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# **SPECIFICATIONS**

#### ENGINE MECHANICAL SYSTEM SPECIFICATIONS

Des	cription	Specifications	Limit
General			
Туре		In-line, DOHC	
Number of cylinde	ers	4	
Bore		76.5 mm (3.0118 in)	
Stroke		87 mm (3.4252 in)	
Total displacemen	ıt	1,599 cc (97.57 cu.in)	
Compression ratio		10.0 : 1	
Firing order		1-3-4-2	
Valve timing		· · ·	
	Opens (BTDC)	-8°	
Intake valve	Closes (ABDC)	60°	
	Opens (BBDC)	46°	
Exhaust valve	Closes (ATDC)	10°	
Cylinder head			
Flatness of gasket	surface	Less than 0.03 mm (0.0012 in)	
Flatness of manifold	Intake	Less than 0.15 mm (0.0059 in)	
mounting surface Exhaust		Less than 0.15 mm (0.0059 in)	
Valve guide hole diameter	STD	$11.000 \sim 11.018 \text{ mm}$ (0.4331 ~ 0.4338 in)	
(Intake, Exhaust)	0.05 OS	$\frac{(0.1351 - 0.1355 \text{ in})}{11.050 \sim 11.068 \text{ mm}}$ $(0.4350 \sim 0.4357 \text{ in})$	
	0.25 OS	$\begin{array}{c} (0.4326 - 0.4327 \text{ in}) \\ \hline 11.250 \sim 11.268 \text{ mm} \\ (0.4429 \sim 0.4436 \text{ in}) \end{array}$	
	0.50 OS	$\frac{(0.452) - 0.4525 \text{ in}}{11.500 \sim 11.518 \text{ mm}}$ $(0.4528 \sim 0.4535 \text{ in})$	
	STD	$30.400 \sim 30.421 \text{ mm}$ (1.1968 ~ 1.1977 in)	
Intake valve seat ring hole diameter	0.3 OS	$\frac{30.700 \sim 30.721 \text{ mm}}{(1.2087 \sim 1.2095 \text{ in})}$	
	0.6 OS	$\begin{array}{c} (1.200 + 1.1200 + 1.1) \\ 31.000 \sim 31.021 \text{ mm} \\ (1.2205 \sim 1.2213 \text{ in}) \end{array}$	
Exhaust valve seat ring hole diameter	STD	27.000 ~ 27.021 mm (1.0630 ~ 1.0638 in)	
	0.3 OS	27.300 ~ 27.321 mm (1.0748 ~ 1.0756 in)	
	0.6 OS	27.600 ~ 27.621 mm	
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		(1.0866 ~ 1.0874 in)	
Camshaft		· · · · · · · · · · · · · · · · · · ·	
Cam height	Intake	43.7492 ~ 43.9492 mm (1.72241 ~ 1.73028 in)	
	Exhaust	44.1494 ~ 44.3494 mm (1.73816 ~ 1.74604 in)	
Journal outer dia Exhaust)	ameter (Intake,	26.964 ~ 26.980 mm (1.0616 ~ 1.0622 in)	
Camshaft cap oi	l clearance	$0.02 \sim 0.061 \text{ mm} (0.0008 \\ \sim 0.0024 \text{ in})$	
End play		0.10 ~ 0.20 mm (0.0039 ~ 0.0079 in)	
Valve			
Valve length	Intake Exhaust	91.8 mm (3.6142 in) 92.4 mm (3.6378 in)	
Stem outer	Intake	5.965 ~ 5.980 mm (0.2348 ~ 0.2354 in)	
diameter	Exhaust	5.950 ~ 5.965 mm (0.2343 ~ 0.2348 in)	
Face angle		45° ~ 45° 30'	
Thickness of valve head	Intake	1.1 mm (0.0433 in)	0.8 mm (0.0315 in)
(margin)	Exhaust	1.3 mm (0.0512 in)	1.0 mm (0.0394 in)
Valve stem to	Intake	0.02 ~ 0.05 mm (0.0008 ~ 0.0020 in)	0.10 mm (0.0039 in)
clearance	Exhaust	$0.035 \sim 0.065 \text{ mm} (0.0014) \\ \sim 0.0026 \text{ in})$	0.15 mm (0.0059 in)
Valve guide			
Length	Intake	36.3 ~ 36.7 mm (1.4291 ~ 1.4449 in)	
Length	Exhaust	39.3 ~ 39.7 mm (1.5472 ~ 1.5630 in)	
Valve seat			
Width of seat	Intake	0.8 ~ 1.2 mm (0.0315 ~ 0.0472 in)	
contact	Exhaust	1.3 ~ 1.7 mm (0.0512 ~ 0.0669 in)	
Seat angle	Intake Exhaust	45° ~ 45° 30' 45° ~ 45° 30'	
Valve spring	Linuali		
Free length		44.0 mm (1.7323 in)	
Load		21.6 ±1.1 kg / 35 mm (47.6 ± 2.4 lb / 1.3780 in)	
l		1	

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		45.1 ± 2.2 kg / 27.2 mm	
		$(99.4 \pm 4.9 \text{ lb} / 1.0709 \text{ in})$	
Out of squareness		Less than 1.5° 3°	
Cylinder block			
Cylinder bore		76.50 ~ 76.53 mm (3.0118 ~ 3.0130 in)	
Flatness of gasks	et surface	Less than 0.05 mm (0.0020 in)	
Piston			
Piston outer diar	neter	76.47 ~ 76.50 mm (3.0106 ~ 3.0118 in)	
Piston to cylinde	er clearance	0.020 ~ 0.040 mm (0.0008 ~ 0.0016 in)	
	No. 1 ring groove	$1.230 \sim 1.255 \text{ mm} (0.0484) \\ \sim 0.0494 \text{ in})$	
Ring groove width	No. 2 ring groove	$1.230 \sim 1.255 \text{ mm} (0.0484) \\ \sim 0.0494 \text{ in})$	
	Oil ring groove	$2.030 \sim 2.055 \text{ mm} (0.0799) \\ \sim 0.0809 \text{ in})$	
Piston ring			
	No. 1 ring	0.04 ~ 0.085 mm (0.0016 ~ 0.0033 in)	0.1 mm (0.0039 in)
Side clearance	No. 2 ring	0.04 ~ 0.085 mm (0.0016 ~ 0.0033 in)	0.1 mm (0.0039 in)
	Oil ring	0.08 ~ 0.175 mm (0.0031 ~ 0.0069 in)	
	No. 1 ring	0.15 ~ 0.30 mm (0.0059 ~ 0.0118 in)	1.0 mm (0.0394 in)
End gap	No. 2 ring	0.35 ~ 0.50 mm (0.0138 ~ 0.0197 in)	1.0 mm (0.0394 in)
	Oil ring	0.20 ~ 0.70 mm (0.0079 ~ 0.0276 in)	1.0 mm (0.0394 in)
Piston pin			
Piston pin outer	diameter	18.001 ~ 18.007 mm (0.7087 ~ 0.7089 in)	
Piston pin hole inner diameter		18.016 ~ 18.021 mm (0.7093 ~ 0.7095 in)	
Piston pin hole clearance		$\begin{array}{c} 0.011 \sim 0.018 \text{ mm} (0.0004 \\ \sim 0.0007 \text{ in}) \end{array}$	
Connecting rod small end hole inner diameter		17.974 ~ 17.985 mm (0.7076 ~ 0.7081 in)	
Connecting rod small end hole clearance		-0.032 ~ -0.016 mm (- 0.0013 ~ -0.0006 in)	
		500 ~ 1,500 kg (1,102 ~	

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1 load	3,306 lb)	
g end inner diameter	48.000 ~ 48.018 mm (1.8898 ~ 1.8905 in)	
aring oil clearance	$\begin{array}{c} 0.018 \sim 0.036 \text{ mm} \ (0.0007 \\ \sim 0.0014 \text{ in}) \end{array}$	
	0.10 ~ 0.25 mm (0.0039 ~ 0.0098 in)	0.4 mm (0.0157 in)
r diameter	49.950 ~ 49.968 mm (1.9665 ~ 1.9672 in)	
liameter	44.954 ~ 44.97 2 mm (1.7698 ~ 1.7705 in)	
No. 1, 2, 4, 5	$\begin{array}{c} 0.022 \sim 0.040 \text{ mm} \ (0.0009 \\ \sim 0.0016 \text{ in}) \end{array}$	0.1 mm (0.0039 in)
No. 3	$\begin{array}{c} 0.028 \sim 0.046 \text{ mm} \ (0.0011 \\ \sim 0.0018 \text{ in}) \end{array}$	0.1 mm (0.0039 in)
	$\begin{array}{c} 0.05 \sim 0.175 \mbox{ mm} \ (0.0020 \\ \sim 0.0069 \mbox{ in}) \end{array}$	0.2 mm (0.0079 in)
	•	
	0.1 mm (0.0039 in)	0.13 mm (0.0051 in)
Inner rotor	0.040 ~ 0.085 mm (0.0016 ~ 0.0033 in)	
Outer rotor	$\begin{array}{c} 0.040 \sim 0.090 \text{ mm} \ (0.0016 \\ \sim 0.0035 \text{ in}) \end{array}$	
	0.060 ~ 0.090 mm (0.0024 ~ 0.0035 in)	
ng pressure	$500 \pm 49.0 \text{ kPa} (5.1 \pm 0.5 \text{ kg/cm}^2, 72.5 \pm 7.1 \text{ psi})$	
Free length	46.6 mm (1.8346 in)	
Load	$\begin{array}{c} 6.1 \pm 0.4 \text{ kg} / 40.1 \text{ mm} \\ (13.4 \pm 0.9 \text{ lb} / 1.5787 \text{ in}) \end{array}$	
	· · · · · · · · · · · · · · · · · · ·	
Total	3.8 L (4.02 US qt, 3.34 Imp qt)	When replacing a short engine or a block assembly
Oil pan	3.0 L (3.17 US qt, 2.64 Imp qt)	
Drain and refill	3.3 L (3.49 US qt, 2.90 Imp qt)	Including oil filter
Recommendation	5W-20/GF4&SM	If not available, refer to the recommended API or ILSAC classification and SAE viscosity number.
	a load g end inner diameter aring oil clearance r diameter liameter No. 1, 2, 4, 5 No. 3 Inner rotor Outer rotor Outer rotor Outer rotor Total Coil pan Drain and refill Recommendation	a load       3,306 lb)         g end inner diameter $48.000 \sim 48.018 \text{ mm} (1.8898 \sim 1.8905 \text{ in})$ aring oil clearance $0.018 \sim 0.036 \text{ mm} (0.0007 \sim 0.0014 \text{ in})$ aring oil clearance $0.010 \sim 0.25 \text{ mm} (0.0039 \sim 0.0098 \text{ in})$ r diameter $49.950 \sim 49.968 \text{ mm} (1.9665 \sim 1.9672 \text{ in})$ liameter $44.954 \sim 44.972 \text{ mm} (1.7698 \sim 1.7705 \text{ in})$ No. 1, 2, 4, 5 $0.022 \sim 0.040 \text{ mm} (0.0009 \sim 0.0016 \text{ in})$ No. 3 $0.028 \sim 0.046 \text{ mm} (0.0011 \sim 0.0018 \text{ in})$ No. 3 $0.028 \sim 0.046 \text{ mm} (0.0016 \text{ mo})$ No. 4000000000000000000000000000000000000

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Oil grade	Classification	API SL, SM or above ILSAC GF3, GF4 or above	Satisfy the requirement of the API or ILSAC classification.
	SAE viscosity grade	Recommended SAE viscosity number	Refer to the " <u>SELECTION OF</u> <u>ENGINE OIL</u> "
Oil pressure (at 80	00 RPM)	100 kPa (1.0 kg/cm <sup>2</sup> , 14.5 psi) or above	Oil temperature in oil pan : $95 \pm 5 \ ^{\circ}C$ (203 ± 41 $^{\circ}F$ )
Cooling system			
Cooling method		Forced circulation with cooling fan	
Coolant quantity		5.5 ~ 5.8 L (5.81 ~6.13 US qt, 4.84 ~5.10 Imp qt)	
	Туре	Wax pellet type	
Thermostat	Opening temperature	88 ± 1.5 °C (190.4 ± 2.7 ° F)	
	Pull opening temperature	100 °C (212 °F)	
	Main valve opening pressure	93.16 ~ 122.58 kPa (0.95 ~ 1.25 kg/cm <sup>2</sup> , 13.51 ~ 17.78 psi)	
Kadiator cap	Vacuum valve opening pressure	$0.98 \sim 4.90 \text{ kPa}$ (0.01 ~ 0.05 kg/cm <sup>2</sup> , 0.14 ~ 0.71 psi)	
Water temperatu			
Туре		Thermistor type	
Resistance	20 °C (68 °F)	$2.45 \pm 0.14$ kohms	
in sistance	80 °C (176 °F)	0.3222 kohms	

#### **TIGHTENING TORQUES**

#### TIGHTENING TORQUES

Item	Quantity	N.m	kgf.m	lb-ft
Cylinder block			•	
Engine support bracket bolt	2	44.1 ~ 53.9	4.5 ~ 5.5	32.5 ~ 39.8
Engine support bracket nut	1	44.1 ~ 53.9	4.5 ~ 5.5	32.5 ~ 39.8
Engine support bracket stay bolt	2	44.1 ~ 53.9	4.5 ~ 5.5	32.5 ~ 39.8
Rear plate bolt	1	9.8 ~ 11.8	1.0 ~ 1.2	$7.2 \sim 8.7$
Engine mounting				
Engine mounting bracket and body fixing bolt	3	49.0 ~ 63.7	$5.0 \sim 6.5$	36.2 ~ 47.0
Engine mounting insulator and engine mounting support bracket fixing nut	1	68.6~93.2	7.0~9.5	50.6 ~ 68.7

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Engine mounting support bracket and engine support bracket fixing bolt	2	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Engine mounting support bracket and engine support bracket fixing nut	1	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Transaxle mounting bracket and body fixing bolt	3	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Transaxle mounting insulator and transaxle support bracket fixing bolt	2	68.6~93.2	7.0 ~ 9.5	50.6 ~ 68.7
Front roll stopper bracket and sub frame fixing bolt	3	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Front roll stopper insulator and front roll stopper support bracket fixing bolt, nut	1	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Rear roll stopper bracket and sub frame fixing bolt	3	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Rear roll stopper insulator and rear roll stopper support bracket fixing bolt, nut	1	49.0 ~ 63.7	5.0 ~ 6.5	36.2 ~ 47.0
Main moving system				
Connecting rod cap nut	8	31.4 ~ 34.3	3.2 ~ 3.5	23.1 ~ 25.3
Crankshaft main bearing cap bolt	10	53.9 ~ 58.8	$5.5 \sim 6.0$	39.8 ~ 43.4
Flywheel bolt (M/T)	5	117.7 ~ 127.5	12.0 ~ 13.0	86.8 ~ 94.0
Drive plate bolt (A/T)	5	117.7 ~ 127.5	12.0 ~ 13.0	86.8 ~ 94.0
Timing belt			·	
Timing belt front upper cover bolt	4	$7.8 \sim 9.8$	0.8 ~ 1.0	5.8 ~ 7.2
Timing belt front lower cover bolt	5	$7.8 \sim 9.8$	0.8 ~ 1.0	5.8 ~ 7.2
Timing belt rear lower LH cover bolt	3	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing belt rear upper LH cover bolt	1	9.8 ~ 11.8	1.0 ~ 1.2	7.2 ~ 8.7
Timing belt rear upper RH cover bolt	2	9.8 ~ 11.8	1.0 ~ 1.2	$7.2 \sim 8.7$
Crankshaft pulley bolt	1	137.3 ~ 147.1	14.0 ~ 15.0	101.3 ~ 108.5
Camshaft sprocket bolt	1	$78.5 \sim 98.1$	8.0 ~ 10.0	57.9 ~ 72.3
Timing belt tensioner bolt	1	19.6 ~ 26.5	2.0 ~ 2.7	14.5 ~ 19.5
Timing belt idler bolt	1	42.2 ~ 53.9	4.3 ~ 5.5	31.1 ~ 39.8
Cylinder head				
Engine cover bolt	4	3.9 ~ 5.9	0.4 ~ 0.6	2.9 ~ 4.3
Cylinder head cover bolt	12	$7.8 \sim 9.8$	0.8 ~ 1.0	5.8 ~ 7.2
Camshaft bearing cap bolt	24	11.8 ~ 13.7	1.2 ~ 1.4	8.7 ~ 10.1

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Intake camshaft and CMP sensor target wheel fixing bolt	1	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Exhaust camshaft and CVVT assembly fixing bolt	1	64.7 ~ 76.5	6.6 ~ 7.8	47.7 ~ 56.4
Timing chain auto tensioner bolt	2	7.8 ~ 9.8	0.8 ~ 1.0	$5.8 \sim 7.2$
OCV (oil control valve) bolt	1	9.8 ~ 11.8	1.0 ~ 1.2	$7.2 \sim 8.7$
OCV (oil control valve) filter	1	$40.2 \sim 50.0$	4.1 ~ 5.1	29.7 ~ 36.9
		29.4 + 90°>	3.0 + 90°>	21.7 + 90°>
Cylinder head bolt	10	Release all bolts>	Release all bolts	Release all bolts>
		29.4 + 90°	> 3.0 + 90°	21.7 + 90°
Cooling system				
Water pump pulley bolt	4	7.8 ~ 9.8	0.8 ~ 1.0	5.8 ~ 7.2
Water pump bolt (8 X 28)	3	11.8 ~ 14.7	1.2 ~ 1.5	8.7 ~ 10.8
Water pump and alternator brace fixing bolt (8 X 45)	1	19.6 ~ 23.5	$2.0 \sim 2.4$	14.5 ~ 17.4
Water pump and alternator brace fixing bolt (8 X 65)	1	19.6 ~ 23.5	$2.0 \sim 2.4$	14.5 ~ 17.4
Thermostat housing nut	2	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Water outlet fitting nut	2	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Water inlet fitting bolt	3	16.7 ~ 19.6	$1.7 \sim 2.0$	12.3 ~ 14.5
Water temperature sensor	1	19.6 ~ 39.2	$2.0 \sim 4.0$	14.5 ~ 28.9
Water pipe fixing bolt	1	9.8 ~ 14.7	1.0 ~ 1.5	7.2 ~ 10.8
Lubrication system				
Oil filter	1	11.8 ~ 15.7	1.2 ~ 1.6	8.7 ~ 11.6
Front case bolt (8 X 22)	1	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Front case bolt (8 X 30)	3	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Front case bolt (8 X 45)	1	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Front case bolt (8 X 60)	1	18.6 ~ 23.5	1.9 ~ 2.4	13.7 ~ 17.4
Oil pan bolt	18	9.8 ~ 11.8	1.0 ~ 1.2	$7.2 \sim 8.7$
Oil pan drain plug	1	39.2 ~ 44.1	$4.0 \sim 4.5$	28.9 ~ 32.5
Oil screen bolt	2	14.7 ~ 21.6	1.5 ~ 2.2	10.8 ~ 15.9
Oil pressure switch	1	14.7 ~ 21.6	1.5 ~ 2.2	10.8 ~ 15.9
Rear oil seal case	5	9.8 ~ 11.8	1.0 ~ 1.2	$7.2 \sim 8.7$
Intake and exhaust system				
Intake manifold and cylinder head fixing nut	6	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Intake manifold and cylinder head fixing bolt (8 X 45)	2	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Intake manifold and cylinder head fixing bolt (8 X 22)	1	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Intake manifold stay bolt	4	17.7 ~ 24.5	1.8 ~ 2.5	13.0 ~ 18.1
Exhaust manifold and cylinder head fixing nut	9	29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3

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O2 sensor to exhaust manifold	1	$49.0\sim58.8$	$5.0 \sim 6.0$	$36.2 \sim 43.4$
Exhaust manifold heat cover and exhaust manifold fixing bolt	3	16.7 ~ 21.6	1.7 ~ 2.2	12.3 ~ 15.9
Air cleaner lower cover fixing bolt	3	7.8~9.8	0.8 ~ 1.0	5.8 ~ 7.2
Throttle body and surge tank fixing bolt and nut	4	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Exhaust manifold and front muffler fixing nut	2	29.4 ~ 39.2	3.0 ~ 4.0	21.7 ~ 28.9
Front muffler and center muffler fixing nut	2	29.4 ~ 39.2	3.0 ~ 4.0	21.7 ~ 28.9
Center muffler and main muffler fixing nut	2	29.4 ~ 39.2	3.0 ~ 4.0	21.7 ~ 28.9

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#### **Cylinder Block - Accent**

# **COMPONENTS AND COMPONENTS LOCATION**

#### COMPONENTS



#### Fig. 1: Identifying Cylinder Block Components (1 Of 2) With Torque Specifications Courtesy of HYUNDAI MOTOR CO.

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#### **Fig. 2: Identifying Cylinder Block Components (2 Of 2) With Torque Specifications Courtesy of HYUNDAI MOTOR CO.**

# **REPAIR PROCEDURES**

#### DISASSEMBLY

- 1. M/T: Remove the fly wheel.
- 2. A/T: Remove the drive plate.
- 3. Install the engine to engine stand for disassembly.
- 4. Remove the timing belt.
- 5. Remove the cylinder head.
- 6. Remove the oil level gauge tube (A).

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#### **Fig. 3: Locating Oil Level Gauge Tube Courtesy of HYUNDAI MOTOR CO.**

7. Remove the knock sensor (A).



#### **<u>Fig. 4: Locating Knock Sensor</u>** Courtesy of HYUNDAI MOTOR CO.

8. Remove the oil pressure switch (A).



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#### **<u>Fig. 5: Locating Oil Pressure Switch</u> Courtesy of HYUNDAI MOTOR CO.**

- 9. Remove the water pump.
- 10. Remove the oil pan (A).



Fig. 6: Locating Oil Pan Courtesy of HYUNDAI MOTOR CO.

11. Remove the oil screen.

Remove the 2 bolts (C), oil screen (A) and gasket (B).



#### **Fig. 7: Locating Bolts, Oil Screen And Gasket Courtesy of HYUNDAI MOTOR CO.**

- 12. Check the connecting rod end play.
- 13. Remove the connecting rod caps and check oil clearance.
- 14. Remove the piston and connecting rod assemblies.
  - 1. Using a ridge reamer, remove all the carbon from the top of the cylinder.
  - 2. Push the piston, connecting rod assembly and upper bearing through the top of the cylinder block.

# **NOTE:** • Keep the bearings, connecting rod and cap together.

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# • Arrange the piston and connecting rod assemblies in the correct order.

- 15. Remove the front case.
- 16. Remove the rear oil seal case.

Remove the 5 bolts (B) and rear oil seal case (A).



#### **Fig. 8: Locating Bolts And Rear Oil Seal Case Courtesy of HYUNDAI MOTOR CO.**

- 17. Remove the crankshaft bearing cap and check oil clearance.
- 18. Check the crankshaft end play.
- 19. Lift the crankshaft (A) out of the engine, being careful not to damage journals.

## **NOTE:** Arrange the main bearings and thrust bearings in the correct order.



#### **<u>Fig. 9: Locating Crankshaft</u>** Courtesy of HYUNDAI MOTOR CO.

20. Check fit between piston and piston pin.

Try to move the piston back and forth on the piston pin.

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If any movement is felt, replace the piston and pin as a set.

- 21. Remove the piston rings.
  - 1. Using a piston ring expender, remove the 2 compression rings.
  - 2. Remove the 2 side rails and oil ring by hand.

# NOTE: Arrange the piston rings in the correct order only.

22. Remove the connecting rod from the piston.

Using a press, remove the piston pin from piston.

(Press-in load : 500 ~ 1,500 kg (1,102 ~ 3,306 lb))

## INSPECTION

#### **Connecting Rod And Crankshaft**

1. Check the connecting rod end play.

Using feeler gauge, measure the end play while moving the connecting rod back and forth.

#### End play

Standard :  $0.1 \sim 0.25 \text{ mm} (0.0039 \sim 0.0098 \text{ in})$ 

Maximum : 0.4 mm (0.0157 in)



## **Fig. 10: Measuring End Play While Moving Connecting Rod Back And Forth Courtesy of HYUNDAI MOTOR CO.**

- A. If out-of-tolerance, install a new connecting rod.
- B. If still out-of-tolerance, replace the crankshaft.
- 2. Check the connecting rod bearing oil clearance.

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- 1. Check the match marks on the connecting rod and cap are aligned to ensure correct reassembly.
- 2. Remove the 2 connecting rod cap nuts.
- 3. Remove the connecting rod cap and lower bearing.
- 4. Clean the crankshaft pin journal and bearing.
- 5. Place a plastigage across the crankshaft pin journal.
- 6. Reinstall the lower bearing and cap, and tighten the nuts.

#### **Tightening torque:**

31.4 ~ 34.3 N.m (3.2 ~ 3.5 kgf.m, 23.1 ~ 25.3 lb-ft)

# NOTE: Do not turn the crankshaft.

- 7. Remove the 2 nuts, connecting rod cap and lower bearing.
- 8. Measure the plastigage at its widest point.

#### Standard oil clearance

 $0.018 \sim 0.036 \text{ mm} (0.0007 \sim 0.0014 \text{ in})$ 



#### **Fig. 11: Measuring Plastigage At Its Widest Point Courtesy of HYUNDAI MOTOR CO.**

9. If the plastigage measures too wide or too narrow, remove the upper and lower bearing and then install a new bearings with the same color mark. (Refer to <u>CONNECTING ROD BEARING</u> <u>SELECTION TABLE</u>).

Recheck the oil clearance.

# CAUTION: Do not file, shim, of scrape the bearings or the caps to adjust clearance.

10. If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing. (Refer to <u>CONNECTING ROD BEARING SELECTION TABLE</u>).

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Recheck the oil clearance.

- NOTE: If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.
  - CAUTION: If the marks are indecipherable because of an accumulation of dirt and dust, do not scrub them with a wire brush or scraper. Clean them only with solvent or detergent.

**Connecting Rod Mark Location** 



**Fig. 12: Identifying Connecting Rod Mark Location Courtesy of HYUNDAI MOTOR CO.** 

**Identification Of Connecting Rod** 

#### CONNECTING ROD BIG-END INNER DIAMETER REFERENCE CHART

Mark	Connecting rod big-end inner diameter
^	48.000 ~ 48.006 mm (1.8898 ~ 1.8900 in)
b	48.006 ~ 48.012 mm (1.8900 ~ 1.8902 in)
с	48.012 ~ 48.018 mm (1.8902 ~ 1.8905 in)

#### **Crankshaft Pin Journal Mark Location**

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Fig. 13: Identifying Crankshaft Pin Journal Mark Location **Courtesy of HYUNDAI MOTOR CO.** 

**Identification Of Crankshaft Pin Journal** 

#### **CRANKSHAFT PIN JOURNAL OUTER DIAMETER REFERENCE CHART**

Mark	Crankshaft pin journal outer diameter
^	44.966 ~ 44.972 mm (1.7703 ~ 1.7705 in)
b	44.960 ~ 44.966 mm (1.7701 ~ 1.7703 in)
с	44.954 ~ 44.960 mm (1.7698 ~ 1.7701 in)

#### **Connecting Rod Bearing Mark Location**



Fig. 14: Identifying Connecting Rod Bearing Mark Location **Courtesy of HYUNDAI MOTOR CO.** 

#### **Identification Of Connecting Rod Bearing**

#### **CONNECTING ROD BEARING THICKNESS REFERENCE CHART**

Mark	Color	Connecting rod bearing thickness
AA	Blue	1.514 ~ 1.517 mm (0.0596 ~ 0.0597 in)
А	Black	1.511 ~ 1.514 mm (0.0595 ~ 0.0596 in)

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В	None	1.508 ~ 1.511 mm (0.0594 ~ 0.0595 in)
С	Green	1.505 ~ 1.508 mm (0.0593 ~ 0.0594 in)
D	Yellow	1.502 ~ 1.505 mm (0.0591 ~ 0.0593 in)

11. Select the bearing by using selection table.

#### **Connecting Rod Bearing Selection Table**

		Connecting rod mark		
		^	b	c
	^	D (Yellow)	C (Green)	B (None)
Crank shaft pin journal mark	b	C (Green)	B (None)	A (Black)
	c	B (None)	A (Black)	AA (Blue)

#### **CONNECTING ROD BEARING SELECTION CHART**

- 3. Check the connecting rods.
  - 1. When reinstalling, make sure that cylinder numbers put on the connecting rod and cap at disassembly match. When a new connecting rod is installed, make sure that the notches for holding the bearing in place are on the same side.
  - 2. Replace the connecting rod if it is damaged on the thrust faces at either end. Also if step wear or a severely rough surface of the inside diameter of the small end is apparent, the rod must be replaced as well.
  - 3. Using a connecting rod aligning tool, check the rod for bend and twist. If the measured value is close to the repair limit, correct the rod by a press. Any connecting rod that has been severely bent or distorted should be replaced.

#### Allowable bend of connecting rod:

0.05 mm / 100 mm (0.0020 in / 3.94 in) or less

#### Allowable twist of connecting rod:

0.1 mm / 100 mm (0.0039 in / 3.94 in) or less

- 4. Check the crankshaft bearing oil clearance.
  - 1. To check main bearing-to-journal oil clearance, remove the main bearing caps and lower bearings.
  - 2. Clean each main journal and lower bearing with a clean shop towel.
  - 3. Place one strip of plastigage across each main journal.
  - 4. Reinstall the lower bearings and caps, then tighten the bolts.

#### **Tightening torque:**

53.9 ~ 58.8 N.m (5.5 ~ 6.0 kgf.m, 39.8 ~ 43.4 lb-ft)

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#### NOTE: Do not turn the crankshaft.

5. Remove the cap and lower bearing again, and measure the widest part of the plastigage.

#### Standard oil clearance:

No. 1, 2, 4, 5 : 0.022 ~ 0.040 mm (0.0009 ~ 0.0016 in)



#### **Fig. 15: Measuring Widest Part Of Plastigage** Courtesy of HYUNDAI MOTOR CO.

6. If the plastigage measures too wide or too narrow, remove the upper and lower bearing and then install a new bearings with the same color mark. (Refer to <u>CRANKSHAFT MAIN BEARING</u> <u>SELECTION TABLE</u>).

Recheck the oil clearance.

# CAUTION: Do not file, shim, or scrape the bearings or the cap to adjust clearance.

7. If the plastigage shows the clearance is still incorrect, try the next larger or smaller bearing. (Refer to <u>CRANKSHAFT MAIN BEARING SELECTION TABLE</u>).

Recheck the oil clearance.

NOTE: If the proper clearance cannot be obtained by using the appropriate larger or smaller bearings, replace the crankshaft and start over.

# CAUTION: If the marks are indecipherable because of an accumulation of dirt and dust, do not scrub them with a wire brush or scraper. Clean them only with solvent or detergent.

#### Cylinder block crankshaft journal bore mark location

Letters have been stamped on the end of the block as a mark for the size of each of the 5 main journal bores. Use them, and the numbers or letters stamped on the crank (marks for main journal

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size), to choose the correct bearings.



#### **Fig. 16: Identifying Cylinder Block Crankshaft Journal Bore Mark Location Courtesy of HYUNDAI MOTOR CO.**

#### Identification Of Cylinder Block Crankshaft Journal Bore

#### CYLINDER BLOCK CRANKSHAFT JOURNAL BORE INNER DIAMETER REFERENCE CHART

Mark	Cylinder block crankshaft journal bore inner diameter
^	54.000 ~ 54.006 mm (2.1260 ~ 2.1262 in)
b	54.006 ~ 54.012 mm (2.1262 ~ 2.1265 in)
c	54.012 ~ 54.018 mm (2.1265 ~ 2.1267 in)

#### Crankshaft main journal mark location



#### **Fig. 17: Identifying Crankshaft Main Journal Mark Location Courtesy of HYUNDAI MOTOR CO.**

#### Identification of crankshaft main journal

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# CRANKSHAFT MAIN JOURNAL OUTER DIAMETER REFERENCE CHART

# Mark Crankshaft main journal outer diameter

^	49.962 ~ 49.968 mm (1.9670 ~ 1.9672 in)
b	49.956 ~ 49.962 mm (1.9668 ~ 1.9670 in)
с	49.950 ~ 49.956 mm (1.9665 ~ 1.9668 in)

#### Crankshaft main bearing mark location



#### **Fig. 18: Identifying Crankshaft Main Bearing Mark Location Courtesy of HYUNDAI MOTOR CO.**

Identification of crankshaft main bearing

Mark	Color	Crankshaft main bearing thickness			
		No. 1, 2, 4, 5	No. 3		
AA	Blue	$2.014 \sim 2.017 \ (0.0793 \sim 0.0794)$	$2.011 \sim 2.014 \ (0.0792 \sim 0.0793)$		
А	Black	$2.011 \sim 2.014 \ (0.0792 \sim 0.0793)$	2.008 ~ 2.011 (0.0791 ~ 0.0792)		
В	None	$2.008 \sim 2.011 \ (0.0791 \sim 0.0792)$	$2.005 \sim 2.008 \; (0.0789 \sim 0.0791)$		
С	Green	$2.005 \sim 2.008 \ (0.0789 \sim 0.0791)$	$2.002 \sim 2.005 \ (0.0788 \sim 0.0789)$		
D	Yellow	$2.002 \sim 2.005 \ (0.0788 \sim 0.0789)$	$1.999 \sim 2.002 \ (0.0787 \sim 0.0788)$		

#### **CRANKSHAFT MAIN BEARING THICKNESS REFERENCE CHART**

8. Select the bearing by using selection table.

#### Crankshaft main bearing selection table

# Cylinder block crankshaft journal bore mark^bc^bcCrank shaft main journal mark^D (Yellow)C (Green)B (None)bC (Green)B (None)A (Black)A (Black)cB (None)A (Black)AA (Blue)

#### **CRANKSHAFT MAIN BEARING SELECTION CHART**

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5. Check the crankshaft end play.

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

#### End play

Standard: 0.05 ~ 0.175 mm (0.0020 ~ 0.0069 in)

Limit : 0.20 mm (0.0079 in)



# Fig. 19: Measuring Thrust Clearance While Prying Crankshaft Back And Forth With Screwdriver Courtesy of HYUNDAI MOTOR CO.

If the end play is greater than maximum, replace the center bearing.

6. Inspect the crankshaft main journals and pin journals.

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

#### Main journal diameter:

49.950 ~ 49.968 mm (1.9665 ~ 1.9672 in)

#### Pin journal diameter:

44.954 ~ 44.972 mm (1.7698 ~ 1.7705 in)

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#### **Fig. 20: Measuring Diameter Of Each Main Journal And Pin Journal Courtesy of HYUNDAI MOTOR CO.**

#### **Cylinder Block**

1. Remove the gasket material.

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

2. Clean the cylinder block

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

3. Inspect the 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.

#### Flatness of cylinder block gasket surface

Standard : Less than 0.05 mm (0.0020 in)

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#### **Fig. 21: Measuring Surface Contacting Cylinder Head Gasket For Warpage Courtesy of HYUNDAI MOTOR CO.**

4. Inspect the cylinder bore.

Visually check the cylinder for vertical scratches.

If deep scratches are present, replace the cylinder block.

5. Inspect the cylinder bore diameter.

Using a cylinder bore gauge, measure the cylinder bore diameter at position in the thrust and axial direction.

#### Standard diameter:

1.6 CVVT : 76.50 ~ 76.53 mm (3.0118 ~ 3.0130 in)



#### **Fig. 22: Measuring Cylinder Bore Diameter At Position In Thrust And Axial Direction Courtesy of HYUNDAI MOTOR CO.**

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

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#### **Fig. 23: Checking Cylinder Bore Size Code On Cylinder Block Bottom Face Courtesy of HYUNDAI MOTOR CO.**

Identification of cylinder bore size

#### CYLINDER BORE INNER DIAMETER REFERENCE CHART

Mark	Cylinder bore inner diameter
А	76.50 ~ 76.51 mm (3.0118 ~ 3.0122 in)
В	76.51 ~ 76.52 mm (3.0122 ~ 3.0126 in)
С	76.52 ~ 76.53 mm (3.0126 ~ 3.0130 in)

7. Check the piston size mark (A) on the piston top face.



#### **Fig. 24: Checking Piston Size Mark On Piston Top Face Courtesy of HYUNDAI MOTOR CO.**

Discrimination of piston outer diameter

#### PISTON OUTER DIAMETER REFERENCE CHART

Mark Piston outer diameter

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A $76.47 \sim 76.48 \text{ mm} (3.0106 \sim 3.0110 \text{ in})$ B $76.48 \sim 76.49 \text{ mm} (3.0110 \sim 3.0114 \text{ in})$ C $76.49 \sim 76.50 \text{ mm} (3.0114 \sim 3.0118 \text{ in})$ 

8. Select the piston related to cylinder bore class.

Piston-to-cylinder clearance:

 $0.02 \sim 0.04 \text{ mm} (0.0008 \sim 0.0016 \text{ in})$ 

#### **Boring cylinder**

1. Oversize pistons should be selected according to the largest bore cylinder.

#### NOTE: The size of piston is stamped on top of the piston.

- 2. Measure the outside diameter of the piston to be used.
- 3. According to the measured O.D (Outer Diameter), calculate the new bore size.

New bore size = piston O.D + 0.02 to 0.04 mm (0.0008 to 0.0016 in)

(clearance between piston and cylinder) - 0.01 mm (0.0004 in) (honing margin.)

4. Bore each of the cylinders to the calculated size.

# CAUTION: To prevent distortion that may result from temperature rise during honing, bore the cylinder holes in the firing order.

- 5. Hone the cylinders, finishing them to the proper dimension (piston outside diameter + gap with cylinder).
- 6. Check the clearance between the piston and cylinder.

**Standard:** 0.02 ~ 0.04 mm (0.0008 ~ 0.0016 in)

# NOTE: When boring the cylinders, finish all of the cylinders to the same oversize. Do not bore only one cylinder to the oversize. (1.6 CVVT : Don't use over size)

#### Piston And Piston Rings

- 1. Clean the piston.
  - 1. Using a gasket scraper, remove the carbon from the piston top.
  - 2. Using a groove cleaning tool or broken ring, clean the piston ring grooves.
  - 3. Using solvent and a brush, thoroughly clean the piston.

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#### NOTE: Do not use a wire brush.

2. The standard measurement of the piston outside diameter is taken, 39.15 mm (1.5413 in) from top land of the piston.

#### **Standard diameter:**

76.47 ~ 76.50 mm (3.0106 ~ 3.0118 in)



#### **Fig. 25: Identifying Piston Outside Diameter Measurement** Courtesy of HYUNDAI MOTOR CO.

3. Calculate the difference between the cylinder bore inner diameter and the piston outer diameter.

#### **Piston-to-cylinder clearance:**

 $0.02 \sim 0.04 \text{ mm} (0.0008 \sim 0.0016 \text{ in})$ 

4. Inspect the piston ring side clearance.

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

#### Piston ring side clearance

No. 1 ring :  $0.04 \sim 0.085 \text{ mm} (0.0016 \sim 0.0033 \text{ in})$ 

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

Oil ring : 0.08 ~ 0.175 mm (0.0031 ~ 0.0069 in)

#### Limit

No. 1 ring : 0.1 mm (0.0039 in)

No. 2 ring : 0.1 mm (0.0039 in)

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#### **Fig. 26: Measuring Clearance Between New Piston Ring And Wall Of Ring Groove Courtesy of HYUNDAI MOTOR CO.**

If the clearance is greater than maximum, replace the piston.

5. Inspect the piston ring end gap.

To measure the piston ring end gap, insert a piston ring into the cylinder bore. Position the ring at right angles to the cylinder wall by gently pressing it down with a piston. Measure the gap with a feeler gauge. If the gap exceeds the service limit, replace the piston rings. If the gap is too large, recheck the cylinder bore inner diameter. If the bore is over the service limit, the cylinder block must be rebored.

#### Piston ring end gap

Standard

No. 1 ring : 0.15 ~ 0.30 mm (0.0059 ~ 0.0118 in)

No. 2 ring : 0.35 ~ 0.50 mm (0.0138 ~ 0.0197 in)

Oil ring : 0.20 ~ 0.70 mm (0.0079 ~ 0.0276 in)

Limit

No. 1, 2 oil ring : 1.0 mm (0.0394 in)

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#### **Fig. 27: Inspecting Piston Ring End Gap Courtesy of HYUNDAI MOTOR CO.**

#### **Piston Pins**

1. Measure the outer diameter of piston pin

#### Piston pin diameter:

18.001 ~ 18.007 mm (0.7087 ~ 0.7089 in)



**Fig. 28: Measuring Outer Diameter Of Piston Pin Courtesy of HYUNDAI MOTOR CO.** 

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2. Measure the piston pin-to-piston clearance.

#### Piston pin-to-piston clearance:

 $0.011 \sim 0.018 \text{ mm} (0.0004 \sim 0.0007 \text{ in})$ 

3. Check the difference between the piston pin outer diameter and the connecting rod small end inner diameter.

#### Piston pin-to-connecting rod interference:

-0.033 ~ -0.016 mm (-0.0013 ~ -0.0006 in)

#### **Oil Pressure Switch**

1. Check the continuity between the terminal and the body with an ohmmeter. If there is no continuity, replace the oil pressure switch.



#### **Fig. 29: Checking Continuity Between Terminal And Body With An Ohmmeter Courtesy of HYUNDAI MOTOR CO.**

2. Check the continuity between the terminal and the body when the fine wire is pushed. If there is continuity even when the fine wire is pushed, replace the switch.

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#### **Fig. 30: Checking Continuity Between Terminal And Body When Fine Wire Pushed Courtesy of HYUNDAI MOTOR CO.**

3. If there is no continuity when a 49.0 kPa (0.5 kg/cm<sup>2</sup>, 7.1 psi) is applied through the oil hole, the switch is operating properly. Check for air leakage. If air leaks, the diaphragm is broken. Replace it.

## REASSEMBLY

#### NOTE:

- Thoroughly clean all parts to assembled.
  - Before installing the parts, apply fresh engine oil to all sliding and rotating surfaces.
  - Replace all gaskets, O-rings and oil seals with new parts.
- 1. Assemble the piston and connecting rod.
  - 1. Use a hydraulic press for installation
  - 2. The piston front mark and the connecting rod front mark must face the timing belt side of the engine.

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#### <u>Fig. 31: Identifying Piston Front Mark And Connecting Rod Front Mark Must Face Timing</u> <u>Belt Side Of Engine</u> Courtesy of HYUNDAI MOTOR CO.

- 2. Install the piston rings.
  - 1. Install the oil ring expander and 2 side rails by hand.
  - 2. Using a piston ring expander, install the 2 compression rings with the code mark facing upward.
  - 3. Position the piston rings so that the ring ends are as shown.



#### **Fig. 32: Identifying Piston Ring End Positions Courtesy of HYUNDAI MOTOR CO.**

- 3. Install the connecting rod bearings.
  - 1. Align the bearing (A) claw with the groove of the connecting rod or connecting rod cap (B).
  - 2. Install the bearings (A) in the connecting rod and connecting rod cap (B).

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**Fig. 33: Locating Bearings And Connecting Rod Cap Courtesy of HYUNDAI MOTOR CO.** 

4. Install the crankshaft main bearings.

## NOTE: Upper bearings have an oil groove of oil holes; Lower bearings do not.

1. Align the bearing claw with the claw groove of the cylinder block, push in the 4 upper bearings (A).



**Fig. 34: Locating Upper Bearings Courtesy of HYUNDAI MOTOR CO.** 

- 2. Align the bearing claw with the claw groove of the main bearing cap, and push in the 5 lower bearings.
- 5. Install the center bearing.

Install the center bearing (A) under the No. 3 journal position of the cylinder block with the oil grooves facing outward.

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#### **<u>Fig. 35: Locating Center Bearing</u> Courtesy of HYUNDAI MOTOR CO.**

- 6. Place the crankshaft on the cylinder block.
- 7. Place the main bearing caps on the cylinder block.
- 8. Install the main bearing cap bolts.

#### NOTE: The main bearing cap bolts are tightened in 2 progressive steps. If any of the bearing cap bolts in broken or deformed, replace it.

- 1. Apply a light coat of engine oil on the threads and under the bearing cap bolts.
- 2. Install and uniformly tighten the 10 bearing cap bolts (A), in several passes, in the sequence shown.

#### **Tightening torque:**

53.9 ~ 58.8 N.m (5.5 ~ 6.0 kgf.m, 39.8 ~ 43.4 lb-ft)



#### **Fig. 36: Identifying Bearing Cap Bolts Tighten Sequence** Courtesy of HYUNDAI MOTOR CO.

- 3. Check that the crankshaft turns smoothly.
- 9. Check the crankshaft end play.
- 10. Install the piston and connecting rod assemblies.

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# NOTE: Before installing the piston, apply a coat of engine oil to the ring grooves and cylinder bores.

- 1. Remove the connecting rod caps, and slip short sections of rubber hose over the threaded ends of the connecting rod bolts
- 2. Install the ring compressor, check that the rings are securely in place, then position the piston in the cylinder, and tap it in using the wooden handle of a hammer.
- 3. Stop after the ring compressor pops free, and check the connecting rod-to-crank journal alignment before pushing the piston into place.
- 4. Apply engine oil to the bolt threads. install the rod caps with bearings, and tighten the nuts.

#### **Tightening torque:**

31.4 ~ 34.3 N.m (3.2 ~ 3.5 kgf.m, 23.1 ~ 25.3 lb-ft)

# NOTE: Maintain downward force on the ring compressor to prevent the rings from expending before entering the cylinder bore.



#### **Fig. 37: Installing Piston And Connecting Rod Assemblies** Courtesy of HYUNDAI MOTOR CO.

- 11. Install the rear oil seal case.
  - 1. Using a razor blade and gasket scraper, remove all the old packing material from the gasket surfaces.

# NOTE: Check that the mating surfaces are clean and dry before applying liquid gasket.

2. Apply liquid gasket as an even bead, centered between the edges of the mating surface.

Liquid gasket: LOCTITE 5900 or equivalent

3. Install the rear oil seal case (A) with 5 bolts (B).

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#### **Tightening torque:**

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



#### **Fig. 38: Locating Rear Oil Seal Case And Bolts** Courtesy of HYUNDAI MOTOR CO.

- 12. Install the rear oil seal.
  - 1. Apply engine oil to a new oil seal lip.
  - 2. Using the SST (09231-21000) and a hammer, tap in the oil seal until its surface is flush with the rear oil seal retainer edge.



#### **<u>Fig. 39: Installing Rear Oil Seal</u>** Courtesy of HYUNDAI MOTOR CO.

- 13. Install the front case.
- 14. Install the oil screen.

Install a new gasket (B) and oil screen (A) with 2 bolts (C).

#### **Tightening torque:**

14.7 ~ 21.6 N.m (1.5 ~ 2.2 kgf.m, 10.8 ~ 15.9 lb-ft)
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## **Fig. 40: Locating Gasket, Oil Screen And Bolts Courtesy of HYUNDAI MOTOR CO.**

- 15. Install the oil pan.
  - 1. Using a razor blade and gasket scraper, remove all the old packing material from the gasket surfaces.

# NOTE: Check that the mating surfaces are clean and dry before applying liquid gasket.

2. Apply liquid gasket as an even bead, centered between the edges of the mating surface.

Liquid gasket: TB1217H or equivalent

- NOTE:
- To prevent leakage of oil, apply liquid gasket to the inner threads of the bolt holes.
  - D not install the parts if five minutes or more have elapsed since applying the liquid gasket.

Instead, reapply liquid gasket after removing the residue.

- After assembly, wait at least 30 minutes before filling the engine with oil.
- 3. Install the oil pan (A) with the bolts.

Uniformly tighten the bolts in several passes.

## **Tightening torque:**

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)

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### **<u>Fig. 41: Locating Oil Pan</u>** Courtesy of HYUNDAI MOTOR CO.

- 16. Install the water pump.
- 17. Install the oil pressure switch.
  - 1. Apply adhesive to 2 or 3 threads.

Adhesive: TB 2310/2350 or equivalent.

2. Install the oil pressure switch (A).

#### **Tightening torque:**

14.7 ~ 21.6 N.m (1.5 ~ 2.2 kgf.m, 10.8 ~ 15.9 lb-ft)



#### **Fig. 42: Locating Oil Pressure Switch** Courtesy of HYUNDAI MOTOR CO.

18. Install the knock sensor (A).

#### **Tightening torque:**

 $16.7 \sim 26.5$  N.m ( $1.7 \sim 2.7$  kgf.m,  $12.3 \sim 19.5$  lb-ft)

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#### **Fig. 43: Locating Knock Sensor** Courtesy of HYUNDAI MOTOR CO.

- 19. Install the oil level gauge tube (A).
  - 1. Install a new O-ring on the oil level gauge tube.
  - 2. Apply engine oil on the O-ring.
  - 3. Install the oil level gauge tube (A) with the bolt.

#### **Tightening torque:**

11.8 ~ 14.7 N.m (1.2 ~ 1.5 kgf.m, 8.7 ~ 10.8 lb-ft)



## **Fig. 44: Locating Oil Level Gauge Tube Courtesy of HYUNDAI MOTOR CO.**

- 20. Install the cylinder head.
- 21. Install the timing belt.
- 22. Remove the engine stand.
- 23. A/T: install the drive plate.

#### **Tightening torque:**

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117.7 ~ 127.5 N.m (12.0 ~ 13.0 kgf.m, 86.8 ~ 94.0 lb-ft)



#### **<u>Fig. 45: Locating Drive Plate</u>** Courtesy of HYUNDAI MOTOR CO.

24. M/T: install the fly wheel.

## **Tightening torque:**

117.7 ~ 127.5 N.m (12.0 ~ 13.0 kgf.m, 86.8 ~ 94.0 lb-ft)

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## **Cylinder Head Assembly - Accent**

## COMPONENTS AND COMPONENTS LOCATION

COMPONENTS



#### **Fig. 1: Identifying Cylinder Head Assembly Components (1 Of 2) With Torque Specifications Courtesy of HYUNDAI MOTOR CO.**

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## **REPAIR PROCEDURES**

#### REMOVAL

Engine removal is not required for this procedure.

CAUTION:

- Use Fender cover to avoid damaging painted surfaces.
- To avoid damaging the cylinder head, wait until the engine coolant temperature drops below normal temperature before removing it.
- When handling a metal gasket, take care not to fold the gasket or damage the contact surface of the gasket.

• To avoid damage, unplug the wiring connectors carefully while holding the connector portion.

- NOTE:
- Mark all wiring and hoses to avoid misconnection.
- Inspect the timing belt before removing the cylinder head.
- Turn the crankshaft pulley so that the No. 1 piston is at top dead center.
- 1. Disconnect the terminals (A) from battery and remove the battery.



#### **Fig. 3: Locating Battery Terminals** Courtesy of HYUNDAI MOTOR CO.

- 2. Remove the engine cover.
- 3. Remove the under cover (A).



**<u>Fig. 4: Locating Under Cover</u> Courtesy of HYUNDAI MOTOR CO.** 

4. Drain the engine coolant.

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Remove the radiator cap to speed draining.

- 5. Remove the intake air hose and air cleaner assembly.
  - 1. Disconnect the breather hose (B) from intake air hose (D).
  - 2. Remove the intake air hose (D) and air cleaner upper cover (C).



#### **Fig. 5: Locating Intake Air Hose And Air Cleaner Upper Cover Courtesy of HYUNDAI MOTOR CO.**

- 3. Disconnect the ECM connector (A) and ECM connector (B) (A/T only).
- 4. Remove the air cleaner element and air cleaner lower cover (C).



#### **Fig. 6: Locating Air Cleaner Element And Air Cleaner Lower Cover Courtesy of HYUNDAI MOTOR CO.**

6. Remove the battery tray (A).

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**Fig. 7: Locating Battery Tray Courtesy of HYUNDAI MOTOR CO.** 

7. Remove the upper radiator hose (A) and lower radiator hose (B).



#### **Fig. 8: Locating Upper Radiator Hose And Lower Radiator Hose Courtesy of HYUNDAI MOTOR CO.**

- 8. Remove the heater hoses (A).
- 9. Remove the fuel hose (B).

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**<u>Fig. 9: Locating Fuel Hose</u>** Courtesy of HYUNDAI MOTOR CO.

- 10. Remove the accelerator cable (A) by loosening the lock-nut, then slip the cable end out of the throttle linkage.
- 11. Disconnect the TPS (Throttle Position Sensor) connector (B) and the MAP sensor connector (C).



#### **Fig. 10: Locating Throttle Position Sensor Connector And Map Sensor Connector Courtesy of HYUNDAI MOTOR CO.**

- 12. Remove the engine wire harness connectors and wire harness clamps from cylinder head and the intake manifold.
  - 1. Disconnect the rear oxygen sensor connector (A).
  - 2. Disconnect the air conditioner compressor switch connector (B).
  - 3. Disconnect the knock sensor connector (C).
  - 4. Disconnect the injector connectors (No. 3, 4) (D).
  - 5. Disconnect the injector connectors (No. 1, 2) (E)

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#### **Fig. 11: Locating Knock Sensor Connector And Injector Connectors Courtesy of HYUNDAI MOTOR CO.**

- 6. Remove the wire harness bracket (A).
- 7. Disconnect the ISA (Idle Speed Actuator) connector (B).



#### **Fig. 12: Locating Wire Harness Bracket And Idle Speed Actuator Connector Courtesy of HYUNDAI MOTOR CO.**

- 8. Disconnect the front oxygen sensor connector (A).
- 9. Disconnect the CKP (Crankshaft Position Sensor) connector (B).
- 10. Disconnect the OCV (Oil Control Valve) connector (C).

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#### **Fig. 13: Locating Front Oxygen Sensor Connector And Oil Control Valve Connector Courtesy of HYUNDAI MOTOR CO.**

- 11. Disconnect the ignition coil connector (A).
- 12. Disconnect the ignition coil condenser connector (B).
- 13. Disconnect the CMP (Camshaft Position Sensor) connector (C).
- 14. Disconnect the ground cable (D).
- 15. Remove the wire harness bracket (E).



#### **Fig. 14: Locating Ignition Coil Connector And Wire Harness Bracket Courtesy of HYUNDAI MOTOR CO.**

- 13. Disconnect the hose (A) of the PCSV (Purge Control Solenoid Valve) side.
- 14. Remove the brake booster vacuum hose (B).

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### **Fig. 15: Locating PCSV Hose And Brake Booster Vacuum Hose Courtesy of HYUNDAI MOTOR CO.**

- 15. Remove the power steering pump and fix the pump to vehicle with a wire. (Refer to <u>POWER</u> <u>STEERING PUMP</u>).
- 16. Remove the ignition coil. (Refer to **<u>IGNITION SYSTEM</u>**).
- 17. Remove the exhaust manifold.
- 18. Remove the intake manifold.
- 19. Remove the timing belt.
- 20. Remove the cylinder head cover.
- 21. Remove the camshaft sprocket.
- 22. Remove the timing chain auto tensioner (A).



#### **Fig. 16: Locating Timing Chain Auto Tensioner** Courtesy of HYUNDAI MOTOR CO.

23. Remove the camshaft bearing caps (A) and camshafts (B).

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**Fig. 17: Locating Camshaft Bearing Caps And Camshafts Courtesy of HYUNDAI MOTOR CO.** 

24. Remove the OCV (Oil Control Valve) (A).





## **Fig. 18: Locating Oil Control Valve** Courtesy of HYUNDAI MOTOR CO.

25. Remove the OCV (Oil Control Valve) filter (A).



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#### **Fig. 19: Locating Oil Control Valve Filter Courtesy of HYUNDAI MOTOR CO.**

26. Remove the engine mounting support bracket fixing bolts (A).



#### **Fig. 20: Locating Engine Mounting Support Bracket Fixing Bolts Courtesy of HYUNDAI MOTOR CO.**

- 27. Remove the cylinder head bolts, then remove the cylinder head.
  - 1. Using 8 mm hexagon wrench, uniformly loosen and remove the 10 cylinder head bolts, in several passes, in the sequence shown.



**Fig. 21: Identifying Cylinder Head Bolts Loosening Sequence** Courtesy of HYUNDAI MOTOR CO.

# CAUTION: Head warpage or cracking could result from removing bolts in an incorrect order.

2. Lift the cylinder head from the dowels on the cylinder block and replace the cylinder head on wooden blocks on a bench.

## CAUTION: Be careful not to damage the contact surfaces of the cylinder

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## head and cylinder block.

#### REPLACEMENT

#### Valve Guide

1. Using the SST (09221 - 3F100A), withdraw the old valve guide toward the bottom of cylinder head.



#### <u>Fig. 22: Removing Old Valve Guide Toward Bottom Of Cylinder Head Using SST (09221 - 3F100A)</u> Courtesy of HYUNDAI MOTOR CO.

- 2. Recondition the valve guide hole of cylinder head so that it can match the newly press-fitted oversize valve guide.
- 3. Using the SST (09221-3F100A, 09221-26000), press-fit the valve guide. The valve guide must be pressfitted from the upper side of the cylinder head. Keep in mind that the intake and exhaust valve guides are different in length.

#### Valve guide length

Intake: 36.3 ~ 36.7 mm (1.4291 ~ 1.4449 in)

Exhaust: 40.8 ~ 41.2 mm (1.6063 ~ 1.6220 in)



#### Fig. 23: Installing Valve Guide Using SST (09221-3F100A, 09221-26000)

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#### **Courtesy of HYUNDAI MOTOR CO.**

- 4. After the valve guide is press-fitted, insert a new valve and check for proper stem-to-guide clearance.
- 5. After the valve guide is replaced, check that the valve is seated properly. Recondition the valve seats as necessary.

Item	Oversize [mm (in)]	Size mark	Valve guide hole inner diameter [mm (in)]	Valve guide outer diameter [mm (in)]	Valve guide protrusion height [mm (in)]
Valve guide	STD	-	$\frac{11.000 \sim 11.018 (0.4331)}{\sim 0.4338}$	$\frac{11.050 \sim 11.060}{(0.4350 \sim 0.4354)}$	
	0.05 (0.002) OS	5	11.050 ~ 11.068 (0.4350 ~ 0.4357)	$\frac{11.100 \sim 11.110}{(0.4370 \sim 0.4374)}$	12.8 (0.5020)
	0.25 (0.010) OS	25	11.250 ~ 11.268 (0.4429 ~ 0.4436)	$11.300 \sim 11.310 \\ (0.4449 \sim 0.4453)$	12.8 (0.3039)
	0.50 (0.020) OS	50	11.500 ~ 11.518 (0.4528 ~ 0.4535)	$\frac{11.550 \sim 11.560}{(0.4547 \sim 0.4551)}$	

#### VALVE GUIDE OVERSIZE SPECIFICATIONS

#### Valve Seat Ring

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



#### Fig. 24: Cutting Away Inner Face Of Valve Seat To Reduce Wall Thickness **Courtesy of HYUNDAI MOTOR CO.**

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

VALVE SEA	RING OVERSIZE SPECIFICATIONS						
Item	Over size [mm (in.)]	Size mark	Sea dia	t ring hole in meter [mm (	nner (in)]	Seat ring outer diameter [mm (in)]	Seat ring height [mm (in)]
	STD	-	3	$0.400 \sim 30.42$	21	30.490 ~ 30.505	4.800 ~ 5.000
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			(1.1968 ~ 1.1977)	(1.2004 ~ 1.2010)	(0.1890 ~ 0.1969)
Intake valve	0.3 (0.012)	30	30.700 ~ 30.721	30.790 ~ 30.805	5.100 ~ 5.300
make valve	OS		(1.2087 ~ 1.2095)	$(1.2122 \sim 1.2128)$	$(0.2008 \sim 0.2087)$
scat mig	0.6 (0.024)	60	31.000 ~ 31.021	31.090 ~ 31.105	5.400 ~ 5.600
	OS		(1.2205 ~ 1.2213)	$(1.2240 \sim 1.2246)$	$(0.2126 \sim 0.2205)$
	STD		$27.000 \sim 27.021$	27.095 ~ 27.115	5.900 ~ 6.100
	51D	-	(1.0630 ~ 1.0638)	$(1.0667 \sim 1.0675)$	$(0.2323 \sim 0.2402)$
Exhaust valve seat ring	0.3 (0.012)	30	27.300 ~ 27.321	27.395 ~ 27.415	6.200 ~ 6.400
			(1.0748 ~ 1.0756)	(1.0785 ~ 1.0793)	(0.2441 ~ 0.2520)
	0.6 (0.024)	60	$27.600 \sim 27.621$	27.695 ~ 27.715	$6.500 \sim 6.700$
			$(1.0866 \sim 1.0874)$	$(1.0904 \sim 1.0911)$	$(0.2559 \sim 0.2638)$

#### DISASSEMBLY

NOTE: Identify HLA (Hydraulic Lash Adjuster), valves, valve springs as they are removed so that each item can be reinstalled in its original position.

1. Remove the HLAs (A).



#### **<u>Fig. 25: Locating HLAs</u>** Courtesy of HYUNDAI MOTOR CO.

- 2. Remove the valves.
  - 1. Using the SST (09222 28000, 09222 28100), compress the valve spring and remove the retainer lock.

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1.6 CVVT



#### Fig. 26: Compressing Valve Spring Using SST (09222 - 28000, 09222 - 28100) Courtesy of HYUNDAI MOTOR CO.

- 2. Remove the spring retainer.
- 3. Remove the valve spring.
- 4. Remove the valve.
- 5. Using a needle-nose pliers, remove the oil seal.
- 6. Using a magnetic finger, remove the spring seat.

#### **INSPECTION**

#### Cylinder Head

1. Inspect for flatness.

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

#### Flatness of cylinder head gasket surface

Standard : Less than 0.03 mm (0.0012 in)

Limit : 0.05 mm (0.0020 in)

#### Flatness of manifold mating surface

Standard : Less than 0.15 mm (0.0059 in)

Limit : 0.20 mm (0.0079 in)

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### **Fig. 27: Measuring Surface Contacting Cylinder Block And Manifolds For Warpage** Courtesy of HYUNDAI MOTOR CO.

2. Inspect for cracks.

Check the combustion chamber, intake ports, exhaust ports and cylinder block surface for cracks. If cracked, replace the cylinder head.

#### Valve And Valve Spring

- 1. Inspect the valve stems and valve guides.
  - 1. Using a caliper gauge, measure the inner diameter of valve guide.

#### Valve guide inner diameter:

6.000 ~ 6.015 mm (0.2362 ~ 0.2368 in)



**Fig. 28: Measuring Inner Diameter Of Valve Guide** Courtesy of HYUNDAI MOTOR CO.

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2. Using a micrometer, measure the outer diameter of valve stem.

#### Valve stem outer diameter

Intake: 5.965 ~ 5.980 mm (0.2348 ~ 0.2354 in)

Exhaust: 5.950 ~ 5.965 mm (0.2343 ~ 0.2348 in)



#### **Fig. 29: Measuring Outer Diameter Of Valve Stem Courtesy of HYUNDAI MOTOR CO.**

3. Subtract the valve stem outer diameter measurement from the valve guide inner diameter measurement.

#### Valve stem- to-guide clearance

#### Standard

Intake:  $0.02 \sim 0.05 \text{ mm} (0.0008 \sim 0.0020 \text{ in})$ 

Exhaust: 0.035 ~ 0.065 mm (0.0014 ~ 0.0026 in)

#### Limit

Intake: 0.10 mm (0.0039 in)

Exhaust: 0.15 mm (0.0059 in)

If the clearance is greater than maximum, replace the valve and valve guide.

#### 2. Inspect the valves.

- 1. Check the valve is ground to the correct valve face angle.
- 2. Check the surface of valve for wear.

If the valve face is worn, replace the valve.

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3. Check the valve head margin thickness.

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

#### Margin

#### Standard

Intake: 1.1 mm (0.0433 in)

Exhaust: 1.3 mm (0.0512 in)

#### Limit

Intake: 0.8 mm (0.0315 in)

Exhaust: 1.0 mm (0.0394 in)



#### **Fig. 30: Checking Valve Head Margin Thickness Courtesy of HYUNDAI MOTOR CO.**

4. Check the surface of valve stem tip for wear.

If the valve stem tip is worn, replace the valve.

- 3. Inspect the valve seats.
  - 1. Check the valve seat for evidence of overheating and improper contact with the valve face. Replace the seat if necessary.
  - 2. Before reconditioning the seat, check the valve guide for wear. If the valve guide is worn, replace it, then recondition the seat.
  - 3. Recondition the valve seat with a valve seat grinder or cutter. The valve seat contact width should be within specifications and centered on the valve face.

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#### **Fig. 31: Reconditioning Valve Seat With Valve Seat Grinder Or Cutter Courtesy of HYUNDAI MOTOR CO.**

- 4. Inspect the valve springs.
  - 1. Using a steel square, measure the out-of-square of valve spring.
  - 2. Using a vernier calipers, measure the free length of valve spring.

#### Valve spring

#### Standard

Free height : 44 mm (1.7323 in)

Load :  $21.6 \pm 1.1$  kg / 35.0 mm ( $47.6 \pm 2.4$  lb / 1.3780 in)

 $45.1 \pm 2.2$  kg / 27.2 mm (99.4  $\pm 4.9$  lb / 1.0709 in)

Out of square: Less than 1.5°

## Limit

Out of square: 3°

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### **Fig. 32: Measuring Free Length Of Valve Spring Courtesy of HYUNDAI MOTOR CO.**

If the loads is not as specified, replace the valve spring.

#### Camshaft

1. Inspect the cam lobes.

Using a micrometer, measure the cam lobe height.

## Cam height

Intake: 43.7492 ~ 43.9492 mm (1.72241 ~ 1.73028 in)

Exhaust: 44.1494 ~ 44.3494 mm (1.73816 ~ 1.74604 in)



## Fig. 33: Measuring Cam Lobe Height Courtesy of HYUNDAI MOTOR CO.

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

- 2. Inspect the camshaft journal clearance.
  - 1. Clean the bearing caps and camshaft journals.
  - 2. Place the camshafts on the cylinder head.

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3. Lay a strip of plastigage across each of the camshaft journal.



#### **Fig. 34: Inspecting Camshaft Journal Clearance Courtesy of HYUNDAI MOTOR CO.**

4. Install the bearing caps and tighten the bolts with specified torque.

## NOTE: Do not turn the camshaft.

- 5. Remove the bearing caps.
- 6. Measure the plastigage at its widest point.

#### **Bearing oil clearance**

Standard : 0.020 ~ 0.061 mm (0.0008 ~ 0.0024 in)

Limit : 0.1 mm (0.0039 in)



#### **Fig. 35: Measuring Plastigage At Its Widest Point Courtesy of HYUNDAI MOTOR CO.**

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

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- 7. Completely remove the plastigage.
- 8. Remove the camshafts.
- 3. Inspect the camshaft end play.
  - 1. Install the camshafts.
  - 2. Using a dial indicator, measure the end play while moving the camshaft back and forth.

### Camshaft end play

Standard : 0.1 ~ 0.2 mm (0.0039 ~ 0.0079 in)



#### **Fig. 36: Measuring End Play While Moving Camshaft Back And Forth Courtesy of HYUNDAI MOTOR CO.**

If the end play is greater than specified, replace the camshaft. If necessary, replace the bearing caps and cylinder head as a set.

3. Remove the camshafts.

#### CVVT (Continuous Variable Valve Timing) Assembly

- 1. Inspect the CVVT (Continuous Variable Valve Timing) assembly.
  - 1. Check that the CVVT (Continuous Variable Valve Timing) assembly will not turn.
  - 2. Apply vinyl tape to all the parts except the one indicated by the arrow in the illustration.

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**Fig. 37: Locating Continuous Variable Valve Timing Assembly Holes Courtesy of HYUNDAI MOTOR CO.** 

3. Wrap tape around the tip of the air gun and apply air of approx. 98 kPa (1 kg/cm<sup>2</sup>, 14 psi) to the port of the camshaft.

Perform this order to release the lock pin for the maximum delay angle locking.)

# NOTE: Wrap around it with a shop rag and the likes, because the oil splashes.

- 4. Under the condition of 3), turn the CVVT assembly to the advance angle side with your hand.
  - A. Depending on the air pressure, the CVVT assembly will turn to the advance side.
  - B. If air is leaking from the port and air pressure cannot be maintained, the locking pin will not release.



#### **Fig. 38: Identifying Continuous Variable Valve Timing Assembly Advance And Retard** Courtesy of HYUNDAI MOTOR CO.

- 5. Except the position where the lock pin meets at the maximum delay angle, let the CVVT assembly turn back and forth and check the movable range and that there is no disturbance.
  - : Movable smoothly in the range about  $20^\circ$

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6. Turn the CVVT assembly with your hand and lock it at the maximum delay angle position.

## HLA (HYDRAULIC LASH ADJUSTER)

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



## **Fig. 39: Inspecting Hydraulic Lash Adjuster Courtesy of HYUNDAI MOTOR CO.**

#### **TROUBLESHOOTING CHART**

No.	Problem	Possible cause	Action
1	Temporary noise when starting a cold engine	Normal	This noise will disappear after the oil in the engine reaches the normal pressure.
2	Continuous noise when the engine is started after parking more than 48 hours.	Oil leakage of the high pressure chamber on the HLA, allowing air to get in.	Noise will disappear within 15 minutes
3	Continuous noise when the engine is first started after rebuilding cylinder head.	Insufficient oil in cylinder head oil gallery.	when engine runs at 2,000~3,000 RPM. If it doesn't disappear, refer to step 7 below.
4	Continuous noise when the engine is started after excessively cranking the engine by the starter motor.	Oil leakage of the high- pressure chamber in the HI A allowing air to get in	CAUTION: Do not run engine at a speed higher than 3,000 RPM, as this may damage
5	Continuous noise when the engine is running after changing the HLA.	Insufficient oil in the HLA.	the HLA.
		Engine oil level too high or too low.	Check oil level. Drain or add oil as necessary.
6	Continuous noise during idle after high engine speed.	Excessive amount of air in the oil at high engine speed.	Check oil supply system
		Deteriorated oil.	Check oil quality. If deteriorated, replace with specified type.
		Low oil pressure	Check oil pressure and oil supply system of each part of engine.

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7 Noise continues for more than minutes.	15 Faulty HLA.	Remove the cylinder head cover and press HLA down by hand. If it moves, replace the HLA.
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## REASSEMBLY

• Thoroughly clean all parts to be assembled.

- Before installing the parts, apply fresh engine oil to all sliding and rotating surface.
- Replace oil seals with new ones.
- 1. Install the valves.

CAUTION:

- 1. Install the spring seats.
- 2. Using the SST (09222 22001), push in a new oil seal.

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



Fig. 40: Pushing In Oil Seal Using SST (09222 - 22001) Courtesy of HYUNDAI MOTOR CO.

3. Install the valve, valve spring and spring retainer.

# NOTE: Place the valve springs so that the side coated with enamel faces toward the valve spring retainer and then installs the retainer.

4. Using the SST (09222 - 28000, 09222 - 28100), compress the spring and install the retainer locks.

After installing the valves, ensure that the retainer locks are correctly in place before releasing the valve spring compressor.

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1.6 CVVT



#### Fig. 41: Compressing Spring Using SST (09222 - 28000, 09222 - 28100) Courtesy of HYUNDAI MOTOR CO.

5. Lightly tap the end of each valve stem two or three times with the wooden handle of a hammer to ensure proper seating of the valve and retainer lock.



#### **Fig. 42: Inspecting Proper Seating Of Valve And Retainer Lock** Courtesy of HYUNDAI MOTOR CO.

2. Install the HLA (Hydraulic Lash Adjuster(s)).

Check that the HLA rotates smoothly by hand.

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**Fig. 43: Locating Hydraulic Lash Adjuster Courtesy of HYUNDAI MOTOR CO.** 

## INSTALLATION

#### NOTE:

- Thoroughly clean all parts to be assembled.
- Always use a new cylinder head and manifold gasket.
- Always use a new cylinder head bolt.
- The cylinder head gasket is a metal gasket. Take care not to bend it.
- Rotate the crankshaft, set the No. 1 piston at TDC.
- 1. Install the cylinder head gasket (A) on the cylinder block.

#### **NOTE:** Be careful of the installation direction.



**Fig. 44: Locating Cylinder Head Gasket** Courtesy of HYUNDAI MOTOR CO.

- 2. Place the cylinder head quietly in order not to damage the gasket with the bottom part of the end.
- 3. Install the cylinder head bolts.
  - 1. Apply a light coat if engine oil on the threads and under the heads of the cylinder head bolts.

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2. Using 8 mm and 10 mm hexagon wrench, install and tighten the 10 cylinder head bolts and plate washers, in several passes, in the sequence shown.

#### **Tightening torque:**

29.4 N.m (3.0 kgf.m, 21.7 lb-ft) + 90° --> Release all bolts --> 29.4 N.m (3.0 kgf.m, 21.7 lb-ft) + 90°

1.6 CVVT



#### **Fig. 45: Identifying Cylinder Head Bolts Tightening Sequence Courtesy of HYUNDAI MOTOR CO.**

4. Install the engine mounting support bracket fixing bolts (A).



#### **Fig. 46: Locating Engine Mounting Support Bracket Fixing Bolts Courtesy of HYUNDAI MOTOR CO.**

5. Install the OCV (Oil Control Valve) filter (A).

#### **Tightening torque:**

 $40.2 \sim 50.0$  N.m ( $4.1 \sim 5.1$  kgf.m,  $29.7 \sim 36.9$  lb-ft)

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1.6 CVVT



**Fig. 47: Locating Oil Control Valve Filter Courtesy of HYUNDAI MOTOR CO.** 

## Always use a new OCV (Oil Control Valve) filter gasket.

- Keep clean the OCV (Oil Control Valve) filter.
- 6. Install the OCV (Oil Control Valve) (A).

## **Tightening torque:**

NOTE:

9.8 ~ 11.8 N.m (1.0 ~ 1.2 kgf.m, 7.2 ~ 8.7 lb-ft)



#### Fig. 48: Locating Oil Control Valve Courtesy of HYUNDAI MOTOR CO.

- CAUTION: Do not reuse the OCV (Oil Control Valve) when dropped.
  - Keep clean the OCV (Oil Control Valve).
  - Do not hold the OCV (Oil Control Valve) sleeve during servicing.
  - When the OCV (Oil Control Valve) is installed on the engine, do not move the engine with holding the OCV (Oil Control Valve)

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#### yoke.

- 7. Install the camshafts.
  - 1. Align the camshaft timing chain with the intake timing chain sprocket and exhaust timing chain sprocket as shown.

1.6 CVVT



#### <u>Fig. 49: Aligning Camshaft Timing Chain With Intake Timing Chain Sprocket And Exhaust</u> <u>Timing Chain Sprocket</u> Courtesy of HYUNDAI MOTOR CO.

2. Install the camshaft (A) and bearing caps (B).

#### **Tightening torque:**

 $11.8 \sim 13.7$  N.m ( $1.2 \sim 1.4$  kgf.m,  $8.7 \sim 10.1$  lb-ft)



#### **Fig. 50: Locating Camshaft And Bearing Caps Courtesy of HYUNDAI MOTOR CO.**

3. Install the timing chain auto tensioner (A).

#### **Tightening torque:**

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 $7.8 \sim 9.8$  N.m ( $0.8 \sim 1.0$  kgf.m,  $5.8 \sim 7.2$  lb-ft)



#### **Fig. 51: Locating Timing Chain Auto Tensioner Courtesy of HYUNDAI MOTOR CO.**

8. Using the SST (09221 - 21000), install the camshaft bearing oil seal.



#### <u>Fig. 52: Installing Camshaft Bearing Oil Seal Using SST (09221 - 21000)</u> Courtesy of HYUNDAI MOTOR CO.

- 9. Install the camshaft sprocket.
- 10. Install the cylinder head cover.
  - 1. Install the cylinder head cover gasket (A) in the groove of the cylinder head cover (B).

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1.6 CVVT



**Fig. 53: Locating Cylinder Head Cover Gasket And Cylinder Head Cover Courtesy of HYUNDAI MOTOR CO.** 

- Before installing the cylinder head cover gasket, thoroughly clean the cylinder head cover and the groove.
  - When installing, make sure the cylinder head cover gasket is seated securely in the corners of the recesses with no gap.
- 2. Apply liquid gasket to the head cover gasket at the corners of the recess.

1.6 CVVT



**Fig. 54: Applying Liquid Gasket To Head Cover Gasket At Corners Of Recess** Courtesy of HYUNDAI MOTOR CO.

NOTE:

- Use liquid gasket, Loctite No. 5999.
- Check that the mating surfaces are clean and dry before applying liquid gasket.
- After assembly, wait at least 30 minutes before filling the engine with oil.
- 3. Install the cylinder head cover (A) with bolts (B).
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Uniformly tighten the bolts in several passes.

Pre-tighten all bolts by  $3.9 \sim 4.9$  N.m ( $0.4 \sim 0.5$  kgf.m,  $2.9 \sim 3.6$  lb-ft) and then tighten by the specified torque.

#### **Tightening torque:**

7.8 ~ 9.8 N.m (0.8 ~ 1.0 kgf.m, 5.8 ~ 7.2 lb-ft)





#### **Fig. 55: Identifying Cylinder Head Cover Bolts Tightening Sequence** Courtesy of HYUNDAI MOTOR CO.

- 11. Install the timing belt.
- 12. Install the intake manifold.
- 13. Install the exhaust manifold.
- 14. Install the ignition coil. (Refer to **IGNITION SYSTEM**).
- 15. Install the power steering pump. (Refer to **POWER STEERING PUMP**).
- 16. Install the brake booster hose (B).
- 17. Connect the hose (A) of the PCSV (Purge Control Solenoid Valve) side.

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### **<u>Fig. 56: Locating PCSV Hose</u> Courtesy of HYUNDAI MOTOR CO.**

- 18. Install the engine wire harness connectors and wire harness clamps to the cylinder head and the intake manifold.
  - 1. Install the wire harness bracket (E).
  - 2. Connect the ground cable (D).
  - 3. Connect the CMP (Camshaft position sensor) connector (C).
  - 4. Connect the ignition coil condenser connector (B).
  - 5. Connect the ignition coil connector (A).



#### **Fig. 57: Locating Ignition Coil Connector Courtesy of HYUNDAI MOTOR CO.**

- 6. Connect the OCV (Oil Control Valve) connector (C).
- 7. Connect the CKP (Crankshaft Position Sensor) connector (B).
- 8. Connect the front oxygen sensor connector (A).

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**Fig. 58: Locating Front Oxygen Sensor Connector Courtesy of HYUNDAI MOTOR CO.** 

- 9. Connect the ISA (Idle Speed Actuator) connector (B).
- 10. Install the wire harness bracket (A).



### **Fig. 59: Locating Wire Harness Bracket Courtesy of HYUNDAI MOTOR CO.**

- 11. Connect the injector connectors (No. 1, 2) (E).
- 12. Connect the injector connectors (No. 3, 4) (D).
- 13. Connect the knock sensor connector (C).
- 14. Connect the air conditioner compressor switch connector (B).
- 15. Connect the rear oxygen sensor connector (A).

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**Fig. 60: Locating Rear Oxygen Sensor Connector Courtesy of HYUNDAI MOTOR CO.** 

- 19. Connect the TPS (Throttle Position Sensor) connector (B) and the MAP sensor connector (C).
- 20. Install the accelerator cable (A).



**Fig. 61: Locating Accelerator Cable Courtesy of HYUNDAI MOTOR CO.** 

- 21. Install the fuel hose (B).
- 22. Install the heater hoses (A).

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#### **Fig. 62: Locating Heater Hoses And Fuel Hose Courtesy of HYUNDAI MOTOR CO.**

23. Install the upper radiator hose (A) and lower radiator hose (B).



#### **Fig. 63: Locating Upper Radiator Hose And Lower Radiator Hose Courtesy of HYUNDAI MOTOR CO.**

24. Install the battery tray (A).

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**<u>Fig. 64: Locating Battery Tray</u> Courtesy of HYUNDAI MOTOR CO.** 

- 25. Install the intake air hose and air cleaner assembly.
  - 1. Install the air cleaner element and air cleaner lower cover (C).

#### **Tightening torque:**

- $7.8 \sim 9.8$  N.m ( $0.8 \sim 1.0$  kgf.m,  $5.8 \sim 7.2$  lb-ft)
- 2. Connect the ECM connector (A) and ECM connector (B) (A/T only).



#### **Fig. 65: Locating ECM Connector And ECM Connector Courtesy of HYUNDAI MOTOR CO.**

- 3. Install the intake air hose (D) and air cleaner upper cover (C).
- 4. Connect the breather hose (B) to intake air hose (D).

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**Fig. 66: Locating Breather Hose And Intake Air Hose Courtesy of HYUNDAI MOTOR CO.** 

26. Install the under cover (A).



**<u>Fig. 67: Locating Under Cover</u> Courtesy of HYUNDAI MOTOR CO.** 

27. Install the engine cover.

### **Tightening torque:**

 $3.9 \sim 5.9$  N.m (0.4 ~ 0.6 kgf.m,  $2.9 \sim 4.3$  lb-ft)

28. Install the battery and connect the battery terminals (A).

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### **Fig. 68: Locating Battery Terminals Courtesy of HYUNDAI MOTOR CO.**

- 29. Fill with engine coolant.
- 30. Start the engine and check for leaks.
- 31. Recheck engine coolant level and oil level.