (c) Remove the 4 nuts, the fan, fluid coupling assembly and fan pulley.
- 9. REMOVE RADIATOR ASSEMBLY (See page CO-21)
- 10. REMOVE DRIVE BELT IDLER PULLEY

Remove the pulley bolt, cover plate and idler pulley.

- 11. REMOVE RH NO.3 TIMING BELT COVER
- (a) Disconnect the PS air hose from the clamp of the timing belt cover.
- (b) Disconnect the wire clamp.
- (c) Disconnect the radiator reservoir outlet hose from the water inlet housing.
- (d) Remove the bolt and nut, disconnect the outlet pipe from the timing belt cover and LH cylinder head.
- (e) Remove the 3 bolts, timing belt cover and gasket.

EM09M-02

ENGINE MECHANICAL - TIMING BELT



12. REMOVE LH NO.3 TIMING BELT COVER

- (a) Disconnect the engine wire from the 2 wire clamps.
- (b) Remove the 4 bolts and nut.
- (c) Disconnect the camshaft position sensor wire from the wire clamp on the timing belt cover.
- (d) Disconnect the sensor connector from the connector bracket.
- (e) Disconnect the sensor connector.
- (f) Remove the wire grommet from the timing belt cover.
- (g) Remove the timing belt cover and gasket.
- 13. REMOVE NO.2 TIMING BELT COVER

Remove the 2 bolts and No.2 timing belt cover.

- 14. DISCONNECT A/C COMPRESSOR FROM ENGINE (See page EM-77)
- 15. REMOVE FAN BRACKET

Remove the 2 bolts, 2 nuts and fan bracket.



16. IF RE-USING TIMING BELT, CHECK INSTALLATION MARKS ON TIMING BELT

Check that there are 3 installation marks on the timing belt by turning the crankshaft pulley as shown in the illustration. HINT:

If the installation marks have disappeared, place a new installation mark on the timing belt before removing each part.



17. LOOSEN CRANKSHAFT PULLEY BOLT

Using SST, loosen the pulley bolt. SST 09213–70010 (90105–08076), 09330–00021

- A01871
- 18. SET NO.1 CYLINDER TO APPROX. 50° ATDC/COM-PRESSION
- (a) Turn the crankshaft pulley and align its groove with timing mark "0" of the No.1 timing belt cover.





(b) Check that the timing marks of the camshaft timing pulleys and timing belt rear plates aligned.

If not, turn the crankshaft 1 revolution (360°).

(c) Turn the crankshaft pulley approx. 50° clockwise, and put the timing mark of the crankshaft pulley in line with the centers of the crankshaft pulley bolt and the idler pulley bolt.

NOTICE:

If the timing belt is disengaged, having the crankshaft pulley at the wrong angle can cause the piston head and valve head to come into contact with each other when you remove the camshaft timing pulley (step 19), causing damage. So always set the crankshaft pulley at the correct angle.

(d) Remove the crankshaft pulley bolt. **NOTICE:**

Do not turn the crankshaft pulley.





19. REMOVE TIMING BELT TENSIONER HINT:

When re–using timing belt:

If the installation marks have disappeared, before remove the timing belt, place 2 new installation marks on the timing belt to match the timing marks of the camshaft timing pulleys.

When replacing timing belt tensioner only:
 To avoid meshing of the timing pulley and timing belt, secure one of them with string. And place matchmarks on the timing belt and RH camshaft timing pulley.



Alternately loosen the 2 bolts, and remove them, the belt tensioner and dust boot.





20. DISCONNECT TIMING BELT FROM CAMSHAFT TIM-ING PULLEYS

 Using SST, loosen the tension spring between the LH and RH camshaft timing pulleys by slightly turning the RH camshaft timing pulley clockwise.

SST 09960-10010 (09962-01000, 09963-00350)

(b) Disconnect the timing belt from the camshaft timing pulleys.

21. REMOVE CAMSHAFT TIMING PULLEYS

Using SST, remove the 4 bolts and timing pulley. Remove the 2 timing pulleys.

SST 09960-10010 (09962-01000, 09963-00350)

- 22. REMOVE GENERATOR (See page CH-8)
- 23. REMOVE DRIVE BELT TENSIONER

Remove the bolt, 2 nuts and belt tensioner.





24. REMOVE CRANKSHAFT PULLEY

Using SST, remove the crankshaft pulley.

SST 09950-50012 (09951-05010, 09952-05010, 09953-05010, 09953-05020, 09954-05020)

NOTICE:

Do not turn the crankshaft pulley.

25. REMOVE NO.1 TIMING BELT COVER

Remove the 4 bolts, timing belt cover.

- 26. REMOVE TIMING BELT GUIDE
- 27. REMOVE TIMING BELT COVER SPACER
- 28. REMOVE TIMING BELT

HINT:

If re-using the belt and the installation mark has disappeared from it, place a new installation mark on the timing belt to the match the dot mark of the crankshaft timing pulley.

29. REMOVE NO.2 IDLER PULLEY

Remove the bolt and idler pulley.



30. REMOVE NO.1 IDLER PULLEY

Using a 10 mm hexagon wrench, remove the bolt, idler pulley and plate washer.



31. REMOVE CRANKSHAFT TIMING PULLEY

Using SST, remove the timing pulley.

SST 09950–50012 (09951–05010, 09952–05010, 09953–05010, 09953–05020, 09954–05010)

NOTICE:

Do not turn the timing pulley.



INSPECTION

1. INSPECT TIMING BELT NOTICE:

• Do not bend, twist or turn the timing belt inside out.

EM09N-02

- Do not allow the timing belt to come into contact with oil, water or steam.
- Do not utilize timing belt tension when installing or removing the mount bolt of the camshaft timing pulley.

If there are any defects, as shown in the illustrations, check these points:

- (a) Premature parting
 - Check for proper installation.
 - Check the timing cover gasket for damage and proper installation.
- (b) If the belt teeth are cracked or damaged, check to see if either camshaft is locked.
- (c) If there is noticeable wear or cracks on the belt face, check to see if there are nicks on the side of the idler pulley lock and water pump.
- (d) If there is wear or damage on only one side of the belt, check the belt guide and the alignment of each pulley.
- (e) If there is noticeable wear on the belt teeth, check timing cover for damage and check gasket has been installed correctly and for foreign material on the pulley teeth.

If necessary, replace the timing belt.



2. INSPECT IDLER PULLEYS

(a) Visually check the seal portion of the idler pulley for oil leakage.

If leakage is found, replace the idler pulley.

(b) Check that the idler pulley turns smoothly.

If necessary, replace the idler pulley.



(a) Visually check the seal portion of the tensioner for oil leakage.

HINT:

If there is only the faintest trace of oil on the seal on the push rod side, the tensioner is all right.

If leakage is found, replace the tensioner.



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(b) Hold the tensioner with both hands and push the push rod strongly as shown to check that it doesn't move.If the push rod moves, replace the tensioner.

NOTICE:

Never hold the tensioner push rod facing downward.

(c) Measure the protrusion of the push rod from the housing end.

Protrusion: 10.5 – 11.5 mm (0.413 – 0.453 in.)

If the protrusion is not as specified, replace the tensioner.

4. INSPECT WATER PUMP (See page CO-9)



2.





INSTALLATION

1. INSTALL CRANKSHAFT TIMING PULLEY

- (a) Align the timing pulley set key with the key groove of the pulley.
- Using SST and a hammer, tap in the timing pulley, facing the flange side inward.
 SST 09223–46011

INSTALL NO.1 IDLER PULLEY

(a) Apply adhesive 2 or 3 threads of the pivot bolt.
 Adhesive:

Part No. 08833–00080, THREE BOND 1344, LOCTITE 242 or equivalent

(b) Using a 10 mm hexagon wrench, install the plate washer and idler pulley with the pivot bolt.

Torque: 34.5 N·m (350 kgf·cm, 25 ft·lbf)

- (c) Check that the pulley bracket moves smoothly.
- 3. INSTALL NO.2 IDLER PULLEY
- (a) Install the idler pulley with the bolt.Torque: 34.5 N-m (350 kgf-cm, 25 ft-lbf)
- (b) Check that the idler pulley moves smoothly.
- 4. TEMPORARILY INSTALL TIMING BELT NOTICE:

The engine should be cold.

(a) Remove any oil or water on the crankshaft pulley, oil pump pulley, water pump pulley, No.1 idler pulley and No.2 idler pulley, and keep them clean.

NOTICE:

Only wipe the pulleys; do not use any cleansing agent.



- (b) Align the installation mark on the timing belt with the timing mark of the crankshaft timing pulley.
- (c) Install the timing belt on the crankshaft timing pulley, No.1 idler pulley and No.2 idler pulley.

5.



- **INSTALL TIMING BELT COVER SPACER**
- (a) Install the gasket to the cover spacer.
- Install the cover spacer.





INSTALL TIMING BELT GUIDE 6.

Install the belt guide, facing the cup side outward. 7. **INSTALL NO.1 TIMING BELT COVER** Install the timing belt cover with the 4 bolts.

8. **INSTALL CRANKSHAFT PULLEY**

- Align the pulley set key with the key groove of the crank-(a) shaft pulley.
- (b) Using SST and a hammer, tap in the crankshaft pulley. SST 09223-46011

INSTALL DRIVE BELT TENSIONER 9.

Install the belt tensioner with the bolt and 2 nuts. Torque: 16 N·m (160 kgf·cm, 12 ft·lbf)

HINT:

Use a bolt 106 mm (4.18 in.) in length.

10. INSTALL GENERATOR (See page CH-18)



CHECK CRANKSHAFT PULLEY POSITION 11.

Check that the timing mark of the crankshaft pulley is aligned with the centers of the crankshaft pulley and the idler pulley bolt.











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12. **INSTALL LH CAMSHAFT TIMING PULLEY**

- (a) Align the camshaft timing tube knock pin with the knock pin groove of the timing pulley.
- Attach the timing pulley to the camshaft timing tube, fac-(b) ing the "L" mark forward.
- (c) Using SST, install the 4 pulley bolts. 09960-10010 (09962-01000, 09963-00350) SST Torque: 7.5 N·m (80 kgf·cm, 66 ft·lbf)

INSTALL RH CAMSHAFT TIMING PULLEY 13.

- (a) Align the camshaft timing tube knock pin with the knock pin groove of the timing pulley.
- Attach the timing pulley to the camshaft timing tube, fac-(b) ing the "R" mark forward.
- Using SST, install the 4 pulley bolts. (C) SST 09960-10010 (09962-01000, 09963-00350) Torque: 7.5 N·m (80 kgf·cm, 66 ft·lbf)
- 14. CONNECT TIMING BELT TO LH CAMSHAFT TIMING PULLEY
- Remove any oil or water on the LH camshaft timing pulley, (a) and keep it clean.

NOTICE:

Only wipe the pulleys; do not use any cleansing agent.

- Using SST, turn the timing pulley. Align the installation (b) mark on the timing belt with the timing mark of the timing pulley, and hang the timing belt on the timing pulley. SST 09960-10010 (09962-01000, 09963-00350)
- Using SST, turn the LH camshaft timing pulley counter-(c) clockwise until there is tension between the crankshaft timing pulley and LH camshaft timing pulley.

SST 09960-10010 (09962-01000, 09963-00350)

- 15. CONNECT TIMING BELT TO RH CAMSHAFT TIMING PULLEY
- Remove any oil or water on the RH camshaft timing pulley (a) and water pump pulley, and keep them clean.

NOTICE:

Only wipe the pulleys; do not use any cleansing agent.

(b) Using SST, turn the timing pulley. Align the installation mark on the timing belt with the timing mark of the timing pulley, and hang the timing belt on the timing pulley. 09960-10010 (09962-01000, 09963-00350) SST







16. SET TIMING BELT TENSIONER

- Using a press, slowly press in the push rod using 981 -(a) 9,807 N (100 – 1,000 kgf, 220 – 2,205 lbf) of pressure.
- Align the holes of the push rod and housing, pass a 1.27 (b) mm hexagon wrench through the holes to keep the setting position of the push rod.
- (c) Release the press.
- (d) Install the dust boot to the belt tensioner.

17. **INSTALL TIMING BELT TENSIONER**

- (a) Temporarily install the belt tensioner with the 2 bolts.
- (b) Alternately tighten the 2 bolts.

Torque: 26 N·m (270 kgf·cm, 19 ft·lbf)

Using pliers, remove the 1.27 mm hexagon wrench from (c) the belt tensioner.

18. **CHECK VALVE TIMING**

- (a) Temporarily install the crankshaft pulley bolt.
- Slowly turn the crankshaft pulley 2 revolutions from TDC (b) to TDC.

NOTICE:

Always turn the crankshaft pulley clockwise.

- stall it. A01872
- Check that each pulley aligns with the timing marks as (c) shown in the illustration. If the timing marks do not align, remove the timing belt and rein-



TIGHTEN CRANKSHAFT PULLEY BOLT 19.

Using SST, install the pulley bolt. SST 09213-54015 (90119-08216), 09330-00021 Torque: 245 N·m (2,500 kgf·cm, 181 ft·lbf)



20. INSTALL FAN BRACKET

Install the fan bracket with the 2 bolts and 2 nuts. **Torque:**

12 mm head: 16 N·m (160 kgf·cm, 12 ft·lbf) 14 mm head: 32 N·m (330 kgf·cm, 24 ft·lbf)

HINT:

Each bolt length is indicated in the illustration. Bolt Length:

106 mm (4.17 in.) for 12 mm head (A)

114 mm (4.49 in.) for 14 mm head (B)

- 21. INSTALL A/C COMPRESSOR (See page EM-82)
- 22. INSTALL NO.2 TIMING BELT COVER

Install the No.2 timing belt cover with the 2 bolts.

Torque: 16 N·m (160 kgf·cm, 12 ft·lbf)



23. INSTALL RH NO.3 TIMING BELT COVER

- (a) Install the gasket to the timing belt cover.
- (b) Fit the timing belt cover, matching it with the fan bracket.
- (c) Install the timing belt cover with the 3 bolts. Torque: 7.5 N-m (80 kgf-cm, 66 in.-lbf)



(d) Install the radiator reservoir outlet pipe to the RH cylinder head and timing belt cover with the bolt and nut.
 Torque: 7.5 N-m (80 kgf-cm, 66 in.-lbf)

- (e) Connect the outlet hose to the water inlet housing.
- (f) Connect the wire clamp.
- (g) Connect the PS air hose to the clamp of the timing belt cover.

24. INSTALL LH NO.3 TIMING BELT COVER

- (a) Install the gasket to the timing belt cover.
- (b) Run the camshaft position sensor wire through the timing belt cover hole.
- (c) Fit the timing belt cover, matching it with the fan bracket.
- (d) Install the timing belt cover with the 4 bolts and nut. Torque: 7.5 N-m (80 kgf-cm, 66 in.-lbf)
- (e) Install the wire grommet to the timing belt cover.
- (f) Install the sensor connector to the connector bracket.
- (g) Connect the sensor connector.

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- (h) Install the sensor wire to the wire clamp on the timing belt cover.
- (i) Install the engine wire to the 2 wire clamps on the timing belt cover.

25. INSTALL DRIVE BELT IDLER PULLEY

Install the idler pulley and cover plate with the bolt. Torque: 37 N-m (380 kgf-cm, 27 ft-lbf)

26. INSTALL RADIATOR ASSEMBLY (See page CO-27)

27. INSTALL FAN PULLEY, FAN, FLUID COUPLING AND DRIVE BELT

- (a) Temporarily install the fan pulley, the fan, fluid coupling assembly with the 4 nuts.
- (b) Install the generator drive belt. (See page CH-18)
- (c) Tighten the 4 nuts holding the fluid coupling to the fan bracket.

Torque: 21 N·m (215 kgf·cm, 16 ft·lbf)

- 28. INSTALL AIR CLEANER AND INTAKE AIR CONNEC-TOR ASSEMBLY
- 29. INSTALL V-BANK COVER
- 30. FILL WITH ENGINE COOLANT
- 31. START ENGINE AND CHECK FOR LEAKS
- 32. RECHECK ENGINE COOLANT LEVEL
- 33. INSTALL AIR CLEANER INLET
- 34. INSTALL BATTERY CLAMP COVER
- 35. INSTALL ENGINE UNDER COVER
- 36. INSTALL OIL PAN PROTECTOR



CYLINDER HEAD COMPONENTS

EM09P-02









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1215

REMOVAL

1. DISCONNECT TIMING BELT FROM CAMSHAFT TIM-ING PULLEYS (See page EM-15)

EM09Q-02

- 2. REMOVE CAMSHAFT TIMING PULLEYS (See page EM-15)
- 3. REMOVE CAMSHAFT POSITION SENSOR (See page IG-10)
- 4. DISCONNECT PS PUMP FROM ENGINE (See page EM-77)

5. DISCONNECT FRONT EXHAUST PIPE FROM TWC

- (a) Remove the 4 bolts and 4 nuts holding the front exhaust pipe to the TWC.
- (b) Disconnect the front exhaust pipe from the 2 TWC, and remove the 2 gaskets.
- (c) Remove the 2 bolts and pipe support bracket.

6. REMOVE TWC

Remove the 3 nuts, TWC and gasket. Remove the 2 TWC.

- 7. REMOVE IGNITION COILS (See page IG-7)
- 8. REMOVE TIMING BELT REAR PLATES
- (a) Remove the 3 bolts, stud bolt, and RH No.1 and No.2 timing belt rear plates.
- (b) Disconnect the wire clamp from the LH timing belt rear plate.
- (c) Remove the 3 bolts, LH No.1 and No.2 timing belt rear plates.



NOTICE:

- Be careful not to drop anything inside the timing belt cover.
- Do not allow the belt to come into correct with oil, water or dust.
- DISCONNECT FUEL INLET HOSE (See page SF-23)
 REMOVE INTAKE MANIFOLD ASSEMBLY
- (a) Disconnect the accelerator cable.
- (b) Disconnect the throttle position sensor connector.





²⁰⁰⁰ LEXUS LS400 (RM717U)

- (c) Disconnect the accelerator pedal position sensor connector.
- (d) Disconnect the throttle motor connector.
- (e) Disconnect the VSV connector for EVAP.
- (f) Disconnect the VSV connector for ACIS.
- (g) Disconnect the 8 injector connectors.
- (h) Disconnect the noise filter connector.



- (j) Disconnect the PCV hose from the PCV valve on the LH cylinder head.
- (k) Disconnect the EVAP hose (from the charcoal canister) from the VSV for EVAP.
- Disconnect the EVAP hose (from the charcoal canister) from the EVAP pipe on the intake manifold.
- (m) Disconnect the EVAP hose (from the intake air connector) from the EVAP pipe on the intake manifold.
- (n) Disconnect the PS air hose from the intake manifold.



- (o) Disconnect the No.1 water bypass hose (from the water inlet housing) from the throttle body.
- (p) Disconnect the No.7 water bypass hose (from the front water bypass joint) from the throttle body.
- (q) Disconnect the 2 wire clamp from the throttle body.
- (r) Remove the 2 bolts and EVAP pipe from the intake manifold.
- (s) Remove the 2 nuts and accelerator cable bracket.
- (t) Disconnect the VSV connector for ACIS from the No.1 V– bank cover bracket.
- (u) Remove the 4 bolts and 3 V–bank cover brackets.
- (v) Remove the bolt and VSV for EVAP.



ENGINE MECHANICAL - CYLINDER HEAD







- (w) Disconnect the engine wire from the RH delivery pipe, rear water bypass joint, intake manifold and cylinder head.
 - Disconnect the 2 wire clamps from the wire clamp bracket on the RH delivery pipe.
 - (2) Remove the 3 bolts, and disconnect the engine wire protector from the rear water bypass joint and RH cylinder head.

(3) Remove the 3 bolts, and disconnect the engine wire protector and wire clamp bracket from the intake manifold.

- (x) Remove the 6 bolts, 4 nuts, intake manifold assembly and 2 gaskets.
- 11. REMOVE WATER INLET AND INLET HOUSING AS-SEMBLY (See page CO-8)

12. REMOVE FRONT WATER BYPASS JOINT

A04269

- (a) Disconnect the ECT sensor connector.
- (b) Remove the 4 nuts, water bypass joint and 2 gaskets.




13. REMOVE REAR WATER BYPASS JOINT

Remove the 4 nuts, water bypass joint and 2 gaskets.

- 14. REMOVE VVT SENSORS
- 15. REMOVE ENGINE HANGERS
- 16. REMOVE OIL DIPSTICK AND GUIDE FOR A/T (See page EM-77)
- 17. REMOVE OIL DIPSTICK AND GUIDE FOR ENGINE (See page LU-9)

18. REMOVE CYLINDER HEAD COVERS

Remove the 9 bolts, 9 seal washers, cylinder head cover and gasket. Remove the 2 cylinder head covers.

- 19. IF NECESSARY, REMOVE SEMI-CIRCULAR PLUGS AND CAMSHAFT HOUSING PLUGS
- 20. REMOVE CAMSHAFT TIMING OIL CONTROL VALVE (See page SF-51)
- 21. REMOVE CAMSHAFTS

NOTICE:

Since the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being removed. If the camshaft is not kept level, the portion of the cylinder head receiving the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.





(a) Check the crankshaft pulley position.

Check that the timing mark of the crankshaft pulley is in aligned with the centers of the crankshaft pulley bolt and idler pulley bolt.

NOTICE:

Having the crankshaft pulley at the wrong angle can cause the piston head and valve head to come into contact with each other when you remove the camshaft, causing damage. So always set the crankshaft pulley at the correct angle.

(b) Rotate the VVT-i pulley from left to right 2 to 3 times within its range of movement (25° <50° CA>) and use a waste cloth to collect the oil from the camshaft timing oil control valve installation hole.

NOTICE:

Approximately 20 cc (1.2 cu in.) of oil will be ejected, so take care not to spill it.



(c) Remove the RH camshafts.

- (1) Boring the service bolt hole of the sub–gear upward by turning the hexagon wrench head portion of the exhaust camshaft with a wrench.
- (2) Secure the sub–gear to the main gear with a service bolt.

Recommended service bolt:

Thread diameter	6 mm
Thread pitch	1.0 mm
Bolt length	16 – 20 mm

HINT:

When removing the camshafts, make sure that the torsional spring force of the sub–gear has been eliminated by the above operation.







(3) Set the timing mark (1 dot mark) of the camshaft main gear at approx. 10° angle by turning the hexagon wrench head portion of the exhaust camshaft with a wrench.

- (4) Uniformly loosen and remove the 22 bearing cap bolts in several passes, in the sequence shown.
- (5) Remove the oil feed pipe, 9 bearing caps, cam shaft timing oil control valve and camshafts.

(d) Remove the LH camshafts.

- (1) Boring the service bolt hole of the sub-gear upward by turning the hexagon wrench head portion of the exhaust camshaft with a wrench.
- (2) Secure the sub–gear to the main gear with a service bolt.

Recommended service bolt:

Thread diameter	6 mm
Thread pitch	1.0 mm
Bolt length	16 – 20 mm

HINT:

When removing the camshaft, make sure that the torsional spring force of the sub–gear has been eliminated by the above operation.

(3) Align the timing mark (2 dot marks) of the camshaft drive gear by turning the hexagon wrench head portion of the exhaust camshaft with a wrench.

- (4) Uniformly loosen and remove the 22 bearing cap bolts in several passes, in the sequence shown.
- (5) Remove the oil feed pipe, 9 bearing caps, cam shaft timing oil control valve filter and camshafts.

HINT:

Arrange the bearing caps in correct order.

22. DISASSEMBLE EXHAUST CAMSHAFTS

(a) Mount the hexagon wrench head portion of the camshaft in a vise.

NOTICE:

A02859

Be careful not to damage the camshaft.

- (b) Using SST, turn the sub–gear clockwise, and remove the service bolt.
 - SST 09960-10010 (09962-01000, 09963-00500)





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Service Bolt

ENGINE MECHANICAL - CYLINDER HEAD



- (c) Using snap ring pliers, remove the snap ring.
- (d) Remove the wave washer.
- (e) Remove the camshaft sub-gear.

(f) Remove the camshaft gear spring.

HINT:

Arrange the camshaft sub–gears and gear spring (RH and LH sides).





- 23. REMOVE CAM SHAFT TIMING TUBES
- (a) Mount the hexagon wrench head portion of the intake camshaft in a vise.

NOTICE:

- Be careful not to damage the camshaft.
- The 4 bolts shown in the illust ration determine the backlash of the gear in the timing tube, so do not remove them. If any of the 4 bolts are removed, install a new camshaft timing tube assembly.
- (b) Remove the straight screw plug and seal washer.
- (c) Using a 10 mm hexagon wrench, and remove the set bolt and camshaft timing tube.

- A02865
- Ground Cable

(d) Using a 5 mm hexagon wrench, and remove the 4 bolts, camshaft drive gear and oil seal.

NOTICE:

Be careful not to damage the camshaft timing tube. 24. REMOVE SPARK PLUGS

- 25. REMOVE CYLINDER HEAD AND EXHAUST MAN-IFOLD ASSEMBLIES
- (a) Disconnect the 2 heated oxygen sensor connectors.
- (b) Remove the bolt, and disconnect the ground cable from the RH cylinder head.



RH Cylinder Head A = 1 A

- (c) Remove the bolt, and disconnect the ground cable from the LH cylinder head.
- (d) Remove the bolt, and disconnect the engine wire protector from the LH cylinder head.

(e) Uniformly loosen the 10 cylinder head bolts on one side of each cylinder head in several passes, in the sequence shown, then do the other side as shown. Remove the 20 cylinder head bolts and plate washers.

NOTICE:

 Cylinder head warpage or cracking could result from removing bolts in incorrect order.

- RH Cylinder Head A
- Do not drop the plate washer for cylinder head bolt into portion A of the cylinder head. If dropped into portion A, the plate washer will pass through the cylinder head and cylinder block into the oil pan.



(f) Lift the cylinder head from the dowels on the cylinder block, and place the 2 cylinder heads on wooden blocks on a bench.

HINT:

If the cylinder head is lift off, pry between the cylinder head and cylinder block with a screwdriver.

NOTICE:

- Be careful not to damage the contact surfaces of the cylinder head and cylinder block.
- The cylinder head should not be tilted so as to secure the valve lifter. If the cylinder head is tilted, remove the valve lifter and check that the adjusting shim is set correctly.



- 26. REMOVE RH EXHAUST MANIFOLD FROM CYLINDER HEAD
- (a) Remove the 3 bolts and heat insulator.
- (b) Remove the 8 nuts, exhaust manifold and gasket.



- 27. REMOVE LH EXHAUST MANIFOLD FROM CYLINDER HEAD
- (a) Remove the 3 bolts and heat insulator.
- (b) Remove the 8 nuts, exhaust manifold and gasket.

EM09R-02

DISASSEMBLY

1. REMOVE VALVE LIFTERS AND SHIMS HINT:

Arrange the valve lifters and shims in correct order.



2. REMOVE VALVES

- (a) Using SST, compress the valve spring and remove the 2 keepers.
 - SST 09202-70020
- (b) Remove the spring retainer.
- (c) Remove the valve spring.
- (d) Remove the valve.
- (e) Remove the spring seat.

HINT:

Arrange the valves, valve springs, spring seats and spring retainers incorrect order.



Using needle-nose pliers, remove the oil seal.

EM09S-02



INSPECTION

- 1. CLEAN TOP SURFACES OF PISTONS AND CYL-INDER BLOCK
- (a) Turn the crankshaft, and bring each piston to top dead center (TDC). Using a gasket scraper, remove all the carbon from the piston top surface.
- (b) Using a gasket scraper, remove all the gasket material from the cylinder block surface.
- (c) Using compressed air, blow carbon and oil from the bolt holes.

CAUTION:

Protect your eyes when using high pressure compressed air.



2. REMOVE GASKET MATERIAL

Using a gasket scraper, remove all the gasket material from the cylinder block contact surface.

NOTICE:

Be careful not to scratch the cylinder block contact surface.



3. CLEAN COMBUSTION CHAMBERS

Using a wire brush, remove all the carbon from the combustion chambers.

NOTICE:

Be careful not to scratch the cylinder block contact surface.

4. CLEAN VALVE GUIDE BUSHINGS

Using a valve guide bushing brush and solvent, clean all the guide bushings.



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5. CLEAN CYLINDER HEAD

Using a soft brush and solvent, thoroughly clean the cylinder head.



6. INSPECT FOR FLATNESS

Using a precision straight edge and feeler gauge, measure the surfaces contacting the cylinder block and the manifolds for warpage.

Maximum warpage: 0.10 mm (0.0039 in.)

If warpage is greater than maximum, replace the cylinder head.



7. INSPECT FOR CRACKS

Using a dye penetrant, check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks. If cracked, replace the cylinder head.



8. CLEAN VALVES

- (a) Using a gasket scraper, chip off any carbon from the valve head.
- (b) Using a wire brush, thoroughly clean the valve.

EM0963 EM0964

Z00052



- INSPECT VALVE STEMS AND GUIDE BUSHINGS
-) Using a caliper gauge, measure the inside diameter of the guide bushing.

Bushing inside diameter: 5.510 – 5.530 mm (0.2169 – 0.2177 in.)

(b) Using a micrometer, measure the diameter of the valve stem.

Valve stem diameter:

Intake	5.470 – 5.485 mm (0.2154 – 0.2159 in.)
Exhaust	5.465 – 5.480 mm (0.2152 – 0.2157 in.)

Subtract the valve stem diameter measurement from the guide bushing inside diameter measurement.
 Standard oil clearance:

Standard oil clearance:

Intake	0.025 – 0.060 mm (0.0010 – 0.0024 in.)
Exhaust	0.030 – 0.065 mm (0.0012 – 0.0026 in.)

Maximum oil clearance:

Intake	0.08 mm (0.0031 in.)
Exhaust	0.10 mm (0.0039 in.)

If the clearance is greater than maximum, replace the valve and guide bushing. (See Page EM-54)





(b) Check that the valve is ground to the correct valve face angle.

Valve face angle: 44.5°



(c) Check the valve head margin thickness. Margin thickness:

Standard	1.0 mm (0.039 in.)
Minimum	0.5 mm (0.020 in.)

If the margin thickness is less than minimum, replace the valve.



(d)	 d) Check the valve overall length. Standard overall length: 	
	Intake	95.05 mm (3.7421 in.)
	Exhaust	95.10 mm (3.7441 in.)
	Minimum o	overall length:
	Intake	94.55 mm (3.7224 in.)
	Exhaust	94.60 mm (3.7244 in.)

If the overall length is less than minimum, replace the valve.

(e) Check the surface of the valve stem tip for wear.

If the valve stem tip is worn, resurface the tip with a grinder or replace the valve.

NOTICE:

EM0255

Do not grind off more than minimum.

11. INSPECT AND CLEAN VALVE SEATS

(a) Using a 45° carbide cutter, resurface the valve seats. Remove only enough metal to clean the seats.



Width EM0183 EM0635



(b) Check the valve seating position.

Apply a light coat of prussian blue (or white lead) to the valve face. Lightly press the valve against the seat. Do not rotate valve.

(c) Check the valve face and seat for the following:

- If blue appears 360° around the face, the valve is concentric. If not, replace the valve.
- If blue appears 360° around the valve seat, the guide and face are concentric. If not, resurface the seat.
- Check that the seat contact is in the middle of the valve face with the following width:

1.0 – 1.4 mm (0.039 – 0.055 in.)

If not, correct the valve seats as follows:

 If the seating is too high on the valve face, use 30° and 45° cutters to correct the seat.

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ENGINE MECHANICAL - CYLINDER HEAD



If the seating is too low on the valve face, use 60° and 45° cutters to correct the seat.

- ЕМ6331
- (d) Hand–lap the valve and valve seat with an abrasive compound.
- (e) After hand-lapping, clean the valve and valve seat.



12. INSPECT VALVE SPRINGS

(a) Using a steel square, measure the deviation of the valve spring.

Maximum deviation: 2.0 mm (0.079 in.)

If the deviation is greater than maximum, replace the valve spring.



(b) Using vernier calipers, measure the free length of the valve spring.

Free length: 54.05 – 54.15 mm (2.1279 – 2.1319 in.)

If the free length is not as specified, replace the valve spring.



(c) Using a spring tester, measure the tension of the valve spring at the specified installed length.
Installed tension:
204 - 226 N (20.8 - 23.0 kgf, 45.9 - 50.7 lbf) at 35.0 mm (1.378 in.)

If the installed tension is not as specified, replace the valve spring.

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13. INSPECT CAMSHAFT FOR RUNOUT

- (a) Place the camshaft on V–blocks.
- (b) Using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout: 0.08 mm (0.0031 in.)

If the circle runout is greater than maximum, replace the camshaft.



14. INSPECT CAM LOBES

Using a micrometer, measure the cam lobe height. Standard cam lobe height:

Intake	42.610 – 42.710 mm (1.6776 – 1.6815 in.)	
Exhaust	42.630 – 42.730 mm (1.6783 – 1.6823 in.)	
Minimum cam lobe height:		
Intake	42.46 mm (1.6717 in)	

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Exhaust	42.48 mm (1.6724 in.)
Intake	42.40 mm (1.07 17 m.)

If the cam lobe height is less than minimum, replace the camshaft.



15. INSPECT CAMSHAFT JOURNALS

Using a micrometer, measure the journal diameter. Journal diameter:

Intake camshaft (A)	30.984 – 31.000 mm (1.2198 – 1.2205 in.)
Others	26.954 – 26.970 mm (1.0612 – 1.0618 in.)

If the journal diameter is not as specified, check the oil clearance.

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16. INSPECT CAMSHAFT TIMING TUBE JOURNALS HINT:

There are 2 size of the camshaft timing tube journal diameter, green and red painted mark accordingly. The mark is painted on the face of the camshaft timing tube.



Using a micrometer, measure the journal diameter. Journal diameter:

39.958 – 39.964 mm (1.5731 – 1.5734 ln.)
39.964 – 39.970 mm (1.5734 – 1.5736 in.)

If the journal diameter is not as specified, check the oil clearance.







17. INSPECT CAMSHAFT GEAR SPRING

Using vernier calipers, measure the free distance between the spring ends.

Free distance: 18.2 – 18.8 mm (0.712 – 0.740 in.) If the free distance is not as specified, replace the gear spring. 18. INSPECT CAMSHAFT BEARINGS

Check that bearings for flaking and scoring.

If the bearings are damaged, replace the bearing caps and cylinder head as a set.

19. INSPECT CAMSHAFT TIMING TUBE AND CAMSHAFT JOURNAL OIL CLEARANCE

HINT:

There are 2 size of the camshaft timing tube journal oil clearance, Marked "A" and "B" accordingly. The mark is stamped on the top of the cylinder heads.

- (a) Install the camshaft timing tube. (See page EM-58)
- (b) Clean the bearing caps and camshaft journals.
- (c) Place the camshafts on the cylinder head.
- (d) Lay a strip of Plastigage across each of the camshaft journals.

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 (e) Install the bearing caps. (See page EM–58) Torque: 16 N·m (160 kgf·cm, 12 ft·lbf)
 NOTICE:

Do not turn the camshaft.

(f) Remove the bearing caps.



(g) Measure the Plastigage at its widest point. **Standard Oil clearance:**

Camshaft timing tube Mark "A"	0.036 – 0.050 mm (0.0014 – 0.0020 in.)
Camshaft timing tube Mark "B"	0.038 – 0.052 mm (0.0015 – 0.0021 in.)
Others	0.030 – 0.067 mm (0.0012 – 0.0026 in.)
Maximum oil clearance:	

Camshaft timing tube 0.085 mm (0.0033 in.) Others 0.10 mm (0.0039 in.)

If the oil clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

- (h) Completely remove the plastigage.
- (i) Remove the camshafts.
- (j) Remove the camshaft timing tube.

20. IF NECESSARY REPLACE CAMSHAFT TIMING TUBE Select a camshaft timing tube according to mark on the cylinder

head.

Cylinder Head	Camshaft timing tube
Mark "A"	Green painted mark
Mark "B"	Red painted mark

21. INSPECT CAMSHAFT THRUST CLEARANCE

- (a) Install the camshaft timing tube. (See page EM-58)
- (b) Install the camshaft. (See page EM–58)



 Using a dial indicator, measure the thrust clearance while moving the camshaft back and forth.
 Standard thrust clearance:

Intake	0.060 – 0.100 mm (0.0024 – 0.0039 in.)
Exhaust	0.040 – 0.090 mm (0.0016 – 0.0035 in.)
Maximum thrust clearance:	
Intake	0.13 mm (0.0051 in.)
Exhaust	0.12 mm (0.0047 in.)
	· · ·

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If the thrust clearance is greater than maximum, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

- Remove the camshafts. (d)
- (e) Remove the camshaft timing tube.
- 22. **INSPECT CAMSHAFT GEAR BACKLASH**
- (a) Install the camshaft timing tube. (See page EM-58)
- Install the camshafts without installing the exhaust cam (b) sub-gear and front bearing cap. (See page EM-58)
- Using a dial indicator, measure the backlash. (C) Backlash:

Standard	0.020 – 0.200 mm (0.0008 – 0.0079 in.)
Maximum	0.30 mm (0.0188 in.)

If the backlash is greater then maximum, replace the camshafts.

(d) Remove the camshafts.

23. **INSPECT VALVE LIFTERS AND LIFTER BORES**

(a) Using a caliper gauge, measure the lifter bore diameter of the cylinder head.

Lifter bore diameter: 31.000 - 31.016 mm (1.2205 - 1.2211 in.)

Using a micrometer, measure the lifter diameter at the (b) valve lifter center line, 12.3 - 12.7 mm (0.484 - 0.500 in.) from the valve lifter head.

Lifter diameter:

30.966 - 30.976 mm (1.2191 - 1.2195 in.)

(c) Subtract the lifter diameter measurement from the lifter bore diameter measurement.

Standard oil clearance:

Standard	0.024 – 0.050 mm (0.0009 – 0.0020 in.)
Maximum 0.07 mm (0.0028 in.)	

If the oil clearance is greater than maximum, replace the lifter. If necessary, replace the cylinder head.





A03209



Upper Intake Manifold Side



24. INSPECT INTAKE MANIFOLD

(a) Upper intake manifold:

Using a precision straight edge and feeler gauge, measure the surface contacting the lower intake manifold for warpage.

Maximum warpage: 0.15 mm (0.0059 in.)

If warpage is greater than maximum, replace the upper intake manifold.

(b) Lower intake manifold:

Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder head and upper intake manifold for warpage.

Maximum warpage: 0.15 mm (0.0059 in.)

If warpage is greater than maximum, replace the lower intake manifold.



25. INSPECT EXHAUST MANIFOLD

Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder head for warpage.

Maximum warpage: 0.50 mm (0.0197 in.)

If warpage is greater than maximum, replace the manifold.

Measuring Point 2.5 mm (0.98 in.)

26. INSPECT CYLINDER HEAD BOLTS

Using vernier calipers, measure the thread outside diameter of the bolt.

Outside diameter:

Standard	9.770 – 9.960 mm (0.3846 – 0.3921 in.)
Minimum 9.60 mm (0.3780 in.)	

If the diameter is less than minimum, replace the bolt.

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REPLACEMENT

- 1. REPLACE VALVE GUIDE BUSHINGS
- (a) Gradually heat the cylinder head to 80 100°C (176 212°F).
- A03196
- (b) Using SST and a hammer, tap out the guide bushing. SST 09201–01055, 09950–70010 (09951–07100)



(c) Using a caliper gauge, measure the bushing bore diameter of the cylinder head.

Both intake and exhaust

Bushing bore diameter mm (in.)	Bushing size
10.285 – 10.306 (0.4049 – 0.4057)	Use STD
10.335 – 10.356 (0.4069 – 0.4077)	Use O/S STD



If the bushing bore diameter of the cylinder head is greater than 10.306 mm (0.4057 in.), machine the bushing bore to the following dimension:

10.335 - 10.356 mm (0.4069 - 0.4077 in.)

If the bushing bore diameter of the cylinder head is greater than 10.356 mm (0.4077 in.), replace the cylinder head.



HINT:

Different the bushings are used for the intake and exhaust.





- (e) Gradually heat the cylinder head to $80 100^{\circ}C (176 212^{\circ}F)$.
- (f) Using SST and a hammer, tap in a new guide bushing to the specified protrusion height.

Protrusion height:

Intake	9.2 – 9.8 mm (0.362 – 0.386 in.)
Exhaust	8.2 – 8.8 mm (0.323 – 0.346 in.)
SST 092	01–01055, 09950–70010 (09951–07100)

 (g) Using a sharp 5.5 mm reamer, ream the guide bushing to obtain the standard specified clearance (See page EM-44) between the guide bushing and valve stem.



2. REPLACE SPARK PLUG TUBE GASKETS

- (a) Bend the 4 ventilation case claw installed on the cylinder head cover to an angle of 90° or more.
- (b) Using a screwdriver, pry out the gasket. **NOTICE:**

Be careful not to damage the cylinder head cover, Tape the screwdrive tip.

- SST Return Claw SST Down Ward
- (c) Using SST and a hammer, tap in a new gasket until its surface is flush with the upper edge of the cylinder head cover.
 - SST 09950-60010 (09551-00240, 09951-00440, 09952-06010), 09950-70010 (09951-07100)

NOTICE:

Be careful of the installation direction.

- (d) Apply a light coat of MP grease to the gasket lip.
- (e) Return the ventilation case claw to its original position.

REASSEMBLY

HINT:

- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply new engine oil to all sliding and rotating surfaces.
- Replace all gaskets and oil seals with new ones.



1. INSTALL SPARK PLUG TUBES

HINT:

When using a new cylinder head, spark plug tubes must be installed.

- (a) Apply adhesive to the end of the spark plug tube.
 Adhesive:
 Part No. 08833–00070, THREE BOND 1324
 or equivalent
- (b) Protrusion A03212
- (b) Using a wooden block and hammer, tap in a new spark tube until there is 48.4 – 49.6 mm (1.906 – 1.953 in.) protruding from the camshaft bearing cap installation surface of the cylinder head.

NOTICE:

Avoid tapping a new spark plug tube in too far by measuring the amount of the protrusion while tapping.



2. INSTALL VALVES

(a) Using SST, push in a new oil seal. SST 09201–41020



(b) Install the valve.

- (c) Install the spring seat.
- (d) Install the valve spring.
- (e) Install the spring retainer.

(f)



Using SST, compress the valve spring and place the 2 keepers around the valve stem. SST 09202–70020

(g) Using a plastic–faced hammer and the valve stem (not in use) tip wound with vinyl tape, lightly tap the valve stem tip to assure proper fit.

NOTICE:

Be careful not to damage the valve stem tip. 3. INSTALL SHIMS AND VALVE LIFTERS

- (a) Install the shim and valve lifter.
- (b) Check that the valve lifter rotates smoothly by hand.



EM108-01



INSTALLATION

- 1. INSTALL RH EXHAUST MANIFOLD TO CYLINDER HEAD
- (a) Place a new gasket on the cylinder head with the white painted marks facing the manifold side.

NOTICE:

Be careful of the installation direction.

(b) Install the exhaust manifold with 8 new nuts. Uniformly tighten the nuts in several passes.

Torque: 44 N·m (450 kgf·cm, 32 ft·lbf)

- (c) Install the heat insulator with the 3 bolts.
- White Painted Mark



- 2. INSTALL LH EXHAUST MANIFOLD TO CYLINDER HEAD
- (a) Place a new gasket on the cylinder head with the white painted marks facing the manifold side.

NOTICE:

A02883

Be careful of the installation direction.

- (b) Install the exhaust manifold with 8 new nuts. Uniformly tighten the nuts in several passes.
 Torque: 44 N-m (450 kgf-cm, 32 ft-lbf)
- (c) Install the heat insulator with the 3 bolts.



3. PLACE CYLINDER HEAD ON CYLINDER BLOCK

(a) Place 2 new cylinder head gaskets in position on the cylinder block.

HINT:

On the rear side of the cylinder head gasket are marks to distinguish the LH and RH banks, a "R" mark for the RH bank and a "L" mark for the LH bank.

NOTICE:

Be careful of the installation direction.

(b) Place the 2 cylinder heads in position on the cylinder head gaskets.



4. INSTALL CYLINDER HEAD BOLTS

- HINT:
- The cylinder head bolts are tightened in 2 progressive steps (steps (c) and (e)).
- If any cylinder head bolt is broken or deformed, replace it.
- (a) Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.
- (b) Install the plate washer to the cylinder head bolt.
- Install and uniformly tighten the 10 cylinder head bolts on one side of the cylinder head in several passes in the sequence shown, then do the other side as shown.
 Torque: 39 N-m (400 kgf-cm, 29 ft-lbf)

If any one of the cylinder head bolts does not meet the torque specification, replace the cylinder head bolt.



NOTICE:

Do not drop the plate washer for cylinder head bolt into portion A of the cylinder head. If dropped into portion A, the plate washer will pass through the cylinder head and cylinder block into the oil pan.



- (d) Mark the front of the cylinder head bolt head with paint.
 (e) Retighten the cylinder head bolts by 90° in the numerical order shown.
- (f) Check that the painted mark is now at a 90° angle to front.



INSTALL ENGINE WIRE

(a) Install the ground cable to RH cylinder head with the bolt.

- (b) Install the engine wire protector to the LH cylinder head with the bolt.
- (c) Install the ground cable to LH cylinder head with the bolt.
- (d) Connect the 2 heated oxygen sensor connectors.
- 6. INSTALL SPARK PLUGS





- ASSEMBLE EXHAUST CAMSHAFT
- (a) Install the camshaft gear spring.
- (b) Install the camshaft sub–gear.

HINT:

7.

- Attach the pins on the gears to the gear spring ends.
- (c) Install the wave washer.



(d) Using snap ring pliers, install the snap ring.



(e) Mount the hexagon wrench head portion of the camshaft in a vise.

NOTICE:

Be careful not to damage the camshaft.



- (f) Using SST, align the holes of the camshaft main gear and sub-gear by turning camshaft sub-gear counterclockwise, and temporarily install a service bolt.
 SST 09960–10010 (09962–01000, 09963–00500)
- (g) Align the gear teeth of the main gear and sub-gear, and tighten the service bolt.



INSTALL CAMSHAFT TIMING TUBES

(a) Place a new oil seal to the timing tube. **NOTICE:**

Be careful installation direction.

ENGINE MECHANICAL - CYLINDER HEAD



- (b) Align the timing tube knock pin with the knock pin groove of the camshaft drive gear, and temporarily install the camshaft drive gear with the 4 bolts.
- (c) Using a 5 mm hexagon wrench, uniformly tighten the 4 bolts.

Torque: 7.5 N·m (80 kgf·cm, 66 in.-lbf) NOTICE:

Be careful not to damage the camshaft timing tube.

(d) Mount the hexagon wrench head portion of the intake camshaft in a vise.

NOTICE:

A03173

Be careful not to damage the camshaft.

- Align
- (e) Align the camshaft knock pin with the camshaft timing tube, and push the camshaft timing tube by hand until you feel it touch the bottom.



(f) Using a 10 mm hexagon wrench, install the set bolt. Torque: 78 N·m (790 kgf·cm, 58 ft·lbf)
(g) Install the seal washer and straight screw plug. Torque: 15 N·m (150 kgf·cm, 11 ft·lbf)

INSTALL CAMSHAFT HOUSING PLUGS

- (a) Remove any old packing (FIPG) material.
- (b) Apply seal packing to the camshaft housing plug grooves. **Seal packing:**

Part No. 08826-00080 or equivalent



(c) Install the 2 camshaft housing plugs to the cylinder heads.**10. INSTALL CAMSHAFTS**

NOTICE:

Since the thrust clearance of the camshaft is small, the camshaft must be kept level while it is being installed. If the camshaft is not kept level, the portion of the cylinder head receiving the shaft thrust may crack or be damaged, causing the camshaft to seize or break. To avoid this, the following steps should be carried out.



(a) Set the crankshaft pulley position.

Turn the crankshaft pulley clockwise or counterclockwise, and put the timing mark of the crankshaft pulley in line with the centers of the crankshaft pulley bolt and idler pulley bolt.

NOTICE:

Having the crankshaft pulley at the wrong angle can cause the piston head and valve head to come into contact with each other when you install the camshaft, causing damage. So always set the crankshaft pulley at the correct angle.



(b) Install the RH camshafts.

- (1) Apply MP grease to the thrust portion of the intake and exhaust camshafts.
- (2) Place the intake and exhaust camshafts.
- (3) Set the timing mark (1 dot mark) of the camshaft main gear at approx. 10° angle.

Date :





(4) Place the camshaft oil control valve filter to the cylinder head.

NOTICE:

Be careful installation direction.

- (5) Remove any old packing (FIPG) material from front bearing cap.
- Apply seal packing to the front bearing cap as (6) shown in the illustration.

Seal packing:

Part No. 08826-00080 or equivalent

- Install a nozzle that has been cut to a 1.5 mm ٠ (0.06 in.) opening.
- Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.

NOTICE:

Do not apply seal packing to the front bearing cap grooves.





Install the front bearing cap. (7)

HINT:

Installing the front bearing cap will determine the thrust portion

of the camshaft. (8) Install the other bearing cap in the sequence shown with the arrow mark facing forward.

HINT:

Align the arrow marks at the front and rear of the cylinder head with the mark on the bearing cap.

Push in the camshaft oil seal. (9)



(10) Apply a light coat of engine oil on the threads and under the heads (D and E) of the bearing cap bolts.

HINT:

Do not apply engine oil under the heads of the bearing cap bolt (A), (B) and (C).









(11) Install the oil feed pipe and the 22 bearing cap bolts as shown.

HINT:

Each bolt length is indicated in the illustration.

Bolt length:

94 mm (3.70 in.) for A

72 mm (2.83 in.) for B

- 25 mm (0.98 in.) for C
- 52 mm (2.05 in.) for D
- 38 mm (1.50 in.) for E
 - (12) Uniformly tighten the 22 bearing cap bolts in several passes, in the sequence shown.

Torque:

Bolt C: 7.5 N·m (80 kgf·cm, 66 in.-lbf) Others: 16 N·m (160 kgf·cm, 12 ft·lbf)

- (13) Boring the service bolt installed in the driven subgear upward by turning the hexagon wrench head portion of the camshaft with a wrench.
- (14) Remove the service bolt.

(c) Install the LH camshafts.

- (1) Apply MP grease to the thrust portion of the intake and exhaust camshafts.
- (2) Place the intake and exhaust camshafts.
- (3) Engage the intake to the exhaust gear by meeting the timing marks (2 dot marks) on each gear.





(4) Place the camshaft oil control valve filter to the cylinder head.

NOTICE:

Be careful installation direction.

- (5) Remove any old packing (FIPG) material.
- (6) Apply seal packing to the front bearing cap.

Seal packing:

Part No. 08826-00080 or equivalent

- Install a nozzle that has been cut to a 1.5 mm (0.06 in.) opening.
- Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.

NOTICE:

Do not apply seal packing to the front bearing cap grooves.





(7) Install the front bearing cap.

HINT:

Installing the front bearing cap will determine the thrust portion of the camshaft.

(8) Install the other bearing cap in the sequence shown with the arrow mark facing forward.

HINT:

Align the arrow marks at the front and rear of the cylinder head with the mark on the bearing cap.

(9) Push in the camshaft oil seal.



 (10) Apply a light coat of engine oil on the threads and under the heads (D and E) of the bearing cap bolts.

HINT:

Do not apply engine oil under the heads of the bearing cap bolt (A), (B) and (C).

(11) Install the oil feed pipe and the 22 bearing cap bolts as shown.

HINT:

Each bolt length is indicated in the illustration.

Bolt length:

94 mm (3.70 in.) for A

72 mm (2.83 in.) for B

25 mm (0.98 in.) for C

- 52 mm (2.05 in.) for D 38 mm (1.50 in.) for E



Service Bolt



(12) Uniformly tighten the 22 bearing cap bolts in several passes, in the sequence shown.

Torque:

Bolt C: 7.5 N·m (80 kgf·cm, 66 in.-lbf) Others: 16 N·m (160 kgf·cm, 12 ft·lbf)

- (13) Boring the service bolt installed in the driven subgear upward by turning the hexagon wrench head portion of the camshaft with a wrench.
- (14) Remove the service bolt.
- 11. CHECK AND ADJUST VALVE CLEARANCE (See page EM-4)

Turn the camshaft and position the cam lobe upward, and check and adjust the valve clearance.

12. INSTALL SEMI-CIRCULAR PLUGS

- (a) Remove any old packing (FIPG) material.
- (b) Apply seal packing to the semi–circular plug grooves. **Seal packing:**

Part No. 08826-00080 or equivalent

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(c) Install the 4 semi-circular plugs to the cylinder heads.

13. INSTALL CYLINDER HEAD COVER

- (a) Remove any old packing (FIPG) material.
- (b) Apply seal packing to the cylinder heads as shown in the illustration.

Seal packing:

Part No. 08826–00080 or equivalent

- (c) Install the gasket to the cylinder head cover.
- (d) Install the seal washer to the bolt.
- (e) Install the cylinder head cover with the 9 bolts. Uniformly tighten the bolts in several passes. Install the 2 cylinder head covers.

Torque: 6.0 N·m (60 kgf·cm, 53 in.-lbf)

- 14. INSTALL ENGINE HANGERS Torque: 37 N·m (380 kgf·cm, 27 ft·lbf)
- 15. INSTALL VVT SENSORS
- 16. INSTALL CAMSHAFT TIMING OIL CONTROL VALVE (See page SF-51)
- 17. INSTALL OIL DIPSTICK AND GUIDE FOR ENGINE (See page LU-16)
- 18. INSTALL OIL DIPSTICK AND GUIDE FOR A/T (See page EM-82)









19. INSTALL REAR WATER BYPASS JOINT

- (a) Install 2 new gaskets to the cylinder head.
- (b) Install the 4 nuts holding the water bypass joint to the cylinder heads. Alternately tighten the nuts.

Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)

20. INSTALL FRONT WATER BYPASS JOINT

- (a) Install 2 new gaskets and the water bypass joint with the 4 nuts. Alternately tighten the nuts.
 - Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)
- (b) Connect ECT sensor connector.
- 21. INSTALL WATER INLET AND INLET HOUSING AS-SEMBLY (See page CO-10)

22. INSTALL INTAKE MANIFOLD ASSEMBLY

(a) Place 2 new gaskets on the cylinder heads with white painted mark facing upward.

NOTICE:

- Align the port holes of the gasket and cylinder head.
- Be careful of the installation direction.
- (b) Place the intake manifold assembly on the cylinder heads.
- (c) Install and uniformly tighten the 6 bolts and 4 nuts in several passes.

Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)

(d)

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-) Connect the engine wire to the RH delivery pipe, rear water bypass joint, intake manifold and RH cylinder head.
 - (1) Connect the wire clamp bracket and wire protector to the intake manifold with the 3 bolts.

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(I)

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(2) Connect the wire protector to the rear water bypass joint and RH cylinder head with the 3 bolts.

- Connect the 2 wire clamp to the wire clamp bracket (3) on the RH delivery pipe.
- (e) Install the 3 V-bank cover brackets with the 4 bolts. Torque: 7.5 N·m (80 kgf·cm, 66 ft·lbf)
- Connect the VSV connector for ACIS to the No.1 V-bank (f) cover bracket.
- Install the accelerator cable bracket with the 2 nuts. (g) Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)
- Install the VSV for EVAP with the bolt. (h)
 - Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)
- (i) Install the EVAP pipe to the intake manifold with the 2 bolts.

- Connect the brake booster vacuum hose to the union on (i) the intake manifold.
- (k) Connect the PCV hose to the PCV valve on the LH cylinder head.
- (I) Connect the EVAP hose (from the charcoal canister) to the VSV for EVAP.
- (m) Connect the EVAP hose (from the charcoal canister) to the EVAP pipe on the intake manifold.
- Connect the EVAP hose (from the intake air connector) to (n) the EVAP pipe on the intake manifold.
- (o) Connect the PS air hose to the intake manifold.



Connect the No.1 water bypass hose (from the water inlet (p) housing) to the throttle body.

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- Connect the No.7 water bypass hose (from the front water (q) bypass joint) to the throttle body.
- (r) Connect the 2 wire clamp to the throttle body.
- (s) Connect the throttle position sensor connector.
- (t) Connect the accelerator pedal position sensor connector.
- Connect the throttle motor connector. (u)
- Connect the VSV connector for EVAP. (v)
- Connect the VSV connector for ACIS. (w)
- Connect the 8 injector connectors. (x)
- (y) Connect the noise filter connector.
- (z) Connect the accelerator cable.
- 23. CONNECT FUEL INLET HOSE (See page SF-23)
- **INSTALL TIMING BELT REAR PLATES** 24.
- (a) Install the RH timing belt rear plates.
 - Install the No.1 timing belt rear plate to the cylinder (1) head with the bolt and stud bolt.

Torque: 7.5 N·m (80 kgf·cm, 66 in. lbf)

install the No.2 timing belt rear plate to the No.1 tim-(2) ing belt rear plate with the 2 bolts.

Torque: 7.5 N·m (80 kgf·cm, 66 in.-lbf)

- Install the LH timing belt rear plates. (b)
 - (1) Connect the wire clamp to the No.1 timing belt rear plate.
 - (2) Install the No.1 timing belt rear plate to the cylinder head with the bolt.

Torque: 7.5 N·m (80 kgf·cm, 66 in.-lbf)

install the No.2 timing belt rear plate to the No.1 tim-(3) ing belt rear plate with the 2 bolts.

Torque: 7.5 N·m (80 kgf·cm, 66 in.-lbf)

25. INSTALL IGNITION COILS (See page IG-7)



26. **INSTALL TWC**

Install a new gasket and the TWC with 3 new nuts. Install the 2 TWC.

Torque: 61.8 N·m (630 kgf·cm, 46 ft-lbf)

ENGINE MECHANICAL - CYLINDER HEAD



27. CONNECT FRONT EXHAUST PIPE TO TWC

- (a) Temporarily install the pipe support bracket to the transmission with the 2 bolts.
- (b) Install a new gasket to each rear end of the TWC.
- (c) Connect the front exhaust pipe to the 2 front TWC and pipe support bracket with the 4 bolts and 4 new nuts.
 Torque: 43.1 N-m (440 kgf-cm, 32 ft-lbf)
- (d) Tighten the 2 bolts holding the pipe support bracket to the transmission.
 - Torque: 43.1 N·m (440 kgf·cm, 32 ft·lbf)
- 28. INSTALL PS PUMP (See page EM-82)
- 29. INSTALL CAMSHAFT POSITION SENSOR (See page IG-11)
- 30. INSTALL CAMSHAFT TIMING PULLEYS (See page EM-22)
- 31. CONNECT TIMING BELT TO CAMSHAFT TIMING PUL-LEYS (See page EM-22)
- 32. CHECK ENGINE OIL LEVEL
ENGINE UNIT COMPONENTS



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REMOVAL

- 1. REMOVE HOOD
- 2. REMOVE OIL PAN PROTECTOR
- 3. REMOVE ENGINE UNDER COVER
- 4. REMOVE LOWER FRONT SUSPENSION MEMBER PROTECTOR
- 5. REMOVE ENGINE MOUNT MEMBER BRACKET PLATE
- 6. DRAIN ENGINE COOLANT
- 7. DRAIN ENGINE OIL
- 8. REMOVE V-BANK COVER
- 9. REMOVE BATTERY CLAMP COVER
- 10. REMOVE AIR CLEANER INLET
- 11. REMOVE AIR CLEANER AND INTAKE AIR CONNEC-TOR ASSEMBLY
- 12. REMOVE BATTERY
- 13. REMOVE DRIVE BELT, FAN FLUID COUPLING AND FAN PULLEY (See page EM-15)
- 14. DISCONNECT ACCELERATOR CABLE TO THROTTLE BODY
- 15. REMOVE RADIATOR ASSEMBLY (See page CO-21)
- 16. REMOVE V-BANK COVER BRACKETS FROM EN-GINE HANGERS
- 17. DISCONNECT CONNECTORS, WIRE, STRAPS, CLAMPS AND HOSES
- (a) Disconnect the engine oil level sensor connector.
- (b) Disconnect the generator connector.
- (c) Disconnect the generator wire.
- (d) Disconnect the engine wire clamp from the bracket on generator.
- (e) Disconnect the ground strap from the RH engine mounting bracket.
- (f) Disconnect the ground strap from under of the LH fender apron.
- (g) Disconnect the engine wire clamp from the cowl panel.
- (h) Disconnect the radiator reservoir hose from the water bypass pipe.
- (i) Disconnect the brake booster vacuum hose from the intake manifold.
- (j) Disconnect the heater hose from the heater water valve.
- (k) Disconnect the heater hose from the water bypass pipe.
- (I) Disconnect the fuel inlet hose from the fuel inlet pipe.
- (m) Disconnect the PS air hose from the intake manifold.
- (n) Disconnect the 2 EVAP hoses from the pipes (from charcoal canister).
- (o) Disconnect the oil pressure switch connector.
- 18. DISCONNECT ENGINE WIRE FROM CABIN
- (a) Remove the under cover.
- (b) Remove the glove compartment.

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- (c) Disconnect the 3 ECM connectors.
- (d) Disconnect the cowl wire connector from the connector on the bracket.
- (e) Disconnect the engine wire clamp from the bracket.

- P21352
- (f) Disconnect the grommet from the cowl panel, and pull out the engine wire.

NOTICE:

Be careful not to damage the engine wire.

19. DISCONNECT PS OIL COOLER PIPE FROM OIL PAN



- 20. DISCONNECT HEATED OXYGEN SENSORS FROM FRONT EXHAUST PIPE
- (a) Disconnect the 2 wire grommets from the floor panel.
- (b) Disconnect the 2 oxygen sensors from the exhaust pipe.





21. REMOVE FRONT EXHAUST PIPE

- (a) Loosen the clamp bolt holding the front exhaust pipe to the center exhaust pipe.
- (b) Remove the 4 bolts and 4 nuts holding the front exhaust pipe to the TWC.
- (c) Remove the front exhaust pipe and 3 gaskets.
- (d) Remove the 2 bolts and pipe support bracket.
- 22. REMOVE TWC

Remove the 3 nuts, TWC and gasket. Remove the 2 TWC.

23. REMOVE CENTER EXHAUST PIPE

- (a) Loosen the 2 clamp bolts, and disconnect the center exhaust pipe from the tailpipes.
- (b) Disconnect the exhaust pipe from the 2 rings on the body brackets, and remove the center exhaust pipe and 2 gaskets.
- 24. REMOVE HEAT INSULATOR FOR REAR SIDE OF FRONT EXHAUST PIPE
- 25. REMOVE FRONT AND REAR CENTER FLOOR CROSSMEMBER BRACES

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26. REMOVE PROPELLER SHAFT (See page PR-3)



27. DISCONNECT A/C COMPRESSOR FROM ENGINE

- (a) Disconnect the A/C compressor connector.
- (b) Disconnect the wire clamp from the wire bracket on the A/C compressor.
- (c) Remove the bolt, and disconnect the ground cable from the A/C compressor stay.
- (d) Remove the bolt, nut and A/C compressor stay.
- (e) Remove the bolt, and disconnect the wire bracket from the A/C compressor.
- (f) Remove the bolt, and disconnect the A/C compressor from the engine.
- 28. REMOVE ABS ACTUATOR





- 29. REMOVE PS PUMP AND OIL RESERVOIR
- (a) Remove the 2 bolts, nut and PS pump from the engine.
- (b) Remove the 3 bolts and PS oil reservoir from the RH fender apron.
- 30. REMOVE HEAT INSULATORS FOR FRONT SIDE OF FRONT EXHAUST PIPE
- 31. REMOVE ENGINE AND TRANSMISSION ASSEMBLY FROM VEHICLE
- (a) Remove the 2 nuts, and disconnect the heater water valve from the cowl panel.
- (b) Attach the engine chain hoist to the engine hangers.
- (c) Remove the 2 nuts holding the engine mounting insulators to the front suspension crossmember.

ENGINE MECHANICAL – ENGINE UNIT



- (d) Remove the nut, and disconnect the transmission control rod from the shift lever.
- (e) Remove the 4 bolts, 4 nuts and rear engine mounting member.



(f) Lift the engine out of the vehicle slowly and carefully. HINT:

Make sure the engine is clear of all wiring, hoses and cables. **NOTICE:**

Be careful not hit the PS gear housing and PNP switch.

- (g) Place the engine and transmission assembly onto the stand.
- 32. DISCONNECT ENGINE WIRE FROM TRANSMISSION
- (a) Disconnect the VSV connector.
- (b) Disconnect the PNP switch connector.
- (c) Disconnect the solenoid connector.
- (d) Disconnect the direct clutch speed sensor connector.
- (e) Disconnect the 4 engine wire clamps from the bracket.





- 33. REMOVE OIL DIPSTICK GUIDE AND DIPSTICK FOR TRANSMISSION
- (a) Remove the bolt.
- (b) Pull out the dipstick guide and dipstick from the port of transmission.
- (c) Remove the O-ring from the dipstick guide.
- 34. REMOVE OIL COOLER PIPES FOR TRANSMISSION

35. REMOVE TORQUE CONVERTER CLUTCH BOLTS

- (a) Remove the 2 bolts and flywheel housing under cover.
- (b) Turn the crankshaft pulley bolt to gain access to each bolt.
- (c) Hold the crankshaft pulley bolt with a wrench, and remove the 6 bolts.



36. REMOVE TRANSMISSION

- (a) Remove the 10 bolts and engine wire bracket.
- (b) Remove the transmission together with the torque converter clutch from the engine.

37. REMOVE DRIVE PLATE

Remove the 8 bolts, front spacer, drive plate and rear spacer.







P21341

INSTALLATION

- 1. INSTALL DRIVE PLATE
- (a) Apply adhesive to 2 or 3 threads of the mounting bolt end.
 Adhesive:

Part No. 08833–00070, THREE BOND 1324 or equivalent

- (b) Install the front spacer, drive plate and rear plate on the crankshaft.
- (c) Install and uniformly tighten the mounting bolts in several passes, in the sequence shown.

Torque: 83 N·m (850 kgf·cm, 61 ft·lbf)

INSTALL TRANSMISSION TO ENGINE

- (a) Attach the transmission to the engine.
- (b) Install the engine wire bracket and 10 bolts. **Torque:**

14 mm head: 37 N·m (380 kgf·cm, 27 ft·lbf) 17 mm head: 72 N·m (730 kgf·cm, 53 ft·lbf)

- INSTALL TORQUE CONVERTER CLUTCH BOLTS
- (a) Apply adhesive to 2 or 3 threads of the bolt end.Adhesive:

Part No. 08833–00070, THREE BOND 1324 or equivalent



(b) Hold the crankshaft pulley bolt with a wrench, and install the 6 bolts evenly.

Torque: 41 N·m (420 kgf·cm, 30 ft·lbf)

HINT:

2.

3.

First install the dark green colored bolt, install the other bolts.

- Install the flywheel housing under cover with the 2 bolts.
 Torque: 18.5 N-m (185 kgf-cm, 14 ft-lbf)
- 4. INSTALL OIL COOLER PIPE FOR TRANSMISSION

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5. INSTALL OIL DIPSTICK GUIDE AND DIPSTICK FOR TRANSMISSION

- (a) Install a new O-ring to the dipstick guide.
- (b) Apply soapy water to the O-ring.
- (c) Connect the dipstick guide end to the dipstick tube of the oil pan.
- (d) Install the dipstick guide with the bolt.
- (e) Install the dipstick.
- 6. CONNECT ENGINE WIRE TO TRANSMISSION
- (a) Connect the VSV connector.
- (b) Connect the PNP switch connector.
- (c) Connect the solenoid connector.
- (d) Connect the direct clutch speed sensor connector.
- (e) Connect the 4 wire clamps to bracket.



- 7. INSTALL ENGINE AND TRANSMISSION ASSEMBLY IN VEHICLE
- (a) Attach the engine chain hoist to the engine hangers.
- (b) Slowly lower the engine and transmission assembly into the engine compartment.

NOTICE:

Be careful not to hit the PS gear housing and PNP switch.

- (c) Insert the stud bolts of the front engine mounting brackets into the stud bolt holes of the front suspension crossmember.
- (d) Keep the engine level.



 (e) Install the rear engine mounting member with the 4 bolts and 4 nuts.
 Torque: Bolt: 25 N-m (250 kgf-cm, 19 ft-lbf) Nut : 13.5 N-m (135 kgf-cm, 10 ft-lbf)
 NOTICE: Be careful of installation direction.

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- (f) Connect the transmission control rod to the shift lever with the nut.
 - Torque: 13 N·m (130 kgf·cm, 9 ft·lbf)
- (g) Install the 2 nuts holding the engine mounting brackets to the front suspension crossmember.

Torque: 70 N·m (700 kgf·cm, 52 ft·lbf)

- (h) Remove the engine chain hoist.
- (i) Install the heater water valve with the 2 nuts.
- 8. INSTALL HEAT INSULATORS FOR FRONT SIDE OF FRONT EXHAUST PIPE
- 9. INSTALL A/C COMPRESSOR
- Install the A/C compressor, compressor stay and wire bracket with the 3 bolts and nut.
 Torgue:

Bolt: 49 N·m (500 kgf·cm, 36 ft·lbf) Nut : 29 N·m (300 kgf·cm, 22 ft·lbf)

- (b) Connect the ground cable to the compressor stay with the bolt.
- (c) Install the wire clamp to the bracket on the A/C compressor.
- (d) Connect the A/C compressor connector.



- 10. INSTALL PS PUMP AND OIL RESERVOIR
- Install the PS pump with the 2 bolts and nut. Alternately tighten the bolts and nut.
 Torque:
 Bolt: 39 N·m (400 kgf·cm, 29 ft·lbf)

Nut : 43 N·m (440 kgf·cm, 32 ft-lbf)

- (b) Install the PS oil reservoir with the 3 bolts.
- 11. INSTALL ABS ACTUATOR
- 12. INSTALL PROPELLER SHAFT (See page PR-9)
- 13. INSTALL FRONT CENTER FLOOR CROSSMEMBER BRACE

Torque: 13 N·m (130 kgf·cm, 9 ft·lbf)

14. INSTALL HEAT INSULATOR FOR REAR SIDE OF FRONT EXHAUST PIPE





- (a) Install 2 new gaskets.
- (b) Install the center exhaust pipe to the rings on the body brackets.
- (c) Connect the center exhaust pipe to the tailpipes. (See page EM-120)



16. INSTALL TWC

Install a new gasket and the TWC with 3 new nuts. Install the 2 TWC.

Torque: 61.8 N·m (630 kgf·cm, 46 ft·lbf)



17. INSTALL FRONT EXHAUST PIPE

- (a) Temporarily install the pipe support bracket with the 2 bolts.
- (b) Install 2 new gaskets to the rear end of the TWC.
- (c) Install a new gasket to the rear of the front exhaust pipe.
- (d) Temporarily connect the front exhaust pipe to the center exhaust pipe.
- (e) Install the front exhaust pipe to the TWC and pipe support bracket with 4 new nuts and the 4 bolts.

Torque:43.1 N·m (440 kgf·cm, 32 ft·lbf)

- (f) Tighten the clamp bolt holding the front exhaust pipe to the center exhaust pipe. (See page EM-120)
- (g) Tighten the 4 bolts holding the pipe support bracket to the transmission.

Torque: 43.1 N·m (440 kgf·cm, 32 ft·lbf)



18. INSTALL HEATED OXYGEN SENSORS

Install the 2 oxygen sensors to the front exhaust pipe.

Torque: 44 N·m (450 kgf·cm, 33 ft·lbf)

- HINT:
 - Before installing the oxygen sensor, twist the sensor wire counterclockwise 3 and 1/2 turns.
- After installing the oxygen sensor, check that the sensor wire is not twisted. If it is twisted, remove the oxygen sensor and reinstall it.
- 19. INSTALL PS OIL COOLER PIPE

ENGINE MECHANICAL – ENGINE UNIT



20. CONNECT ENGINE WIRE TO CABIN

- (a) Push in the engine wire through the cowl panel. Install the grommet.
- (b) Connect the 3 ECM connectors.
- (c) Connect the cowl wire connector to the connector on the bracket.
- (d) Connect the engine wire clamp to the bracket.
- (e) Install the glove compartment.
- (f) Install the under cover.
- 21. CONNECT CONNECTORS, WIRE, STRAPS, CLAMPS AND HOSES
- (a) Connect the engine oil level sensor connector.
- (b) Connect the generator connector.
- (c) Connect the generator wire.
- (d) Connect the engine wire clamp to the bracket on the generator.
- (e) Connect the ground strap to the RH engine mounting bracket.
- (f) Connect the ground strap to under of the LH fender apron.
- (g) Connect the engine wire clamp to the bracket on the cowl panel.
- (h) Connect the radiator reservoir hose to the water bypass pipe.
- (i) Connect the brake booster vacuum hose to the intake manifold.
- (j) Connect the heater hose to the heater water valve.
- (k) Connect the heater hose to the water bypass pipe.
- Connect the fuel inlet hose to the fuel inlet pipe. (See page SF-23)
- (m) Connect the PS air hose to the intake manifold.
- (n) Connect the 2 EVAP hoses to the pipes (from the charcoal canister).
- (o) Connect the oil pressure switch connector.
- 22. INSTALL V-BANK COVER BRACKETS TO ENGINE HANGERS
- 23. INSTALL RADIATOR ASSEMBLY (See page CO-27)
- 24. INSTALL BATTERY
- 25. CONNECT ACCELERATOR CABLES TO THROTTLE BODY
- 26. INSTALL FAN PULLEY, FAN, FLUID COUPLING AND DRIVE BELT (See page EM-22)
- 27. INSTALL AIR CLEANER AND INTAKE AIR CONNEC-TOR ASSEMBLY
- 28. INSTALL AIR CLEANER INLET
- 29. INSTALL BATTERY CLAMP COVER
- 30. FILL WITH ENGINE COOLANT
- 31. FILL WITH ENGINE OIL
- 32. START ENGINE AND CHECK FOR LEAKS

- 33. INSTALL ENGINE MOUNT MEMBER BRACKET PLATE
- 34. INSTALL LOWER FRONT SUSPENSION MEMBER PROTECTOR
- 35. INSTALL V–BANK COVER
- 36. INSTALL ENGINE UNDER COVER
- 37. INSTALL OIL PAN PROTECTOR
- 38. INSTALL HOOD
- 39. PERFORM ROAD TEST

Check for abnormal noise, shock, slippage, correct shift points and smooth operation.

40. RECHECK ENGINE COOLANT AND OIL LEVELS

CYLINDER BLOCK COMPONENTS



EM09Z-02



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EM0A0-02

DISASSEMBLY

- 1. INSTALL ENGINE TO ENGINE STAND FOR DISASSEMBLY
- 2. REMOVE TIMING BELT AND PULLEYS (See page EM-15)
- 3. REMOVE CYLINDER HEAD (See page EM-34)
- 4. REMOVE RH ENGINE MOUNTING BRACKET
- 5. REMOVE LH ENGINE MOUNTING BRACKET

6. REMOVE WATER BYPASS PIPE

- (a) Disconnect the engine wire clamp from the bracket on the water bypass pipe.
- (b) Remove the bolt.
- (c) Pull out the water bypass pipe from the water pump.
- (d) Remove the O-ring from the water bypass pipe.
- 7. REMOVE STARTER (See page ST-5)
- 8. REMOVE KNOCK SENSORS (See page SF-85)

9. REMOVE ENGINE WIRE

- (a) Disconnect the crankshaft position sensor connector.
- (b) Remove the 2 bolts, and disconnect the engine wire from the RH side of the cylinder block.

LH Side Ground Cable Bracket Wire Protector Cover v A01878



(c) Remove the 2 bolts and engine wire cover from the LH side of the cylinder block.

- (d) Remove the 4 bolts and engine wire.
- 10. REMOVE WATER PUMP (See page CO-8)
- 11. REMOVE NO.2 OIL PAN (See page LU-9)
- 12. REMOVE OIL PAN BAFFLE PLATE (See page LU-9)
- 13. REMOVE NO.1 OIL PAN (See page LU-9)
- 14. REMOVE OIL STRAINER (See page LU-9)
- 15. REMOVE OIL PUMP (See page LU–9)
- 16. REMOVE WATER SEAL PLATE

Remove the 2 bolts and seal plate.

17. REMOVE ENGINE COOLANT DRAIN UNIONS Remove the RH and LH drain unions.

Pull O-Ring







18. REMOVE REAR OIL SEAL RETAINER

- (a) Remove the 7 bolts.
- (b) Using a screwdriver, remove the oil seal retainer by prying the portions between the oil seal retainer and main bearing cap.
- (c) Remove the O-ring.

19. CHECK CONNECTING ROD THRUST CLEARANCE

Using a dial indicator, measure the thrust clearance while moving the connecting rod back an forth.

Thrust clearance:

Standard	0.160 – 0.290 mm (0.0063 – 0.0138 in.)
Maximum	0.35 mm (0.0138 in.)

If the thrust clearance is greater than maximum, replace the connecting rod assembly(s). If necessary, replace the crank-shaft.

Connecting rod thickness:

22.880 - 22.920 mm (0.9008 - 0.9024 in.)



20. REMOVE CONNECTING ROD CAPS AND CHECK OIL CLEARANCE

- (a) Check the matchmarks on the connecting rod and cap to ensure correct reassembly.
- (b) Remove the 2 connecting rod cap bolts.



(c) Using the 2 removed connecting rod cap bolts, remove the connecting rod cap and lower bearing by wiggling the connecting rod cap right and left.

HINT:

Keep the lower bearing inserted with the connecting rod cap.

(d) Clean the crank pin and bearing.

(e) Check the crank pin and bearing for pitting and scratches. If the crank pin or bearing is damaged, replace the bearings. If necessary, replace the crankshaft.

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(f) Lay a strip of Plastigage across the crank pin.



(g) Install the connecting rod cap with the 2 bolts. (See page EM-110)

NOTICE:

Do not turn the crankshaft.

(h) Remove the 2 bolts, connecting rod cap and lower bearing. (See procedure (b) and (c) above)



(i) Measure the Plastigage at its widest point. **Oil clearance:**

Standard	0.027 – 0.053 mm (0.0011 – 0.0021 in.)
Maximum	0.065 mm (0.0026 in.)

If the oil clearance is greater than maximum, replace the bearings. If necessary, replace the crankshaft.

Number Mark No.4 No.4 No.4 No.4 No.4 No.4 No.3 No.1 No.2 Number Mark Number Mark EM6408 EM6408 EM6407 EM6407 EM6408 EM6407 EM6407

HINT:

If using a standard bearing, replace it with one having the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers imprinted on the connecting rod cap and crankshaft, then selecting the bearing with the same number as the total. There are 6 sizes of standard bearings, marked "2", "3", "4", "5", "6" and "7".

	Number mark											
Connecting rod cap	1	1	2	1	2	3	2	3	4	3	4	4
Crankshaft	1	2	1	3	2	1	3	2	1	3	2	3
Use bearing	2	~ `	3		4			5		(6	7

EXAMPLE:

Connecting rod cap "3" + Crankshaft "1"

= Total number 4 (Use bearing "4")

Reference Connecting rod big end inside diameter:

Mark "1"	55.000 – 55.006 mm (2.1654 – 2.1656 in.)
Mark "2"	55.006 – 55.012 mm (2.1656 – 2.1658 in.)
Mark "3"	55.012 – 55.018 mm (2.1658 – 2.1661 in.)
Mark "4"	55.018 – 55.024 mm (2.1661 – 2.1663 in.)

Crankshaft crank pin diameter:

Mark "1"	51.994 – 52.000 mm (2.0470 – 2.0472 in.)
Mark "2"	51.988 – 51.994 mm (2.0468 – 2.0470 in.)
Mark "3"	51.982 – 51.988 mm (2.0465 – 2.0468 in.)

Standard sized bearing center wall thickness:

Mark "2"	1.484 – 1.487 mm (0.0584 – 0.0585 in.)
Mark "3"	1.487 – 1.490 mm (0.0585 – 0.0587 in.)
Mark "4"	1.490 – 1.493 mm (0.0587 – 0.0588 in.)
Mark "5"	1.493 – 1.496 mm (0.0588 – 0.0589 in.)
Mark "6"	1.496 – 1.499 mm (0.0589 – 0.0590 in.)
Mark "7"	1.499 – 1.502 mm (0.0590 – 0.0591 in.)

(j) Completely remove the Plastigage.

21. REMOVE PISTON AND CONNECTING ROD ASSEMBLIES

- (a) Using a ridge reamer, remove all the carbon from the top of the cylinder.
- (b) Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

HINT:

- Keep the bearings, connecting rod and cap together.
- Arrange the piston and connecting rod assemblies in correct order.

22. CHECK CRANKSHAFT THRUST CLEARANCE

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

Thrust clearance:

Standard	0.020 – 0.220 mm (0.0008 – 0.0087 in.)
Maximum	0.30 mm (0.0118 in.)

If the thrust clearance is greater than maximum, replace the thrust washers as a set.

Thrust washer thickness:

2.440 - 2.490 mm (0.0961 - 0.0980 in.)







- 23. REMOVE MAIN BEARING CAPS AND CHECK OIL CLEARANCE
- (a) Remove the 10 main bearing cap bolts.



(b) Uniformly loosen and remove the 20 main bearing cap bolts in several passes, in the sequence shown.



 Using 2 screwdrivers, pry out the main bearing cap, and remove the 5 main bearing caps, 5 lower bearings and 2 lower thrust washers (No.3 main bearing cap only).

NOTICE:

Be careful not to damage the cylinder block. HINT:

- Keep the lower bearing and main bearing cap together.
- Arrange the main bearing caps and lower thrust washers in correct order.
- (d) Lift out the crankshaft.
- (e) Remove the 2 upper thrust washers.

HINT:

- Arrange the upper thrust washers in correct order.
- Keep the upper bearings together with the cylinder block.
- (f) Clean each main journal and bearing.
- (g) Check each main journal and bearing for pitting and scratches.

If the journal or bearing is damaged, replace the bearings. If necessary, replace the crankshaft.

 (h) Install the 10 main bearings and 5 main bearing caps with the 30 bolts. Do not install the crankshaft. (See page EM-110)



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- (i) Using a cylinder gauge, measure the inside diameter of the main bearing. Bearing inside diameter:
 - 66.986 67.000 mm (2.6372 2.6378 in.)
 - Measure the diameter of the main journal.
- (j) (See page EM-100)
- (k) Subtract the main journal diameter measurement from the main bearing inside diameter measurement. Standard clearance:

Maximum clearance:				
Others	0.029 – 0.045 mm (0.0011 – 0.0018 in.)			
No.1 and No.5	0.017 – 0.033 mm (0.0007 – 0.0013 in.)			

No.1 and No.5	0.043 mm (0.0017 in.)
Others	0.055 mm (0.0022 in.)



If the oil clearance is greater than maximum, replace the bearings. If necessary, replace the crankshaft. HINT:

If using a standard bearing, replace it with one having the same number. If the number of the bearing cannot be determined, select the correct bearing by adding together the numbers imprinted on the cylinder block and crankshaft, then refer to the table below for the appropriate bearing number. There are 5 sizes of the standard bearings. For No.1 and No.5 position bearings, use bearings marked "3", "4", "5", "6" and "7". For others position bearings, use bearings marked "1", "2", "3", "4" and "5".

No.1, No.5:

		Use t	bearing
		Upper	Lower
Cylinder block (A) + Crankshaft (B)	0-5	3	3
	6 – 8	3	4
	9 – 11	4	4
	12 – 14	4	5
	15 – 17	5	5
	18 – 20	5	6
	21 – 23	6	6
	24 – 26	6	7
	27 – 28	7	7

EXAMPLE: Cylinder block "08" + Crankshaft "06" = Total number 14 (Use bearing "4" (Upper), "5" (Lower))

Others:

	Use bearing		
		Upper	Lower
	0 - 5	1	1
	6 – 8	1	2
Cylinder block (A) + Crankshaft (B)	9 – 11	2	2
	12 – 14	2	3
	15 – 17	3	3
	18 – 20	3	4
	21 – 23	4	4
	24 – 26	4	5
	27 – 28	5	5

EXAMPLE: Cylinder block "08" + Crankshaft "06" = Total number 14 (Use bearing "2" (Upper), "3" (Lower))

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Reference Cylinder block main journal bore diameter (A):

Mark "00"	72.000 mm (2.8346 in.)
Mark "01"	72.001 mm (2.8347 in.)
Mark "02"	72.002 mm (2.8347 in.)
Mark "03"	72.003 mm (2.8348 in.)
Mark "04"	72.004 mm (2.8348 in.)
Mark "05"	72.005 mm (2.8348 in.)
Mark "06"	72.006 mm (2.8349 in.)
Mark "07"	72.007 mm (2.8349 in.)
Mark "08"	72.008 mm (2.8350 in.)
Mark "09"	72.009 mm (2.8350 in.)
Mark "10"	72.010 mm (2.8350 in.)
Mark "11"	72.011 mm (2.8351 in.)
Mark "12"	72.012 mm (2.8351 in.)
Mark "13"	72.013 mm (2.8352 in.)
Mark "14"	72.014 mm (2.8352 in.)
Mark "15"	72.015 mm (2.8352 in.)
Mark "16"	72.016 mm (2.8353 in.)

Crankshaft main journal diameter (B):

Mark "00"	67.000 mm (2.6378 in.)
Mark "01"	66.999 mm (2.6378 in.)
Mark "02"	66.998 mm (2.6377 in.)
Mark "03"	66.997 mm (2.6377 in.)
Mark "04"	66.996 mm (2.6376 in.)
Mark "05"	66.995 mm (2.6376 in.)
Mark "06"	66.994 mm (2.6376 in.)
Mark "07"	66.993 mm (2.6375 in.)
Mark "08"	66.992 mm (2.6375 in.)
Mark "09"	66.991 mm (2.6374 in.)
Mark "10"	66.990 mm (2.6374 in.)
Mark "11"	66.989 mm (2.6374 in.)
Mark "12"	66.988 mm (2.6373 in.)

Standard bearing center wall thickness: No.1 and No.5

Mark "3"	2.492 – 2.495 mm (0.0981 – 0.0982 in.)
Mark "4"	2.495 – 2.498 mm (0.0982 – 0.0983 in.)
Mark "5"	2.498 – 2.501 mm (0.0983 – 0.0985 in.)
Mark "6"	2.501 – 2.504 mm (0.0985 – 0.0986 in.)
Mark "7"	2.504 – 2.507 mm (0.0986 – 0.0987 in.)

Others	
Mark "1"	2.486 – 2.489 mm (0.0979 – 0.0980 in.)
Mark "2"	2.489 – 2.492 mm (0.0980 – 0.0981 in.)
Mark "3"	2.492 – 2.495 mm (0.0981 – 0.0982 in.)
Mark "4"	2.495 – 2.498 mm (0.0982 – 0.0983 in.)
Mark "5"	2.498 – 2.501 mm (0.0983 – 0.0985 in.)

(I) Remove the 10 bolts, 20 nuts, 5 main bearing caps and 5 lower main bearing.

(See procedure (a) to (c) above)

(m) Remove the 5 upper main bearings from the cylinder block.

HINT:

Arrange the main bearing caps, bearings and thrust washers in correct order.

24. CHECK FIT BETWEEN PISTON AND PISTON PIN

Try to move the piston back and forth on the piston pin. If any movement is felt, replace the piston and pin as a set.



25. REMOVE PISTON RINGS

- (a) Using a piston ring expander, remove the 2 compression rings.
- (b) Remove the 2 side rails and oil ring by hand.

HINT:

v A02090

Arrange the piston rings in correct order only.

26. DISCONNECT CONNECTING ROD FROM PISTON

- (a) Using
 - (a) Using a small screwdriver, pry out the 2 snap rings.





(b) Gradually heat the piston to approx. $60^{\circ}C$ (140°F).



- (c) Using a plastic–faced hammer and brass bar, lightly tap out the piston pin and pin and remove the connecting rod.HINT:
 - The piston and pin are a matched set.
 - Arrange the pistons, pins, rings, connecting rods and bearings in correct order.



INSPECTION

1. REMOVE GASKET MATERIAL

Using a gasket scraper, remove all the gasket material from the top surface of the cylinder block.

EM0A1-02

2. CLEAN CYLINDER BLOCK

Using a soft brush and solvent, thoroughly clean the cylinder block.

NOTICE:

If the cylinder is washed at high temperatures, the cylinder liner sticks out beyond the cylinder block, so always wash the cylinder block at a temperature of 45° or less.



3. INSPECT TOP SURFACE OF CYLINDER BLOCK FOR FLATNESS

Using a precision straight edge and feeler gauge, measure the surface contacting the cylinder head gasket for warpage.

Maximum warpage: 0.07 mm (0.0028 in.)

If warpage is greater than maximum, replace the cylinder block.



4. INSPECT CYLINDER FOR VERTICAL SCRATCHES

Visually check the cylinder for vertical scratches. If deep scratches are present, replace the cylinder block.

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Front (2) (1) Thrust (2) Axial Direction (2) Axial Direction (0.39 in.) (0.39 in.)

5. INSPECT CYLINDER BORE DIAMETER

HINT:

There are 3 sizes of the standard cylinder bore diameter, marked "1", "2" and "3" accordingly. The mark is stamped on the top of the cylinder block.

Using a cylinder gauge, measure the cylinder bore diameter at positions A, B and C in the thrust and axial directions. **Standard diameter:**

Mark "1"	87.500 – 87.510 mm (3.4449 – 3.4453 in.)
Mark "2"	87.510 – 87.520 mm (3.4453 – 3.4457 in.)
Mark "3"	87.520 – 87.530 mm (3.4457 – 3.4461 in.)

Maximum diameter: 87.73 mm (3.4539 in.)

If the diameter is greater than maximum, replace the cylinder block.



6. REMOVE CYLINDER RIDGE

If the wear is less than 0.2 mm (0.008 in.), using a ridge reamer, grind the top of the cylinder.



7. INSPECT MAIN BEARING CAP BOLTS

Using vernier calipers, measure the tension portion diameter of the bolt.

Diameter:

Standard	7.500 – 7.600 mm (0.2953 – 0.2992 in.)
Minimum	7.20 mm (0.2835 in.)

If the diameter is less than minimum, replace the stud bolt.

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ENGINE MECHANICAL - CYLINDER BLOCK

8.



CLEAN PISTON

(a) Using a gasket scraper, remove the carbon from the piston top.



Using a groove cleaning tool or broken ring, clean the pis-(b) ton ring grooves.



(c) Using solvent and a brush, thoroughly clean the piston. NOTICE: Do not use a wire brush.



INSPECT PISTON OIL CLEARANCE HINT:

There are 3 sizes of the standard piston diameter, marked "1", "2" and "3" accordingly. The mark is stamped on the piston top.

Using a micrometer, measure the piston diameter at right (a) angles to the piston pin center line, 26.5 mm (1.04 in.) from the piston head.

Piston diameter:

9.

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Mark "1"	87.406 – 87.416 mm (3.4411 – 3.4416 in.)
Mark "2"	87.416 – 87.426 mm (3.4416 – 3.4420 in.)
Mark "3"	87.426 – 87.436 mm (3.4420 – 3.4424 in.)

- Measure the cylinder bore diameter in the thrust direc-(b) tions. (See step 5 above)
- Subtract the piston diameter measurement from the cylin-(c) der bore diameter measurement.

Oil clearance:

Standard	0.084 – 0.104 mm (0.0033 – 0.0041 in.)
Maximum	0.124 mm (0.0049 in.)

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A02074 A02075 If the oil clearance is greater than maximum, replace all the 8 pistons. If necessary, replace the cylinder block.



HINT

Use new cylinder block:

- Use a piston with the same number mark as the cylinder diameter marked on the cylinder block.
- The shape of the piston varies for the RH and LH banks. The RH piston is marked with "R", the LH piston with "L".



105 mm

10. INSPECT PISTON RING GROOVE CLEARANCE

Using a feeler gauge, measure the clearance between new piston ring and the wall of the ring groove.

Ring groove clearance:

No.2	0.010 – 0.050 mm (0.0004 – 0.0020 in.)
No.1	0.020 – 0.070 mm (0.0008 – 0.0028 in.)

If the clearance is not as specified, replace the piston.

11. INSPECT PISTON RING END GAP

- (a) Insert the piston ring into the cylinder bore.
- (b) Using a piston, push the piston ring a little beyond the bottom of the ring travel, 105 mm (4.13 in.) from the top of the cylinder block.

ENGINE MECHANICAL - CYLINDER BLOCK



(c) Using a feeler gauge, measure the end gap. **Standard end gap:**

N	· · · · · · · · · · · · · · · · · · ·
Oil (Side rail)	0.150 – 0.500 mm (0.0059 – 0.0197 in.)
No.2	0.500 – 0.700 mm (0.0197 – 0.0276 in.)
No.1	0.250 – 0.450 mm (0.0098 – 0.0177 in.)

Maximum end gap:

No.1	1.05 mm (0.0413 in.)
No.2	1.30 mm (0.0512 in.)
Oil (Side rail)	1.10 mm (0.0433 in.)

If the end gap is greater than maximum, replace the piston ring. If the end gap is greater than maximum, even with a new piston ring, replace the cylinder block.



12. INSPECT PISTON PIN FIT

At 60 $^{\circ}$ C (140 $^{\circ}$ F), you should be able to push the piston pin into the piston pin hole with your thumb.





13. INSPECT CONNECTING ROD ALIGNMENT

Using a rod aligner and feeler gauge, check the connecting rod alignment.

- Check for bend.
- Maximum bend:

0.05 mm (0.0020 in.) per 100 mm (3.94 in.)

If bend is greater than maximum, replace the connecting rod assembly.

- Check for twist
- Maximum twist:

0.15 mm (0.0059 in.) per 100 mm (3.94 in.)

If twist is greater than maximum, replace the connecting rod assembly.



- 14. INSPECT PISTON PIN OIL CLEARANCE
 - Using a caliper gauge, measure the inside diameter of the connecting rod bushing.

Bushing inside diameter: 22.005 – 22.014 mm (0.8663 – 0.8667 in.)

(b) Using a micrometer, measure the piston pin diameter. **Piston pin diameter:**



(c) Subtract the piston pin diameter measurement from the bushing inside diameter measurement.

Oil clearance:

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Standard	0.005 – 0.011 mm (0.0002 – 0.0004 in.)
Maximum	0.05 mm (0.0020 in.)

If the oil clearance is greater than maximum, replace the bushing. If necessary, replace the piston and piston pin as a set.





15. INSPECT CONNECTING ROD BOLTS

Using vernier calipers, measure the tension portion of the connecting rod bolt.

Diameter:

Standard	7.200 – 7.300 mm (0.2835 – 0.2874 in.)
Minimum	7.00 mm (0.2756 in.)

If the diameter is less than minimum, replace the bolt.

16. INSPECT CRANKSHAFT FOR CIRCLE RUNOUT

- (a) Place the crankshaft on V–blocks.
- (b) Using a dial indicator, measure the circle runout at the center journal.

Maximum circle runout: 0.08 mm (0.0031 in.)

If the circle runout is greater than maximum, replace the crankshaft.

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17. INSPECT MAIN JOURNALS AND CRANK PINS

(a) Using a micrometer, measure the diameter of each main journal and crank pin.

Diameter:

Main journal	66.988 – 67.000mm (2.6373 – 2.6378 in.)
Crank pin	51.982 – 52.000 mm (2.0465 – 2.0472 in.)

If the diameter is not as specified, check the oil clearance (See disassembly). If necessary, replace the crankshaft.

(b) Check each main journal and crank pin for taper and outof-round as shown.

Maximum taper and out–of–round: 0.02 mm (0.0008 in.)

If the taper and out–of–round is greater than maximum, replace the crankshaft.





REPLACEMENT

- 1. REPLACE CONNECTING ROD BUSHINGS
- (a) Using SST and a press, press out the bushing. SST 09222–30010
- Oil Hole P20666
- (b) Align the oil holes of a new bushing and the connecting rod.
- (c) Using SST and a press, press in the bushing. SST 09222–30010

- (d) Using a pin hole grinder, hone the bushing to obtain the standard specified clearance (See page EM-100) between the bushing and piston pin.

- P20668
- (e) Check the piston pin fit at normal room temperature. Coat the piston pin with engine oil, and push it into the connecting rod with your thumb.



2. REPLACE CRANKSHAFT FRONT OIL SEAL HINT:

There are 2 methods ((a) and (b)) to replace the oil seal. (a) If oil pump is removed from cylinder block:

(1) Using a screwdriver, pry out the oil seal.

Cut Position

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- (2) Using SST and a hammer, tap in a new oil seal until its surface is flush with the oil pump body edge.
- SST 09316-60011 (09316-00011)
- (3) Apply MP grease to the oil seal lip.

- If oil pump is installed to the cylinder block: (b)
 - (1) Using a knife, cut off the oil seal lip.
 - Using a screwdriver, pry out the oil seal. (2)

NOTICE:

2 R21331 Be careful not to damage the crankshaft. Tape the screwdriver tip.

- (3) Apply MP grease to a new oil seal lip.
- Using SST and a hammer, tap in the oil seal until its (4) surface is flush with the oil pump body edge.
- SST 09316-60011 (09316-00011)







REPLACE CRANKSHAFT REAR OIL SEAL 3. HINT:

There are 2 methods ((a) and (b)) to replace the oil seal which. If rear oil seal retainer is removed from cylinder block: (a)

- (1) Using a screwdriver and hammer, tap out the oil seal.
 - (2) Using SST and a hammer, tap in a new oil seal until its surface is flush with the rear oil seal retainer edge.
 - SST 09223-56010
 - Apply MP grease to the oil seal lip. (3)


SST

(b) If rear oil seal retainer is installed to cylinder block:

- (1) Using a knife, cut off the oil seal lip.
- (2) Using a screwdriver, pry out the oil seal.

NOTICE:

Be careful not to damage the crankshaft. Tape the screwdriver tip.

- (3) Apply MP grease to a new oil seal lip.
- (4) Using SST and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.
- SST 09223-56010

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REASSEMBLY

HINT:

- Thoroughly clean all parts to be assembled.
- Before installing the parts, apply new engine oil to all sliding and rotating surfaces.

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- Replace all gaskets, O–rings and oil seals with new parts.
- 1. ASSEMBLE PISTON AND CONNECTING ROD
- (a) Using a small screwdriver, install a new snap ring on one side of the piston pin hole.
- (b) Gradually heat the piston to about $60^{\circ}C$ (140°F).







 (d) Position the piston front mark with respect to the outside mark on the connecting rod as shown in the diagram.
 NOTICE:

The installation directions of the piston and connecting rod are different for the RH and LH banks. The RH piston is marked with "R", the LH piston with "L".

(e) Align the piston pin holes of the piston and connecting rod, and push in the piston pin with your thumb.



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

EM-111

2.











INSTALL PISTON RINGS

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

Code mark:

No.1	1R
No.2	2R

(c) Position the piston rings so that the ring ends are as shown.

NOTICE:

Do not align the ring ends.

INSTALL BEARINGS

- (a) Align the bearing claw with the groove of the connecting rod or connecting cap.
- (b) Install the bearings in the connecting rod and connecting rod cap.

4. INSTALL MAIN BEARINGS

HINT:

- Main bearings come in widths of 19.5 mm (0.768 in.) and 22.5 mm (0.886 in.). Install the 22.5 mm (0.886 in.) bearings in the No.1 and No.5 cylinder block journal positions with the main bearing cap. Install the 19.5 mm (0.768 in.) bearings in the other positions.
- Upper bearings have an oil groove and oil holes; lower bearings do not.

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(a) Align the bearing claw with the claw groove of the cylinder block, and push in the 5 upper bearings.



 (b) Align the bearing claw with the claw groove of the main bearing cap, and push in the 5 lower bearings.
 HINT:

HINI:

A number is marked on each main bearing cap to indicate the installation position.



5. INSTALL UPPER THRUST WASHERS

Install the 2 thrust washers under the No.3 journal position of the cylinder block with the oil grooves facing outward.

6. PLACE CRANKSHAFT ON CYLINDER BLOCK



- 7. PLACE MAIN BEARING CAPS AND LOWER THRUST WASHERS ON CYLINDER BLOCK
- (a) Install the 2 thrust washers on the No.3 bearing cap with the grooves facing outward.



(b) Install the 5 main bearing caps in their proper locations.



HINT:

Place the bearing caps level and let them return to their original position by their own weight.

NOTICE:

8.

Do not install the main bearing cap by tapping it.



INSTALL MAIN BEARING CAP BOLTS HINT:

- The main bearing cap bolts are tightened in 2 progressive steps (steps (b) and (d)).
 - If any one of the main bearing cap bolts is broken or deformed, replace it.
- Apply a light coat of engine oil on the threads and under (a) the main bearing cap bolts.
- Install and uniformly tighten the 20 main bearing cap bolts (b) in several passes, in the sequence shown.

Torque: 27 N·m (275 kgf·cm, 20 ft·lbf)

If any one of the main bearing cap bolts does not meet the torque specification, replace the main bearing cap bolt.



- Mark the front of the main bearing cap bolt with paint. (c)
- Retighten the main bearing cap bolts by 90° in the numer-(d) ical order shown.
- (e) Check that the painted mark is now at a 90° angle to the front.



- Install a new seal washer to the main bearing cap bolt.
- (g) Install and uniformly tighten the 10 main bearing cap bolts.

Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)

- Check that the crankshaft turns smoothly. (h)
- CHECK CRANKSHAFT THRUST CLEARANCE 9. (See page EM-90)

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10. INSTALL PISTON AND CONNECTING ROD ASSEMBLES

Using a piston ring compressor, push the correctly numbered piston and connecting rod assemblies into each cylinder with the front mark of the piston facing forward. **NOTICE:**

The shape of the piston varies for the RH and LH banks. The RH piston is marked with "R", the LH piston with "L".



- 11. PLACE CONNECTING ROD CAP ON CONNECTING ROD
- (a) Match the numbered connecting rod cap with the connecting rod.
- (b) Align the pin groove of the connecting rod cap with the pins of the connecting rod, and install the connecting rod cap.
- (c) Check that the outside mark of the connecting rod cap is facing in correct direction.



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12. INSTALL CONNECTING ROD CAP BOLTS

HINT:

- The connecting rod cap bolts are tightened in 2 progressive steps (steps (b) and (d)).
- If any one of the connecting rod cap bolts is broken or deformed, replace it.
- (a) Apply a light coat of engine oil on the threads and under the heads of the connecting rod cap bolts.
- (b) Install and alternately tighten the 2 connecting rod cap bolts in several passes.

Torque: 25 N·m (250 kgf·cm, 18 ft·lbf)

If any one of the connecting rod cap bolts does not meet the torque specification, replace the connecting rod cap bolts.

- (c) Mark the front of the connecting cap bolt with paint.
 (d) Retighten the cap bolts 90° as shown.
 - (e) Check that the painted mark is now at a 90° angle to the front.
 - (f) Check that the crankshaft turns smoothly.
 - 13. CHECK CONNECTING ROD THRUST CLEARANCE (See page EM-90)
 - 14. INSTALL REAR OIL SEAL RETAINER
 - (a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the oil seal retainer and cylinder block.
 - Using a razor blade and gasket scraper, remove all the oil packing (FIPG) material from the gasket surfaces and sealing grooves.
 - Thoroughly clean all components to remove all the loose material.
 - Using a non-residue solvent, clean both sealing surfaces.
 - (b) Apply seal packing to the oil seal retainer as shown in the illustration.

Seal packing:

Part No. 08826–00080 or equivalent

- Install a nozzle that has been cut to a 2 3 mm (0.08 0.12 in.) opening.
- Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.







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Date :

 Immediately remove nozzle from the tube and reinstall cap.



- (c) Install a new O–ring to the cylinder block.
- (d) Install the oil seal retainer with the 7 bolts.Torque: 8.0 N·m (80 kgf·cm, 71 in.·lbf)



- **15.** INSTALL ENGINE COOLANT DRAIN UNIONS(a) Apply seal packing to 2 or 3 threads.
 - Seal packing: Part No. 08826–00100 or equivalent



(b) Install the RH and LH drain unions. Torque: 49 N·m (500 kgf·cm, 36 ft·lbf)

HINT:

After applying the specified torque, rotate the drain union clockwise until its drain port is facing forward.

- 16. INSTALL WATER SEAL PLATE
- (a) Remove any old packing (FIPG) material and be careful not to drop any oil on the contact surfaces of the seal plate and cylinder block.
 - Using a razor blade and gasket scraper, remove all the old packing (FIPG) material from the gasket surfaces and sealing groove.
 - Thoroughly clean all components to remove all the loose material.
 - Using a non-residue solvent, clean both sealing surfaces.



Apply seal packing to the seal plate as shown in the illustration.

Seal packing:

Part No. 08826–00080 or equivalent

- Install a nozzle that has been cut to a 2 3 mm (0.08 0.12 in.) opening.
- Parts must be assembled within 5 minutes of application. Otherwise the material must be removed and reapplied.
- Immediately remove nozzle from the tube and reinstall cap.
- (c) Install the seal plate with the 2 nuts. Alternately tighten the nuts in several passes.

Torque: 14 N·m (145 kgf·cm, 10 ft·lbf)

- 17. INSTALL OIL PUMP (See page LU-16)
- 18. INSTALL OIL STRAINER (See page LU–16)
- 19. INSTALL NO.1 OIL PAN (See page LU-16)
- 20. INSTALL OIL PAN BAFFLE PLATE (See page LU-16)
- 21. INSTALL NO.2 OIL PAN (See page LU-16)
- 22. INSTALL WATER PUMP (See page CO-10)





- (a) Install the engine wire to the LH side of the cylinder block with the 4 bolts.
- (b) Install the engine wire cover with the 2 bolts.



- (c) Install the engine wire to the RH side of the cylinder block with the 2 bolts.
- (d) Connect the crankshaft position connector.
- 24. INSTALL KNOCK SENSORS (See page SF-85)
- 25. INSTALL STARTER (See page ST-17)





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26. INSTALL WATER BYPASS PIPE

- (a) Install a new O-ring to the water bypass pipe.
- (b) Apply soapy water to the O-ring.
- (c) Push the water bypass pipe end into the pipe hole of the water pump.
- (d) Install the water bypass pipe with the bolt.Torque: 18 N·m (185 kgf·cm, 13 ft·lbf)
- (e) Install the engine wire clamp to the bracket on the water bypass pipe.

27. INSTALL RH ENGINE MOUNTING BRACKET

Install the mounting bracket with the 4 bolts.

Torque: 36 N·m (370 kgf·cm, 27 ft·lbf) HINT:

The RH mounting bracket is marked with "R".



28. INSTALL LH ENGINE MOUNTING BRACKET

Install the mounting bracket with the 4 bolts. HINT:

- The LH mounting bracket is marked with "L". Torque: 36 N-m (370 kgf-cm, 27 ft-lbf)
- 29. INSTALL CYLINDER HEADS (See page EM-58)
- 30. INSTALL TIMING BELT AND PULLEYS (See page EM-22)
- 31. DISCONNECT ENGINE FROM ENGINE STAND

EXHAUST SYSTEM COMPONENTS

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INSTALLATION CONNECT CENTER EXHAUST PIPE TO FRONT EXHAUST PIPE AND TAILPIPES

HINT:

- Install a new gasket to the exhaust pipe in the correct direction.
- Fit together the clamp protrusion and pipe hollow, and tighten the clamp bolt until A and B of the clamp are just touching.