SECTION EN EM ENGINE MECHANICAL o

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CONTENTS

KA24DE

PRECAUTIONS	. 5
Precautions for Drain Coolant	. 5
Precautions for Disconnecting Fuel Piping	. 5
Precautions for Removal and Disassembly	. 5
Precautions for Inspection, Repair and Replace-	
ment	. 5
Precautions for Assembly and Installation	. 5
Parts Requiring Angular Tightening	. 5
Precautions for Liquid Gasket	. 6
REMOVAL OF LIQUID GASKET SEALING	. 6
LIQUID GASKET APPLICATION PROCEDURE	. 6
PREPARATION	. 7
Special Service Tools	. 7
Commercial Service Tools	. 8
NOISE, VIBRATION, AND HARSHNESS (NVH)	
TROUBLESHOOTING	10
NVH Troubleshooting — Engine Noise	10
Use the Chart Below to Help You Find the Cause	
of the Symptom	11
ENGINE ROOM COVER	12
Removal and Installation of Engine Room Right	
Side	12
REMOVAL	12
INSTALLTION	12
Removal and Installation of Engine Room Rear	
Cover	12
REMOVAL	12
INSTALLATION	13
DRIVE BELTS	14
Checking Drive Belts	14
Tension Adjustment	14
POWER STEERING PUMP BELT	14
AIR CONDITIONER COMPRESSOR BELT	14
ALTERNATOR AND WATER PUMP BELT	15
Removal and Installation	15
REMOVAL	15
INSTALLATION	15
AIR CLEANER AND AIR DUCT	16
Removal and Installation	16

REMOVAL	16	F
INSTALLATION	17	
Changing Air Cleaner Element	18	
REMOVAL	18	G
INSTALLATION	18	0
THROTTLE BODY	19	
Removal and Installation	19	ш
REMOVAL	19	
INSPECTION AFTER REMOVAL	20	
INSTALLATION	20	
Disassembly and Assembly	20	
DISASSEMBLY	20	
ASSEMBLY	20	
INTAKE MANIFOLD	21	J
Removal and Installation	21	
REMOVAL	21	
INSPECTION AFTER REMOVAL	22	K
INSTALLATION	22	
EXHAUST MANIFOLD	23	
Removal and Installation	23	
REMOVAL	23	L
INSPECTION AFTER REMOVAL	24	
INSTALLATION	24	
INSPECTION AFTER INSTALLATION	24	M
OIL PAN AND OIL STRAINER	25	
Removal and Installation	25	
REMOVAL	25	
INSPECTION AFTER REMOVAL	25	
INSTALLATION	25	
INSPECTION AFTER INSTALLATION	26	
SPARK PLUG (CONVENTIONAL)	27	
Removal and Installation	27	
REMOVAL	27	
INSPECTION AFTER REMOVAL	27	
INSTALLATION	27	
FUEL INJECTOR AND FUEL TUBE	28	
Removal and Installation	28	
REMOVAL	28	
INSTALLATION	29	
INSPECTION AFTER INSTALLATION	29	

ROCKER COVER	30
Removal and Installation	30
REMOVAL	30
INSTALLATION	30
CAMSHAFT	32
Removal and Installation	32
REMOVAL	32
INSTALLATION	34
INSPECTION AFTER REMOVAL	35
Valve Clearance	38
INSPECTION	38
ADJUSTMENT	38
SECONDARY TIMING CHAIN	41
Removal and Installation	41
REMOVAL	41
INSPECTION AFTER REMOVAL	44
INSTALLATION	45
PRIMARY TIMING CHAIN	49
Removal and Installation	49
REMOVAL	50
INSPECTION AFTER REMOVAL	51
INSTALLATION	51
CYLINDER HEAD	55
On-Vehicle Service	55
CHECKING COMPRESSION PRESSURE	55
Removal and Installation	56
REMOVAL AND INSTALLATION	56
Disassembly and Assembly	57
DISASSEMBLY	57
ASSEMBLY	58
INSPECTION AFTER DISASSEMBLY	58
ENGINE ASSEMBLY	63
Removal and Installation	63
REMOVAL	64
INSTALLATION	65
INSPECTION AFTER INSTALLATION	66
CYLINDER BLOCK	67
Disassembly and Assembly	67
DISASSEMBLY	68
ASSEMBLY	70
How to Select Piston and Bearing	74
	74
HOW TO SELECT PISTON	75
HOW TO SELECT CONNECTING ROD BEAR-	
	75
HOW TO SELECT MAIN BEARING	76
Inspection After Disassembly	78
	78
CONNECTING ROD SIDE CLEARANCE	78
PISTON AND PISTON PIN CLEARANCE	78
PISTON RING SIDE CLEARANCE	79
	79
	80
	80
CONNECTING KOD BUSHING OIL CLEAR-	00
	ØU o⊿
	01
INNER DIAMETER OF MAIN BEARING HOUS-	

ING	81
PISTON TO CYLINDER BORE CLEARANCE	82
OUTER DIAMETER OF CRANKSHAFT JOUR	-
NAL	83
OUTER DIAMETER OF CRANKSHAFT PIN	83
OUT-OF-ROUND AND TAPER OF CRANK-	
SHAFT	83
CRANKSHAFT RUNOUT	83
OIL CLEARANCE OF CONNECTING ROD	
BEARING	84
OIL CLEARANCE OF MAIN BEARING	84
CRUSH HEIGHT OF MAIN BEARING	85
OIL JET	85
OIL JET RELIEF VALVE	85
FLY WHEEL RUNOUT	86
SERVICE DATA AND SPECIFICATIONS (SDS)	87
Standard and Limit	87
GENERAL SPECIFICATIONS	87
DRIVE BELTS	87
INTAKE MANIFOLD AND EXHAUST MANI-	
FOLD	87
SPARK PLUG	88
SECONDARY TIMING CHAIN	88
CYLINDER HEAD	88
VALVE	88
CAMSHAFT AND CAMSHAFT BEARING	92
CYLINDER BLOCK	92
PISTON, PISTON RING AND PISTON PIN	93
CONNECTING ROD	94
CRANKSHAFT	94
MAIN BEARING	95
CONNECTING ROD BEARING	95
FLYWHEEL	96
Tightening Torque	96

ZD30DD

PRECAUTIONS	98
Precautions for Drain Coolant	98
Precautions for Disconnecting Fuel Piping	98
Precautions for Removal and Disassembly	98
Precautions for Inspection, Repair and Replace	-
ment	98
Precautions for Assembly and Installation	98
Parts Requiring Angular Tightening	98
Precautions for Liquid Gasket	99
REMOVAL OF LIQUID GASKET SEALING	99
LIQUID GASKET APPLICATION PROCEDUR	E99
PREPARATION	100
Special Service Tools	100
Commercial Service Tools	102
NOISE, VIBRATION, AND HARSHNESS (NVH)	
TROUBLESHOOTING	103
NVH Troubleshooting —Engine Noise	103
Use the Chart Below to Help You Find the Caus	е
of the Symptom.	104
ENGINE ROOM COVER	105
Removal and Installation of Engine Room Right	

Side	105
REMOVAL	105
INSTALLATION	105
Removal and Installation of Engine Room Rear	
Cover	105
REMOVAL	105
INSTALLATION	106
DRIVE BEI TS	107
Checking Drive Belt	107
Tension Adjustment	107
Pomoval and Installation	107
	107
	107
PRESSOR DELI	107
	109
	109
	109
	109
Dummy Pulley	109
REMOVAL	109
INSPECTION AFTER REMOVAL	109
INSTALLATION	109
AIR CLEANER AND AIR DUCT	110
Removal and Installation	110
REMOVAL	110
INSTALLATION	111
Changing Air Cleaner Element	112
REMOVAL	112
INSTALLATION	112
INTAKE MANIFOLD COLLECTOR AND INTAKE	
MANIFOLD	113
Removal and Installation	
	113
REMOVAL	113 113
REMOVAL	113 113 115
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION	113 113 115 115
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION EXHAUST MANIFOLD	113 113 115 115 117
REMOVAL	113 113 115 115 115 117
REMOVAL	113 113 115 115 115 117 117
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION EXHAUST MANIFOLD Removal and Installation REMOVAL INSPECTION AFTER REMOVAL	113 113 115 115 115 117 117 117
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION EXHAUST MANIFOLD Removal and Installation REMOVAL INSPECTION AFTER REMOVAL INSTALLATION	113 113 115 115 115 115 117 117 118 118
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION EXHAUST MANIFOLD Removal and Installation REMOVAL INSPECTION AFTER REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION	113 113 115 115 115 115 117 117 117 118 118 118
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION EXHAUST MANIFOLD Removal and Installation REMOVAL INSPECTION AFTER REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION OIL PAN AND OIL STRAINER	113 113 115 115 117 117 117 118 118 118 118
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION Removal and Installation REMOVAL INSPECTION AFTER REMOVAL INSPECTION AFTER REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION OIL PAN AND OIL STRAINER	113 113 115 115 115 117 117 117 118 118 118 118 119
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION EXHAUST MANIFOLD Removal and Installation REMOVAL INSPECTION AFTER REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION OIL PAN AND OIL STRAINER Removal and Installation REMOVAL	113 113 115 115 117 117 117 118 118 118 118 119 119
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION EXHAUST MANIFOLD Removal and Installation REMOVAL INSPECTION AFTER REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION OIL PAN AND OIL STRAINER Removal and Installation REMOVAL	113 113 115 115 117 117 117 117 118 118 118 118 119 119
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION Removal and Installation REMOVAL INSPECTION AFTER REMOVAL INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION OIL PAN AND OIL STRAINER Removal and Installation REMOVAL INSTALLATION	113 113 115 115 115 117 117 117 117 118 118 118 118 119 119 120
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION Removal and Installation REMOVAL INSPECTION AFTER REMOVAL INSPECTION AFTER REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION OIL PAN AND OIL STRAINER Removal and Installation REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION	113 113 115 115 115 117 117 117 118 118 118 119 119 119 120 120
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION EXHAUST MANIFOLD Removal and Installation REMOVAL INSPECTION AFTER REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION OIL PAN AND OIL STRAINER Removal and Installation REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION	113 113 115 115 115 117 117 117 117 118 118 118 118 119 119 120 120 120 121
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION EXHAUST MANIFOLD Removal and Installation REMOVAL INSPECTION AFTER REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION OIL PAN AND OIL STRAINER Removal and Installation REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION REMOVAL	113 113 115 115 115 117 117 117 117 117 117 118 118 118 119 119 120 120 120 121
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION EXHAUST MANIFOLD Removal and Installation REMOVAL INSPECTION AFTER REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION OIL PAN AND OIL STRAINER Removal and Installation REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION GLOW PLUG Removal and Installation REMOVAL	113 113 115 115 115 117 117 117 117 117 117 117
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION Removal and Installation REMOVAL INSPECTION AFTER REMOVAL INSPECTION AFTER REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION OIL PAN AND OIL STRAINER Removal and Installation REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION	113 113 115 115 115 117 117 117 117 117 118 118 118 119 120 120 120 120 121 121 121
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION Removal and Installation REMOVAL INSPECTION AFTER REMOVAL INSPECTION AFTER REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION OIL PAN AND OIL STRAINER Removal and Installation REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION	113 113 115 115 115 117 117 117 117 117 118 118 118 119 120 120 120 121 121 121 121
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION Removal and Installation REMOVAL INSPECTION AFTER REMOVAL INSPECTION AFTER REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION OIL PAN AND OIL STRAINER Removal and Installation REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION Removal and Installation REMOVAL	113 113 115 115 115 117 117 117 117 117 118 118 118 118 119 120 120 120 121 121 121 121 122 123
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION EXHAUST MANIFOLD Removal and Installation REMOVAL INSPECTION AFTER REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION OIL PAN AND OIL STRAINER Removal and Installation REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION Removal and Installation REMOVAL INSTALLATION	113 113 115 115 115 117 117 117 117 117 117 118 118 118 118
REMOVAL INSPECTION AFTER REMOVAL INSTALLATION EXHAUST MANIFOLD Removal and Installation REMOVAL INSPECTION AFTER REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION OIL PAN AND OIL STRAINER Removal and Installation REMOVAL INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION INSPECTION AFTER INSTALLATION Removal and Installation REMOVAL INSTALLATION REMOVAL INSTALLATION REMOVAL INSTALLATION	113 113 115 115 115 117 117 117 117 118 118 118 118 119 119 120 120 120 121 121 121 121 122 123 123

INJECTION TUBE AND INJECTION NOZZLE	125	
Removal and Installation	125	A
REMOVAL	125	
INSPECTION AFTER REMOVAL	127	
INSTALLATION	127	ΕM
INSPECTION AFTER INSTALLATION	128	
ELECTRONICCONTROLFUELINJECTIONPUMP	2129	
Removal and Installation	129	0
REMOVAL	129	C
INSTALLATION	132	
INSPECTION AFTER INSTALLATION	134	
ROCKER COVER	135	D
Removal and Installation	135	
REMOVAL	135	
INSTALLATION	136	E
CAMSHAFT	138	
Removal and Installation	138	
	139	F
INSPECTION AFTER REMOVAL	139	
INSTALLATION	141	
	142	0
	142	G
	144	
TIMING CHAIN	141	
	147	Н
	147	
	149	
	143	
Removal and Installation	151	
REMOVAL	152	
	155	J
	157	
	160	
On-Vehicle Service	160	K
CHECKING COMPRESSION PRESSURE	160	1.
Removal and Installation	161	
REMOVAL	161	
INSPECTION AFTER REMOVAL	162	L
INSTALLATION	163	
Disassembly and Assembly	166	
DISASSEMBLY	166	M
ASSEMBLY	167	
INSPECTION AFTER DISASSEMBLY	167	
ENGINE ASSEMBLY	172	
Removal and Installation	172	
REMOVAL	172	
INSTALLATION	174	
INSPECTION AFTER INSTALLATION	175	
CYLINDER BLOCK	176	
Disassembly and Assembly	176	
DISASSEMBLY	177	
ASSEMBLY	181	
How to Select Piston	184	
	184	
SELECTIVE PISTON COMBINATION	184	
INSPECTION AFTER DISASSEMBLY	185	

SERVICE DATA AND SPECIFICATIONS (SDS)	194
Standard and Limit	194
GENERAL SPECIFICATIONS	194
INTAKE MANIFOLD AND EXHAUST MANI-	
FOLD	194
DRIVE BELTS	194
CYLINDER HEAD	195
VALVE	195
CAMSHAFT AND CAMSHAFT BEARING	199

CYLINDER BLOCK	199
PISTON, PISTON RING AND PISTON PIN	200
CONNECTING ROD	201
CRANKSHAFT	201
AVAILABLE MAIN BEARING	202
AVAILABLE CONNECTING ROD BEARING	202
MISCELLANEOUS COMPONENTS	202
Tightening torque	203

PRECAUTIONS

[KA24DE]

PRECAUTIONS	PFP:00001
Precautions for Drain Coolant	A EBS007JS
Drain coolant when engine is cooled.	
Precautions for Disconnecting Fuel Piping	EBS007JT
 Before starting work, make sure no fire or spark producing items are in the work area. Release fuel pressure before disassembly. After disconnecting pipes, plug openings to stop fuel leakage. 	С
Precautions for Removal and Disassembly	EBS007JU
 When instructed to use special service tools, use the specified tools. Always be careful to avoid forceful or uninstructed operations. Exercise maximum care to avoid damage to mating or sliding surfaces. Cover openings of engine system with tape or the equivalent if necessary to seal out foreign 	work safely,
 Mark and arrange disassembly parts in an organized way for easy troubleshooting and re-ass When loosening nuts and bolts, as a basic rule, start with the one furthest outside, then the on opposite, and so on. If the order of loosening is specified, do exactly as specified. 	e diagonally
Precautions for Inspection, Repair and Replacement	EBS007JV
 Before repairing or replacing, thoroughly inspect parts. Inspect new replacement parts in the and replace if necessary. 	same way,
Precautions for Assembly and Installation	ebsoo7jw H
 Use torque wrench to tighten bolts or nuts. When tightening nuts and bolts, as a basic rule, equally tighten in several different steps star ones in center, then ones on inside and outside diagonally in this order. If the order of tighten fied, do exactly as specified. 	ting with the ing is speci-
Replace with new gasket, packing, oil seal or O-ring.	
• Thoroughly wash, clean, and air-blow each part. Carefully check oil or coolant passages for ar and blockage.	וע restriction J
 Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth Before assembly, oil sliding surfaces well. 	ו lint or dust. K
Release air within route after draining coolant.	
 After repairing, start engine and increase engine speed to check coolant, fuel, oil, and exha for leakage. 	ust systems
Parts Requiring Angular Tightening	EBS007JX
 Use an angle wrench for the final tightening of the following engine parts: Cylinder head bolts Connecting rod cap puts 	Μ
 Do not use a torque value for final tightening. 	
 The torque value for these parts are for a preliminary step. 	

• Ensure thread and seat surfaces are clean and coated with engine oil.

Precautions for Liquid Gasket REMOVAL OF LIQUID GASKET SEALING

• After removing the mounting bolts and nuts, disconnect and remove the liquid gasket sealing using a seal cutter.

CAUTION:

Be careful not to damage the mating surfaces.

• In areas where the cutter is difficult to use, use a plastic hammer to lightly tap the areas where the liquid gasket is applied.

CAUTION:

If for some unavoidable reason a tool such as a flat-bladed screwdriver is used, be careful not to damage the mating surfaces.

LIQUID GASKET APPLICATION PROCEDURE

- 1. Using a scraper, remove the old liquid gasket adhering to the gasket application surface and the mating surface.
- Remove the liquid gasket completely from the groove of the gasket application surface, mounting bolts, and bolt holes.
- 2. Wipe the gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.
- 3. Attach the liquid gasket to the tube presser. **Use Genuine Liquid Gasket or equivalent.**
- 4. Apply the gasket without breaks to the specified location with the specified dimensions.
- If there is a groove for the liquid gasket application, apply the gasket to the groove.
- As for the bolt holes, normally apply the gasket inside the holes. Occasionally, it should be applied outside the holes. Make sure to read the text of service manual.
- Within five minutes of gasket application, install the mating component.
- If the liquid gasket protrudes, wipe it off immediately.
- Do not retighten after the installation.
- After 30 minutes or more have passed from the installation, fill the engine oil and coolant.

CAUTION:

If there are specific instructions in the service manual, observe them.







PREPARATION

[KA24DE]

PREPARATION Special Service Tools

PFP:00002

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EBS007JZ

-			
Tool number Tool name		Description	EM
KV10111100 Seal cutter	ZZA0013D	Removing steel oil pan and rear timing chain case	C
KV10117100 Heated oxygen sensor wrench	ZZA1007D	Loosening or tightening heated oxygen sensors with 22 mm (0.87 in) hexagon nut	E F
KV10105800 Timing chain stopper	ZZA1006D	Removing and installing idler sproket	G
KV101151S0 Lifter stopper set 1 KV10115120 Lifter stopper 2 KV10115110 Camshaft pliers	© ZZA0103D	Changing valve lifter shims	J
KV10112100 Angle wrench	ZZA0120D	Tightening bolts for bearing cap, cylinder head, etc.	L
KV10116200 Valve spring compressor KV10111200 Adapter	ZZA0993D	Disassembling and assembling valve components	
KV10116100 Valve oil seal puller	ZZA0015D	Removing valve oil seal	

PREPARATION

[KA24DE]



Commercial Service Tools

EBS007K0

PREPARATION

[KA24DE]



NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING NVH Troubleshooting —Engine Noise

PFP:00003



EM-10

NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING [KA24DE]

Use the Chart Below to Help You Find the Cause of the Symptom.

- 1. Locate the area where noise occurs.
- 2. Confirm the type of noise.
- 3. Specify the operating condition of engine.
- 4. Check specified noise source.

If necessary, repair or replace these parts.

			Opera	ting cond	ition of er	ngine				
Location of noise	Type of noise	Before warm- up	After warm- up	When start- ing	When idling	When racing	While driving	Source of noise	Check item	Refer- ence page
Top of engine	Ticking or clicking	С	А	_	A	В	_	Tappet noise	Valve clearance	<u>EM-38</u>
Rocker cover Cylinder head	Rattle	С	A	_	A	В	С	Camshaft bearing noise	Camshaft journal clear- ance Camshaft runout	<u>EM-36</u> <u>EM-35</u>
	Slap or knock	_	A	_	В	В	_	Piston pin noise	Piston and piston pin clearance Connecting rod bush- ing clearance	<u>EM-80</u> <u>EM-80</u>
Crank- shaft pul- ley Cylinder block (Side of	Slap or rap	A		_	В	В	A	Piston slap noise	Piston-to-bore clear- ance Piston ring side clear- ance Piston ring end gap Connecting rod bend and torsion	<u>EM-80</u> <u>EM-79</u> <u>EM-79</u> <u>EM-80</u>
(Side of engine) Oil pan	Knock	А	В	С	В	В	В	Connect- ing rod bearing noise	Connecting rod bush- ing clearance (Small end) Connecting rod bear- ing clearance (Big end)	<u>EM-80</u> <u>EM-80</u>
	Knock	A	В	_	A	В	С	Main bearing noise	Main bearing oil clear- ance Crankshaft runout	<u>EM-84</u> <u>EM-83</u>
Front of engine Timing chain cover	Tapping or ticking	A	A	_	В	В	В	Timing chain and chain ten- sioner noise	Timing chain cracks and wear Timing chain tensioner operation	<u>EM-44</u> <u>EM-51</u>
	Squeak- ing or fizz- ing	A	В	_	В	_	С	Other drive belts (Sticking or slip- ping)	Drive belts deflection	<u>EM-14</u>
Front of engine	Creaking	А	В	A	В	A	В	Other drive belts (Slipping)	Idler pulley bearing operation	
	Squall Creak	А	В	_	В	A	В	Water pump noise	Water pump operation	<u>CO-21</u>

A: Closely related B: Related C: Sometimes related ---: Not related

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ENGINE ROOM COVER

ENGINE ROOM COVER

Removal and Installation of Engine Room Right Side



REMOVAL

- 1. Open engine compartment LH cover and secure it.
- 2. Remove RH seat. Refer to SE-4, "FRONT SEAT".
- Partially remove floor carpet.
- 4. Disconnect harness protector secured together at front right. Disconnect harness connector to move harness routed on top of engine compartment RH cover aside.
- 5. Move parking brake lever and cable from engine compartment RH cover. Refer to PB-3, "PARKING BRAKE SYSTEM" .
- 6. Remove mounting bolts, and remove engine compartment RH cover.

CAUTION:

When taking it out of vehicle, do not allow it to interfere with vehicle.

INSTALLTION

- Install in reverse order of removal following instructions below. .
- 1. Temporarily tighten bolt No. 1 shown in the figure.
- Tighten bolt No. 2 shown in figure to specified torque. 2.
- Tighten other bolts except bolt "A" shown in the figure (bolt No. 1 is included) to specified torque in any 3. given order.
- 4. Close engine compartment LH cover.
- 5. Tighten bolt "A" shown in the figure to specified torque.

Removal and Installation of Engine Room Rear Cover REMOVAL

- 1. Move folded seat on engine compartment rear cover side rearward, if applicable.
- 2. Partially remove floor carpet.
- 3. Remove mounting bolts, and remove engine compartment rear cover.

[KA24DE]

PFP:14049



INSTALLATION

Following instructions below, install in reverse order of removal.

- 1. Tighten bolts No. 1 to No. 3 shown in the figure to specified torque in this order.
- 2. Tighten other bolts to specified torque in any given order.



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DRIVE BELTS

DRIVE BELTS

Checking Drive Belts

WARNING:

Be sure to perform when the engine is stopped.

- Inspection should be done only when engine is cold, or over 30 SEC. 117 minutes after engine is stopped.
- Measure belt tension with tension meter (special service tool) at points marked ▼ shown in the figure.
- Measure belt deflection by applying load of 98.1 N {10 kg} to ▼.



Power steering pump belt

Unit: mm (in)

EBS00AM2

	Deflection adjustment		
	Used belt		Now bolt
	Limit	After adjustment	New Dell
Alternator	11 (0.43)	7 - 8 (0.28 - 0.31)	6 - 7 (0.24 - 0.28)
Air conditioner compressor	13 (0.51)	8 - 10 (0.31 - 0.39)	7 - 8 (0.28 - 0.31)
Power steering oil pump	13 (0.51)	8 - 10 (0.31 - 0.39)	7 - 8 (0.28 - 0.31)
Applied pushing force		98 N (10 kg, 72 lb)	

Tension Adjustment

CAUTION:

- When belt is replaced with a new one, tighten it a little stronger than current one to accommodate for insufficient adaptability with pulley grooves.
- When tension of belt being used exceeds "Retightening limit", adjust it to value for "Used belt".
- When installing belt, make sure that it is correctly engaged with pulley groove.
- Keep oil and water away from belt.
- Do not twist or bend belt excessively.

POWER STEERING PUMP BELT

- 1. Open and fix engine compartment LH cover.
- 2. Loosen idler pulley lock nut (A) and adjust tension by turning adjusting bolt (B).
 - For specified belt tension, refer to <u>EM-14</u>, "Checking Drive <u>Belts"</u>.
- 3. Tighten nut (A).

🖸 : 25.5 - 32.4 N·m (2.6 - 3.3 kg-m, 19 - 23 ft-lb)



AIR CONDITIONER COMPRESSOR BELT

- 1. Open and fix engine compartment LH cover (passenger side for RHD models or driver-side for LHD models).
- 2. Loosen idler pulley lock nut (C) and adjust tension by turning adjusting bolt (D).
- For specified belt tension, refer to EM-14, "Checking Drive Belts".
- 3. Tighten nut (C).

[KA24DE]

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	🖸 : 25.5 - 32.4 N·m (2.6 - 3.3 kg-m, 19 - 23 ft-lb)	А
AL.	TERNATOR AND WATER PUMP BELT	
1.	Remove front-side under cover.	EM
2.	Remove RH seat. Refer to <u>SE-4, "FRONT SEAT"</u> .	
3.	Remove engine compartment RH cover. Refer to EM-12, "ENGINE ROOM COVER".	
4.	Loosen alternator mounting bolt (E) and adjuster lock bolt (F), and adjust tension by turning adjusting nut (G).	С
	 For specified belt tension, refer to <u>EM-14, "Checking Drive Belts"</u>. 	
5.	Tighten bolts (E), (F) and (G).	D
	🖸 : 45.1 - 59.8 N·m (4.6 - 6.1 kg-m, 34 - 44 ft-lb) for E bolt	
	😶 : 15.7 - 20.6 N·m (1.6 - 2.1 kg-m, 12 - 15 ft-lb) for F bolt	Е
Re RE	emoval and Installation EBS007KG MOVAL	F
•	Loosen each belt while referring to "Adjustment", and remove them one by one starting from the one in front.	0
INS	STALLATION	G
1.	Install belts to pulley in reverse order of removal.	
2.	Adjust belt tension.	Н
	CAUTION:	
	 When checking belt tension immediately after installation, first, adjust to specified value. Then, after turning crankshaft more than two turns, re-adjust to specified value to avoid variation in deflection between pulleys. 	Ι
	 Tighten idler pulley lock nut by hand and measure tension without looseness. 	
3.	Tighten each adjusting bolt and nut to the specified torque.	J
4.	Make sure that tension of each belt is within the standard.	
		K

AIR CLEANER AND AIR DUCT

AIR CLEANER AND AIR DUCT



[KA24DE]

Removal and Installation



- 13 Resonator
- 16 Air cleaner case
- Washer 19
- 22 Dust pan
- 25 Dust exhaust valve
- 28 Air duct
- 31 Resonator
- 34 Resonator

- 14 Clamp 17
- Grommet
- Wing nut 20
- 23 Washer
- 26 Grille
- Grommet 29
- 32 Grommet
- 35 Clamp

- 12 Air hose
 - 15 Mass air flow meter
 - 18 Air cleaner element
 - Seal ring 21
 - 24 Wing nut
 - 27 Screw
 - Air duct 30
 - 33 Collar

REMOVAL

- Remove rear-side under cover. 1.
- 2. Open and fix engine room LH cover.
- 3. Remove RH seat. Refer to SE-4, "FRONT SEAT" .
- 4. Remove engine room RH cover. Refer to EM-12, "ENGINE ROOM COVER" .
- 5. Remove floor cover behind RH seat.
- 6. Disconnect harness connector from airflow sensor.

EM-16

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EBS007K8

AIR CLEANER AND AIR DUCT

- 7. For correct installation, make matching marks on each connection.
- 8. Remove from engine side after separating the system with the following procedure.
- Remove PCV hose (A). a.
- b. Remove air duct (B).
- Separate air hose (C) and resonator (D). C.
- d. Remove resonator (E).
- e. Remove air hose (C).
- f. Remove resonator (D).
- g. Remove mass air flow sensor (F).
 - **CAUTION:**
 - Handle with care, avoiding any shocks.
 - Do not disassemble it.
 - Do not touch sensor part.
- h. After removing mud flap of front RH wheel, remove resonator (G).
- When removing following parts, remove EVAP canister, and set i. it aside.
- i. Remove resonator (H).
- Remove air cleaner case (I). k.
- When removing components inside vehicle on right-hand, 9. remove them with the following procedure.
- Remove components up to air cleaner case (I), referring to step a. 8.
- Remove intake grille from outside of vehicle. b.
- Remove kicking plate on RH side, and lift up panel under RH C. side seat belt anchor.
- d. Lift up air duct (J) from vehicle opening, and separate it from air duct (K).
- e. Pull and remove air duct (K).
- f. Remove air duct (J) from mounting hole of air duct (K).

INSTALLATION

Install in reverse order of removal, paying attention to points below.

After aligning matching marks marked when removing, install each connection, and firmly tighten clamps.

EM-17

Install dust drain valve so that its opening is along circumference.







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[KA24DE]

Changing Air Cleaner Element REMOVAL

NOTE:

- Mark "*" in the figure shows part of lift arm.
- For replacement of air cleaner element, it is not necessary to lift up vehicle.
- 1. Remove brake pipe protector under vehicle, behind front RH wheel.
- 2. Remove 3 clips, and the cover at the bottom of air cleaner case.
- 3. Remove wing nut, dust pan under air cleaner case, and then air cleaner element.



INSTALLATION

Install in the reverse order of removal.

THROTTLE BODY

[KA24DE]



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Removal and Installation



- 1. Remove RH seat. Refer to <u>SE-4, "FRONT SEAT"</u>.
- 2. Remove engine compartment RH cover. Refer to EM-12, "ENGINE ROOM COVER" .
- 3. Remove air duct on throttle body. Refer to EM-16, "AIR CLEANER AND AIR DUCT" .
- 4. Disconnect accelerator cable, and set it aside.
- 5. Disconnect harness connector.
- 6. Disconnect water hose.
 - After disconnection, plug the hose to prevent coolant leaks.
- 7. Loosen mounting bolts in reverse order shown in the figure, and remove throttle body.



FBS008X8

INSPECTION AFTER REMOVAL

If idle is rough when engine is cold or warmed up, check and adjust the fast idle cam (FIC). Refer to EC-28, "Fast Idle Cam (FIC) Inspection and Adjustment".

INSTALLATION

Install in reverse order of removal, paying attention to points below.

- For throttle body, tighten mounting bolts in two steps in the numerical order shown in the figure.
- For adjustment of accelerator cable, refer to ACC-3, "ACCEL-ERATOR CONTROL SYSTEM (KA24DE)" .

└└ 1st step : 8.8 - 10.8 N⋅m (0.9 - 1.1 kg-m, 78 - 95 in-lb)

🙄 2nd step : 17.7 - 21.6 N·m (1.8 - 2.2 kg-m, 13 - 15 ft-lb)



Disassembly and Assembly



Gasket

7

Spring 8 IACV-AAC valve 6 plunger

DISASSEMBLY

Disassemble referring to the component illustration.

ASSEMBLY

Assemble in reverse order of disassembly, paying attention to points below.

- Insert throttle position sensor into throttle body, with connectors . positioned as shown in the figure. Then rotate it in the direction shown by arrow and temporarily tighten mounting screws.
- While they are turned in direction shown by arrow, circumference of sensor hits projection. Avoid hitting projection by giving slight space, and insert projection into inside of mounting screw long hole. (It is temporarily held in place by counter-action of spring.)
- After adjustment on vehicle, tighten mounting screws. For adjusting procedure, refer to EC-45, "Basic Inspection" .



INTAKE MANIFOLD

[KA24DE]



REMOVAL

- 1. Release fuel pressure. Refer to EC-27, "Fuel Pressure Release" .
- 2. Drain coolant. Refer to CO-9, "ENGINE COOLANT" .
- 3. Remove RH seat. Refer to SE-4, "FRONT SEAT" .
- 4. Remove engine compartment RH cover and rear cover. Refer to EM-12, "ENGINE ROOM COVER" .
- 5. Remove floor cover behind RH seat.

- 6. Move aside main harness above intake manifold.
- 7. Disconnect PCV hose between rocker cover and air duct.
- 8. Remove air duct between throttle body and mass air flow sensor. Refer to <u>EM-16, "AIR CLEANER AND</u> <u>AIR DUCT"</u>.
- 9. Remove throttle body. Refer to EM-19, "THROTTLE BODY".
- 10. Remove fuel tube and injector assembly. Refer to EM-28, "FUEL INJECTOR AND FUEL TUBE" .
- 11. Disconnect radiator hose (upper).
- 12. Disconnect hoses connected to intake manifold.

Separate water hose and PCV hose behind intake manifold when removing intake manifold.

- 13. Remove intake manifold with the following procedure.
- a. Loosen mounting bolts and nuts in reverse order shown in the figure.
- b. Pull out stud bolts on rear.
- c. Disconnect water hose and PCV hose on back side, and remove intake manifold.



INSPECTION AFTER REMOVAL

Surface Distortion

• Using straightedge and feeler gauge, inspect surface distortion of intake manifold.

Limit

: 0.1 mm (0.004 in)



INSTALLATION

Assemble in reverse order of removal, paying attention to the following.

Intake Manifold Bolts

• Tighten in numerical order as shown in the figure.

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□ : 15.7 - 18.6 N⋅m (1.6 - 1.8 kg-m, 12 - 13 ft-lb)
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Water Outlet

• Install gasket so that identification mark face as shown in component parts drawing.

EXHAUST MANIFOLD

[KA24DE]



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- 1. Remove under cover on rear side.
- Remove exhaust front tube. Refer to EX-2, "EXHAUST SYSTEM" . 2.
- Open and fix engine compartment LH cover. 3.
- 4. Remove heated oxygen sensor with the following procedure.
- Remove engine compartment rear cover. Refer to EM-12, "ENGINE ROOM COVER" . a.
- b. Disconnect heated oxygen sensor harness connector from bracket on intake manifold No. 4 port, and remove all harness clamps.
- Using socket for heated oxygen sensor removal and installation C. (special service tool), remove heated oxygen sensor.
- 5. Remove exhaust manifold cover.



EXHAUST MANIFOLD

[KA24DE]

6. Loosen mounting nuts in reverse order shown in the figure, and remove exhaust manifold.



INSPECTION AFTER REMOVAL

• Using straightedge and feeler gauge, inspect surface distortion of intake manifold.

Limit

: 0.3 mm (0.012 in)



INSTALLATION

Install in the reverse order of removal, paying attention to the following.

• Tighten in numerical order as shown in the figure.

🖸 : 37.3 - 48.1 N·m (3.8 - 4.9 kg-m, 28 - 35 ft-lb)



INSPECTION AFTER INSTALLATION

Start engine, and check for exhaust gas leakage and unusual noise by increasing engine speed.

OIL PAN AND OIL STRAINER

[KA24DE]

OIL PAN AND OIL STRAINER PFP:11110 А **Removal and Installation** EBS007KB SEC. 110-150 -0 🖸 c) ΕM *1 Oil pan side ጎጉ (5) 2 D 15.7 - 18.6 (1.6 - 1.8, 12 - 13)E 🔮 6.4 - 7.5 (0.66 - 0.76, 57 - 66) F **3** (*1) Apply genuine liquid gasket or equivalents. 🕑 : N•m (kg-m, in-lb) 8 🗿 🔽 29.4 - 39.2 • N•m (kg-m, ft-lb) (3.0 - 3.9, 22 - 28) PBIC0432E Oil strainer Oil pan drain plug washer 1 Gasket 2 3 4 Oil pan drain plug 5 Oil pan Н

REMOVAL

WARNING:

To avoid the danger of being scalded, never drain the engine oil when the engine is hot.

- 1. Remove under covers on front-side, and rear-side.
- 2. Drain engine oil. Refer to LU-5, "ENGINE OIL" .
- 3. Loosen mounting bolts in reverse order shown in the figure, and remove them.

NOTE:

There are no screw holes in the area marked with \star on cylinder block. (No mounting bolts.)

- Using a seal cutter (special service tool), separate liquid gasket, 4. and remove oil pan.
- 5. Remove oil strainer.



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INSPECTION AFTER REMOVAL

Check oil strainer and clean it if any object attached.

INSTALLATION

Install in the reverse order of removal paying attention to the following.

Installing Oil Pan

- 1. Apply liquid gasket thoroughly as shown in illustration.
 - Use Genuine Liquid Gasket or equivalent.

- 7 (0.28) r® Α-3.5 - 4.5 (0.138 - 0.177) dia. Unit: mm (in) , PBIC0433E 1(5) \star 3 \star ★ \bigcirc 9 ⑪ (13) (15) 16 ⓓ 1 12 8 ٩ 2 6 Front Tighten bolts in numerical order. ★ : These holes are not used. SEM985F
- 2. Tighten mounting bolts in numerical order as shown in the figure.

NOTE:

There are no screw holes in the area marked with \bigstar on cylinder block. (No mounting bolts.)

Installing Drain Plug Washer

Refer to illustration of component parts for installation direction.

INSPECTION AFTER INSTALLATION

Check for leakage of engine oil when engine is warmed.

SPARK PLUG (CONVENTIONAL)

SPARK PLUG (CONVENTIONAL)

Removal and Installation REMOVAL

- 1. Open and fix engine compartment LH cover.
- 2. Disconnect high-tension cables from rocker cover.
- 3. Remove spark plugs with a spark plug wrench (commercial service tool).
 - Remove and install No. 4 cylinder by connecting extension bar of 75 mm and universal socket to spark plug wrench.



INSPECTION AFTER REMOVAL

Check spark plug gap. Adjust or replace if necessary.

: 1.0 - 1.1 mm (0.039 - 0.043 in)	
BKR5E-11	
BKR6E-11	
BKR7E-11	

KR5E-11 KR6E-11 KR7E-11



• Use a wire brush for cleaning, if necessary.

INSTALLATION

Install in the reverse order of removal, paying attention to the following.

Spark plug:

O: 20 - 29 N·m (2.0 - 3.0 Kg-m, 14 - 22 ft-lb)

- Refer to EM-30, "ROCKER COVER" for installation of spark plug cap and high-tension cables.
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FUEL INJECTOR AND FUEL TUBE

FUEL INJECTOR AND FUEL TUBE

PFP:1

Removal and Installation



- 7 Fuel return hose 8 Vacuum hose 9 O-ring
- 10 Fuel pressure regulator

CAUTION:

• Apply new engine oil when installing the parts that specified to do so in the figure.

REMOVAL

- 1. Release fuel pressure. Refer to EC-27, "Fuel Pressure Release" .
- 2. Remove RH seat. Refer to SE-4, "FRONT SEAT" .
- 3. Remove engine compartment RH cover. Refer to EM-12, "ENGINE ROOM COVER" .
- 4. Disconnect PCV hose between rocker cover and air duct.
- 5. Remove air duct on throttle body. Refer to EM-16, "AIR CLEANER AND AIR DUCT" .
- 6. Disconnect fuel injector harness connector.
- 7. Move aside main harness above intake manifold.
- 8. Disconnect vacuum hose from fuel tube.
- 9. Disconnect fuel feed hose and fuel return hose. CAUTION:

Plug hoses to prevent fuel from draining.

10. Remove fuel tube and injector assembly.

CAUTION:

Do not incline it, or remaining fuel in pipes may drain from pipes.

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[KA24DE]

FUEL INJECTOR AND FUEL TUBE

- 11. Expand and remove clips securing fuel injectors.
- 12. Extract fuel injectors straight from fuel tubes.
 - Be careful not to damage injector nozzles during removal.
 - Do not bump or drop fuel injectors.
 - Do not disassemble.



INSTALLATION

- 1. Carefully install O-rings, including the one used with the pressure regulator.
- Lubricate O-rings by smearing new engine oil.
- Be careful not to damage O-rings and surfaces for O-ring sealing with service tools, finger nails or clips. Do not expand or twist O-rings.
- Discard old clips; replace with new ones.
- 2. Position clips in grooves on fuel injectors.
- Make sure that protrusions of fuel injectors are aligned with cutouts of clips after installation.
- 3. Align protrusions of fuel tubes with those of fuel injectors.
- 4. Do not incline it, or remaining fuel in pipes may drain from pipes.
 - Insert hose until its end touches bulge on fuel tube. Install clamp, avoiding bulge, and securely tighten it.
- 5. Tighten fuel tube assembly mounting bolts alternatively in two steps.

1st step : 7.8 - 10.8 N·m (0.8 - 1.1 kg-m, 69 - 95 ft-lb)

2nd step :15.7 - 18.6 N·m (1.6 - 1.8 kg-m, 12 - 13 ft-lb)

- 6. Connect fuel feed nose and fuel return hose.
 - Insert hose until its end touches bulge on fuel tube. Install clamp, avoiding bulge, and securely tighten it.
- 7. Install all removed parts in the reverse order of removal.

INSPECTION AFTER INSTALLATION

Check on Fuel Leakage

- 1. Start the engine, and run it for a few minutes with engine at idle.
- 2. Stop the engine, and check for fuel leakage both visually and by odor of gasoline.

NOTE:

Use mirrors for checking on invisible points.

CAUTION:

Do not touch the engine immediately after stopped, as engine becomes extremely hot.



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[KA24DE]

ROCKER COVER

PFP:13264







4 Gasket

REMOVAL

- 1. Open and fix engine compartment LH cover.
- 2. Remove engine compartment rear cover. Refer to EM-12, "ENGINE ROOM COVER".
- 3. Disconnect PCV hose.
- 4. Disconnect spark plug cap and high-tension cables, and set them aside.
- 5. Loosen mounting bolts in reverse order shown in the figure, and remove rocker cover.



INSTALLATION

Install in the reverse order of removal, paying attention to the following.

ROCKER COVER

[KA24DE]

Installing Rocker Cover

- 1. Apply liquid gasket to positions shown in the figure (semicircular plug seal on engine side: total 4).
 - Use genuine liquid gasket or equivalents.
- 2. Install rocker cover so that semicircular plug part on rocker cover gasket is securely inserted into mounting part on engine.



3. Tighten mounting bolts in numerical order shown in the figure. **NOTE:**

No.1 and No.2 means dual step tightening.



Spark Plug Cap and High Tension Cable

• Install them to clips, and perform wiring of cables, referring to the figure for correct placement.



CAMSHAFT

[KA24DE]

CAMSHAFT

PFP:13001





- 1 Camshaft bracket 4 Camshaft sprocket (Exhaust)
- 2 5 Camshaft (Exhaust)
- Camshaft sprocket (Intake)

CAUTION:

Apply new engine oil to parts marked in illustration before installation.

REMOVAL

- 1. Remove following parts.
 - Power steering pump belt (Refer to <u>EM-14, "DRIVE BELTS"</u>.)
 - Power steering pump support bracket
 - Idler pulley bracket for power steering pump belt
 - Rocker cover (Refer to EM-30, "ROCKER COVER".)
- 2. Set No.1 cylinder to TDC in compression stroke.
- Rotate crankshaft pulley clockwise and align notch of matching a. marks (yellow paint) to timing indicator on front cover.



CAMSHAFT

Intake side

Mating

- b. At same time, make sure that matching marks on camshaft sprockets are located as shown in the figure. Make matching marks on secondary timing chain links with paint.
 - If dislocated, rotate crankshaft pulley one more turn to line up matching marks to positions in the figure.

3. Push secondary timing chain tensioner with metal bar, then fix it with stopper pin.

CAUTION:

Do not remove cylinder head front cover. NOTE:

When cylinder head front cover is removed, cylinder head gasket needs to be replaced.

• Using hard wire, make a stopper pin as shown in the figure.

4. Hold camshaft hexagonal head with 26 mm (1.02 in) spanner, and loosen camshaft sprocket bolt.

NOTE:

Each camshaft has two camshaft hexagonal heads: one in front, and the other in rear.











Exhaust side

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[KA24DE]

- 5. Remove camshaft sprockets.
 - Hold secondary timing chain in place, using chain stopper (special service tool) to prevent it from slipping from idler sprocket.





- 7. Remove camshaft.
- 8. Remove adjusting shim and valve lifter.
 - Check mounting positions, and store them without mixing them up.



INSTALLATION

- 1. Install valve lifters and adjusting shims.
 - Install them in their original positions.
 - Install adjusting shims with their stamp marks facing downward (valve lifter side).
- 2. Install camshaft.
 - Intake and exhaust are identified by direction of No. 1 cylinder cam nose when knock pin at front end faces straight upward.

For intake:

Cam nose faces toward intake manifold side For exhaust: Cam nose faces toward exhaust manifold side





• Install camshafts so that knock pins at front end face straight upward (position of No.1 cylinder at compression TDC).

[KA24DE]

- 3. Install camshaft bracket.
 - Install them in their original positions and directions, referring to mark on top surface of camshaft bracket.

4. Tighten camshaft bracket mounting bolts in two steps in numerical order shown in the figure.

CAUTION:

Tighten them from outside toward inside.

1st step : 2.0 N·m (0.2 kg-m, 18 in-lb)
2nd step :9.0 - 11.8 N·m (0.92 - 1.2 kg-m, 80 - 104 ft-lb)





- 5. Install camshaft sprockets.
 - Camshaft sprockets are common for intake and exhaust sides. Sprockets have two matching marks. When aligning matching marks, refer to the figure.
 - Align matching mark of camshaft sprocket and that of secondary timing chain made on it when removed. Then install camshaft.
 - If they are not aligned, align them by turning hexagonal part of camshaft with a spanner.
 - Make sure that timing chain does not slip on idler pulley, and remove chain stopper (special service tool).
 - Hold hexagonal part of camshaft with spanner, and tighten camshaft sprocket mounting bolt.
 NOTE:

Each camshaft has one hexagonal part at both front and rear, respectively.

- 6. Pull out stopper pins from secondary timing chain tensioner.
- 7. Check and adjust valve clearance. Refer to EM-38, "Valve Clearance" .
- 8. Install other parts in reverse order of removal.

INSPECTION AFTER REMOVAL

Camshaft Runout

- Put V block on, and support No.1 and No.5 journal of camshaft.
- Set dial gauge vertically to No.3 journal.
- Turn camshaft to one direction with hands, and measure camshaft runout (Total indicator reading) on dial gauge.

Standard	: Less than 0.04 mm (0.0016 in)
Limit	: 0.08 mm (0.0031 in)





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CAMSHAFT

Camshaft Cam Height

1. Measure camshaft cam height.

Standard:

Intake: 41.755 - 41.945 mm (1.644 - 1.651 in) Exhaust: 41.815 - 42.005 mm (1.646 - 1.654 in) Limit: Intake and exhaust: 0.2 mm (0.008 in)

2. If wear is beyond the limit, replace camshaft.

Camshaft Journal Clearance

Outer Diameter of Camshaft Journal

Measure outer diameter of camshaft journal.

Standard : 27.935 - 27.955 mm (1.0998 - 1.1006 in)





Inner Diameter of Camshaft Bracket

- Tighten camshaft bracket bolt with specified torque.
- Using inside micrometer, measure inner diameter of camshaft bracket.

: 28.000 - 28.025 mm (1.1024 - 1.1033 in) Standard

Calculation of Camshaft Journal Clearance

(Journal clearance) = (inner diameter of camshaft bracket) - (outer diameter of camshaft journal)

Standard	: 0.045 - 0.090 mm (0.0018 - 0.0035 in)
Limit	: 0.15 mm (0.0059 in)

When out of the specified range above, replace either or both camshaft and cylinder head.

NOTICE:

Inner diameter of camshaft bracket is manufactured together with cylinder head. Replace the whole cylinder head assembly.

Camshaft End Play

Install dial gauge in thrust direction on front end of camshaft. • Measure end play of dial gauge when camshaft is moved forward/backward (in direction to axis).

Standard	: 0.070 - 0.148 mm (0.0028 - 0.0058 in)
Limit	: 0.2 mm (0.008 in)

- When out of the specified range, replace with new camshaft and measure again.
- When out of the specified range again, replace with new cylinder head.




Camshaft Sprocket Runout

- 1. Install camshaft in cylinder head.
- 2. Install camshaft sprocket to camshaft.
- 3. Measure camshaft sprocket runout.

Limit : Less than 0.15 mm (0.0059 in)

4. If it exceeds the limit, replace camshaft sprocket.



Valve Lifter and Adjusting Shim

 Check if surface of valve lifter and adjusting shim has any wear or cracks.



Valve Lifter Clearance

Outer Diameter of Valve Lifter

• Measure outer diameter of valve lifter.

Standard : 33.960 - 33.975 mm (1.3370 - 1.3376 in)



Valve Lifter Hole Diameter

• Using inside micrometer, measure diameter of valve lifter hole of cylinder head.

Standard : 34.000 - 34.021 mm (1.3386 - 1.3394 in

Calculation of Valve Lifter Clearance

(Valve lifter clearance) = (hole diameter of valve lifter) – (outer diameter of valve lifter)

Standard : 0.025 - 0.061 mm (0.0010 - 0.0024 in

• When out of specified range, referring to each specification of outer and inner diameter, replace either or both valve lifter and cylinder head.



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Valve Clearance INSPECTION

3.

Check valve clearance while engine is warm but not running.

- 1. Remove rocker cover and all spark plugs.
- 2. Set No. 1 cylinder at TDC on its compression stroke.
- Align pointer with TDC mark on crankshaft pulley.
- Check that valve lifters on No. 1 cylinder are loose and valve lift-• ers on No. 4 are tight. If not, turn crankshaft one revolution (360°) and align as above.
- Check only those valves shown in the figure.

- 4. Using a feeler gauge, measure clearance between valve lifter and camshaft.
- Record any valve clearance measurements which are out of specification. They will be used later to determine the required replacement adjusting shim.

Valve clearance (HOT) : Intake 0.31 - 0.39 mm (0.012 - 0.015 in) Exhaust 0.39 - 0.47 mm (0.015 - 0.019 in)

- 5. Turn crankshaft one revolution (360°) and align mark on crankshaft pulley with pointer.
- 6. Check those valves shown in the figure.
- Use the same procedure as mentioned in step 4. •
- 7. If all valve clearances are within specification, install the following parts.
- Rocker cover
- All spark plugs

ADJUSTMENT

Adjust valve clearance while engine is cold.













- 1. Turn crankshaft to position cam lobe on camshaft of valve that must be adjusted upward.
- 2. Place Tool (A) around camshaft as shown in figure.
- 3. Rotate Tool (A) so that lifter is pushed down. Before placing Tool (A), rotate notch toward center of cylinder head (See figure.), to simplify shim removal later. **CAUTION:**

Be careful not to damage cam surface with Tool (A).

Place Tool (B) between camshaft and the edge of the valve lifter 4. to retain valve lifter.

CAUTION:

- Tool (B) must be placed as close to camshaft bracket as possible.
- Be careful not to damage cam surface with Tool (B).
- 5. Remove Tool (A).
- 6. Rotate adjusting shim until hole is visible. Blow air into the hole to separate adjusting shim from valve lifter.

7. Remove adjusting shim using a small screwdriver and a magnetic finger.











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- 8. Determine replacement adjusting shim size as follows.
- a. Using a micrometer determine thickness of removed shim.
- b. Calculate thickness of new adjusting shim so valve clearance comes within specified values.
 - R = Thickness of removed shim
 - N = Thickness of new shim

M = Measured valve clearance (Hot)

Intake N = R + [M - 0.35 mm (0.0138 in)]Exhaust N = R + [M - 0.43 mm (0.0169 in)]

Shims are available in thicknesses from 1.96 mm (0.0772 in) to 2.68 mm (0.1055 in), in steps of 0.02 mm (0.0008 in).

- c. Select new shim with thickness as close as possible to calculated value.
 - Refer to EM-88, "VALVE" .
- 9. Install new shim using a suitable tool.
- Install with the surface on which the thickness is stamped facing down.
- 10. Place Tool (A) as mentioned in steps 2 and 3.
- 11. Remove Tool (B).
- 12. Remove Tool (A).
- 13. Recheck valve clearance. Refer to <u>EM-38, "INSPECTION"</u>.

Valve clearance:

Unit: mm (in)

	Hot	Cold* (reference data)
Intake	0.31 - 0.39 (0.012 - 0.015)	0.28 - 0.36 (0.011 - 0.014)
Exhaust	0.39 - 0.47 (0.015 - 0.019)	0.34 - 0.42 (0.013 - 0.017)

*: Approximately 20°C (68°F)





[KA24DE]

SECONDARY TIMING CHAIN

PFP:13028 EBS00825

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Removal and Installation



CAUTION:

Apply new engine oil to parts marked in illustration before installation. NOTE:

- This section describes removal and installation procedure of secondary timing chain along with removal and installation of cylinder head.
- Procedure for removal and installation of camshaft is described in <u>EM-32</u>, "<u>CAMSHAFT</u>", as it is different from description in this section.

REMOVAL

- 1. Release fuel pressure. Refer to EC-27, "Fuel Pressure Release" .
- 2. Drain engine coolant from radiator and cylinder block. Refer to CO-9, "ENGINE COOLANT" .

EM-41

- 3. Remove driver seat. Refer to SE-4, "FRONT SEAT" .
- 4. Remove engine compartment RH cover and rear cover. Refer to EM-12, "ENGINE ROOM COVER" .
- 5. Remove floor cover behind RH seat.
- 6. Adjust No. 1 cylinder to TDC position in compression stroke. Refer to EM-32, "CAMSHAFT" .
- 7. Remove following parts.
 - Intake manifold: Refer to EM-21, "INTAKE MANIFOLD" .
 - Exhaust manifold: Refer to EM-23, "EXHAUST MANIFOLD" .
 - Drive belts: Refer to EM-14, "DRIVE BELTS" .
 - Radiator shroud (Upper and lower)
 - Cooling fan: Refer to CO-20, "COOLING FAN" .
- 8. Remove power steering oil pump. Fix it along with reservoir tank on vehicle with rope or similar means. **CAUTION:**

Fix reservoir tank to prevent power steering fluid from leaking.

- 9. Remove power steering pump bracket, and idler pulley bracket for power steering pump belt.
- 10. Remove rocker cover. Refer to EM-30, "ROCKER COVER" .
- 11. Remove camshaft sprocket, and camshaft. Refer to <u>EM-32, "CAMSHAFT"</u>. **NOTE:**

The following steps in removal procedure are not necessary at this point.

- Step 2: Application of matching marks to secondary timing chain
- Step 5: Fixing of secondary timing chain
- 12. Remove cylinder head front cover with the following procedure.
- a. Remove all mounting bolts (A G) of cylinder head front cover.



- b. Completely loosen cylinder head bolts in reverse order shown in the figure.
 - Do not remove cylinder head at this point. (Remove it in step 16.)



c. Slightly tap cylinder head front cover from back side with an appropriate wooden bar to remove it.



[KA24DE]

timing

chain

Secondary

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- 13. Remove secondary timing chain from idler sprocket small-diameter side.
- 14. Remove chain tensioner.

- 15. Remove idler sprocket and idler shaft with the following procedure.
 - 1. Make a matching mark on primary timing chain with paint at a location that corresponds to the matching mark on idler sprocket large-diameter side.

2. Compress sleeve of primary timing chain tensioner, and hold it with stopper pin (self-made tool).

- Make stopper pin the size shown in the figure.
- Use hard wire for material.



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Approx. 3 (0.12) Unit: mm (in)

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3. Fix primary timing chain by inserting chain stopper (special service tool) to prevent it from slipping from crankshaft sprocket.



- Chain stopper is difficult to pull out because of interference with idler sprocket large-diameter side when being removed. Use it after circumference of upper surface is chamfered.
- 4. Remove idler sprocket, and idler shaft.

CAUTION:

Do not carry idler shaft with idler sprocket large-diameter side facing downward to prevent it from falling off.



16. Remove cylinder head and cylinder head gasket.

INSPECTION AFTER REMOVAL

Timing Chain

Check timing chain for cracks and excessive wear at roller links. Replace chain if necessary.



Idler Sprocket End Play

- Install idler sprocket to cylinder head, and tighten mounting bolts to specified torque.
- Set dial gauge to idler sprocket front end.
- Move idler sprocket in thrust direction (back-and-forth), and read indication on gauge.

Standard : 0.2 - 0.3 mm (0.008 - 0012 in)



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Idler Sprocket Oil Clearance Idler Sprocket Inner Diameter

• Using inside micrometer measure the inner diameter.

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Standard : 29.025 - 29.050 mm (1.1427 - 1.1437 in)
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Idler Shaft Outer Diameter

• Using micrometer measure the outer diameter.

Standard : 28.987 - 29.000 mm (1.1412 - 1.1420 in)



Calculation of Idler Sprocket Oil Clearance

• (Idler sprocket oil clearance) = (Idler sprocket inner diameter) - (Idler shaft outer diameter)

Standard : 0.025 - 0.063 mm (0.0010 - 0.0025 in)

• If outside the standard, replace either idler sprocket, idler shaft, or both, referring to standard value of each single unit.

INSTALLATION

NOTE:

- The figure shows the relationship between the mating mark on each timing chain and that on the corresponding sprocket, with the components installed.
- 1. Make sure that stopper pin of primary timing chain tensioner is in place. If not, reinstall it.
- 2. Install cylinder head gasket.
- 3. Temporarily install cylinder head assembly.
 - Install cylinder head assembly to cylinder block by aligning it with dowel pins.



- Temporarily install rear-most two cylinder head bolts shown in the figure.
- Install washers to mounting bolt seats on cylinder head.
 NOTE:

Washers are not directional.

- Apply engine oil to bolt threads and seats.
- Support bolt approximately 10 mm (0.39 in) above seating position. (Make room under lower end, when lifting up front end of cylinder head.)
- 4. Install idler sprocket.
- a. Install idler shaft to idler sprocket.
- b. Install washer so that flat side faces idler sprocket. Refer to component illustration $\underline{\mathsf{EM-41}}$.
- c. Align matching mark painted on primary timing chain during removal with the one on idler sprocket large-diameter side. Then install it to cylinder head.
- d. Remove chain stopper from primary timing chain.
- e. Remove stopper pin from primary timing chain tensioner, and release tensioner.
- 5. Install secondary timing chain tensioner.
- 6. Align matching mark of idler sprocket small-diameter with yellow link of secondary timing chain, and install it.
 - Tension it with a piece of wood to prevent idler sprocket from slipping from secondary timing chain.

NOTE:

Any one of three aligning yellow links is acceptable (evenly spaced).

- 7. Fix secondary timing chain tensioner.
 - Compress chain tensioner sleeve, and fix it with stopper pin.









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Apply engine oil to bolt threads and seats.

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CAUTION:

head assembly.

CAUTION:

sprocket.

bolts.

CAUTION:

NOTE:



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Stopper pin

11. Tighten cylinder head bolts.

• Follow the steps below to tighten fixing bolts in the order shown in figure.

CAUTION:

- In step "d", loosen bolts in the reverse order of that indicated in figure.
- a. Apply engine oil to threads and seating surface of bolts.
- b. Tighten all bolts to 29.4 N·m (3.0 kg-m, 22 ft-lb).
- c. Tighten all bolts to 79.4 N·m (8.1 kg-m, 59 ft-lb).
- d. Completely loosen all bolts.
- e. Tighten all bolts to 24.5 to 34.3 N⋅m (2.5 to 3.5 kg-m, 18 to 25 ft-lb).
- f. Turn all bolts 86 to 91 (target: 86) degrees clockwise. CAUTION:

Check and confirm the tightening angle by using angle wrench or protractor. Avoid judgment by visual inspection without the tool.

- 12. Install cylinder head front cover and tighten bolts as shown in the figure.
- 13. Install camshafts. Refer to EM-32, "CAMSHAFT" .

- 14. Install camshaft sprockets.
 - Camshaft sprocket has two matching marks because intake and exhaust sides are common parts. For marks to be used, refer to the figure.
 - Install it by aligning matching mark of camshaft sprocket with that of secondary timing chain (yellow link).
 - If it is not aligned with camshaft dowel, align it by turning hexagonal part of camshaft with wrench.
 - Remove chain stopper (special service tool). Be careful to prevent timing chain from slipping on idler pulley during work.
- 15. Tighten camshaft sprocket bolts. Refer to EM-32, "CAMSHAFT"
- 16. Remove stopper pin from secondary timing chain tensioner.
- 17. Install in the reverse order of removal after the step.







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EM-49

- Camshaft sprocket 1
- 4 Idler shaft
- 7 Power steering pump bracket
- 10 PCV separator
- 13 Gasket
- 16 Crankshaft pulley
- 19 Distributor
- 22 Oll thrower
- 25 Primary timing chain
- 28 Collared O-ring

- 2 Chain tensioner
- 5 Washer
- 8 Cylinder head front cover
- 11 Gasket
- 14 Alternator adjusting bar
- 17 Front oil seal
- 20 Distributor cap
- 23 Oil pump drive gear
- 26 Chain slack guide
- 29 Water connector

- Idler sprocket 3
- 6 secondary timing chain
- Idler pulley and bracket ASSY 9
- 12 Oil pump ASSY
- 15 Washer
- 18 O-ring
- 21 Chain tension guide
- 24 Crankshaft sprocket
- 27 Chain tensioner

CAUTION:

Apply new engine oil to parts marked in illustration before installation.

REMOVAL

- 1. Perform steps 1 9, removal of "Secondary timing chain". Refer to EM-41, "SECONDARY TIMING CHAIN".
- 2. Remove air conditioner compressor mounting bolts. Remove and fix compressor to vehicle body with wire or rope. At this point, avoid applying an excessive load to air conditioning pipe.
- 3. Remove air conditioner compressor bracket.
- 4. Remove alternator. Refer to SC-11, "CHARGING SYSTEM".
- 5. Remove oil pan. Refer to EM-25, "OIL PAN AND OIL STRAINER".
- 6. Remove rocker cover. Refer to EM-30, "ROCKER COVER" .
- Remove camshaft, secondary timing chain, and cylinder head referring to EM-41, "SECONDARY TIMING 7. CHAIN"..
- Remove crankshaft pulley with the following procedure. 8.
- Fix crankshaft with a piece of wood. Loosen crankshaft pulley a. mounting bolt, and pull it out by approximately 10 mm (0.31 in).
- Engage tab of crankshaft pulley (commercial service tool) to b. back side of crankshaft pulley, and remove crankshaft pulley.



- 9. Remove distributor.
- 10. Remove oil pump. Refer to LU-8, "OIL PUMP".
- 11. Remove front cover.

CAUTION:

When loosening bolt marked "*", it is necessary to reinstall front cover to prevent oil leakage. Do not carelessly remove alternator adjusting bar.



- 12. Remove front oil seal from front cover.
 - Lift it up with flat head screwdriver (or similar tool) and remove it.
- 13. Remove oil thrower and oil pump drive gear from crankshaft.

EM-50

14. Remove chain tensioner, chain tension guide, and chain slack guide.

15. Remove primary timing chain, and crankshaft sprocket.

INSPECTION AFTER REMOVAL

Timing Chain

Check timing chain for cracks and excessive wear at roller links. Replace chain if necessary.



INSTALLATION

NOTE:

- The figure shows the relationship between the mating mark on each timing chain and that on the corresponding sprocket, with the components installed.
- 1. Make sure that No. 1 cylinder is at its TDC.
 - Check that crankshaft key faces upward.
- 2. Install collared O-rings (2 pieces) to cylinder block.



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- 3. Install chain tension guide, and slack guide.
 - Mounting bolts of tension guide and slack guide, when tightened to specified torque, should make room between flange and guide. Be careful not to tighten excessively.
- 4. Install primary timing chain, crankshaft sprocket, oil pump drive gear, and oil thrower.
 - For installation direction, refer to the figure.

NOTE:

At this point, it is not necessary to align matching marks of chain and sprocket. (Align in step 7.)

- 5. Temporarily install cylinder head gasket, and cylinder head.
 - Temporarily install them with two bolts at end.
 - Support bolt approximately 10 mm (0.31 in) above seating position. (Make room at front end when lifting up front end of cylinder head.)
- 6. Align matching mark (yellow) of primary timing chain, and that of crankshaft sprocket.
- 7. Align matching mark (yellow) of primary timing chain, and that of idler sprocket large-diameter side.
- 8. After aligning each matching mark, install idler sprocket to cylinder head.
- 9. Install chain tensioner.
 - Compress chain tensioner sleeve, fix it with pin, and then install it.
 - After installation, pull out fixing pin, and release sleeve.
- 10. Install front oil seal to front cover.
 - Using oil seal drift (special service tool) or 56 mm (2.20 in) diameter drift (commercial service tool), press-in oil seal until it becomes flush with front cover mounting surface.
 - Be careful not to cause any scratches or burrs on circumference of oil seal when pressing it in.
- 11. Install PCV separator to front cover.







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- 12. Install water connector to front cover.
 - Apply liquid gasket to position in the figure without interruption.

Use genuine liquid gasket or equivalents.







- 13. Install front cover with the following procedure.
- a. Apply liquid gasket to position in the figure without interruption. Use genuine liquid gasket or equivalents.
- b. Install front cover.
 - CAUTION:
 - Install it so as to prevent collared O-ring from dropping off, and front oil seal lip from being damaged.
 - Install it so as not to damage cylinder head gasket lower surface on front cover upper end.
 - After installation, wipe off liquid gasket that protrudes from mounting surface of oil pan.
- c. Tighten mounting bolts.
 - For bolt length, refer to the following.
 A: 20 mm (0.79 in) of M6 (0.24 in) dia.
 B: 40 mm (1.57 in) of M6 (0.24 in) dia.
 C: 65 mm (2.56 in)
 D: 75 mm (2.95 in)
 - Bolts above without indication of diameter are all M8 (0.31 in) diameter.
 - Tighten mounting bolts marked "*" (tightened together with alternator adjusting bar) after installing and aligning alternator,
- 14. Install crankshaft pulley.
 - Fix crankshaft with a piece of wood, and tighten crankshaft pulley mounting bolt.
- 15. Install oil pump.
 - Align matching marks of spindle gear and oil pump body. Install it when No. 1 cylinder is set to its compression TDC.



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16. Install distributor.

- Insert distributor into front cover by aligning projection (convex) of oil pump spindle gear and notch (concave) of rotor shaft.
- If alignment is difficult, remove distributor cap, and align them while moving rotor head.

NOTE:

Spindle gear projection and rotor shaft are off-set. Installation is possible in only one direction.



17. For the following procedure, refer to EM-41, "SECONDARY TIMING CHAIN" .

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CYLINDER HEAD

On-Vehicle Service CHECKING COMPRESSION PRESSURE

- 1. Warm up engine thoroughly. Then, stop it.
- 2. Open engine room LH cover and fix it. Refer to EM-12, "ENGINE ROOM COVER" .
- 3. Release fuel pressure. Refer to EC-27, "Fuel Pressure Release" .
- 4. Remove spark plug from each cylinder. Refer to EM-27, "SPARK PLUG (CONVENTIONAL)" .
- 5. Disconnect fuel injector harness connector so that no fuel is injected.
- 6. Connect engine tachometer (not required in use of CONSULT-II).
- 7. Install compression tester with adapter onto spark plug hole.
- 8. With accelerator pedal fully depressed, turn ignition switch to "START" for cranking. When the gauge pointer stabilizes, read the compression pressure and engine rpm. Perform these steps to check each cylinder.

	kPa (bar, kg/cm ² , psi) /rpm	
Standard	Minimum	Deference limit between cylinders
1,226 (12.26, 12.5, 178) / 300	1,030 (10.30, 10.5, 149) / 300	98 (0.98, 1.0, 14) / 300



CAUTION:

Always use a fully changed battery to obtain specified engine speed.

- If the engine speed is out of specified range, check battery liquid for proper gravity. Check engine speed
 again with normal battery gravity.
- If compression pressure is below minimum value, check valve clearances and parts associated with combustion chamber (Valve, valve seat, piston, piston ring, cylinder bore, cylinder head, cylinder head gasket). After the checking, measure compression pressure again.
- If some cylinders have low compression pressure, pour small amount of engine oil into the spark plug hole of the cylinder to re-check it for compression.
- If the added engine oil improves the compression, the piston rings may be worn out or damaged. Check the piston rings and replace if necessary.
- If the compression pressure remains at low level despite the addition of engine oil, the valves may be malfunctioning. Check the valves for damage. Replace the valve or valve seat accordingly.
- If two adjacent cylinders have respectively low compression pressure and their compression remains low even after the addition of engine oil, the gaskets are leaking. In such a case, replace the cylinder head gaskets.
- 9. Install spark plug, harness connectors and engine cover.

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Removal and Installation





CAUTION:

Apply new engine oil to parts marked in illustration before installation.

REMOVAL AND INSTALLATION

Refer to <u>EM-41, "SECONDARY TIMING CHAIN"</u> for detailed procedure.

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CAUTION:

Apply new engine oil to parts marked in illustration before installation.

DISASSEMBLY

- 1. Remove spark plugs.
- 2. Remove adjusting shim and valve lifter.
 - Check the installation position of removed parts, and keep them to avoid being confused.
- 3. Remove valve collet.
 - Compress valve spring with valve spring compressor. Remove valve collet with magnet driver or like that.
- 4. Remove valve spring retainer and valve spring.
- 5. Push valve stem to combustion chamber side, and remove valve.
 - Inspect valve guide clearance before removal. Refer to <u>EM-59, "Valve Guide Clearance"</u>.
 - Check the installation position of removed parts, and keep them to avoid being confused.



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- 6. Remove valve oil seal with valve oil seal puller.
- 7. Remove valve spring seat.
- 8. When valve seat must be replaced, refer to <u>EM-60, "Valve Seat</u> <u>Replacement"</u>.
- 9. When valve guide must be replaced, refer to <u>EM-59</u>, "Valve <u>Guide Replacement</u>".



ASSEMBLY

- 1. Install valve guide. Refer to EM-59, "Valve Guide Replacement" .
- 2. Install valve seat. Refer to EM-60, "Valve Seat Replacement" .
- 3. Install valve spring seat.
- 4. Install valve oil seal.
 - Apply new engine oil to the inside of oil seal.
 - Install with valve oil seal drift to match dimension in illustration.
- 5. Install valve.
 - Install larger diameter one to intake side.



- 6. Install valve spring.
 - Install narrow pitch side to cylinder head side.
- 7. Install valve spring retainer.
- 8. Install valve collet.
 - Compress valve spring with valve spring compressor. Install valve collet with magnet hand.
 - Tap stem edge lightly with plastic hammer after installation to check its installed condition.
- 9. Install valve lifter and adjusting shim.
- 10. Install spark plug with spark plug wrench.

INSPECTION AFTER DISASSEMBLY

Cylinder Head Distortion

1. Wipe off oil and remove water scale (like deposit), gasket, sealer, carbon, etc with scraper.

CAUTION:

Use utmost care not to allow gasket debris to enter passages for oil or water.

2. At each of several locations on bottom surface of cylinder head, measure distortion in six directions.

Limit

: 0.1mm (0.004 in)





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Valve Guide Clearance

Perform this inspection before removing valve guide.

- 1. Make sure that the valve stem diameter is within the specification. Refer to EM-88, "Valve Dimensions".
- 2. Push the valve out by approx. 10 mm (0.39 in) toward the combustion chamber side to measure the valve deflection (in the direction of dial gauge) with dial gauge.
- 3. The half of the deflection accounts for the valve guide clearance.

Standard	
Intake	: 0.020 - 0.053 mm (0.0008 - 0.0021 in)
Exhaust	: 0.040 - 0.056 mm (0.0016 - 0.0029 in)
Limit	
Intake	: 0.08 mm (0.0031 in)
Exhaust	: 0.1 mm (0.004 in)

Valve Guide Replacement

When valve guide is removed, replace with oversized (0.2 mm, 0.008 in) valve seat.

To remove valve guide, heat cylinder head to 110 to 130°C (230 1. to 266°F) by soaking in heated oil.



3. Ream cylinder head valve guide hole. Valve guide hole diameter (for service parts) Intake and exhaust : 11.175 - 11.196 mm (0.4400 - 0.4408 in)







4. Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.

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5. Press valve guide from camshaft side to dimensions as in illustration.

6. Using valve guide reamer, apply reamer finish to valve guide.

in)

Intake and exhaust : 7.000 - 7.018 mm (0.2756 - 0.2763

L : 13.3 - 13.9 mm (0.524 - 0.547 in)





Valve Seat Contact

Standard

- After confirming that the dimensions of valve guides and valves are within specifications, perform this procedure.
- Apply prussian blue (or white lead) onto contacting surface of valve seat to check the condition of the valve contact on the surface.
- Check if the contact area band is continuous all around the circumference.
- If not, grind to adjust valve fitting and check again. If the contacting surface still has N.G conditions even after the re-check, replace valve seat.

Valve Seat Replacement

When valve seat is removed, replace with oversized (0.5 mm, 0.020 in) valve seat.

- 1. Bore out old seat until it collapses. Boring should not continue beyond the bottom face of the seat recess in cylinder head. Set the machine depth stop to ensure this.
- 2. Ream cylinder head recess diameter for service valve seat.
- Be sure to ream in circles concentric to the valve guide center.
- This will enable valve seat to fit correctly.





- 3. Heat cylinder head to 110 to 130°C (230 to 266°F) by soaking in heated oil.
- 4. Provide valve seats cooled well with dry ice. Force fit valve seat into cylinder head.

CAUTION:

Avoid directly to touching cold valve seats.

5. Using valve seat cutter set or valve seat grinder, finish the seat to the specified dimensions.

CAUTION:

When using valve seat cutter, firmly grip the cutter handle with both hands. Then, press on the contacting surface all around the circumference to cut in a single drive. Improper pressure on with the cutter or cutting many different times may result in stage valve seat.

• Grind to obtain the dimensions indicated in figure.









- 6. Using compound, grind to adjust valve fitting.
- 7. Check again for normal contact.



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Valve Spring Squareness

Set try square along the side of valve spring and rotate the spring. Measure the maximum clearance between the top face of spring and try square.

Limit : Less than 1.9 mm (0.075 in)



Valve Spring Dimension and Valve Spring Pressure Load

Check valve spring load at specified spring height.

Standard:	
Free height	: 50.37 mm (1.9831 in)
Installation height	: 37.8 mm (1.488 in)
Installation load	: 193.3- 224.7 N (20 - 22 kg, 143- 165 lb)
Height with valve opened	: 29.17 mm (1.1484 in)
Load with valve opened	: 291- 329 N (41- 45 kg, 290 - 326 lb)



ENGINE ASSEMBLY

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ENGINE ASSEMBLY

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7 Rear engine mounting bolt

WARNING:

- Situate vehicle on a flat and solid surface.
- Place chocks at front and back of rear wheels.
- For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.

CAUTION:

- Always be careful to work safely, avoid forceful or uninstructed operations.
- Do not start working until exhaust system and coolant are cool enough.
- For work items that are not covered by the engine main body section, refer to the applicable sections.
- Always use the support point specified for lifting.
- Use either 2-pole lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.
- For supporting points for lifting and jacking points, refer to GI-36, "Garage Jack and Safety Stand"

REMOVAL

Outline

Remove engine and transmission assembly with suspension member downwards. Then separate engine from transmission.

Preparation

- 1. Remove floor cover behind RH and LH seats.
- 2. Open and fix engine compartment LH cover and secure it.
- 3. Remove RH seat. Refer to SE-4, "FRONT SEAT" .
- 4. Remove engine compartment RH cover and rear cover. Refer to EM-12, "ENGINE ROOM COVER" .
- 5. Release fuel pressure. Refer to EC-27, "Fuel Pressure Release" .
- 6. Open fuel filler cap, and release internal pressure of fuel tank.
- 7. Disconnect battery ground cable.
- 8. Remove following parts.
 - Plate (under radiator)
 - Under covers at front and rear sides
 - LH/RH front wheels
 - Drive belts. Refer to EM-14, "DRIVE BELTS" .
 - Reservoir tank, radiator shroud, and radiator. Refer to CO-13, "RADIATOR" .
- 9. Drain engine coolant. Refer to CO-9, "ENGINE COOLANT" .
- 10. Disconnect engine harness at vehicle side. Temporarily fix it on engine upper side.

Engine room LH

- 11. Disconnect harness between vehicle and engine.
- 12. Remove distributor.

CAUTION:

Close opening with tape to avoid entry of any foreign materials into engine.

Engine room RH

- 13. Disconnect PCV hose and air hose (between engine compartment RH side and vehicle). Refer to <u>EM-16,</u> <u>"AIR CLEANER AND AIR DUCT"</u>.
- 14. Disconnect fuel feed hose and fuel return hose on engine side, and move them aside. **CAUTION:**

Plug disconnected hoses to prevent fuel leakage.

- 15. Disconnect heater hose from heater pipe, and plug hose to prevent engine coolant leakage.
- 16. Disconnect all hoses (vacuum hose and others) connected to vehicle at engine side.
- 17. Remove power steering oil pump from engine. Temporarily fix it on vehicle with rope in a manner in which excessive load is applied to piping. Refer to <u>PS-32, "POWER STEERING OIL PUMP"</u>.

Engine room RR

- 18. Disconnect terminals S and B from starter motor, and move harness to vehicle.
- 19. Disconnect vacuum hose and harness connector from canister purge control valve.
- 20. Disconnect engine ground attached to upper front end of transmission, at vehicle side.

Vehicle underbody

- 21. Remove air conditioner compressor from bracket, and temporarily fix it aside. Refer to <u>MTC-94, "A/C</u> <u>CYCLE"</u>.
- 22. Remove exhaust front tube, and bracket on transmission side.
- 23. Remove rear propeller shaft. Refer to PR-3, "REAR PROPELLER SHAFT" .
- 24. Remove all harness connectors from transmission, and temporarily fix them on vehicle.
- 25. Remove clutch operating cylinder from transmission, and temporarily fix it aside. Refer to <u>CL-10, "OPER-ATING CYLINDER"</u>.
- 26. Remove shift control wires from transmission, and temporarily fix them aside. Refer to <u>MT-10, "CONTROL</u> <u>LINKAGE"</u>.

EM-64

- [KA24DE] 27. Disconnect engine coolant piping for rear heater between vehicle and engine and transmission assembly (vehicle with rear heater). А 28. Remove brake caliper from steering knuckle. Temporarily secure brake hose on body with rope to avoid putting a load on it. Refer to BR-21, "FRONT DISC BRAKE" . 29. Remove cross member under oil pan. Refer to FSU-15, "FRONT SUSPENSION MEMBER". ΕM 30. Remove stabilizer from steering knuckle. Refer to FSU-15, "FRONT SUSPENSION MEMBER". 31. Remove suspension lower arm on suspension member side and damper lower end side, to free it together with steering knuckle. Refer to FSU-15, "FRONT SUSPENSION MEMBER". Removal 32. Securely support bottom surface of engine and transmission with two transmission jacks. D CAUTION: Make lifting height minimal where work under vehicle can be performed. Reserve room for lifting up (height where engine upper part protrudes above vehicle bottom). Е Take fixing measures as necessary so that jack does not slip from supporting surface. (The figure shows fixing with a rope as an example.) 33. Pull out rear engine mounting through-bolt from upper surface of transmission. F 34. Remove suspension member mounting bolts. Refer to FSU-15, "FRONT SUSPENSION MEMBER" 35. Carefully lift up vehicle, and remove engine and transmission assembly from vehicle. Transmission NOTE: Support jack The figure shows an example with the vehicle front and rear Н supported by a 2-pole lift and using two transmission jacks. Transmission (Vehicle rear is not shown in the figure.) 11 iack KBIA0893E **CAUTION:** Make sure that no part interferes with vehicle. • Make sure that every part is connected. • Make sure that vehicle does not fall off by shifting of center of gravity of vehicle, or counter-. [action. (Refer to "CAUTION" in the beginning.) [Disassemble work]
 - On level ground, separate engine and transmission in the following procedure.

CAUTION:

During operation, securely support engine by placing pieces of wood under engine oil pan, transmission oil pan, and suspension member, and suspend engine slings from a hoist.

36. Install hooks of lifting chain into front and rear engine slings (attached to engine). Lift it up with hoist, and lower it to floor from jack.

CAUTION:

Securely support engine by placing pieces of wood under bottom surface.

37. Remove engine and transmission assembly from suspension member.

CAUTION:

Securely support engine by placing pieces of wood under bottom surface.

- 38. Remove starter motor. Refer to SC-21, "STARTING SYSTEM".
- 39. Separate engine and transmission. Refer to MT-13, "TRANSMISSION ASSEMBLY".

INSTALLATION

Install in the reverse order of removal.

- Where positioning pin is used, be sure to securely insert it into the hole of mating part.
- Do not allow oil to adhere to mount insulators. Be careful not to damage mount insulators.
- Be sure that each mount insulator is not twisted, and has uneven thickness at right and left when it is installed.

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INSPECTION AFTER INSTALLATION

- Before starting engine, check the levels of coolant, lubrications, working oils, and of air conditioner refrigerant. If less than required quantity, fill to the specified level.
- Run engine to check for unusual noise and vibration.
- Warm up engine thoroughly to make sure there is no leakage of coolant, lubricants, working oil, fuel, and exhaust gas.

CYLINDER BLOCK

[KA24DE]



CAUTION:

Apply new engine oil to parts marked in illustration before installation.

EM-67

CYLINDER BLOCK

DISASSEMBLY

- 1. Remove engine assembly. Refer to EM-63, "ENGINE ASSEMBLY".
- 2. Remove starter motor. Refer to SC-21, "STARTING SYSTEM" .
- 3. Separate engine from transmission. Refer to MT-13, "TRANSMISSION ASSEMBLY".
- 4. Remove the parts that may restrict installation of engine to general-purpose engine stand.
- a. Remove the following parts.
 - Alternator. Refer to <u>SC-11, "CHARGING SYSTEM"</u>.
 - Alternator bracket.
 - Air compressor bracket
 - LH and RH engine mounting bracket
 - Oil filter and bracket. Refer to LU-12, "OIL COOLER BRACKET" .
- b. Install engine attachment to the right side of cylinder block.
- c. Lift the engine with hoist to install it onto the general-purpose engine stand.

NOTE:

Use an engine stand that has a load capacity large enough for supporting the engine weight.



Widely use engine stand

(Commercially available

PBIC0085E

product)

NOTE:

The figure shows an example of general-purpose engine stand that can hold mating surface of transmission with drive plate and rear plate removed.

- 5. Drain engine oil and coolant from inside of engine.
- 6. Remove the following components.
 - Throttle body. Refer to <u>EM-19, "THROTTLE BODY"</u>.
 - Intake manifold. Refer to EM-21, "INTAKE MANIFOLD" .
 - Exhaust manifold. Refer to EM-23, "EXHAUST MANIFOLD" .
 - Oil pump. Refer to LU-8, "OIL PUMP" .
 - Oil pan, oil strainer. Refer to <u>EM-25, "OIL PAN AND OIL</u> <u>STRAINER"</u>.
 - Rocker cover. Refer to <u>EM-30, "ROCKER COVER"</u>.
 - Camshaft. Refer to <u>EM-32, "CAMSHAFT"</u>.
 - Secondary timing chain, cylinder head. Refer to EM-41, "SECONDARY TIMING CHAIN" .
 - Crankshaft pulley, front cover and primary timing chain. Refer to EM-49, "PRIMARY TIMING CHAIN" .
 - Clutch disc, clutch cover. Refer to CL-14, "CLUTCH DISC, CLUTCH COVER AND FLYWHEEL" .
- 7. Remove pilot bush.
 - Using pilot bushing puller, remove the bushing from rear edge of crankshaft.
- 8. Remove flywheel.
 - Secure ring gear with ring gear stopper, then loosen and remove installation bolt.
 - Loosen mounting bolts diagonally.
- 9. Remove rear plate
- 10. Remove rear oil seal retainer
 - Insert slotted screwdriver between main bearing cap and rear oil seal retainer to remove them.



EM-68

11. Remove rear oil seal.

• Using slotted screwdriver push out rear oil seal. CAUTION:

Be careful not to damage rear oil seal retainer.

- 12. Remove the piston and connecting rod assembly.
- a. Position the crankshaft pin corresponding to the connecting rod to be removed onto the bottom dead center.
- b. Remove the connecting rod cap.
- c. Using a hammer handle or similar tool, push the piston and connecting rod assembly out to the cylinder head side.
 - Before removing the piston and connecting rod assembly, check the connecting rod side clearance. Refer to <u>EM-78</u>, <u>"CONNECTING ROD SIDE CLEARANCE"</u>.
- 13. Remove the piston rings form the piston.
 - Use a piston ring expander.

CAUTION:

- When removing the piston rings, be careful not to damage the piston.
- Be careful not to damage piston rings by expanding them excessively.
- Before removing the piston rings, check the piston ring side clearance. Refer to <u>EM-79, "PISTON RING SIDE CLEARANCE"</u>
- 14. Remove the piston from the connecting rod as follows.
- a. Using a snap ring pliers, remove the snap ring.







b. Heat piston to 60 to 70° C (140 to 158° F) with drier or equivalent.



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c. Push out piston pin with stick of outer diameter approximately 18 mm (0.71 in).



- 15. Remove main bearing cap.
- a. Loosen main bearing cap bolts in several steps in reverse order shown in the figure, and remove them.
 - Before removal, paint the mark of journal number on each journal for correct identification during installation.
 - Measure crankshaft side clearance before loosening main bearing cap bolts. Refer to <u>EM-78, "CRANKSHAFT SIDE</u> <u>CLEARANCE"</u>.
- b. Using main bearing cap bolts, remove main bearing cap while shaking it right and left.

- Remove No. 3 and No. 5 main bearing caps with cap puller (special service tool).
- A sliding hammer type main bearing cap remover (special service tool: KV101 14700) can be used.
- 16. Remove crankshaft.
- 17. .Pull out main bearings from cylinder block and main bearing cap.

CAUTION:

Identify installation positions, and store them without mixing them up.

18. Remove oil jets.

ASSEMBLY

- 1. Fully air-blow coolant passage and oil passage in cylinder block, inside of crankshaft case, and cylinder bores to remove any foreign material.
- 2. Install oil jets.
 - Oil jets for No. 1 and 3 cylinders are different from those for No. 2 and 4 in shape.





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- Insert knock pin of oil jet to knock pin hole on cylinder block, and tighten mounting bolts.
- 3. Install main bearing with the following procedure.
- a. Clean bearing mounting surfaces on cylinder block and main bearing cap to remove any foreign material, dust, and oil.
- When installing main bearing be careful with orientation. b.
 - Install main bearing with oil hole and groove to cylinder block, and the one without oil hole and groove to main cap.
 - Before installing bearing, lubricate bearing surface (inside) with new engine oil. Do not apply engine oil to reverse side of bearing, but thoroughly clean it.
 - Align stopper notches on bearings and install.
 - Make sure that oil holes in crankshaft and main bearing are aligned.
 - Be aware that shape and dimension are different according to installed location.
- 4. Install crankshaft to cylinder block.
 - Make sure that crankshaft can be rotated smoothly by hand.
- 5. Install main bearing cap.

shown in the figure.

- Main bearing cap is identified by identification paint No. made on it before it is removed.
- Install it with arrow facing to front.

NOTE:

6.

Main bearing cap cannot be replaced as a single part, because it is machined together with cylinder block.





Install piston to connecting rod. 7.

crankshaft rotates smoothly.

SHAFT SIDE CLEARANCE" .

- Using snap ring pliers (commercial service tool), install snap ring to groove of piston rear side. a.
- Install piston to connecting rod. h
 - Using hot-air blower, heat piston to 60 to 70°C (140 to 158°F) so that piston pin can be easily inserted by hand. Insert piston pin into piston and connecting rod from front side of piston.



- Assemble so that front mark on piston head and oil hole in connecting rod are positioned as shown in the figure.
- c. Install snap ring to front side of piston.
 - Refer to step (a) to install snap ring.
 - After installation, make sure that connecting rod moves smoothly.



Piston ring expander

Second ring





• Position end gaps of each piston ring as shown in the figure.



- When installing connecting rod bearing, lubricate bearing surface (inside) with new engine oil. Do not apply engine oil to reverse side of bearing, but thoroughly clean it.
- Align projection on connecting rod bearing and stopper notch on connecting rod, and install.





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EM-73

- 10. Install piston and connecting rod assembly to crankshaft.
 - Set crankshaft pin to BDC in compression stroke.
 - Lubricate cylinder bore, piston, and crankshaft pin with new engine oil.
 - Check cylinder position and cylinder No. of connecting rod.
 - Using a piston ring compressor (commercial service tool), install piston so that front mark on piston head faces toward engine front as shown in the figure.
- 11. Tighten connecting rod nuts with the following procedure.
- a. Lubricate connecting rod bolts and seat of nuts with new engine oil.
- Tighten to a torque of 13.7 15.7 N-m (1.4 1.6 kg-m, 10.1 b. 11.5 ft-lb).
- Make matching marks (with white paint) on each nut and con-C. necting rod cap, all in same direction. (when using a protractor)
- d. Turn all nuts another 60 to 65 degrees (Target: 60 degrees). **CAUTION:**

Always use either angle wrench (special service tool) or protractor. Avoid tightening based on visual check alone.

- After tightening nuts, make sure that crankshaft rotates smoothly.
- Check connecting rod side clearance. Refer to EM-78, "CONNECTING ROD SIDE CLEARANCE" .

CYLINDER BLOCK

12. Install rear oil seal to oil seal retainer.

13. Install rear oil seal retainer.

14. Install rear plate.

15. Install flywheel.

figure without interruption.

- Using oil seal drift (special service tool), press-in oil seal until it is flush with oil seal retainer. Be careful not to cause damage or burr to circumference of oil seal.
- Apply engine oil or chassis grease to circumference of oil seal lip.

• Fix crankshaft with ring gear stopper (special service tool).

Tighten mounting bolts diagonally in several steps.



Unit: mm (in)

Suitable tool







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16. Install pilot bushing.

- Install it, using a ϕ 20 mm (0.79 in) drift (commercial service tool).
- Drive-in pilot bush until it reaches crankshaft.



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17. Install knock sensor.

CAUTION:

Exercise extreme caution not to allow any impacts on sensor. If sensor is subject to impact, replace it.

- Make sure that no foreign objects adhere to mounting surfaces on cylinder block and knock sensor.
- Install it so that sensor connector faces toward engine front.
- Use genuine mounting bolts only.
- Do not tighten mounting bolt while holding connector.
- 18. Assemble in reverse order of disassembly.

How to Select Piston and Bearing DESCRIPTION



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Connecting points	Connecting parts	Selection items	Selection methods
Between cylinder block to crankshaft	Main bearing	Main bearing grade (bearing thickness)	Determined by match of cylin- der block bearing housing grade (inner diameter of hous- ing) and crankshaft journal grade (outer diameter of jour- nal)
Between crankshaft to connect- ing rod	Connecting rod bearing	Connecting rod bearing grade (bearing thickness)	Connecting rod bearing grade = crankshaft pin grade (outer diameter of pin). No grade exists for inner diameter of con- necting rod large end.
Between cylinder block to pis- ton	Piston and piston pin assembly. The piston is available together with piston pin as an assembly.	Piston grade (piston outer diameter)	Piston grade = cylinder bore grade (inner diameter of bore)
*Between piston to connecting rod	_	_	_

*For the service parts, the grade for fitting cannot be selected between a piston pin and a connecting rod. (Only 0 grade is available.) The information at the shipment from the plant is described as a reference.

- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.
- For details of the measurement method of each part, the reuse standards, and the selection method of the selective fitting parts, refer to the text.

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HOW TO SELECT PISTON

When New Cylinder Block is Used:

1. Check the cylinder bore grade on the upper face of cylinder block.

- 2. Select the piston of the same grade.
- NOTE:
 - The piston is available together with piston pin as an assembly.
 - The piston pin (piston pin bore) grade is provided only for the parts installed at the plant. For service parts, no grades can be selected (Only 0 grade is available.).





When Cylinder Block is Reused:

- 1. Measure the cylinder block bore inner diameter.
- 2. Determine the bore grade by comparing the measurement with the values under the cylinder bore inner diameter of the piston selection table.
- 3. Select the piston of the same grade.

Piston Selection Table

			••••••(••)
Grade number (Mark)	1	2	3
Inner diameter of cylinder bore	89.000 - 89.010 (3.5039 -	89.010 - 89.020	89.020 - 89.030
	3.5043)	(3.5043 - 3.5047)	(3.5047 - 3.5051)
Outer diameter of piston	88.970 - 88.980 (3.5027 -	88.980 - 88.990	88.990 - 89.000
	3.5031)	(3.5031 - 3.5035)	(3.5035 - 3.5039)

HOW TO SELECT CONNECTING ROD BEARING When New Connecting Rod and Crankshaft are Used:

- 1. Compare the pin diameter grade of the crankshaft on front surface with the values of the selection table of connecting rod bearing.
- 2. Select the bearing of the same grade.

NOTE:

There is no grading for connecting rod big end.



When Crankshaft and Connecting Rod are Reused:

- 1. Confirm connecting rod big end inner diameter is within the standard.
- 2. Measure the pin outer diameter of the crankshaft.

EM-75

Unit: mm (in)

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- 3. Compare the measurement with the values of the selection table of connecting rod bearing.
- 4. Select the bearing of the same grade.

Selection Table of Connecting Rod Bearing

Unit: mm (in) 53.000 - 53.013 (2.0866 - 2.0871) Connecting rod big end inner diameter Crankshaft pin outer diameter Grade (Mark) -(No grade) Bearing grade No. 0 49.968 - 49.974 0 Bearing thickness range: 1.505 - 1.508 (0.0593 - 0.0594) (1.9672 - 1.9675)Color: Black Bearing grade No.1 49.962 - 49.968 Bearing thickness range: 1.508 - 1.511 (0.0594 - 0.0595) 1 (1.9670 - 1.9672)Color: Brown Bearing grade No.2 49.956 - 49.962 2 Bearing thickness range: 1.511 - 1.514 (0.0595 - 0.0596) (1.9668 - 1.9670)Color: Green

Under Size Bearings Usage Guide

- When the specified oil clearance is not obtained with standard size connecting rod bearings, use undersize (US) bearings.
- When using undersize bearings, measure the bearing inner diameters with bearings installed, and grind the crankshaft pin so that the oil clearance satisfies the standard.

Bearing undersize table

		Unit: mm (in)
	Size	Thickness
US	0.25 (0.0098)	1.652 - 1.960 (0.0769 - 0.0772)

CAUTION:

In grinding the crankshaft pin to use undersize bearings, keep the fillet R (All crankshaft pins).



HOW TO SELECT MAIN BEARING

NOTE:

Diameter grading is available for all journals of crankshaft and cylinder block.

When New Cylinder Block and Crankshaft are Used:

- 1. Apply main bearing housing grade (0, 1 and 2) on bottom of cylinder block banks to row in main bearing selection table.
- 2. Apply journal diameter grade on crankshaft front to column in main bearing selection table.

Journal grade

All journal : 0, 1 and 2

 Find bearing grade at crossing of row and column in main bearing selection table.

Main bearing STD All journal : STD 0 - 4



When Cylinder Block and Crankshaft are Reused:

- Measure inner diameter of cylinder block main bearing housing 1. and outer diameter of crankshaft journal.
- 2. Apply measurement in above step 1 to main bearing selection table.
- 3. Follow step 3 and later in "When new cylinder block and crankshaft are used".



Main Bearings Grade Table

Cylinder block mair	n bearing h	ousing inner diameter	63.645 - 63.654 (2.5057 - 2.5061)	63.654 - 63.663 (2.5061 - 2.5064)	63.663 - 63.672 (2.5064 - 2.5068)
Crankshaft journal outer diameter	Grade number		0	1	2
59.967 - 59.975 (2.3609 - 2.3612)	0	Bearing grade No.Bearing thicknessIdentification color	STD 0 1.821 - 1.825 (0.0717 - 0.0719) Black	STD 1 1.825 - 1.829 (0.0719 - 0.0720) Brown	STD 2 1.829 - 1.833 (0.0720 - 0.0722) Green
59.959 - 59.967 (2.3606 - 2.3609)	1	Bearing grade No.Bearing thicknessIdentification color	STD 1 1.825 - 1.829 (0.0719 - 0.0720) Brown	STD 2 1.829 - 1.833 (0.0720 - 0.0722) Green	STD 3 1.833 - 1.837 (0.0722 - 0.0723) Yellow
59.951 - 59.959 (2.3603 - 2.3606)	2	Bearing grade No.Bearing thicknessIdentification color	STD 2 1.829 - 1.833 (0.0720 - 0.0722) Green	STD 3 1.833 - 1.837 (0.0722 - 0.0723) Yellow	STD 4 1.837 - 1.841 (0.0723 - 0.0725) Blue

Use Under Size Bearing Usage Guide

- Use under size (US) bearing when oil clearance with standard size main bearing is not within specification.
- When using under size (US) bearing, measure inner diameter of bearing installed and grind journal until oil clearance falls within specification.

Bearing under size table

	Unit: mm (in)
Size	Thickness
US 0.25 (0.0098)	1.952 - 1.960 (0.0769 - 0.0772)

CAUTION:

In grinding the crankshaft journal to use undersize bearings, keep the fillet R (All journals).



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Unit: mm (in)

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Inspection After Disassembly CRANKSHAFT SIDE CLEARANCE

 Using a dial gauge, measure the clearance between the thrust bearings and the crankshaft arm when the crankshaft is moved fully forward or backward.

Standard: 0.050 - 0.180 mm (0.0020 - 0.0071 in)Limit: 0.30 mm (0.0118 in)

• If the measured value exceeds the repair limit, replace the thrust bearings, and measure again. If it still exceeds the repair limit, replace the crankshaft also.

CONNECTING ROD SIDE CLEARANCE

• Measure side clearance between connecting rod and crankshaft arm with feeler gauge.

Standard: 0.200 - 0.400 mm (0.0079 - 0.0157 in)Limit: 0.60 mm (0.0236 in)

• If the measured value exceeds the repair limit, replace the connecting rod, and measure again. If it still exceeds the repair limit, replace the crankshaft also.

PISTON AND PISTON PIN CLEARANCE

Inner Diameter of Piston Pin

 Measure the inner diameter of piston pin bore with an insidemicrometer.

Standard : 20.993 - 21.005 mm (0.8265 - 0.8270 in)



• Measure outer diameter of piston pin with a micrometer.

Standard : 20.989 - 21.001 mm (0.8263 - 0.8268 in)



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Inside micrometer



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Piston and Piston Pin Clearance

(Piston pin clearance) = (Piston pin bore diameter) – (Outer diameter of piston pin)

Standard : 0.002 - 0.006 mm (0.0001 - 0.0002 in)

- If clearance is exceeds specification, replace both of piston/piston pin assembly.
- For replacing piston/piston pin assembly. Refer to <u>EM-82, "PIS-</u> <u>TON TO CYLINDER BORE CLEARANCE"</u>.



PISTON RING SIDE CLEARANCE

• Measure side clearance of piston ring and piston ring groove with feeler gauge.

Standard:	
Top ring	0.040 - 0.080 mm (0.0016 - 0.0031 in)
2nd ring	0.030 - 0.070 mm (0.0012 - 0.0028 in)
Oil ring	0.065 - 0.135 mm (0.0026 - 0.0053 in)
Limit:	
Top ring	0.10 mm (0.0039 in)
2nd ring	0.10 mm (0.0039 in)



• If out of specification, replace piston and/or piston ring assembly.

PISTON RING END GAP

- Check if inner diameter of cylinder bore is within specification. Refer to <u>EM-82</u>, "Inner Diameter of Cylinder Bore".
- Insert piston ring until middle of cylinder with piston, and measure gap.

Standard:

Top ring	0.28 - 0.52 mm (0.0110 - 0.0205 in)
2nd ring	0.45 - 0.69 mm (0.0177 - 0.0272 in)
Oil ring	0.20 - 0.69 mm (0.0079 - 0.0272 in)
Limit:	
The second second	0.40

Top ring	0.10 mm (0.0039 in)
2nd ring	0.10 mm (0.0039 in)
Oil ring	0.10 mm (0.0039 in)

- If out of specification, replace piston ring. If gap still exceeds the limit even with a new ring, re-bore cylinder and use oversized piston and piston ring.

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CONNECTING ROD BEND AND TORSION

• Check with connecting rod aligner.

Bend:

Limit 0.15 mm (0.0059 in) per 100 mm (3.94 in) length Torsion:

Limit 0.30 mm (0.0118 in) per 100 mm (3.94 in) length



• If it exceeds the limit, replace connecting rod assembly.



CONNECTING ROD BEARING (BIG END)

• Install the connecting rod cap without the connecting rod bearing installed. After tightening the connecting rod nut to the specified torque, measure the connecting rod large end inner diameter using an inside micrometer.

Standard : 53.000 - 53.013 mm (2.0866 - 2.0871 in)



CONNECTING ROD BUSHING OIL CLEARANCE (SMALL END) Inner Diameter of Connecting Rod (Small End)

Measure inner diameter of bushing.

Standard : 21.000 - 21.012 mm (0.8268 - 0.8272 in)



Outer Diameter of Piston Pin

Measure outer diameter of piston pin.
Standard : 20.989 - 21.001 mm (0.8263 - 0.8268 in)



Connecting Rod Bushing Oil Clearance (Small End)

(Connecting rod small end oil clearance) = (Inner diameter of connecting rod small end) – (Outer diameter of piston pin)

Standard : 0.005 - 0.017 mm (0.0002 - 0.007 in) Limit : 0.023 (0.0009)

- If the measured value exceeds the standard, replace the connecting rod assembly and/or piston and piston pin assembly.
- If replacing the piston and piston pin assembly, refer to the Table for Selective Fitting for Piston to select the piston corresponding to the applicable bore grade of the cylinder block to be used. Refer to <u>EM-75, "HOW TO SELECT CONNECTING ROD</u> <u>BEARING"</u>.

CYLINDER BLOCK DISTORTION

 Using a scraper, remove gasket on the cylinder block surface, and also remove oil, scale, carbon, or other contamination.
CAUTION:

Be careful not to allow gasket flakes to enter the oil or coolant passages.

 Measure the distortion on the block upper face at some different points in 6 directions.

Limit : 0.1 mm (0.004 in)

INNER DIAMETER OF MAIN BEARING HOUSING

- Install the main bearing caps with the main bearings removed, and tighten the mounting bolts to the specified torque.
- Using a bore gauge, measure the inner diameter of the main bearing housing.

Standard : 63.645 - 63.672 mm (2.5057 - 2.5068 in)

 If out of the standard, replace the cylinder block and main bearing caps as an assembly.

NOTE:

These components cannot be replaced as a single unit, because they were processed together.







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- C: Honing allowance 0.02 mm (0.0008 in)
- 2. install main bearing caps and tighten bolts to specified torque. This will prevent distortion of cylinder bores.
- 3. Cut cylinder bore.

PISTON TO CYLINDER BORE CLEARANCE Inner Diameter of Cylinder Bore

Using a bore gauge, measure cylinder bore for wear, out-ofround and taper at 6 different points on each cylinder. (X and Y directions at A, XY and B)

Standard inner diameter: 89.000 - 89.030 mm (3.5039 - 3.5051 in) Wear limit: 0.20 mm (0.0079 in) **Out-of-round (Difference between X and Y):** 0.015 mm (0.0006 in) Taper limit (Difference between A and B): 0.01 mm (0.0004 in)



If the measured value exceeds the repair limit, or if there are scratches and/or seizure on the cylinder inner wall, hone or bore the inner wall.

Outer Diameter of Piston

Measure piston skirt diameter.

Measuring point	
(Distance from the top	: 48 mm (1.89 in)
face)	
- · · ·	: 88.970 - 89.000 mm

Standard



Piston to Cylinder Bore Clearance

Calculate by outer diameter of piston skirt and inner diameter of cylinder (direction X, position B).

(3.5027 - 3.5039 in)

(Clearance) = (Inner diameter of cylinder) – (Outer diameter of piston skirt)

: 0.020 - 0.040 mm (0.0008 - 0.0016 in) Standard

- If it exceeds the standard, rebore and replace piston/piston pin assembly.
- Oversize piston and piston ring are provided. When using an oversize piston, hone the cylinder so that the clearance of the piston cylinder satisfies the standard.

: 0.5 OS Over sized by 0.5 mm (0.020 in) **Oversize (OS) piston** : 1.0 OS Over sized by 1.0 mm (0.039 in)

 $\mathbf{D} = \mathbf{A} + \mathbf{B} - \mathbf{C}$

- Rebore cylinder as follows.
- Determine cylinder bore size by adding piston-to-cylinder bore clearance to piston diameter. 1.

Rebore size calculation:

Where, **D: Bored diameter** A: Piston diameter as measured **B:** Piston-to-bore clearance

EM-82

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- When any cylinder needs boring, all other cylinders must also be bored.
- Do not cut too much out of cylinder bore at a time. Cut only 0.05 mm (0.0020 in) or so at a time.
- 4. Hone cylinders to obtain specified piston-to-bore clearance.
- 5. Measure finished cylinder bore for out- of-round and taper.
 - Measurement should be done after cylinder bore cools down.

OUTER DIAMETER OF CRANKSHAFT JOURNAL

Measure outer diameter of crankshaft journals.

Standard : 59.951 - 59.975 mm (2.3603 - 2.3612 in)



OUTER DIAMETER OF CRANKSHAFT PIN

Measure outer diameter of crankshaft pin.

Standard : 49.956 - 49.974 mm (1.9668-1.9675 in)

OUT-OF-ROUND AND TAPER OF CRANKSHAFT

- Using a micrometer, measure the dimensions at 4 different points shown in the figure on each journal and pin.
- Out-of-roundness is indicated by the difference in dimension between X and Y at A and B.
- Taper is indicated by the difference in dimension between A and B at X and Y.

Limit:

Out-of-round (X-Y) : 0.005 mm (0.0002 in) Taper (A-B) : 0.005 mm (0.0002 in)

CRANKSHAFT RUNOUT

- Place a V-block on a precise flat table to support the journals on the both end of the crankshaft.
- Place a dial gauge straight up on the No. 3 journal.
- While rotating the crankshaft, read the movement of the pointer on the dial gauge. (Total indicator reading)

: 0.08 mm (0.0031 in) Limit:







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OIL CLEARANCE OF CONNECTING ROD BEARING

Method of Measurement

 Install the connecting rod bearings to the connecting rod and the cap, and tighten the connecting rod nut to the specified torque. Using a inside micrometer measure the inner diameter of connecting rod bearing.

(Oil clearance) = (Inner diameter of connecting rod bearing) – (Outer diameter of crankshaft pin)

Standard	: 0.010 - 0.035	mm (().0004 -	0.0014 in)
andara				

Limit : 0.09 mm (0.0035 in)

 If clearance cannot be adjusted within the standard, grind crankshaft pin and use undersized bearing. Refer to <u>EM-75, "HOW</u> <u>TO SELECT CONNECTING ROD BEARING"</u>.

Method of Using Plastigage

- Remove oil and dust on the crankshaft pin and the surfaces of each connecting bearing completely.
- Cut a plastic gauge slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes.
- Install the connecting rod bearings to the connecting rod cap, and tighten the connecting rod nut to the specified torque.
 CAUTION:

Never rotate the crankshaft.

• Remove the connecting rod cap and bearings, and using the scale on the plastic gauge bag, measure the plastic gauge width.

NOTE:

The procedure when the measured value exceeds the repair limit is same as that described in "the method by calculation."

OIL CLEARANCE OF MAIN BEARING

Method of Measurement

• Install the main bearings to the cylinder block and main bearing cap. Measure the main bearing inner diameter with the bearing cap bolt tightened to the specified torque.

(Oil clearance) = (Inner diameter of main bearing) – (Outer diameter of crankshaft journal)

Standard	: 0.020 - 0.047 mm (0.0008 - 0.0019 in)
Limit	: 0.1 mm (0.004 in)

 If the measured value exceeds the repair limit, select main bearings referring to the main bearing inner diameter and crankshaft journal outer diameter, so that the oil clearance satisfies the standard. Refer to <u>EM-76, "HOW TO SELECT MAIN BEARING"</u>







Method of Using Plastigage

- Remove oil and dust on the crankshaft journal and the surfaces of each main bearing completely.
- Cut a plastic gauge slightly shorter than the bearing width, and place it in crankshaft axial direction, avoiding oil holes
- Tighten the main bearing bolts to the specified torque.

CAUTION:

Never rotate the crankshaft.

 Remove the bearing cap and bearings, and using the scale on the plastic gauge bag, measure the plastic gauge width.
NOTE:

The procedure when the measured value exceeds the repair limit is same as that described in "the method by calculation."

CRUSH HEIGHT OF MAIN BEARING

• When the bearing cap is removed after being tightened to the specified torque with main bearings installed, the tip end of bearing must protrude.

Standard : There must be crush height

• If the standard is not met, replace main bearings.





OIL JET

- Check nozzle for deformation and damage.
- Blow compressed air from nozzle, and check for clogs.
- If it is not satisfied, clean or replace oil jet.



OIL JET RELIEF VALVE

- Using a clean plastic stick, press check valve in oil jet relief valve. Make sure that valve moves smoothly with proper reaction force.
- If it is not satisfied, replace oil jet relief valve.



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FLY WHEEL RUNOUT

Measure deflection (Total indicator reading) during a turn.

Limit : 0.15 mm (0.0059 in)



[KA24DE]

SERVICE DATA AND SPECIFICATIONS (SDS)

Standard and Limit GENERAL SPECIFICATIONS

Cylinder arrangement		In-line 4	EM
Displacement cm ³ (cu in)		2,389 (145.78)	_
Bore and stroke mm (in)		89 x 96 (3.50 x 3.78)	-
Valve arrangement	Valve arrangement		- 0
Firing order		1-3-4-2	_
Number of piston rings	Compression	2	D
Number of piston rings	Oil	1	
Number of main bearings		5	
Compression ratio		9.2	- E
Compression pressure kPa (bar, kg/cm ² , psi)/300 rpm	Standard	1,226 (12.26, 12.5, 178)	_
	Minimum	1,030 (10.30, 10.5, 149)	F
	Differential limit between cylinders	98 (1.0, 14)	_
		TDO	G



53

DRIVE BELTS

216

	Deflection adjustment		
	Used belt		Now bolt
	Limit	After adjustment	New Dell
Alternator	11 (0.43)	7 - 8 (0.28 - 0.31)	6 - 7 (0.24 - 0.28)
Air conditioner compressor	13 (0.51)	8 - 10 (0.31 - 0.39)	7 - 8 (0.28 - 0.31)
Power steering oil pump	13 (0.51)	8 - 10 (0.31 - 0.39)	7 - 8 (0.28 - 0.31)
Applied pushing force	98 N (10 kg, 72 lb)		

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INTAKE MANIFOLD AND EXHAUST MANIFOLD

232

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

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Unit: mm (in)

32

Unit: mm (in)

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SPARK PLUG

[KA24DE]

	Unit: mm (in)	
Item	Standard	
Spark plug gap	1.0 - 1.1 (0.039 - 0.043)	

SECONDARY TIMING CHAIN

Unit: mm (in)

Unit: mm (in)

Item	Standard
Idler sprocket end play	0.2 - 0.3 (0.008 - 0.012)
Idler sprocket inner diameter	29.025 - 29.050 (1.1427 - 1.1437)
Idler shaft outer diameter	28.987 - 29.000 (1.1412 - 1.1420)
Idler sprocket oil clearance	0.025 - 0.063 (0.0010 - 0.0025)

CYLINDER HEAD



Item	Limit
Cylinder head distortion	0.1 (0.004)

VALVE Valve Dimensions



Valve head diameter "D"	Intake	36.5 - 36.7 (1.437 - 1.445)	
	Exhaust	31.2 - 31.4 (1.228 - 1.236)	
Valve length "L"	Intake	101.17 - 101.47 (3.9831 - 3.9949)	
	Exhaust	98.67 - 98.97 (3.8846 - 3.8964)	
Valve stem diameter "d"	Intake	6.965 -6.980 (0.2742 - 0.2748)	
	Exhaust	6.945 - 6.960 (0.2734 - 0.2740)	
Valve seat angle "α"	Intake	45°15′ - 45°45′	
	Exhaust		

[KA24DE]

Valvo margin "T"	Intake	1.1 (0.0433)	Λ
vaive margin i	Exhaust	1.3 (0.0512)	P

Valve Clearance

		Unit: mm (in)	ΕM
Item	Cold* (reference data)	Hot	
Intake	0.28 - 0.36 (0.011 - 0.014)	0.31 - 0.39 (0.012 - 0.015)	
Exhaust	0.34 - 0.42 (0.013 - 0.017)	0.39 - 0.47 (0.015 - 0.019)	С

*: Approximately 20°C (68 °F)

Available Shims



SEM308D

Thickness mm (in)	Identification mark	
1.96 (0.0772)	196	
1.98 (0.0780)	198	
2.00 (0.0787)	200	
2.02 (0.0795)	202	
2.04 (0.0803)	204	
2.06 (0.0811)	206	0
2.08 (0.0819)	208	
2.10 (0.0827)	210	K
2.12 (0.0835)	212	
2.14 (0.0843)	214	
2.16 (0.0850)	216	
2.18 (0.0858)	218	
2.20 (0.0866)	220	M
2.22 (0.0874)	222	
2.24 (0.0882)	224	
2.26 (0.0890)	226	
2.28 (0.0898)	228	
2.30 (0.0906)	230	
2.32 (0.0913)	232	
2.34 (0.0921)	234	
2.36 (0.0929)	236	
2.38 (0.0937)	238	
2.40 (0.0945)	240	
2.42 (0.0953)	242	
2.44 (0.0961)	244	
2.46 (0.0969)	246	

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Thickness mm (in)	Identification mark
2.50 (0.0984)	250
2.52 (0.0992)	252
2.54 (0.1000)	254
2.56 (0.1008)	256
2.58 (0.1016)	258
2.60 (0.1024)	260
2.62 (0.1031)	262
2.64 (0.1039)	264
2.66 (0.1047)	266
2.68 (0.1055)	268

Valve Spring

Free height mm (in)		50.37 (1.9831)
Installation height mm (in)		37.8 (1.488)
height during valve open mm (in)		29.17 (1.1484)
Procedure N (kg, lb) at height mm (in)	Standard	193.3 - 224.7 (20.3 -22.9 , 43 - 50) at 37.80 (1.4882)
		393.2 - 442.3 (40.1 -45.1, 88 - 99) at 29.17 (1.1484)
Out-of-square mm (in)		Less than 1.9 (0.075)

Valve Lifter

	Unit: mm (in)
	Standard
Valve lifter outer diameter	33.960 - 33.975 (1.3370 - 1.3776)
Lifter guide inner diameter	34.000 - 34.021 (1.3386 - 1.3394)
Clearance between lifter and lifter guide	0.025 - 0.061 (0.0010 - 0.0024)

Valve Guide



		Standard	Service
Valve guide	Outer diameter	11.023 - 11.034 (0.4340 - 0.4344)	11.223 - 11.234 (0.4418 - 0.4423)
(Intake and exhausi)	Inner diameter (Finished size)	7.000 - 7.018 (0	0.2756 - 0.2763)
Cylinder head valve guide hole diameter		10.975 - 10.996 (0.4321 - 0.4329)	11.175 - 11.196 (0.4400 - 0.4408)
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)	
		Standard	Limit

[KA24DE]

Ctom to valve quide electrones	Intake		0.020 - 0.053 (0.0008 - 0.0021)	0.020 - 0.053 0.08 (0	
Stem to valve guide clearance	Exhaust	ust 0.040 - 0.073 (0.0016 - 0.0029)		0.1	(0.004)
Projection length "L"			13.3 -	13.9 (0.524 - 0.547)	
Valve Seat					
					Unit: mm (in)
	C	Cylinder head			r
///////			EXHAUST		L
					E
н			н		
-		D		D	F
					/
				······································	
h,			h,		ŀ
h ₂					
$\overline{\langle}$	*45°15' - 45°45'	34 (1.34)	*45°15' -		
*50°	*: (1	36.1 - 36.3 1.421 - 1.429)	*50°	*30.6 - 30.8 (1.205 - 1.213)	
d				d	
Contacting width	(W): 1.48 - 1.63 (0.0583 - 0.064	12)	Contacting width (W): 1	.8 - 2.0) 071 - 0.079)	
	(0.0000 0.000		*· Machining data		
				actining data	AEM456
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	le haust		B		P.
	EXILIAN		Intake		
		- halle			
	Ŧ	- Hh	H A		
	5	The state			
			SEM621F		
			Standard	Servio	 ж
Cylinder head seat recess diam	eter Intake	37.500 -	37.516 (1.4764 - 1.4770)	38.000 - 38.016 (1.4961 - 1.4967)	
(D)	Exhaust	32.200 -	32.216 (1.2677 - 1.2683)	32.700 - 32.716 (1	2874 - 1.2880)
Valve seat interference fit	Intake		0.064 - 0.096 (0	0.0025 - 0.0038)	
	Exhaust		0.064 - 0.096 (0	0.0025 - 0.0038)	
Valve seat outer diameter (d)	Intake	37.580 -	37.596 (1.4795 - 1.4802)	38.080 - 38.096 (1.	4992 - 1.4998)
	Exhaust	32.280 - 32.296 (1.2709 - 1.2715)		32.780 - 32.796 (1.2905 - 1.2912)	

[KA24DE]

Depth (H)	Intake	6.1 - 6.3 (0.	240 - 0.248)	
	Exhaust	6.1 - 6.3 (0.240 - 0.248)		
Height (h1)	Intake	5.8 - 6.0 (0.228 - 0.236)	5.3 - 5.5 (0.209 - 0.217)	
	Exhaust	5.9 - 6.0 (0.232 - 0.236)	5.32 - 5.42 (0.209 - 0.213)	
Height (h2)	Intake	0.24 - 0.64 (0.0094 - 0.0252)		
	Exhaust	0.43 - 0.73 (0.0169 - 0.0287)		
Depth (L)	Intake	42.02 - 42.52		
	Exhaust	42.03 - 42.53		

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)



SEM671

		Standard	Limit
Camshaft runout [TIR*]		Less than 0.04 (0.0016)	0.08 (0.0031)
Com hoight "A"	Intake	41.755 - 41.945 (1.644 - 1.651)	—
Can neight A	Exhaust	41.815 - 42.005 (1.646 - 1.654)	—
Wear limit of cam height	Intake and exhaust	_	0.2 (0.008)
Outer diameter of camshaft journal		27.935 - 27.955 (1.0998 - 1.1006)	—
Inner diameter of camshaft bearing		28.000 - 28.025 (1.1024 - 1.1033)	—
Camshaft journal clearance		0.045 - 0.090 (0.0018 - 0.0035)	0.15 (0.0059)
Camshaft end play		0.070 - 0.148 (0.0028 - 0.0058)	0.2 (0.008)
Camshaft sprocket runout [TIR*]		Less than 0.15 (0.0059)	—

*: Total indicator reading

CYLINDER BLOCK



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Unit: mm (in)

Cylinder bore	Inner diameter	Standard	Grade No. 1	89.000 - 89.010 (3.5039 - 3.5043)	
			Grade No. 2	89.010 - 89.020 (3.5043 - 3.5047)	A
			Grade No. 3	89.020 - 89.030 (3.5047 - 3.5051)	-
		Wear limit		0.2 (0.008)	EM
Out-of-round (X – Y)				Less than 0.015 (0.0006)	
Taper (A – XY – B)		Less than 0.010 (0.0004)			
Cylinder block height (From crankshaft center)				246.95 - 247.05 (9.7224 - 9.7264)	C
Main journal inner diameter grade (Without bearing)	Grade No. 0 Grade No. 1 Grade No. 2			63.645 - 63.654 (2.5057 - 2.5061) 63.654 - 63.663 (2.5061 - 2.5064) 63.663 - 63.672 (2.5064 - 2.5068)	D

PISTON, PISTON RING AND PISTON PIN Available Piston

a SEMB04E

Piston skirt diameter "A"	Standard	Grade No. 1	88.970 - 88.980 (3.5027 - 3.5031)	_	
		Grade No. 2	88.980 - 88.990 (3.5031 - 3.5035)		
		Grade No. 3	88.990 - 89.000 (3.5035 - 3.5039)	<i>i</i>) J	
	Service	0.5 (0.020)	89.470 - 89.500 (3.5224 - 3.5236)		
	(Oversize)	1.0(0.039)	89.970 - 90.000(3.5421 - 3.5433)	K	
"H" dimension			Approximately 48 (1.89)		
Piston pin bore diameter			20.993 - 21.005 (0.8265 - 0.8270)		
Piston-to-piston pin clearance		Standard	0.002 - 0.006 (0.0001 - 0.0002)	L	
Piston-to-cylinder bore clearance S		Standard	0.020 - 0.060 (0.0008 - 0.0016)		

Piston Ring

Unit: mm (in)

		Standard	Limit
	Тор	0.040 - 0.080 (0.0016 - 0.0031)	0.10 (0.0040)
Side clearance	2nd	0.030 - 0.070 (0.0012 - 0.0028)	0.10 (0.0040)
	Oil ring	0.065 - 0.135 (0.0026 - 0.0053)	_
	Тор	0.28 - 0.52 (0.0110 - 0.0205)	1.0 (0.039)
End gap	2nd	0.45 - 0.69 (0.0177 - 0.0272)	1.0 (0.039)
	Oil (rail ring)	0.20 - 0.69 (0.0079 - 0.0272)	1.0 (0.039)

Piston Pin

Piston pin outer diameter	20.989 - 21.001 (0.8263 - 0.8268)
Interference fit of piston pin to piston	0.002 to 0.006 (0.0001 to 0.0002)

[KA24DE]

Piston pin to connecting rod bushing clearance

Standard Limit

0.005 - 0.017 (0.0002 - 0.0007) 0.023(0.0009)

CONNECTING ROD

Unit: mm (in)



SEM570A				
Center distance		164.95 - 165.05 (6.4941 - 6.4980)		
Bend [per 100 (3.94)]	Limit	0.15 (0.0059)		
Torsion [per 100 (3.94)]	Limit	0.30 (0.0118)		
Connecting rod small end inner diameter		23.987 - 24.000 (0.9444 - 0.9449)		
Piston pin bushing inner diameter* Grade No. 0		21.000 - 21.012 (0.8268 - 0.8272)		
Connecting rod big end inner diameter		53.000 - 53.013 (2.0866 - 2.0871)		
Connecting red aids electrones	Standard	0.200 - 0.400 (0.0079 - 0.0157)		
	Limit	0.60 (0.0236)		

*: After installing in connecting rod

CRANKSHAFT



[KA24DE]

		Standard		0.050 - 0.1	8 0 (0.0020 - 0.0071)
Crankshaft side clearance	Limit			0.30 (0.0118)	
Fillet R (Journal and pin)				2.2 - 2	.2 (0.079 - 0.087)
*: Total indicator reading					
MAIN BEARING					
					Unit: mm (in)
)	
				9	
			No. 5		
			NO. 4		
			No. 3		
		No. 2			
		Front No. 1	SEM448C		
Grade number		Thickness	Identification	color	Remarks
0	1 821 - 1	1 825 (0 0717 - 0 0719)	(UPR/LW Black	к)	
1	1.825 - 7	1.829 (0.0719 - 0.0720)	Brown		_
2	1.829 - 1	1.833 (0.0720 - 0.0722)	Green		Grade and color are the same
3	1.833 - 1.837 (0.0722 - 0.0723)		Yellow		
4	1.837 - 1.841 (0.0723 - 0.0725)		Blue		
Jndersize					
					Unit: mm (in)
	TI	hickness			Main journal diameter
0.25 (0.0098))	1.952 - 1.960 (0.	.0769 - 0.0772)	Grind so t specified	hat bearing clearance is the value.
Main Bearing Oil Cle	arance				
					Unit: mm (in)
Main bearing oil clearance	-	Standard	0.0	20 - 0.047 (0.0008 - 0.0019)
				0.1 (0.0	04)
CONNECTING ROD	BEARING	Č			
	۶r 	Thickness "T" mm (in)		Black	
1		1.505 - 1.508 (0.0593 - 0.0594)		Brown	
2 1.511 - 1.514 (0		1.511 - 1.514 (0.	595 - 0.0596) Green		Green
Indoreiza		1		1	
JIIUEISIZE					Unit: mm (in)
Thickness		hickness		С	rank pin journal diameter
0.25 (0.0098) 1.952 - 1.9		1.952 - 1.960 (0.	.0769 - 0.0772)	Grind so t	hat bearing clearance is the
				specified	
searing On Clearant	, €				Unit: mm (in)
Connecting rod bearing oil o	learance	Standard		0.010 - 0.03	5 (0.0004 - 0.0014)
Connecting rod bearing oil clearance		Limit		0.0	9 (0.0035)

FLYWHEEL

Unit: mm (in)

Unit: N·m (kg-m, ft-lb)

EBS007KS

[KA24DE]

Item	Limit
Flywheel runout	0.15 (0.0059)

Tightening Torque

*1: Parts to be tightened in particular orders.

1)-: Order of tightening when tightening two or more times separately.

Unit: N·m (kg-m, in-lb)* 2 8.8 - 10.8 (0.9 -1.1, 78 - 95)*² *1 Throttle body 1) 2) 17.7 - 21.6 (1.8 - 2.2, 13 - 15) IACV-FICD solenoid valve 17.7 - 24.5 (1.8 - 2.4, 13 - 18) IACV-AAC valve 3.4 - 4.9 (0.35 - 0.49, 30 - 43)*2 Throttle position sensor 2.0 - 2.4 (0.21 - 0.24, 18 - 21)*2 *1 Intake manifold 15.7 - 18.6 (1.6 - 1.8, 12 - 13) Intake manifold support [M8] 15.7 - 18.6 (1.6 - 1.8, 12 - 13) [M10] 30.4 - 36.3 (3.1 - 3.7, 23 - 26) 19.6 - 29.4 (2.0 - 2.9, 15 - 21) Engine coolant temperature sensor Thermal transmitter 14.7 - 19.6 (1.5 - 1.9, 11 - 14) *1 Exhaust manifold 37.3 - 48.1 (3.8 - 4.9, 28 - 35) Exhaust manifold cover 5.1 - 6.5 (0.5 - 0.66, 46 - 57)*² 40.2 - 50.0 (4.1 - 5.1, 30 - 36) Heated oxygen sensor Fuel tube assembly 1) 7.8 - 10.8 (0.8 - 1.1, 69 - 95)*2 2) 15.7 - 18.6 (1.6 - 1.8, 12 - 13) Fuel pressure regulator 2.9 - 3.8 (0.30 - 0.38, 26 - 33)*2 *1 Rocker cover 7.8 - 10.8 (0.8 - 1.1, 69 - 95)*2 *1 Oil pan 6.4 - 7.5 (0.66 - 0.76, 57 - 66)*² Oil pan drain plug 29.4 - 39.2 (3.0 - 3.9, 22 - 28) 15.7 - 18.6 (1.6 - 1.8, 12 - 13) Oil strainer Cylinder head front cover [M6] 6.4 - 7.5 (0.66 - 0.76, 57 - 66)*² [M8] 15.7 - 18.6 (1.6 - 1.8, 12 - 13) Front cover [M6] $6.4 - 7.5 (0.66 - 0.76, 57 - 66)^{*2}$ [M8] 12.7 - 18.6 (1.3 - 1.8, 10 - 13) PCV valve 19.6 - 29.4 (2.0 - 3.0, 15 - 21) Breather separator 6.4 - 7.5 (0.66 - 0.76, 57 - 66)*² 143 - 152 (14.5 - 15.5, 105 - 112) Crankshaft pulley Idler shaft 65.7 - 82.4 (6.7 - 8.4, 49 - 60) Camshaft sprocket 167 - 177 (17.0 - 18.0, 124 - 130) 2.0 (0.2, 18)*2 Camshaft bracket *1 1) 2) 9.0 - 11.8 (0.92 - 1.2, 80 - 104)*2 6.4 - 7.5 (0.66 - 0.76, 57 - 66)*² Chain tensioner (Primary) (Secondary) 6.4 - 7.5 (0.66 - 0.76, 57 - 66)*² Chain tension guide 12.7 - 18.6 (1.3 - 1.8, 10 - 13) 15.7 - 18.6 (1.6 - 1.8, 12 - 13) Chain slack guide Distributor 12.7 - 18.6 (1.3 - 1.8, 10 - 13)

[KA24DE]

*1	Cylinder head	1) 2) 3)	29.4 (3.0, 22) 79.4 (8.1, 59) 0 (0, 0)	A
		4) 5)	24.5 - 34.3 (2.5 - 3.5, 18 - 25) 86 - 91° (angle tightening)	
	Cylinder head sub bolt		6.4 - 7.5 (0.66 - 0.76, 57 - 66)* ²	EIV
	Spark plug		19.6 - 29.4 (2.0 - 2.9, 15 - 21)	
*1	Main bearing cap		46.1 - 55.9 (4.7 - 5.7, 34 - 41)	C
	Connecting rod	1) 2)	13.7 - 15.7 (1.4 - 1.6, 10 - 12) 60° - 65° (angle tightening)	
	Rear oil seal retainer		6.4 - 7.5 (0.66 - 0.76, 57 - 66) ^{*2}	D
	Oil jet eye-bolt		30.4 - 40.2 (3.1 - 4.1, 23 - 29)	
	Knock sensor		20.6 - 26.5 (2.1 - 2.7, 16 - 19)	E
	Flywheel		143 - 152 (14.5 - 15.5, 105 - 112)	

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PRECAUTIONS

PRECAUTIONS

Precautions for Drain Coolant

• Drain coolant when engine is cooled.

Precautions for Disconnecting Fuel Piping

- Before starting work, make sure no fire or spark producing items are in the work area.
- Release fuel pressure before disassembly.
- After disconnecting pipes, plug openings to stop fuel leakage.

Precautions for Removal and Disassembly

- When instructed to use special service tools, use the specified tools. Always be careful to work safely, avoid forceful or uninstructed operations.
- Exercise maximum care to avoid damage to mating or sliding surfaces.
- Cover openings of engine system with tape or the equivalent, if necessary, to seal out foreign materials.
- Mark and arrange disassembly parts in an organized way for easy troubleshooting and re-assembly.
- When loosening nuts and bolts, as a basic rule, start with the one furthest outside, then the one diagonally opposite, and so on. If the order of loosening is specified, do exactly as specified.

Precautions for Inspection, Repair and Replacement

• Before repairing or replacing, thoroughly inspect parts. Inspect new replacement parts in the same way, and replace if necessary.

Precautions for Assembly and Installation

- Use torque wrench to tighten bolts or nuts.
- When tightening nuts and bolts, as a basic rule, equally tighten in several different steps starting with the ones in center, then ones on inside and outside diagonally in this order. If the order of tightening is specified, do exactly as specified.
- Replace with new gasket, packing, oil seal or O-ring.
- Thoroughly wash, clean, and air-blow each part. Carefully check oil or coolant passages for any restriction and blockage.
- Avoid damaging sliding or mating surfaces. Completely remove foreign materials such as cloth lint or dust. Before assembly, oil sliding surfaces well.
- Release air within route after draining coolant.
- After repairing, start engine and increase engine speed to check coolant, fuel, oil, and exhaust systems for leakage.

Parts Requiring Angular Tightening

- Use an angle wrench for the final tightening of the following engine parts:
- Cylinder head bolts
- Main bearing cap bolts
- Connecting rod cap nuts
- Crankshaft pulley bolt (No angle wrench is required as the bolt flange is provided with notches for angular tightening)
- Do not use a torque value for final tightening.
- The torque value for these parts are for a preliminary step.
- Ensure thread and seat surfaces are clean and coated with engine oil.

[ZD30DD]

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EBS006EY

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Precautions for Liquid Gasket REMOVAL OF LIQUID GASKET SEALING

• After removing the mounting bolts and nuts, disconnect and remove the liquid gasket sealing using a seal cutter.

CAUTION:

Be careful not to damage the mating surfaces.

 In areas where the cutter is difficult to use, use a plastic hammer to lightly tap the areas where the liquid gasket is applied.

CAUTION:

If for some unavoidable reason a tool such as a flat-bladed screwdriver is used, be careful not to damage the mating surfaces.

LIQUID GASKET APPLICATION PROCEDURE

- 1. Using a scraper, remove the old liquid gasket adhering to the gasket application surface and the mating surface.
- Remove the liquid gasket completely from the groove of the gasket application surface, mounting bolts, and bolt holes.
- 2. Wipe the gasket application surface and the mating surface with white gasoline (lighting and heating use) to remove adhering moisture, grease and foreign materials.
- 3. Attach the liquid gasket to the tube presser. Use Genuine Liquid Gasket or equivalent.
- 4. Apply the gasket without breaks to the specified location with the specified dimensions.
- If there is a groove for the liquid gasket application, apply the gasket to the groove.
- As for the bolt holes, normally apply the gasket inside the holes. Occasionally, it should be applied outside the holes. Make sure to read the text of service manual.
- Within five minutes of gasket application, install the mating component.
- If the liquid gasket protrudes, wipe it off immediately.
- Do not retighten after the installation.
- After 30 minutes or more have passed from the installation, fill the engine oil and coolant.

CAUTION:

If there are specific instructions in the service manual, observe them.







[ZD30DD]



PREPARATION

PREPARATION Special Service Tools

PFP:00002

[ZD30DD]

EBS006F2

Tool number Tool name		Description
KV10111100 Seal cutter		Removing steel oil pan and rear timing chain case
	S-NT046	
ED19600620 Compression gauge adapter	181 mm (7.13 in) S-NT820	Checking compression pressure
KV10109300 Pulley holder		a: 68 mm (2.68 in) b: 8 mm (0.31 in)
	S-NT628	
KV101151S0 Lifter stopper set 1 KV10115110 Camshaft pliers 2 KV10115120 Lifter stopper	(1) (2) S-NT041	Changing valve lifter shims
KV10112100 Angle wrench	S-NT014	Tightening bolts for bearing cap, cylinder head, etc.
KV101092S0 Valve spring compressor 1 KV10109210 Compressor 2 KV10109220 Adapter	(1) (2), (3) (3) (3) : M3 (3)	Disassembling and assembling valve components
KV10107902 Valve oil seal puller		Removing valve oil seal

EM-100

PREPARATION

[ZD30DD]

Tool number Tool name		Description	А
KV10115600 Valve oil seal drift	s-NT603	Installing valve oil seal Use side A. a: 20 (0.79) dia. b: 13 (0.51) dia. c: 10.3 (0.406) dia. Unit: mm (in)	EM
KV101056S0	0111000	Preventing crankshaft from rotating	
Ring gear stopper 1 KV10105630 Adapter 2 KV10105610 Plate	e h a the b contract of the co	a: 3 (0.12) e: 107 (4.21) b: 6.4 (0.252) f: 14 (0.55) c: 2.8 (0.110) g: 20 (0.79) d: 6.6 (0.260) h: 14 (0.55) dia. Unit: mm (in)	D
KV11106100 Engine sub-attachment	ZZA1200D		F
KV10106500 Engine attachment	ZZA0020D	When overhauling engine	Η Ι J
ST0501S000 Engine stand assembly	ZZA0022D		K
WS39930000		Pressing the tube of liquid gasket	
Tube presser	S-NT052		Μ
ST16610001 Pilot bearing puller	ZZA0046D	Removing pilot bearing	

PREPARATION

Commercial Service Tools

EBS006F3

[ZD30DD]

Tool number Tool name	Description	
Valve seat cutter set		Finishing valve seat dimensions
	S-NT048	
EM03470000		Installing piston assembly into cylinder bore
Piston ring compressor		
	S-NT044	
Piston ring expander		Removing and installing piston ring
	S-NT030	

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NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING NVH Troubleshooting — Engine Noise



EM-103

NOISE, VIBRATION, AND HARSHNESS (NVH) TROUBLESHOOTING [ZD30DD]

Use the Chart Below to Help You Find the Cause of the Symptom.

EBS006F5

- 1. Locate the area where noise occurs.
- 2. Confirm the type of noise.
- 3. Specify the operating condition of engine.
- 4. Check specified noise source.

If necessary, repair or replace these parts.

	Type of noise	Operating condition of engine								
Location of noise		Before warm- up	After warm- up	When start- ing	When idling	When racing	While driving	Source of noise	Check item	Refer- ence page
Top of engine	Ticking or clicking	С	А	_	А	В	_	Tappet noise	Valve clearance	<u>EM-142</u>
Rocker cover Cylinder head	Rattle	С	A	_	A	В	С	Camshaft bearing noise	Camshaft journal clear- ance Camshaft runout	<u>EM-140</u> <u>EM-139</u>
	Slap or knock	_	A		В	В		Piston pin noise	Piston and piston pin clearance Connecting rod bush- ing clearance	<u>EM-186</u> <u>EM-188</u>
Crank- shaft pul- ley Cylinder block (Side of	Slap or rap	A	_		В	В	A	Piston slap noise	Piston-to-bore clear- ance Piston ring side clear- ance Piston ring end gap Connecting rod bend and torsion	<u>EM-189</u> <u>EM-186</u> <u>EM-187</u> <u>EM-187</u>
(olde ol engine) Oil pan	Knock	A	В	С	В	В	В	Connect- ing rod bearing noise	Connecting rod bush- ing clearance (Small end) Connecting rod bear- ing clearance (Big end)	<u>EM-188</u> <u>EM-188</u>
	Knock	A	В	_	A	В	С	Main bearing noise	Main bearing oil clear- ance Crankshaft runout	<u>EM-191</u> <u>EM-190</u>
Front of engine Timing chain cover	Tapping or ticking	A	A		В	В	В	Timing chain and chain ten- sioner noise	Timing chain cracks and wear Timing chain tensioner operation	<u>EM-149</u> <u>EM-103</u>
	Squeak- ing or fizz- ing	А	В		В		С	Other drive belts (Sticking or slip- ping)	Drive belts deflection	<u>EM-107</u> <u>EM-103</u>
Front of engine	Creaking	А	В	A	В	A	В	Other drive belts (Slipping)	Idler pulley bearing operation	
	Squall Creak	A	В		В	A	В	Water pump noise	Water pump operation	<u>CO-44.</u> <u>"INSPEC-</u> <u>TION</u> <u>AFTER</u> <u>REMOVA</u> <u>L"</u>

A: Closely related B: Related C: Sometimes related —: Not related

ENGINE ROOM COVER

[ZD30DD]



3. Remove mounting bolts, and remove engine room rear cover.

INSTALLATION

Following instructions below, install in reverse order of removal.

- 1. Tighten bolts No. 1 to No. 3 shown in the figure to specified torque in this order.
- 2. Tighten other bolts to specified torque in any given order.



DRIVE BELTS

DRIVE BELTS

Checking Drive Belt

WARNING:

Be sure to perform after engine has stopped.

- Accessory belt is automatically adjusted by auto tensioner, so tension check for accessory belt is unnecessary.
- Check drive belt for wear, damage or cracks, replace if necessary.
- Check drive belt grooves for deposit of foreign materials such as sand and mud. Clean or replace if necessary.

Tension Adjustment

• Belt tensioning is not necessary, as it is automatically adjusted by auto belt tensioner.

Removal and Installation WATER PUMP, ALTERNATOR AND A/C COMPRESSOR BELT

NOTE:

In following sentences, water pump-alternator-air compressor belt is called "belt", and drive belt auto tensioner F is "auto tensioner".

Removal

- 1. Remove under cover at front.
- 2. Retract and secure (or hold) auto tensioner following steps below.
- a. Ensure to hold 19 mm (0.75 in) -hexagon portion (A shown in figure) on auto tensioner with a ring-end wrench or socket wrench.

NOTE:

- Tools with handle of 500 mm (19.69 in) or more is recommended.
- Do not loosen bolts or nuts during work.



b. Carefully rotate hexagon (A) in direction shown by arrow (to loosen).

CAUTION:

- Because tensioner has large reaction force, ensure to hold it securely with a tool.
- If a sudden force is applied, hexagon (A) may be damaged. Carefully rotate it in accordance with retraction of damper unit.



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[ZD30DD]

c. At this point, insert a stubby screwdriver [6 mm (0.24 in)-diameter] from front of vehicle into retaining boss (B) on alternator bracket. Secure tensioner arm with it.



- Insert a stubby screwdriver fully until its handle contacts. Reaction force from auto tensioner is applied to handle to secure it.
- If no suitable stubby screwdriver is prepared, keep belt loose and carry out step 3.

CAUTION:

Do not put hands within area where they may be caught by belt if retaining tool slips off.

3. Release belt starting from alternator pulley to remove.

CAUTION:

- When removing or installing, step away from each pulley, hold side of belt. This is to prepare for the case if retaining tool slips off.
- Handle removed belt carefully, avoiding oil and coolant contamination. Do not twist or bend it with excessive force.

Installation

• Following same procedure as removal, while holding auto tensioner in belt loosening direction, and install belt.

CAUTION:

- Do not put hands within area where they may be caught by belt, preparing for the case if retaining tool slips off.
- After belt installation, check that belt grooves and pulley ridges are securely engaged.

NOTE:

Unusual noise (belt whining) may occur at engine start just after belt installation. It is caused by some belt-topulley contact state, and will stop in a short time. It will disappear as time goes by.
Drive Belt Auto Tensioner REMOVAL

- 1. Remove front side under cover.
- 2. Remove drive belt.
- 3. Remove alternator. Refer to SC-11, "CHARGING SYSTEM" .
- 4. Remove auto tensioner.



INSPECTION AFTER REMOVAL

- Check that pulley has no looseness and rotates smoothly.
- Check damper unit for oil leak.

INSTALLATION

• Install in the reverse order of removal.

Dummy Pulley REMOVAL

- 1. Remove front side under cover.
- 2. Remove drive belt.
- 3. Remove dummy pulley.



INSPECTION AFTER REMOVAL

• Check that pulley has no looseness and rotates smoothly.

INSTALLATION

• Install in the reverse order of removal.



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AIR CLEANER AND AIR DUCT

AIR CLEANER AND AIR DUCT

PFP:16500

EBS006FB

[ZD30DD]

Removal and Installation



37. Collar

38. Resonator

39. Clamp

- REMOVAL
- 1. Remove rear side under cover.
- 2. Open engine room LH cover and secure it.
- 3. Remove RH seat. Refer to <u>SE-4, "FRONT SEAT"</u>.
- 4. Remove engine room right side cover and engine room rear cover. Refer to <u>EM-105</u>, "<u>ENGINE ROOM</u> <u>COVER</u>".
- 5. Remove floor cover behind RH seat.

EM-110

AIR CLEANER AND AIR DUCT

[ZD30DD]

6. Remove fuel feed and return hoses above air duct in engine compartment at engine side. Move them aside.

CAUTION:

Fit plugs onto removed hoses to prevent fuel leak.

- 7. Move harness between right side of vehicle and top of intake manifold. This allows air hoses and ducts to be taken out smoothly.
- 8. Disconnect harness connector of intake air temperature sensor from air cleaner case.
- 9. Put a mating mark onto each connection for reference at installation.
- 10. Following order below, disconnect components starting from engine side to remove.
- a. Remove PCV hose.
- b. Remove air hose.
- c. Remove air duct and air hose.
 - Intake manifold collector can be removed with them.
- d. Disconnect air duct (E) from resonator (F).
- e. Remove air duct.
- f. Remove air hose.
- g. Remove resonator.
- h. Remove mud flap on front RH wheel to remove resonator (H).
- i. If following components shall be removed, remove fuel filter bracket assembly.
- j. Remove resonator.
- k. Remove air cleaner case.
- 11. If components inside RH body shall be removed, follow steps below.
- a. Referring to step 10, remove all the components to be removed up to air cleaner case (J) (included).
- b. Remove air inlet grille from outside of vehicle.
- c. Remove RH-side kicking plate. Partially remove panel below RH-side seat belt anchor.
- d. Raise air duct (K) from body opening to disconnect it from air duct (L).
- e. Pull air duct (L) forward to disconnect.
- f. Remove air duct (K) out of mounting hole of air duct (L).

INSTALLATION

Following instructions below, install in reverse order of removal.

- Aligning mating marks, reconnect connections. Securely tighten clamps.
- Connect air hose (F) with arrow on upper side facing air cleaner case.





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AIR CLEANER AND AIR DUCT

• Install dust drain valve with its opening facing outward.

Drain valve Dust pan Image circle Lower side view KBIA0819E

EBS0096U

[ZD30DD]

Changing Air Cleaner Element REMOVAL

NOTE:

- "*" mark shown on figure indicates portions of lift arm.
- When air cleaner element is replaced, no lifting of vehicle is required.
- 1. Remove brake pipe protector from underbody at behind of front RH wheel.
- 2. Remove 3 clips, and remove cover on bottom of air cleaner case.
- 3. Remove wing nuts. Remove dust pan and air cleaner element on lower portion of air cleaner case in this order.

INSTALLATION

Install in the reverse order of removal.



[ZD30DD]

INTAKE MANIFOLD COLLECTOR AND INTAKE MANIFOLD

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Removal and Installation



- 1. Ground wire
- EGR volume control valve cover 4.
- 7. Gasket
- 10. EGR volume control valve
- 13. Intake manifold collector cover
- 16. Intake manifold
- 19. Intake manifold collector support
- 22. Fuel tube
- 25. Oil level gauge guide and level gauge 26. O-ring

- 2. Harness bracket
- 5. Gasket
- 8. Bracket
- 11. Water hose
- 14. Intake manifold collector
- 17. Gasket 20. O-ring
- 23. Harness bracket

- Water pipe
- EGR tube 6.
- 9. Gasket
- 12. Harness bracket
- 15. Gasket
- 18. Harness bracket
- 21. Throttle control actuator
- Intake air control valve control sole-24.
- noid valve bracket assembly

REMOVAL

WARNING:

To avoid the danger of being scalded, never drain the coolant when the engine is hot.

1. Remove rear side under cover.

EM-113

INTAKE MANIFOLD COLLECTOR AND INTAKE MANIFOLD

[ZD30DD]

- 2. Open engine room LH cover and secure it.
- 3. Remove RH seat. Refer to <u>SE-4, "FRONT SEAT"</u>.
- 4. Remove engine room right side and engine room rear cover. Refer to <u>EM-105</u>, "ENGINE ROOM COVER"
- 5. Remove floor cover behind RH seat.

CAUTION:

Fit plugs onto removed hoses to prevent fuel leak.

- 6. Drain coolant. If EGR volume control valve shall be installed, fit a plug onto water hose.
- 7. Disconnect fuel feed and return hoses above air duct in engine compartment at engine side. Move them aside.

CAUTION:

Fit plugs onto removed hoses to prevent fuel leak.

- 8. Remove air ducts, air hoses, resonator, and PCV hose between engine and air cleaner case. Refer to <u>EM-110</u>, "AIR CLEANER AND AIR DUCT".
 - Disconnect air hose and air duct on throttle control actuator together with intake manifold collector.
- 9. Remove 6 bolts shown by arrow in figure. Remove intake manifold collector cover.
- 10. Disconnect vacuum hoses from throttle control actuator.
 - Check that each vacuum hose color is corresponding to identification color (white/red) on throttle control actuator. Put an identification mark, if necessary.



11. Remove bolts shown by arrow in figure. Remove EGR volume control valve cover.





- 12. Remove bolts A shown in figure. Separate intake manifold collector from EGR volume control valve.
- 13. Remove bolt B shown in figure. Separate air duct from cylinder block.
- 14. Remove bolts C shown in figure. Separate intake manifold collector from support.

INTAKE MANIFOLD COLLECTOR AND INTAKE MANIFOLD

[ZD30DD]



INSPECTION AFTER REMOVAL

Surface Distortion

• Using straightedge and feeler gauge, inspect surface distortion of intake manifold lower and intake manifold upper.

Limit : 0.2 mm (0.008 in)



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INSTALLATION

• Following instructions below, install in reverse order of removal.

INTAKE MANIFOLD COLLECTOR AND INTAKE MANIFOLD

[ZD30DD]

Intake Manifold



• Tighten in numerical order as shown in the figure.

2: 25 - 28 N·m (2.5 - 2.9 kg-m, 18 - 20 ft-lb)

Intake Manifold Collector



• Tighten in numerical order as shown in the figure.

Installation of Throttle Control Actuator

• Diagonally tighten mounting bolts onto throttle control actuator evenly in several steps.

EGR Volume Control Valve

 After temporarily tightening all the mounting bolts and nuts, tighten EGR volume control valve and EGR tube to specified torque.

Connecting Vacuum Tube

• Install each vacuum hose onto mating throttle control actuator with the same identification color.

EXHAUST MANIFOLD

[ZD30DD]

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EXHAUST MANIFOLD



- 1. Remove rear side under cover.
- 2. Open engine room LH cover and secure it.
- 3. Remove engine room rear cover. Refer to EM-105, "ENGINE ROOM COVER".
- 4. Remove exhaust front tube. Refer to EX-2, "EXHAUST SYSTEM" .
- Μ Disengage intermediate fixing point of harness (between side of air compressor and top of rocker cover) 5. to make it movable.
- Remove harness bracket (top of exhaust manifold cover). 6.
- Remove heater pipe (with rear heater models). CO-45, "THERMOSTAT AND WATER PIPING" . 7.
- Remove bolts shown by arrows in the figure. Remove exhaust 8. manifold cover.
- Remove mounting nuts and stud bolts from EGR tube at 9. exhaust manifold side.



[ZD30DD]

10. Loosen mounting bolts in reverse order shown in figure. Remove exhaust manifold.



INSPECTION AFTER REMOVAL

Surface Distortion

• Use a reliable straightedge and feeler gauge to check the flatness of exhaust manifold fitting surface.

Limit : 0.2mm (0.008in)



INSTALLATION

• Install in reverse order of removal.

Exhaust Manifold

• Tighten mounting bolts in reverse order shown in figure. Install exhaust manifold.

🖸 : 24.5 - 28.4 N·m (2.5 - 2.9 kg-m, 18 - 20 ft-lb)



INSPECTION AFTER INSTALLATION

• Start engine, and raise engine speed to check no exhaust emission leaks.

OIL PAN AND OIL STRAINER

[ZD30DD]



• Even after coolant has been drained in step 4, remaining coolant in piping will come out. Use a tray to collect it.

OIL PAN AND OIL STRAINER

- 7. Following steps below, remove oil pan.
- a. Remove RH and LH engine gussets.
- b. Remove insulator from rear bottom of oil pan.
- c. Loosen and remove oil pan mounting bolts in descending order shown in figure.
- d. Using a seal cutter (special service tool), separate liquid gasket, and remove oil pan.

CAUTION:

Do not remove sheet metal part (inner pan) attached onto inner side of oil pan.

8. Remove oil strainer.

INSTALLATION

Following instructions below, install in reverse order of removal.

Install Oil Pan

2.

3.

- 1. Apply liquid gasket thoroughly as in illustration.
 - Use Genuine Liquid Gasket or equivalent.

Tighten mounting bolts in the numerical order.

Retighten mounting bolts in ascending order shown in figure.



[ZD30DD]





Install Drain Plug Washer

• Install it in direction shown in "Component Parts Illustration".

INSPECTION AFTER INSTALLATION

• Check for leakage of engine oil when engine is warmed.

[ZD30DD]





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Removal and Installation



Apply new engine oil when installing the parts that specified to do so in the figure. 1. Glow plate 2. Glow harness 3. Glow nut

Glow plug

4. Glow plug oil seal

REMOVAL

CAUTION:

Remove it only if necessary. If carbon adheres, it may be stuck and broken.

5.

- 1. Open engine room LH cover and secure it.
- 2. Remove RH seat. Refer to $\underline{\text{SE-4}, \text{"FRONT SEAT"}}$.
- 3. Remove engine room right side cover and engine room rear cover. Refer to <u>EM-105</u>, "<u>ENGINE ROOM</u> <u>COVER</u>".
- 4. Disconnect harness connector from glow plate. Move it from above rocker cover.
- 5. Remove glow nut to remove glow plate.
 - For No. 4 cylinder, open access hole removing grommet on vehicle-side floor arch first. Then loosen glow nut through access hole.
- 6. Remove rocker cover. Refer to EM-135, "ROCKER COVER" .
- 7. Remove glow plug.
 - For No. 4 cylinder, remove and install it out of/through grommet hole on vehicle-side floor arch.

CAUTION:

• When removing or installing, do not use impact-applying tools such as an air impact wrench.



• Handle it carefully without giving any impact, even after removal. [As a guide, if it drops from height of 10 cm (3.94 in) or higher, always replace it.]

INSTALLATION

- 1. Select suitable glow plug.
 - There will be some parts supplied from different manufacturers because of parallel provision. When selecting it, do not mix parts from different manufacturers for one engine. Be sure to check identification paint.
- 2. Remove adhered carbon from glow plug installation hole with a reamer.
- 3. Install glow plug.
- 4. During rocker cover installation process, install glow plug oil seal. Refer to <u>EM-135, "ROCKER COVER"</u>.
- 5. Install remaining parts in reverse order of removal.



VACUUM PUMP

[ZD30DD]



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REMOVAL

- 1. Remove radiator shroud. Refer to CO-36, "RADIATOR" .
- Remove cooling fan. Refer to CO-42, "COOLING FAN" . 2.
- 3. Remove vacuum hose vacuum pump side.
- 4. Remove vacuum pump.
 - Remove mounting bolts, and pull off vacuum pump straight toward front of engine.
 - If it is difficult to be pulled off due to stuck spline, tap it with a plastic hammer to remove.

CAUTION:

Do not disassemble vacuum pump.

INSTALLATION

Following instructions below, install in reverse order of removal.

When connected, vacuum hose shall be inserted securely by at least 15 mm (0.59 in).

INSPECTION AFTER INSTALLATION

Following steps below, check vacuum generated by vacuum pump.

1. Disconnect vacuum hose, and connect a vacuum gauge via 3way connector. Or, remove plug on vacuum pipe, and connect a vacuum gauge. (Figure shows later case.)

NOTE:

- Connect a vacuum gauge to any point where vacuum generated by vacuum pump can be measured. (Figure shows an example.)
- 2. Start engine, and measure generated vacuum at idle speed.



Standard : -93 to -101 kPa (-933 to -1,013 mbar, -700 to -760 mmHg, -27.56 to -29.92 inHg)

- If outside of standard, check for air suction in vacuum route, and measure again.
- If still outside of standard, replace vacuum pump.

[ZD30DD]

INJECTION TUBE AND INJECTION NOZZLE PFP:00018 А **Removal and Installation** EBS007GT SEC. 111•185 * 2 🔽 10.7 - 12.7 (1.1 - 1.3, 8 - 9) \mathbf{A} ΕM P Upper To spill (5) 🔽 14.7 - 16.7 connector ନ୍ନ Œ (1.5 - 1.7)To electronic 11 - 12) íπ Ħ control fuel **22.6 - 26.5** injection pump 6 Paint (2.3 - 2.7, . 17 - 19) (8 1 9 🖪 🕄 E ര 🕼 🖸 10.7 - 12.7 1 (1.1 - 1.3, 8 - 9) 0 21.6 - 24.5 (2.2 - 2.5, 16 - 18) F (To nozzle) (16) 1) 🖸 🕄 Front P Н (15) Apply engine oil. 24.5 - 28.4 26.5 - 29.4 (2.5 - 2.9, 18 - 20) (2.7 - 3.0, 20 - 21)🕑 : N•m (kg-m, in-lb) Ð (To pump) 🕐 : N•m (kg-m, ft-lb) Ø 😃 2.5 - 3.4 (0.25 - 0.35, 22 - 30) PBIC0513E 1 Spill tube 2 Eve-bolt 3 Copper washer Spill tube 5 Washer 4 Bolt 6 7 Nozzle support 8 9 O-ring Injection nozzle assembly Κ 10 Nozzle gasket 11 Nozzle oil seal 12 Clamp 13 Clamp Clamp 15 Clamp 14 18 Copper washer 16 Injection tube 17 Eye-bolt 19 Spill connector

CAUTION:

Apply new engine oil to parts marked in illustration before installation. NOTE:

In the figure, intake manifold is omitted.

REMOVAL

NOTE:

For better visibility, intake manifold is omitted from figures below. Remove and install injection tube with intake manifold installed.

- 1. Remove intake manifold collector. Refer to <u>EM-113</u>, <u>"INTAKE MANIFOLD COLLECTOR AND INTAKE</u> <u>MANIFOLD"</u>.
- 2. Move harness above intake manifold.
- 3. Remove engine oil level gauge.
- 4. Remove harness connector from electronic control fuel injection pump. Refer to <u>EM-129</u>, "<u>ELECTRONIC</u> <u>CONTROL FUEL INJECTION PUMP</u>".
- 5. Remove spill hose.
- 6. Following steps below, remove injection tubes.
- a. Put a paint mark or tag to identify each cylinder.

EM-125

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[ZD30DD]

- Use a fuel-resistant method.
- b. Remove clamps (3 positions), and remove tubes in order of 2-1-4-3 individually.

CAUTION:

Be careful not to allow leaked fuel to contaminate engine compartment. Especially, ensure to keep engine mount insulator clear of fuel.

NOTE:

Removal procedure of high-pressure injection nozzle assembly is shown below.

7. Remove rocker cover. Refer to EM-135, "ROCKER COVER" .





assembly and cylinder head. If only injection tube shall be removed and installed, nozzle oil seal replacement is not

NOTE:

8. Remove nozzle oil seal.

- required. 9. If necessary, remove spill collector.
 - Put a mating mark before removal to resume pipe original angle at installation.

• Using a slotted screwdriver, pry flange to remove oil seal.

- 10. Remove spill tube.
- 11. Following steps below, remove high-pressure injection nozzle assembly.
- a. Remove nozzle support.
- b. Hold high-pressure injection nozzle assembly. While rotating it to left and right, raise it to remove. **CAUTION:**
 - Handle high-pressure injection nozzle assembly carefully without giving any impact.
 - Do not disassemble high-pressure injection nozzle assembly.
- c. If nozzle gasket remains in cylinder head, hook it with tip of a slotted screwdriver and pull it out.



INJECTION TUBE AND INJECTION NOZZLE

INSPECTION AFTER REMOVAL

Inspection of High-Pressure Injection Nozzle Assembly

- Connect a nozzle tester to high-pressure injection nozzle assembly.
- Move nozzle tester lever fully by speed of 1 stroke/second. At the same time, check valve opening pressure and injection performance during injection.

Standard	: 20,399 to 22,458 kPa (204 to 225 bar, 208 to				
	229 kg/cm ² , 2,958 to 3,256 psi)				
Limit	· 17 751 kPa (178 bar, 181 kg/cm ² , 2 574 psi)				

NOTE:

High-pressure injection nozzle assembly injects in 2-stage pressure. Judge its performance (OK/NG) by checking valve opening pressure at 1st stage.

Injection performance NG:

Does not inject straight and strong (B in the figure). Fluid drops (C in the figure). Does not inject evenly (D in the figure).

If valve opening pressure exceeds limit value, or injection performance is NG, replace high-pressure injection nozzle assembly.

CAUTION:

Do not disassemble high-pressure injection nozzle assembly.



INSTALLATION

- Following steps below, install high-pressure injection nozzle assembly. 1.
- Install O-ring and nozzle gasket to high-pressure injection nozzle assembly, and insert them into cylinder a. head.
- b. Secure it with support.
- 2. Connect spill tube.

NOTE:

Connection of spill gasket may be broken, even if it is tighten to specified torque. It does not affect perfor-Μ mance.

- 3. Connect spill connector.
 - Connect it with mating mark aligned to resume original angle of pipe.
- 4. Carry out air tightness test for spill tube.
 - Connect a vacuum handy pump to spill connector. Check that vacuum is retained while applying following vacuum.

- If outside of standard, reconnect spill tube and spill connector. (Replace gasket in this case.)
- 5. Install nozzle oil seal.

• Insert it straight until its flange fully contacts cylinder head. CAUTION:

Check gutter spring in seal on high-pressure injection nozzle assembly for missing.



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INJECTION TUBE AND INJECTION NOZZLE

[ZD30DD]

- 6. Remove rocker cover. Refer to EM-135, "ROCKER COVER" .
- 7. Following steps below, connect injection tubes.
- a. Connect tubes individually to each cylinder in order of 3-4-1-2.
- b. Install clamps (3 positions) and secure it.
- 8. Connect spill hose.
 - Connect it with painted hose end facing spill connector and paint mark upward. Refer to "Component Parts Illustration".
- 9. Install remaining parts in reverse order of removal.



10. Before starting engine, bleed air from fuel piping. Refer to FL-4, "FUEL FILTER (ZD30DD)" .

INSPECTION AFTER INSTALLATION

Start engine, and increase engine speed to check for fuel leak.

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ELECTRONIC CONTROL FUEL INJECTION PUMP

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CAUTION:

- Apply new engine oil to parts marked in illustration before installation.
- When removing or installing the timing chain as incidental work of the fuel injection pump removal/installation, always secure the internal mechanism of the idler gear with bolts before removing or installing the fuel injection pump sprocket. Do not refer to the procedure for "TIMING CHAIN" in EM section based on No. 1 cylinder compression top dead center. (Unless otherwise specified.)
- Before removing and installing fuel injection pump, be sure to remove sprocket. Do not loosen or remove installation bolt in the center of fuel injection pump. If loosened or removed, replace injection pump assembly.
- Idler gear inner mechanism fixing bolt is installed in bare engine. After timing chain and related parts are installed, be sure to remove the fixing bolt.

REMOVAL

- 1. Drain engine coolant.
- 2. Remove the following:
 - Rocker cover (Refer toEM-135, "ROCKER COVER")
 - Intake manifold collector (Refer to EM-113, "INTAKE MANIFOLD COLLECTOR AND INTAKE MANI-FOLD")
 - Injection tube and spill tube (Refer to EM-125, "INJECTION TUBE AND INJECTION NOZZLE")
 - Water outlet
 - Radiator shroud (Refer to CO-36, "RADIATOR")

EM-129

- Radiator (Refer to <u>CO-36, "RADIATOR"</u>)
- Cooling fan (Refer to <u>CO-42, "COOLING FAN"</u>)
- Drive belt (Refer to <u>EM-107, "DRIVE BELTS"</u>)
- Insulator
- Vacuum pump and vacuum (Refer to EM-123, "VACUUM PUMP")
- 3. Move the following:
 - TDC sensor and harness (Refer to EM-151, "TIMING GEAR")
 - Power steering oil pump (Refer to <u>PS-32, "POWER STEERING OIL PUMP"</u>)
- 4. Remove the harness connector from the fuel injection pump.
 - After pulling the connector stopper all the way back, remove the connector.

NOTE:

When the stopper is pulled all the way back, the interlocked-connector will come off.

As for installation, when the connector is pushed all the way forward until the stopper locks, the interlocked-connector is inserted.

- 5. Remove the fuel injection pump rear bracket.
- 6. Remove the chain cover.

• Remove the installation bolts A, B, and C shown in the figure. CAUTION:

During chain cover removal, seal the opening to prevent foreign objects from getting into the engine.





- 7. Fix the internal mechanism of the idler gear (scissors gear structure). CAUTION:
 - Always perform this work. If timing gear contacting idler gear "A" is removed without performing this work, some difficulties will occur. Inner mechanism (scissors gear structure) of idler gear "A" will open, resulting in idler gear "A" displacement.
 - For bare engine, fixing is unnecessary because idler gear inner mechanism fixing bolt is installed.
- a. Remove the plug on the front side of the gear case.
- b. While turning the crankshaft pulley clockwise, check the tightening bolt hole of the idler gear internal mechanism through the plug hole.
 - Conduct the visual check using a mirror.

CAUTION:

When checking, note that there are 2 other holes (with no thread) beside the tightening bolt hole on the idler gear.



c. Install the tightening bolt [Part No.: 08120-62028, thread diameter: M6, length: 20 mm (0.79 in), pitch: 1.0 mm (0.039 in)] to the idler gear tightening bolt hole, and tighten to the specified torque:

🖤 : 2.5 - 3.4 N·m (0.25 - 0.35 kg-m, 22 - 30 in-lb)

CAUTION:

- To protect the idler gear (A) from damage, do not use the substitute part for the tightening bolt.
- Hereafter, do not turn the crankshaft to avoid hitting tightening bolt head against the gear case.
- Do not remove the idler gear (A) tightening bolt before installations of the timing chain and related parts are completed.
- 8. Make mating marks on the camshaft sprocket, fuel injection pump sprocket, and timing chain with paint.
- 9. Make mating marks on the fuel injection pump gear and idler gear with paint.

- 10. Remove the chain tensioner.
- a. Loosen the upper and lower installation bolts.
- b. While holding the chain tensioner by hand, remove the upper installation bolt to release the spring tension.
- c. Remove the lower installation bolt first, and then the chain tensioner.

NOTE:

Since the chain tensioner does not have a mechanism to prevent the plunger pop-out, watch out for the fall of the plunger and spring. (Return prevention mechanism is available.)

CAUTION:

Be careful not to drop plunger and plunger spring.

- 11. Remove the timing chain slack guide.
- 12. Remove the camshaft sprocket and timing chain at the same time.
 - Make mating marks on each sprocket and timing chain.
 - Hold the hexagon head of the camshaft on the exhaust manifold side, and loosen the camshaft sprocket installation bolt.

CAUTION:

Do not loosen the installation bolt using a chain tension.



Γ

Fuel injection

Fuel injection pump

pump gear

Markinc

sprocket

Timing chain

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Marking

Camshaft

R sprocket

Idler gear JEF264Z

Marking





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- 13. Remove the fuel injection pump sprocket and gear as an assembly.
 - Fix the fuel injection pump gear with the pulley holder, and loosen the installation bolt for removal.
 - Try not to move the pump shaft when removing.

NOTE:

Connect the sprocket and gear with a dowel pin, and tighten them together with the installation bolt.



- 14. Make the mating marks on the fuel injection pump flange and front plate with paint.
 15. Remove installation bolts first, and then fuel injection pump.
- 15. Remove installation bolts first, and then fuel injection pump toward the rear side of the engine.

NOTE:

When the fuel injection pump is stationary, it can still be retained by the dowel without all bolts.

CAUTION:

Do not disassemble or adjust the fuel injection pump.

INSTALLATION

NOTE:

The injection timing adjustment to correct the installation angle deviation is not necessary. Install the pump in the proper position according to the dowel and installation bolts.

- 1. Install the fuel injection pump from the rear side of the engine.
 - Match the dowel of the spacer to the dowel hole of the pump side for installation.
 - Replace the seal washer of the installation bolt with a new one.
- 2. Align the mating marks of the fuel injection pump flange and front plate, and then adjust the approximate flange position.
 - Each hole [6 mm (0.24 in) dia.] is used as a reference point for the fuel injection pump flange, fuel injection pump gear, and fuel injection pump sprocket.

NOTE:

Only during removal/installation at No. 1 cylinder compression top dead center, can the hole [6 mm (0.24 in) dia.] of the pump body be aligned.







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- 3. Install the fuel injection pump sprocket and gear as an assembly.
 - Align the mating marks of the idler gear and fuel injection pump gear properly.



- 4. Tighten the installation bolt of the fuel injection pump sprocket.
 - Fix the fuel injection pump gear with the pulley holder, and tighten the installation bolt.

CAUTION:

Before tightening the installation bolt, check again that the mating marks of the idler gear and fuel injection pump gear are aligned.

- 5. Install the camshaft sprocket and timing chain at the same time.
 - Align the mating marks of the fuel injection pump sprocket and camshaft sprocket, and install the timing chain.
 - Holding the hexagon head of the camshaft with a wrench, tighten the camshaft sprocket installation bolt.

CAUTION:

Do not tighten the installation bolt using a chain tension.

- 6. Install the timing chain, related parts, and the chain cover. Refer to $\underline{\mathsf{EM-147}}$, "TIMING CHAIN".
- 7. Remove the tightening bolt of the idler gear internal mechanism. **CAUTION:**

Bear engine is supplied with fixing bolt installed. Be sure to remove the bolt.

8. Apply the liquid gasket to the screw of the plug, and tighten the plug.

1: 7.9 - 9.8 N·m (0.8 - 1.0 kg-m, 70 - 86 in-lb)

- Use Genuine Liquid Gasket or equivalent.
- 9. Install the fuel injection pump rear bracket.
 - Tighten all the installation bolts temporarily, and then tighten them firmly with both surfaces of the fuel injection pump and cylinder block attached to the installation surface.









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- 10. Connect the harness connector of the fuel injection pump.
 - Insert the harness connector until the stopper is completely locked.

NOTE:

When the connector is pushed fully to lock the stopper, the interlocked-connector is inserted.



- 11. Install is in the reverse order of removal.
- 12. Before starting engine, bleed air from fuel piping. Refer to FL-4, "FUEL FILTER (ZD30DD)" .

INSPECTION AFTER INSTALLATION

Start engine, and increase engine speed to check for fuel leak.

ROCKER COVER

[ZD30DD]





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Removal and Installation



- 2. Open engine room LH cover and secure it.
- 3. Remove RH seat. Refer to <u>SE-4, "FRONT SEAT"</u>.
- 4. Remove engine room RH cover and engine room rear cover. Refer to EM-105, "ENGINE ROOM COVER"
- 5. Remove harness bracket at LH rocker cover.
- 6. Disconnect PCV hose from rocker cover.
- 7. Disconnect harness connector from glow plate. Move it from above rocker cover.
- 8. Remove glow nut to remove glow plate.
 - For No. 4 cylinder, open access hole removing grommet on vehicle-side floor (arch behind engine) first. Then loosen glow nut through access hole.



ROCKER COVER

9. Remove glow plug oil seal from rocker cover.

 While holding cutout on top of oil seal with pliers, rotate it counterclockwise to remove.

Notch (4 areas)

- 10. Following steps below, remove rocker cover.
- Loosen and remove mounting bolts in reverse order shown in a. the figure.
- b. Raise rocker cover in direction of glow plug inclination to avoid contacting glow plug.
- Changing angle of rocker cover frequently, take it out from c. between body and cylinder head.



Liquid gasket application area (4 areas)

Gear[`]case

Cylinder head

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Glow plug óil seal

Engine

front

cover

Timing chain

INSTALLATION

- 1. Following steps below, apply liquid gasket to points shown in the figure.
 - Use genuine liquid gasket or equivalents.
- a. Using a spatula, fill gap between mating faces with sealant.
- b. Apply additional sealant into a heap.
- 2. Install rocker cover gasket into mounting groove on rocker cover.
 - Apply liquid gasket slightly onto several points on rocker cover gasket to prevent missing during installation. Then secure it to rocker cover.

CAUTION:



- Install it with tab of front mark "FR" coming front of engine and upward. Refer to "Component Parts Illustration".
- 3. Changing angle of rocker cover frequently, take it into between body and cylinder head. **CAUTION:**
 - Be careful to keep rocker cover gasket securely, avoiding dropping it.
 - Do not touch liquid gasket applied to cylinder head.
- 4. Following steps below, tighten rocker cover mounting bolts.
- Temporarily tighten mounting bolts No. 9 and No. 11 in the figa. ure.
- Temporarily tighten remaining mounting bolts in ascending order b. shown in the figure.



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ROCKER COVER

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- c. Install glow plug oil seal.
 - While holding cutout on top of oil seal with pliers, rotate it clockwise to tighten.

- d. Tighten mounting bolts to specified torque in order shown in the figure.
- e. Retighten mounting bolts to specified torque in order shown in the figure.



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5. Install remaining parts in reverse order of removal.

CAMSHAFT

[ZD30DD]

CAMSHAFT

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Removal and Installation



CAUTION:

Apply new engine oil to parts marked in illustration before installation. NOTE:

In the figure below, baffle plate on top surface of No.1, 3 and 5 camshaft bracket is omitted.

 This engine will have a different valve arrangement from normal DOHC 4-valve type engines. As both camshafts on this engine have intake and exhaust camshafts, in this chapter they are named as follows:

Camshaft (Right side) : Intake manifold side camshaft Camshaft (Left side) : Exhaust manifold side camshaft

- The same parts are used for the right and left sides.
- Refer to the figure for intake and exhaust valve arrangement. (The camshafts have, alternately, either an intake valve or an exhaust valve.)



REMOVAL

- 1. Set the No. 1 cylinder at TDC, then remove the chain case, timing chain and other parts in connection. Refer to EM-147, "TIM-ING CHAIN" .
- 2. Remove the camshaft gear.
 - Loosen the camshaft gear installation bolt by fixing the hexagonal portion of the camshaft.

NOTE:

The idler gear cannot be removed at this point as the gear case is in the way. (The cylinder head can be removed as a single unit.)

- Remove the camshaft.
 - Place distinguishing marks on the right and left sides with paint.
 - Loosen and remove the installation bolt in reverse order shown in the figure.
- 4. Remove the adjusting shim and valve lifter.
 - Remove by taking notice of the installation position, and place outside engine in order to prevent confusion.

INSPECTION AFTER REMOVAL

Visual Check of Camshaft

- Check the camshaft for one sided wear or scratches.
- Replace the camshaft if there are abnormalities.

Camshaft Runout

- Prepare V-block on a flat surface and secure camshaft journals No. 1 and No. 5.
- Set the dial gauge vertically on journal No. 3.
- Rotate camshaft in one direction by hand, then read needle movement on dial indicator. (Total indicator reading)

Limit : 0.04 mm (0.0016 in)



Height of Cam Nose

Measure by using a micrometer.

Standard:

Intake & Exhaust

40.98 - 41.02 mm (1.6134 - 1.6150 in)





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Camshaft Oil Clearance

Measure by using a micrometer.





Camshaft Bracket Inner Diameter

- Install camshaft bracket and tighten bolts to the specified torque.
- Measure inner diameter of camshaft bracket using an inside micrometer.

Standard: 30.000 - 30.021 mm (1.1811 - 1.1819 in) dia.



Camshaft Oil Clearance Calculations

(Oil clearance) = (Camshaft bracket inner diameter) – (Camshaft journal outer diameter)

Standard: 0.045 - 0.090 mm (0.0018 - 0.0035 in) dia.

• If it exceeds the standard value, refer to the standard value of each unit, then replace the camshaft and/or cylinder head.

NOTE:

As the camshaft bracket is manufactured with the cylinder head, it is impossible to replace only the camshaft bracket.

Camshaft End Play

• Set the dial gauge to the front end of the camshaft. Measure the end play by moving the camshaft in the direction of the axle.

Standard:0.065 - 0.169 mm (0.0026 - 0.0067 in)Limit:0.2 mm (0.0079 in)

- If end play exceeds the limit, replace camshaft and measure camshaft end play again.
- If end play still exceeds the limit after replacing camshaft, replace cylinder head.



CAMSHAFT

Visual Inspection of Valve Lifter and Adjusting Shim

- Check lifter side for any signs of wear or damage. Replace if there are any abnormalities.
- Check cam nose contact and sliding surfaces for wear and scratches. Replace if there are any abnormalities.

Valve Lifter Clearance

Measure the outer diameter of the valve lifter with a micrometer.

Standard: 34.450 - 34.465 mm (1.3563 - 1.3569 in) dia.

Valve Lifter Diameter

Measure the bore diameter of the cylinder head valve lifter with an inside micrometer.

Standard: 34.495 - 34.515 mm (1.3581 - 1.3589 in) dia.



Valve Lifter Clearance Calculations

(Clearance) = (Valve lifter bore diameter) – (Valve lifter outer diameter)

Standard: 0.030 - 0.065 mm (0.0012 - 0.0026 in)

If it exceeds the standard value, refer to the outer diameter and bore diameter standard values and replace valve lifter and/or cylinder head.

INSTALLATION

- 1. Install the valve lifter and adjusting shim.
 - Make sure that these are installed in the same position as before the removal process.
- 2. Install the camshaft.
 - Follow the distinguishing marks that were placed on in the removal process.
 - Face the key in the direction shown in the figure.









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3. Install the camshaft bracket.

- Refer to the camshaft bracket upper side journal No. and install.
- Looking from the exhaust manifold side (left side of engine), install in the direction that the journal number can be read correctly.
- Place baffle plate onto upper face of No. 1, No.3 and No.5 camshaft brackets, and tighten together.
- 4. Tighten the installation bolts in numerical order in the figure.
- a. Tighten to 9.8 to 14.7 N·m (1.0 to 1.5 kg-m, 8 to 10 ft-lb).
 - Make sure that the thrust portion of the camshaft is fitted properly in the head installation side.
- b. Tighten to 19.6 to 23.5 N·m (2.0 to 2.4 kg-m, 15 to 17 ft-lb).
- 5. Install the camshaft gear.
 - Align the match marks, and install the idler gear and each camshaft gear to the position shown in the figure.
 - Tighten the camshaft gear installation bolt by fixing the hexagonal portion of the camshaft.
- 6. Install the timing chain, all other related parts and chain cover. Refer to $\underline{\mathsf{EM-147}}$, "TIMING CHAIN".
- After installing the timing chain, check and adjust the valve clearance before installing the spill tube. Refer to <u>EM-195, "Valve Clearance"</u>.
- 8. Install in the reverse order of removal.

Valve Clearance INSPECTION

- When the camshaft or parts in connection with valves are removed or replaced, and a fault has occurred (poor starting, idling, or other faults) due to the misadjustment of the valve clearance, inspect as follows.
- Inspect and adjust when the engine is cool (at normal temperature).
- Be careful of the intake and exhaust valve arrangement. The valve arrangement is different from that in a normal engine.
 NOTE:

The camshafts have, alternately, either an intake valve or an exhaust valve.(Refer to illustration)

- 1. Remove the following parts.
 - Front side under cover



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CAMSHAFT

- Rocker cover (Refer to <u>EM-135, "ROCKER COVER"</u>)
- 2. Remove baffle plate beforehand from top surface of No.3 and No.5 camshaft journal.
 - Remove baffle plate at the positions below where valve spring reaction force to camshaft journal is small.

No.3 baffle plate : Position where both No.2 cylinder exhaust camshaft and No.3 cylinder intake camshaft do not push the valve.

No.5 baffle plate : The compression top dead center of No.4 cylinder.

- Tighten camshaft journal mounting bolt in two steps in the order of center, and right and left.
- a. Tighten to 9.8 to 14.7 N·m (1.0 to 1.5 kg-m, 8 to 10 ft-lb).
- b. Tighten to 19.6 to 23.5 N·m (2.0 to 2.4 kg-m, 15 to 17 ft-lb).
- 3. Set the No. 1 cylinder at TDC.
- a. Rotate the crankshaft pulley clockwise, and align the TDC mark of the crankshaft pulley with the timing indicator of the TDC sensor bracket.

- b. Confirm that the cam nose of the No. 1 cylinder and the knock pin of the camshaft sprocket is in the position shown in the figure.
 - Rotate the crankshaft pulley again if not in the position shown in the figure.

4. While referring to the figure, measure the valve clearance in the circled area of the table below.

	No. 1		No. 2		No. 3		No. 4	
measuring point	INT	EXH	INT	EXH	INT	EXH	INT	EXH
When the No. 1 cylinder is in the TDC	×	×	×			×		

• The injection order is 1-3-4-2.







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 Measure the valve clearance using a fine feeler gauge when the engine is cool (at normal temperature).

Standard:

Intake and exhaust : 0.35 ± 0.05 mm (0.014 ± 0.002 in)

5. Set the No. 4 cylinder at TDC by rotating the crankshaft clockwise once.



No. 2 No. 3

[ZD30DD]

No. 4

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Measuring point	INU. I		NO. 2		NU. 5		NO. 4	
	INT	EXH	INT	EXH	INT	EXH	INT	EXH
When the No. 4 cylinder is in the TDC				×	×		×	×

7. If the valve clearance is outside the specification, adjust as follows.

ADJUSTMENTS

- Remove the adjusting shim for parts which are outside the specified valve clearance.
- 1. Remove the spill tube. Refer to EM-125, "INJECTION TUBE AND INJECTION NOZZLE" .
- 2. Extract the engine oil on the upper side of the cylinder head (for the air gun used in step 7).
- 3. Rotate the crankshaft to face the camshaft for adjusting shims that are to be removed upward.
- 4. Grip the camshaft with camshaft pliers, the using the camshaft as a support point, push the adjusting shim downward to compress the valve spring.

CAUTION:

Do not damage the camshaft, cylinder head, or the outer circumference of the valve lifter.

5. With the valve spring in a compressed state, remove the camshaft pliers by securely setting the outer circumference of the valve lifter with the end of the lifter stopper .

• Hold the lifter stopper by hand until the shim is removed. **CAUTION:**

Do not retrieve the camshaft pliers forcefully, as the camshaft will be damaged.



Engine front 🖉


- 6. Move the rounded hole of the adjusting shim to the front with a very thin screwdriver.
 - When the adjusting shim on the valve lifter will not rotate smoothly, restart from step 4 with the end of the lifter stopper touching the adjusting shim.
- 7. Remove the adjusting shim from the valve lifter by blowing air through the rounded hole of the shim with an air gun.

9. Measure the thickness of the adjusting shim using a micrometer.

Calculation method of the adjusting shim thickness:

10. Select the new adjusting shim from the following methods.

t1 = Thickness of the removed shim C1 = Measured valve clearance

[when the engine is cool (at normal temperature)]

t = Adjusting shim thickness

C₂ = Specified valve clearance

0.35 mm (0.0138 in)

2.40

3.05

• Measure near the center of the shim (the part that touches the

CAUTION:

camshaft).

t = t1 + (C1 - C2)

To prevent any remaining oil from being blown around, thoroughly wipe the area clean and wear protective goggles.

8. Remove the adjusting shim by using a magnetic hand.

 Stamped
 Shim thickness mm (in)

 2.35
 2.35 (0.0925)

New adjusting shims have the thickness stamped on the rear



11. Fix the selected adjusting shim to the valve lifter.

CAUTION:

side.

Place the stamped side of the adjusting shim to the valve lifter.

12. Compress the valve spring using the camshaft pliers and remove the lifter stopper.

2.40 (0.0945)

3.05 (0.1201)

- 13. Rotate the crankshaft 2 to 3 times by hand.
- 14. Confirm that the valve clearance is within the specification.



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- 15. Install baffle plate on top surface of No.3 and No.5 camshaft journal.
 - Tighten the mounting bolts in two steps in the order of center, and right and left.
- a. Tighten to 9.8 to 14.7 N·m (1.0 to 1.5 kg-m, 8 to 10 ft-lb).
- b. Tighten to 19.6 to 23.5 N·m (2.0 to 2.4 kg-m, 15 to 17 ft-lb).
- 16. Install remaining parts in reverse order of removal.

TIMING CHAIN

[ZD30DD]

TIMING CHAIN



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- CAUTION:
- Apply new engine oil to parts marked in illustration before installation.
- As the internal mechanism of the idler gear must first of all, and always, be set by a bolt when removing the timing chain before removing the fuel injection pump and timing gear, follow the procedures on, removal of timing chain after setting idler gear, in EM-129, "ELECTRONIC CONTROL FUEL INJECTION PUMP".
- This chapter will deal with the summary of removing the timing chain before removing the camshaft and cylinder head.

REMOVAL

- Remove the following parts.
 - Rocker cover (Refer to <u>EM-135, "ROCKER COVER"</u>)
 - Spill tube (Refer to EM-125, "INJECTION TUBE AND INJECTION NOZZLE")
 - Coolant (Drain)
 - Radiator upper hose

EM-147

- Water outlet
- Radiator shroud (Refer to <u>CO-36, "RADIATOR"</u>)
- Cooling fan (Refer to CO-42, "COOLING FAN")
- Drive belt (Refer to <u>EM-107, "DRIVE BELTS"</u>)
- Vacuum pipe and vacuum pump (Refer to EM-123, "VACUUM PUMP")
- 2. Move the following parts.
 - TDC sensor and harness
 - Power steering oil pump (Refer to PS-32, "POWER STEERING OIL PUMP")
- 3. Remove the chain cover.
 - Remove the holding bolts A to C shown in the figure.

CAUTION:

While the chain cover is removed, be careful not to allow entry of dust or foreign objects.









tor of the gear case to the timing mark of the crankshaft pulley.

4. Set the No. 1 cylinder to the compression TDC.

- b. Make sure that the camshaft sprocket mating mark is in the position shown in the figure.
 - If the mating mark is not in position, turn the crankshaft pulley once more and position it.

NOTE:

a.

When removing at No. 1 cylinder compression TDC, each sprocket and chain is fitted using the mating mark, therefore there is no need to apply any mating marks beforehand.

- 5. Remove the chain tensioner.
- Loosen upper and lower holding bolts. a.
- Holding the chain tensioner in your hand, remove the upper b. holding bolt and release the spring tension.
- Remove the lower holding bolt, then remove the chain tensioner. C. NOTE:

The chain tensioner does not have a mechanism which prevents the ejection of the plunger. (It does have a mechanism which prevents the plunger from returning.)

CAUTION:

Be careful not to drop the plunger and spring.

- 6. Remove the timing chain slack guide.
- 7. Remove the timing chain with camshaft sprocket.
 - Loosen the camshaft sprocket holding bolt by fixing the hexagonal portion of the intake manifold side camshaft with a spanner, etc.

CAUTION:

Do not loosen the holding bolt by using the tension of the chain.

8. Remove the timing chain tensioner guide.

INSPECTION AFTER REMOVAL

Timing Chain

Check timing chain for cracks and excessive wear at roller links. Replace chain if necessary.





INSTALLATION

- 1. Install the timing chain tensioner guide.
- 2. Install the camshaft sprocket and the timing chain together.
 - Install by aligning the sprocket and timing chain mating marks.
 - Tighten the camshaft sprocket holding bolt by fixing the hexagonal portion of the camshaft.

CAUTION:

Do not tighten in the holding bolt using the tension of the chain.

3. Install the timing chain slack guide.

CAUTION:

When the holding bolt is tightened to the specified torque, there is a gap between the guide and bolt. Do not overtighten.



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- 4. Install the chain tensioner.
- a. With the chain tensioner in the position shown in the figure (with the plunger on the outer side), temporarily tighten the holding bolt. (1 in figure)
- b. Press the plunger into the tensioner body while pressing on the clips which prevent the plunger from returning. (2 in figure)
- c. Install the upper side holding bolt while holding the plunger down with your finger and rotating it 180 degrees. (3 and 4 in figure)
- d. Tighten the holding bolt to the specified torque.
- 5. Install the chain cover.
- a. Before installing chain cover, apply liquid gasket to mating surface as shown.
 - Use genuine liquid gasket or equivalents.





A C C C A A C A C



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(0.039±0.020 in)

- b. Install the chain cover.
 - The length of the holding bolt will vary depending on the part.
 - A: 20 mm (0.79 in)
 - B: 50 mm (1.97 in)
 - C: 60 mm (2.36 in)
- 6. Install by following all removal procedures in reverse. **CAUTION:**
 - Arrange the TDC sensor harness in the position shown in the figure.
 - Make sure that the harness has no deflection around the vicinity of the crankshaft pulley when installing the clamp.

[ZD30DD]

TIMING GEAR

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Removal and Installation



1	Electronic control fuel injection pump	2	O-ring	3	Spacer
4	Gasket	5	Front plate	6	Seal washer
7	Fuel injection pump gear	8	Fuel injection pump sprocket	9	Balancer shaft (right)
10	Crankshaft gear	11	Balancer shaft (left)	12	O-ring
13	Gear case	14	TDC sensor	15	Bracket
16	Plug	17	Front oil seal	18	Crankshaft pulley
19	Drive belt auto tensioner	20	Bracket	21	O-ring
22	O-ring	23	O-ring	24	Gasket
25	Thrust plate	26	Idler gear (B)	27	Idler shaft
28	Thrust plate	29	Idler gear (A)	30	Idler shaft
31	Gasket	32	O-ring	33	Keys
	- ·· ·				

34 Oil jet

CAUTION:

Apply new engine oil to parts marked in illustration before installation.

REMOVAL

- 1. Drain engine coolant.
- 2. Remove the following parts:
 - Oil pan and oil strainer (Refer to EM-119, "OIL PAN AND OIL STRAINER")
 - Rocker cover (Refer to EM-135, "ROCKER COVER")
 - Spill tube (Refer to EM-125, "INJECTION TUBE AND INJECTION NOZZLE")
 - Radiator hose
 - Water outlet
 - Radiator shroud and radiator (Refer to CO-36, "RADIATOR")
 - Cooling fan (Refer to CO-42, "COOLING FAN")
 - Drive belt (Refer to <u>EM-107, "DRIVE BELTS"</u>)
 - Vacuum pump and vacuum pipe (Refer to EM-123, "VACUUM PUMP")
 - Alternator (Refer to <u>SC-11, "CHARGING SYSTEM"</u>)
- 3. Move the following parts:
 - TDC sensor harness
 - Power steering oil pump (Refer to PS-32, "POWER STEERING OIL PUMP")
 - A/C compressor (Refer to <u>MTC-94, "A/C CYCLE"</u>)
- 4. Remove the following parts:
 - A/C compressor bracket
 - Drive belt auto tensioner and idler pulley
- 5. Following steps below, secure inner mechanism (scissors gear structure) of idler gear (A).

CAUTION:

Always carry out this work. If timing gear contacting idler gear (A) is removed without performing this work, some difficulties will occur. Inner mechanism (scissors gear structure) of idler gear (A) is opened, resulting in idler gear (A) replacement.

a. Remove plug in front of gear case.



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- b. Rotate crank pulley clockwise. At the same time, check fixing bolt hole for inner mechanism of idler gear (A) from plug hole.
 - Visually check it using a mirror.

CAUTION:

Be careful not to check a wrong hole. Idler gear (A) has 2 extra holes (without thread) in addition to fixing hole.

Install fixing bolt [part No.: 08120-62028, bolt size: M6 (0.24 in), C. bolt length: 20 mm (0.79 in)] into fixing bolt hole for idler gear (A). Tighten it to specified torque below.

🕑 : 2.5 - 3.5 N·m (0.25 - 0.35 kg-m, 22 - 30 in-lb)

CAUTION:

a.

b.

NOTE:

CAUTION:

dropping them.

- Do not use a substitute for fixing bolt. Idler gear (A) may be broken.
- From this point, do not rotate crankshaft. Head of fixing bolt may interfere with gear case.
- Do not remove fixing bolt for idler gear (A) until timing chain and related parts have been installed.
- Paint mating marks onto camshaft sprocket, fuel injection pump 6. sprocket, and timing chain.
 - Paint mating marks onto easy-to-see places with oil-resistant method.
- 7. Paint mating marks onto fuel injection pump gear and idler gear.
 - Paint mating marks onto easy-to-see places with oil-resistant method.

While pressing chain tensioner by hand, remove upper mount-

Be careful to keep plunger and spring securely, avoiding

c. Remove lower mounting bolt, and remove chain tensioner.

popping out. (It has return stopping mechanism.)

Timing chain Marking 47 Camshaft Ē Fuel injection &Z sprocket 11 pump gear 0r Marking Markind THE DI ×Z Fuel injection pump Idler gear JEF264Z sprocket



Chain tensioner has no mechanism preventing plunger from



- 9. Remove timing chain slack guide.
- 10. Remove timing chain together with camshaft sprocket.

8. Following steps below, remove chain tensioner.

Loosen upper and lower mounting bolts.

ing bolt to relieve spring tension.

- Paint mating marks onto each sprocket and timing chain.
- While holding camshaft hexagon with a wrench, loosen cam sprocket mounting bolts.

CAUTION:

Do not loosen mounting bolts using chain tension.

11. Remove TDC sensor.

CAUTION:

- Handle it carefully without giving any impact.
- Do not place it where iron chips can adhere.
- Keep it clear of objects affected by magnetic fields.
- 12. Remove water pump. Refer to CO-43, "WATER PUMP" .



13. Remove crank pulley.

• Secure crankshaft by inserting hammer handle into gap around counter weight. Loosen mounting bolts to remove crank pulley.

CAUTION:

- Be careful not to damage crankshaft.
- Be careful to keep inside of engine clear of foreign materials.
- · Handle crank pulley carefully to avoid damaging or magnetizing protrusion for signal detection.



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- 14. Remove gear case.
 - There are 3 pry grooves (shown by arrows in figure) on gear case. Using grooves and a flat-bladed screwdriver or seal cutter (special service tool), remove gear case.
- 15. Remove front oil seal from gear case.
 - Using a flat-bladed screwdriver, remove it.

CAUTION:

Be careful not to damage gear case.



- 16. Remove each timing gear.
 - Before removal, check backlash between each two gears. Refer to EM-155, "INSPECTION AFTER REMOVAL".

CAUTION:

- Do not loosen inner mechanism fixing bolt of idler gear (A). (If inner mechanism is opened, idler gear cannot be reused.)
- After removing idler gears (A) and (B), do not face rear side downward. Idler main shaft will drop.
- Use a pulley holder (special service tool). While securing fuel injection timing gear with pulley holder, loosen mounting bolts.



Pull balancer shaft straight out to avoid damaging bushing inside of cylinder block.

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- 17. Remove electronic control fuel injection pump. Refer to <u>EM-129, "ELECTRONIC CONTROL FUEL</u> <u>INJECTION PUMP"</u>.
- 18. Remove front plate.

INSPECTION AFTER REMOVAL

Backlash of Each Gear

Method using a fuse wire

- Tighten the holding bolts of each gear to specification.
- Place a wire in the biting area of the teeth between the gears to be checked, rotate the crankshaft in the operating direction so that the wire is taken inwards.
- Measure the crushed area of the wire with a micrometer.





Method using dial gauge

- Tighten the holding bolts of each gear to specification.
- Place the dial gauge on the tooth surface area of the gear to be checked.
- With the other gear in a set position, measure the dial gauge value while moving the gear left and right.

Standard : 0.07 - 0.11 mm (0.0028 - 0.0043 in) Limit : 0.20 mm (0.0079 in)

- If it exceeds the limit, replace the gear and measure again.
- If it exceeds the limit again, check for the installation condition of the gear driving parts, wear of shaft and gear, and oil clearance.

Idler Gear End Play

- Tighten the holding bolts to the specification.
- Measure the clearance between the gear plate and idler gear using a feeler gauge.

0		0
Unit:	mm	(in)

	Standard	Limit
Idler gear (A)	0.06 - 0.12 (0.0024 - 0.0047)	0 15 (0 0059)
Idler gear (B)		0.13 (0.0033)

• If it exceeds the limit, replace the idler gear, shaft, and gear plate.

Idler Gear Oil Clearance

• Measure the inner diameter (d1) of the idler gear shaft.

```
Standard:

Idler gear (A)

43.000 - 43.020 mm (1.6929 - 1.6937 in) dia.

Idler gear (B)

28.600 - 28.620 mm (1.1260 - 1.1268 in) dia.
```

• Measure the outer diameter (d2) of the idler shaft.

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Standard:
Idler gear (A)
42.959 - 42.975 mm (1.6913 - 1.6919 in) dia.
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Idler gear (B)

- 28.567 28.580 mm (1.1247 1.1252 in) dia.
- Calculate the oil clearance. Clearance = d1 - d2

Unit: mm (in)

	Standard	Limit
Idler gear (A)	0.025 - 0.061 (0.0010 - 0.0024)	0.2 (0.0079)
Idler gear (B)	0.020 - 0.053 (0.0008 - 0.0021)	0.2 (0.0073)

• If it exceeds the limit, refer to each standard specification and replace the idler gear and/or shaft.

Balancer Shaft End Play

• Measure the clearance between the plate and gear using a feeler gauge.

Standard : 0.07 - 0.22 mm (0.0028 - 0.0087 in)

If it exceeds the specification, replace the balancer shaft assembly.

NOTE:

As the gears are press-fitted, there are no service setting for individual parts.



Outer diameter of balancer shaft journal

Measure the outer diameter of the balancer shaft journal with a micrometer.

Standard:

Front side

50.875 - 50.895 mm (2.0029 - 2.0037 in) dia.

Rear side

50.675 - 50.695 mm (1.9951 - 1.9959 in) dia.

Inner diameter of balancer shaft bearing

Measure the inner diameter of the balancer shaft bearing using a bore gauge.

Standard:

Front side

50.940 - 51.010 mm (2.0055 - 2.0083 in) dia.

Rear side

50.740 - 50.810 mm (1.9976 - 2.0004 in) dia.

Oil clearance calculations

(Oil clearance) = (Bearing inner diameter) – (Journal outer diameter)

Standard	: 0.045 - 0.135 mm (0.0018 - 0.0053 in)
Limit	: 0.180 mm (0.0071 in)







INSTALLATION

- 1. Install the front plate.
- a. Install the O-ring and gasket to the cylinder block.
- b. Install the front plate.
 - Lightly tap with a hammer if the dowel pin cannot be inserted easily.



Make sure that the O-ring does not pop out.

- c. Apply liquid gasket with a spreader between the cylinder block plate under the cylinder block (oil pan side) and the front plate (shown by the arrows in the figure).
- 2. Install the electronic control fuel injection pump. Refer to <u>EM-132</u>, "INSTALLATION" .
 - After installing the fuel pump to the front plate, align the 6 mm (0.24 in) dia. hole of the pump flange and the 6 mm (0.24 in) dia. hole position of the pump body.
- 3. Install each timing gear.
 - Align the match marks of the timing gears by referring to the figure below.





- 4. Install the front oil seal to the gear case.
 - Apply engine oil to the fitting side.
 - Evenly insert the front oil seal using a drift [outer dia.: approx. 64 mm (2.52 in)] completely.

CAUTION:

Make sure the oil seal does not spill off the end side of the gear case.



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5. Install the gear case.

- a. Before installing gear case, apply liquid gasket to mating surface as shown.
- b. Install the O-rings to the gear case.
- c. Install the gasket to the gear case.
- d. Install the gear case.
 - Tap the area around the dowel pin with a plastic hammer if it cannot be inserted easily.

CAUTION:

Do not pop out the O-rings.

e. Install the holding bolt referring to the figure.

Bolt length:

- A: 30 mm (1.18 in)
- B: 50 mm (1.97 in)
- C: 80 mm (3.15 in)
- f. Install the holding bolts from the rear side of the front plate.



- 6. Install the crankshaft pulley.
 - Insert by aligning the 2 flat face of the oil pump with the 2 flat face of the shaft on the rear side of the crankshaft pulley.

CAUTION:

Do not damage the oil seal lip when inserting.

7. Install the water pump. Refer to CO-43, "WATER PUMP" .

- Install it before installing the TDC sensor.
- 8. Install the TDC sensor.
 - Align the bracket knock pin with the hole on the gear case side and tighten the holding bolt.
 - Confirm that the clearance between the end of the sensor and the signal detection protrusion of the crankshaft pulley is within the specification.

Standard: $1 \pm 0.5 \text{ mm} (0.039 \pm 0.020 \text{ in})$

Arrange the TDC sensor harness to the position shown in the figure.

CAUTION:

Confirm that the harness has no deflection around the crankshaft pulley when installing the clamp.

- 9. Install the camshaft sprocket and timing chain at the same time.
 - Align the mating marks of the fuel injection pump sprocket and camshaft sprocket, and install the timing chain.
 - Holding the hexagon head of the camshaft with wrench, tighten the camshaft sprocket installation bolt.

CAUTION:

Do not tighten the installation bolt using a chain tension.

10. Install the timing chain, related parts, and the chain cover. Refer to <u>EM-147, "TIMING CHAIN"</u>.





EM-158

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- 11. Remove the internal mechanism setting bolt of the idler gear (A).
- 12. Apply liquid gasket to the plug thread.
- 13. Install remaining parts in reverse order of removal.



On-Vehicle Service CHECKING COMPRESSION PRESSURE

- 1. Warm up engine thoroughly. Then, stop it.
- 2. Using CONSULT-II, make sure no error codes are indicated for self-diagnosis items. Refer to <u>EC-204</u>, <u>"TROUBLE DIAGNOSIS BASIC INSPECTION"</u>.
 - Do not disconnect CONSULT-II until the end of this operation; it will be used to check engine rpm and for error detection at the end of this operation.
- 3. Disconnect the negative battery terminal.
- 4. Remove the following parts.
 - Rocker cover (Refer to EM-135, "ROCKER COVER" .)
- 5. To prevent fuel from being injected during inspection, remove fuel injection pump fuse [ENG CONT (20A)] from fuse box on the right side of engine compartment.
 - Among marks on fuse box, [ENG CONT2 (20A)] is for fuel injection pump fuse.
- Remove glow plugs from all the cylinders. Refer to <u>EM-121,</u> <u>"GLOW PLUG"</u>.

CAUTION:

- Before removal, clean the surrounding area to prevent entry of any foreign materials into the engine.
- Carefully remove glow plugs to prevent any damage or ^L breakage.
- Handle with care to avoid applying any shock to glow plugs.
- 7. Install adapter to installation holes of glow plugs and connect compression gauge for diesel engine.

🖸 : 14.7 - 19.6 N·m (1.5 - 2.0 kg-m, 11 - 14 ft-lb)

- 8. Connect battery negative terminal.
- Set the ignition switch to "START" and crank. When gauge pointer stabilizes, read compression pressure and engine rpm. Repeat the above steps for each cylinder.
 - Always use a fully-charged battery to obtain specified engine speed.
 Unit: kPa (bar, kg/cm, psi)/rpm

Standard	Minimum	Difference limit between cylinders
2,942 (29.42, 30.0, 427)/ 200	2,452 (24.52, 25.0, 356)/ 200	294 (2.94, 3.0, 43)/200

- When engine rpm is out of the specified range, check the specific gravity of battery liquid. Measure again under corrected conditions.
- If engine rpm exceeds the limit, check valve clearance and combustion chamber components (valves, valve seats, cylinder head gaskets, piston rings, pistons, cylinder bores, cylinder block upper and lower surfaces) and measure again.
- If compression pressure is low in some cylinders, apply engine oil from glow plug installation hole. Then check pressure again.
- If compression pressure becomes normal after applying oil, piston ring may be worn or damaged. Check piston ring for malfunction. If any, replace piston ring.
- If compression pressure is still low after applying oil, valve may be malfunctioning. Check valve for malfunction. If contact malfunction is found, replace valve or valve seat.
- If compression pressure in adjacent two cylinders is low after applying oil, pressure may be leaking from gasket. In this case, replace cylinder head gasket.





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- b. Disconnect battery negative terminal.
- c. Install glow plug and install all the parts removed in step 4.
 CAUTION:
 Replace glow plug oil seal with new one Refer to FM-121

Replace glow plug oil seal with new one. Refer to <u>EM-121, "GLOW PLUG"</u>, <u>EM-135, "ROCKER</u> <u>COVER"</u>.

- d. Install fuel injection pump fuse [ENG CONT (20A)].
- e. Connect battery negative terminal.
- f. Using CONSULT-II make sure no error code is indicated for items of self-diagnosis.

Removal and Installation



CAUTION:

Apply new engine oil to parts marked in illustration before installation.

REMOVAL

- 1. Remove drain coolant.
- 2. Remove the following parts:
 - Rocker cover (Refer to EM-135, "ROCKER COVER")
 - Injection tube, spill tube and injection nozzle (Refer to <u>EM-125, "INJECTION TUBE AND INJECTION</u> <u>NOZZLE"</u>)

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- Intake manifold collector and intake manifold (Refer to <u>EM-113</u>, "INTAKE MANIFOLD COLLECTOR <u>AND INTAKE MANIFOLD</u>")
- Exhaust manifold (Refer to EM-117, "EXHAUST MANIFOLD")
- Timing chain (Refer to EM-147, "TIMING CHAIN")
- Camshaft (Refer to EM-138, "CAMSHAFT")
- 3. Remove mounting bolts of the gear case and water pump as shown by arrows in the figure.



- 4. Remove oil return tube from cylinder head rear side.
- 5. Remove cylinder head assembly.
 - Loosen and remove mounting bolts in the reverse order shown in the figure.
 - Lift up the cylinder head assembly to avoid interference with dowel pins located between the block and head, and remove cylinder head assembly.

CAUTION:

- Do not drop the O-ring located between the front of cylinder head and the rear of gear case into the engine.
- Remove glow plug in advance to avoid damage as the tip of the glow plug projects from the bottom of the cylinder head, or, place wood blocks beneath both ends of the cylinder head to keep the cylinder bottom from any contact.
- For glow plug removal, the following shall be noted.

CAUTION:

- To avoid breakage, do not remove glow plug unless necessary.
- Perform continuity test with glow plug installed.
- Keep glow plug from any impact. (Replace if dropped from a height 10 cm (3.94 in) or higher.)
- Do not use air impact wrench.

6. Remove idler gear.

CAUTION:

While removing idler gear, keep the rear of idler gear facing up to prevent idler shaft from falling.

INSPECTION AFTER REMOVAL

Cylinder Head Bolt Deformation

- Using micrometer, measure the outer diameters d1 and d2 of bolt thread as shown in the figure.
- If the necking point can be identified, set it as measuring point d2.
- Calculate the difference between d1 and d2.

Limit: 0.15 mm (0.0059 in)

• If out of the limit, replace cylinder head bolt.





Idler Gear End Play

- Tighten mounting bolts to the specified torque.
- Using feeler gauge, measure the clearance between gear plate and idler gear.

Standard:0.07 - 0.14 mm (0.0028 - 0.0055 in)Limit:0.2 mm (0.0079 in)

• If the measured value exceeds the limit value, replace idler gear, shaft, and gear plate.

Idler Gear Oil Clearance

• Measure the inner diameter (d1) of idler gear shaft hole.

Standard: 26.000 - 26.020 mm (1.0236 - 1.0244 in)

• Measure the outer diameter (d2) of idler shaft.

Standard: 25.967 - 25.980 mm (1.0223 - 1.0228 in)

• Calculate gear clearance. (Clearance) = (d1) - (d2)

Standard:0.023 - 0.053 mm (0.0009 - 0.0021 in)Limit:0.1mm (0.004 in)

• If out of the limit, replace idler gear or idler shaft, or both.

INSTALLATION

- 1. Install cylinder head gasket.
 - Cylinder head gasket to be installed is selected by its thickness through the following procedure.
 - When replacing gasket only
 - Install gasket with same thickness as the one removed.
 - Gasket thickness is identified by the number of notches located on rear-left side.

Grade	Gasket thickness* mm (in)	No. of notches
1	0.65 (0.0256)	1
2	0.70 (0.0276)	2

*: Thickness of gasket tightened with head bolts

 The number of notches can be checked at the position shown in the figure before cylinder head is removed. (It is necessary to remove exhaust manifold.)



- When repairing/replacing the following
- When the top of cylinder block or crankshaft pin/journal is ground





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- When cylinder block, piston, connecting rod, or crankshaft is replaced
- a. Move piston toward TDC.
- b. Position dial indicator on cylinder block as shown in the figure, and adjust the needle to "0".
- c. Move dial indicator stand aside, and position the dial indicator to the measuring point as shown in the figure.
- d. Rotate crankshaft slowly, and read the value on dial indicator at piston's maximum height.
- e. Repeat above procedure at 2 positions of each cylinder (8 positions in total for 4 cylinders), and select the appropriate gasket by comparing the maximum crown depression with the table.



Grade	Piston crown depression	Gasket thickness*	No. of notches
1	More than 0.078 mm (0.0031 in)	0.65 mm (0.0256 in)	1
2	Less than 0.078 mm (0.0031 in)	0.70 mm (0.0276 in)	2

*: Thickness of gasket tightened with head bolts

- 2. Install idler gear and idler shaft.
 - Check that the counter marks with camshaft gear, "AA" and "BB", are located on the front side of the engine. Refer to Component Parts Illustration.

CAUTION:

Since idler gear cannot be installed or removed with cylinder head assembly mounted on the engine because of interference with gear case, make sure that there are no reverse installations or uninstalled parts.

- 3. Install cylinder head assembly.
- a. Attach gasket onto the rear of gear case.
- b. Install O-ring to the rear of gear case.
- c. Align cylinder head assembly with dowel pin of cylinder block and install.

CAUTION:

- Make sure the O-ring does not fall off. Be careful not to drop the O-ring.
- Do not damage gasket located at the front.
- 4. Position cylinder head assembly close to the rear of the gear case.
- a. Install cylinder head bolts to the front and rear of cylinder head respectively, and tighten to the specified torque.

🖸 : 39.2 - 49.0 N·m (4.0 - 5.0 kg-m, 29 - 36 ft-lb)

- b. Loosen cylinder head bolts completely.
- c. Install gear case mounting bolts to 2 positions shown by arrows in the figure, and tighten to the specified torque.

(1.0 kg-m, 87 in-lb)





- 5. Tighten cylinder head bolts in the order indicated in the figure.
- Apply engine oil to installation bolt threads and washers. a.
- Tighten bolts to 98.1 to 103 N·m (10.0 to 10.5 kg-m, 73 to 75 ftb. lb).
- Loosen bolts completely until the torque becomes 0 N·m (0 kgc. m, 0 in-lb).

CAUTION:

8. Install glow plug.

bolt is installed again.

9.

For procedure "c", loosen bolts in the reverse order as indicated in the figure.

- Tighten bolts to 39.2 to 44.1 N·m (4.0 to 4.5 kg-m, 29 to 32 ft-lb). d.
- Tighten bolts at the angle of 90 to 95° (target is 90°). (Angle e. tightening)
- f. Once again, tighten bolts at the angle of 90 to 95° (target is 90°). (Angle tightening) **CAUTION:**

Perform the following procedure to check turning angle of angle tightening, and do not judge by visual check.

- Make counter marks on the bolt head of cylinder head and cylinder head surface with paint, and check the turning angle.
- Check the turning angle using angle indicator of angle wrench.

• Do not install 2 different types of glow plugs in the engine.

• Using reamer, remove the carbon adhering to the installation

- 6. Loosen gear case mounting bolts which were tightened in "c" of procedure 4, retighten them to the specified torque.
- 7. Install water pump installation bolt (removed at step 3).

parallel. (Refer to the figure for identification.)

hole of glow plug, and install glow plug. Install oil return tube to cylinder head rear side.

Make sure that the same glow plugs are installed.







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Disassembly and Assembly



CAUTION:

Apply new engine oil to parts marked in illustration before installation.

DISASSEMBLY

- 1. Remove adjusting shims and valve lifters.
 - Check the installation positions, and keep them to avoid being confused.
- 2. Remove valve
 - Using valve spring compressor, compress valve spring. Using magnetic hand, remove valve collets.
- Remove valve spring retainers and valve springs.
- 4. Remove valves as pressing valve stems toward combustion chamber.
 - Before removing the valve, check the valve guide clearance. Refer to EM-168, "Valve Guide Clearance" .
 - Check installation positions, and keep them to avoid being confused.

NOTE:

Refer to the figure for intake and exhaust valve positions. (Intake and exhaust valve driving cams are provided alternately for each camshaft.)





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- 5. Remove valve oil seals using valve oil seal puller.
- Remove valve spring seats. 6.
- 7. Before removing valve spring seats, perform valve seat contact check. Refer to EM-169, "Valve Seat Contact"
- Before removing valve guides, perform valve guide clearance 8. check. Refer to EM-168, "Valve Guide Clearance" .

ASSEMBLY

- 1. Install valve guides, refer to EM-168, "Valve Guide Clearance".
- Install valve seats, refer to EM-169, "Valve Seat Contact" . 2.
- 3. Using valve oil seal drift, install valve oil seals referring to the dimension shown in the figure.
 - The figure shows the dimension before valve spring seats are installed.
- 4. Install valve spring seats.
- 5. Install valves.
 - Install the valves with bigger openings to intake valve side.
 - Note that valve layout here is different from that of conventional the engine.
- Install valve spring.
 - When installing valve spring, make sure that a smaller pitch side (identification paint-applied side) faces the cylinder head.

Identification color : Pink

- 7. Install valve spring retainers.
- 8. Using valve spring compressor, compress valve springs. Then install valve collets using magnetic hand, .
 - After installing valve collets, tap the stem end using a plastic hammer, and check the installation status.
- 9. Install valve lifters and adjusting shims to the same positions as before.

INSPECTION AFTER DISASSEMBLY **Cylinder Head Distortion**

Using straightedge and feeler gauge, check the bottom of the cylinder head for distortion.

Limit : 0.2 mm (0.008 in)



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Cylinder Head

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Valve Dimension

Using micrometer, measure the dimensions of each part.

Standard:

Intake valve Exhaust valve a: 113.5mm (4.47 in) 113.5 mm (4.47 in) b: 3.8 - 4.2 mm 3.8 - 4.2 mm

- (0.150 0.165 in) (0
- c: 1.5 mm (0.059 in)
- d: 6.962 6.977 mm (0.2741 - 0.2747 in)
- D: 31.9 32.1 mm (1.256 - 1.264 in)

α: **45°00 - 45°30**′

- (0.150 0.165 in) 1.5 mm (0.059 in) 6.945 - 6.960 mm
- (0.2734 0.2740 in)
- 29.9 30.1 mm
 - (1.177 1.185 in)
- 45°00 45°30′



Valve Guide Clearance

- Perform the inspection before removing valve guides.
- Check that the valve stem diameter is within specifications.
- Push valve approximately 25 mm (0.98 in) toward combustion chamber, move valve toward dial indicator to measure valve movement.
- Valve guide clearance is 1/2 of movement on dial indicator.

Standard:

Intake : 0.023 - 0.053 mm (0.0009 - 0.0021 in) Exhaust : 0.040 - 0.070 mm (0.0016 - 0.0028 in) Limit: Intake : 0.18 mm (0.0071 in) Exhaust : 0.10 mm (0.0039 in)

• If the measured value exceeds the limit, replace valve guide.

Valve Guide Replacement

- There is no setup for oversized valve guide.
- 1. Heat cylinder head to 110 to $130^{\circ}C$ (230 to $266^{\circ}F$) in oil bath.

2. Using valve guide drift, tap valve guides out from the combustion chamber side.









Heat cylinder head to 110 to 130°C (230 to 266°F) in oil bath.

side, referring to the dimension shown in the figure.

Using valve guide drift, press fit valve guides from camshaft

Reaming specifications: Intake and Exhaust 7.000 - 7.015 mm (0.2756 - 0.2762 in) .008

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Valve Seat Contact

3.

4.

Check valve seat for any evidence of pitting at valve contact surface, and reseat or replace if worn out excessively.

When repairing valve seats, check valve and valve guide for wear beforehand. If worn, replace them. Then check valve seat.



Valve Seat Replacement

- When removing valve seat, replace it with oversized [0.5 mm (0.0020 in)] valve seat.
- Cut valve seat to make it thin, and pull it out. 1.
- 2. Machine cylinder head inner diameter at valve seat installation position.

Machining dimension:

Intake

33.500 - 33.515 mm (1.3189 - 1.3195 in) dia.

Exhaust

31.995 - 32.010 mm (1.2596 - 1.2602 in) dia.

- 3. Heat cylinder head to approximately 110 to 130°C (230 to 266°F) in oil bath.
- 4. After cooling valve seats sufficiently with dry ice, press fit it to cylinder head. **CAUTION:**

Do not touch the cooled valve seats directly by hand.





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5. Using valve seat cutter, finish processing referring to the dimensions shown in the figure.

CAUTION:

When using valve seat cutter, grasp cutter handle with both hands, press cutter onto contacting face all around, and cut thoroughly. If cutter is pressed unevenly or repeatedly, the valve seat surface may be damaged.

6. Using compound, perform valve fitting.



7. Check again to make sure that contacting status is satisfactory. For details, Refer to <u>EM-198, "Valve Seat"</u>.



Valve Spring Squareness

Position a straightedge to valve spring, turn the spring, and measure the maximum clearance value between top surface of spring and the straightedge.

Limit: 2.4 mm (0.0945 in)



Valve Spring Dimensions and Valve Spring Pressure Load

Using valve spring tester, check the following.

Free length	: 55.43 mm (2.1823 in)
Installation height	: 40.8 mm (1.6063 in)
Installation load	: 180 - 206 N (18.4 - 21.0 kg, 40.6 - 46.3 lb)



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ENGINE ASSEMBLY

PFP:10001

EBS006FQ

[ZD30DD]

Removal and Installation



- Rear engine mounting bracket
 RH engine mounting insulator
- Rear engine mounting insulator
 LH engine mounting bracket
- 3. RH engine mounting bracket
- 6. RH engine mounting insulator

WARNING:

- Situate vehicle on a flat and solid surface.
- Place chocks at front and back of rear wheels.
- For engines not equipped with engine slingers, attach proper slingers and bolts described in PARTS CATALOG.

CAUTION:

- Always be careful to work safely, avoid forceful or uninstructed operations.
- Do not start working until exhaust system and coolant are cool enough.
- For work items that are not covered by the engine main body section, refer to the applicable sections.
- Always use the support point specified for lifting.
- Use either 2-pole lift type or separate type lift as best you can. If board-on type is used for unavoidable reasons, support at the rear axle jacking point with transmission jack or similar tool before starting work, in preparation for the backward shift of center of gravity.
- For supporting points for lifting and jacking points, refer to GI-36, "Garage Jack and Safety Stand"

REMOVAL

Outline

At first, remove engine transmission assembly with suspension member downward. Then separate engine from transmission.

Preparation

1. Remove floor cover (behind RH and LH seats).

ENGINE ASSEMBLY

Rer	moval	
10.	with steering knuckle. Refer to FSU-15, "FRONT SUSPENSION MEMBER".	
ษ. 10	Remove suspension lower arm at suspension member and lower end of damper to make them movable.	
ö. 0	Remove cross member under on pan. Refer to FSU-15, "FRONT SUSPENSION MEMBER".	
0	brake hose overload. Refer to <u>BR-21, "FRONT DISC BRAKE"</u> .	
7.	Remove brake caliper from steering knuckle, and temporarily fasten it on vehicle with a rope to prevent brake base sworlead. Befor to PR 31. "EPONT DISC PRAKE"	
6.	Disconnect rear heater coolant piping at between vehicle and engine transmission assembly. (For vehi-	
5.	Disconnect shift control wires from transmission, and temporarily fasten it aside work easy. Refer to TRANSMISSION/TRANSAXLE, <u>MT-10, "CONTROL LINKAGE"</u> .	
4.	Remove clutch operating cylinder from transmission, and temporarily fasten it aside work easy. Refer to TRANSMISSION/TRANSAXLE, <u>CL-10</u> , <u>"OPERATING CYLINDER"</u> .	
3.	Disconnect all the harnesses from transmission, and temporarily fasten them on vehicle.	
2.	Remove rear propeller shaft. Refer to <u>PR-3, "REAR PROPELLER SHAFT"</u> .	M
1.	Disconnected exhaust front tube and bracket on transmission.	
Veł	nicle Underbody	L_
3.	Disconnect engine ground cable located above front end of transmission from vehicle. (In the figure, they are secured with rope. This is an example.)	I
2.	Disconnect harness connector from EGR volume control valve, and move harness onto vehicle.	K
1.	Disconnect S-terminal and B-terminal from starter motor, and move harness onto vehicle.	
Eng	gine Room Rear Side	
3.	Remove power-assisted steering oil pump from engine. Temporarily fasten it on vehicle with a rope to prevent pipe overload. Refer to <u>PS-32</u> , "POWER STEERING OIL PUMP" .	J
2.	Disconnect PCV hose and air hose (between engine RH-side and vehicle). Refer to <u>EM-110, "AIR</u> <u>CLEANER AND AIR DUCT"</u> .	
	Fit plugs onto disconnected hoses to prevent oil leak.	
	CAUTION:	П
⊏n (Une κουπ κπ Disconnect fuel feed and return hoses above air duct in engine compartment, and move them aside	
ა. ნო	Disconnect all the hoses (ex. vacuum hose) connected to vehicle at engine-side.	
2.	Disconnect neater nose from neater pipe, and fit a plug onto hose end to prevent coolant leak.	G
•	C pipe overload.	
1.	Remove A/C compressor from engine, and temporarily fasten it on vehicle with a rope. This will prevent A/	F
Fn		
9.	Disconnect engine harness from engine, and temporarily fasten it aside to make on-vehicle work easy.	<u> </u>
8	Drain engine coolant Refer to CO-32 "ENGINE COOLANT"	F
	 Drive beits (Refer to <u>EWI-107</u>, <u>DRIVE BELIS</u>) Reservoir tank, radiator shroud and radiator (Refer to CO-36, "PADIATOP".) 	
	Front tire of right and left Drive belte (Refer to EM 107, "DRIVE RELIES")	D
	Front and rear side under cover	
	 Plate (radiator under side) 	C
7.	Remove following parts.	C
6.	Remove engine room RH cover and engine room rear cover. Refer to <u>EM-105</u> , " <u>ENGINE ROOM COVER</u> ".	
5.	Remove RH seat. Refer to <u>SE-4, "FRONT SEAT"</u> .	
4.	Open engine room LH cover and fasten it.	
3.	Disconnect battery negative terminal.	А
2.	Remove fuel filler cap to relieve inner pressure in fuel tank.	

1. Using 2 transmission jacks, securely hold engine and transmission from bottom.

EM-173

CAUTION:

- Adjust height of lift as low as possible to allow workers to carry out further underbody work. In
 addition, lift shall be able to raise more (so that engine top can come out of vehicle underbody.)
- If necessary, secure jacks and supported faces to prevent a slip. (An example in the figure uses a rope to secure.)
- 2. Pull off rear engine mount through bolt at top of transmission.
- 3. Remove suspension member mounting bolts. Refer to <u>FSU-15</u>, <u>"FRONT SUSPENSION MEMBER"</u>.

4. Carefully raise lift to remove engine transmission assembly from vehicle.

NOTE:

Figure shows 2-post lift, using 2 transmission jacks and safety stands at front and rear (rear view is omitted). This is only an example.

CAUTION:

- When carrying out this work, be sure to check any parts for interfering vehicle body.
- Be sure to check that all the applicable connections have been properly disconnected.
- Be careful to prevent vehicle from dropping from lift. Change in center of gravity or unexpected behavior of vehicle may cause the problem. (Refer to CAUTION mentioned above.)

[Disassemble Work]

Following shows disassemble work on level ground.

CAUTION:

During this work, always support bottom with a piece of wood. Suspend engine slings with a hoist. Be sure to check safety of work at any time.

- 1. Install engine slings onto front left of cylinder head.
 - **CAUTION:**

Use specified service parts for engine slings and mounting bolts.

🖸 : 35.3 - 45.1 N·m (3.6 - 4.6 kg-m, 26 - 33 ft-lb)

NOTE:

For rear-side (rear right of cylinder head), use original parts.

2. Hook hoisting attachment onto engine slings at front and rear. Then suspend with a hoist to lower it to floor.

CAUTION:

Always support bottom with a piece of wood to ensure safety.

3. Remove engine transmission assembly from suspension member. **CAUTION:**

Always support bottom with a piece of wood to ensure safety.

- 4. Remove starter motor. Refer to <u>SC-21, "STARTING SYSTEM"</u>.
- 5. Separate engine from transmission. Refer to MT-13, "TRANSMISSION ASSEMBLY".

INSTALLATION

Following instructions below, install in reverse order of removal.







•	Securely insert locating pin into mating holes and cutouts.	
•	Handle each mount insulator carefully, preventing oil contamination and damage.	А
•	No twisting or imbalance of right and left thickness shall be observed in mount insulator after installation.	
INS	SPECTION AFTER INSTALLATION	
•	Before starting engine, check for coolant level and lubrication/hydraulic oil/fluid levels. If necessary, fill it up to specified amount.	
•	Before starting engine, bleed air from fuel piping. Refer to FL-4, "FUEL FILTER (ZD30DD)".	\sim
•	Start engine, and check for abnormal noise and vibration.	C
•	Warm up engine sufficiently, and check there is no leak of coolant, lubrication/hydraulic oil/fluid, fuel, and/	
	or exhaust emission.	D
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CYLINDER BLOCK

[ZD30DD]

CYLINDER BLOCK

PFP:11010

EBS006FR

Disassembly and Assembly



CYLINDER BLOCK

[ZD30DD]

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1	Rear oil seal and retainer assembly	2	Oil pressure switch	3	Washer	A
4	Oil jet relief valve	5	Cylinder block	6	Top ring	
7	Second ring	8	Oil ring	9	Oil jet	
10	Piston pin	11	Snap ring	12	Piston	EM
13	Main bearing	14	Thrust bearing	15	Connecting rod	
16	Кеу	17	Connecting rod bearing	18	Connecting rod cap	
19	Connecting rod nut	20	Lower cylinder block sub bolt	21	Lower cylinder block main bolt	0
22	Lower cylinder block sub bolt	23	Lower cylinder block	24	Main bearing	C
25	Crankshaft	26	Rear plate	27	Pilot bush	
28	Flywheel	29	Drain plug			D
						D

CAUTION:

Apply new engine oil to parts marked in illustration before installation.

DISASSEMBLY

- Remove engine assembly from the vehicle, then separate engine and transmission. Refer to <u>EM-172</u>, <u>"ENGINE ASSEMBLY"</u>.
- 2. Remove clutch cover and disk. Refer to <u>CL-14, "CLUTCH DISC,</u> <u>CLUTCH COVER AND FLYWHEEL"</u>.
- 3. If they need to be replaced, replace pilot bushing.
 - Using pilot bushing puller, remove the bushing from rear edge of crankshaft.



- 4. Install engine to engine stand as follows.
- a. Remove flywheel.
- b. Secure ring gear with ring gear stopper, then loosen and remove installation bolt.
- c. Remove rear plate.



- d. Install engine sub-attachment to the rear side of cylinder block.
 - Align knock pins on cylinder block with pin holes on attachment to install.

NOTE:

Installation bolts are part of engine sub-attachment.

e. Install engine attachment.

NOTE:

Use commercially available M12 (0.47 in) mounting bolts and nuts (4 sets) with strength grade of 9T (minimum).



[ZD30DD]

f. Hoist engine and install it to the engine stand. **NOTE:**

It is possible to set engine sub-attachment and engine attachment to engine stand, then install engine later.



• Commercial engine stand can be used.

NOTE:

The figure shows an example of general-purpose engine stand that can hold mating surface of transmission with drive plate and rear plate removed.



- 5. Drain engine oil and coolant from inside engine.
- 6. Remove the following parts and related parts. (Only major parts are listed.)
 - Intake manifold collector and intake manifold (Refer to <u>EM-113, "INTAKE MANIFOLD COLLECTOR</u> <u>AND INTAKE MANIFOLD"</u>)
 - Exhaust manifold (Refer to <u>EM-117</u>, "EXHAUST MANIFOLD")
 - Rocker cover (Refer to <u>EM-135, "ROCKER COVER"</u>)
 - Injection tube and injection nozzle (Refer to EM-125, "INJECTION TUBE AND INJECTION NOZZLE")
 - Oil pan and oil strainer (Refer to EM-119, "OIL PAN AND OIL STRAINER")
 - Water pump (Refer to CO-43, "WATER PUMP")
 - Thermostat and water piping (Refer to CO-45, "THERMOSTAT AND WATER PIPING")
 - Vacuum pump and vacuum pipe (Refer to EM-123, "VACUUM PUMP")
 - Timing chain (Refer to EM-147, "TIMING CHAIN")
 - Timing gear (Refer to <u>EM-151, "TIMING GEAR"</u>)
 - Electronic control fuel injection pump (Refer to <u>EM-129, "ELECTRONIC CONTROL FUEL INJECTION</u> <u>PUMP"</u>)
 - Camshaft (Refer to <u>EM-138, "CAMSHAFT"</u>)
 - Cylinder head (Refer to EM-160, "CYLINDER HEAD")
 - Oil cooler (Refer to LU-20, "OIL COOLER")
 - Accessory, accessory bracket and mount brackets

EM-178

7. Remove rear oil seal and retainer assembly.

• Insert slotted screwdriver into lower sealing block and rear oil seal retainer to remove them. **NOTE:**

Oil seal alone is not available as a service parts.

- 8. Remove piston and connecting rod assembly.
 - Before removing piston and connecting rod assembly, check connecting rod side clearance.
 Refer to EM-186, "Connecting Rod Side Clearance".
- a. Move crankshaft pin to be removed to approximately BDC.
- b. Remove connecting rod caps.
- c. Using the grip of a hammer, press the piston and connecting rod assembly out to cylinder head side.



CAUTION:

When removing the piston and connecting rod assembly, prevent the big end of the connecting rod from interfering with the oil jet.

- 9. Remove connecting rod bearings from connecting rods and caps.
 - Keep them by cylinder to avoid confusion.



- 10. Remove piston rings from pistons using piston ring expander.
 - When removing, prevent pistons from being damaged.
 - Do not expand piston rings excessively. This may damage the piston rings.



Long-nose pliers PBIC0388E

- 11. Remove pistons from connecting rods.
- a. Using long nose pliers, remove snap rings.

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b. Using industrial dryer, heat pistons up to 60 to 70°C (140 to $158\,^{\circ}\text{F}).$



c. Using rod with outer diameter of 30 mm (1.18 in), press piston pins out.









- 12. Remove lower cylinder block.
 - The lower cylinder block is the lower part of the cylinder block, which works as the main bearing cap (beam) and oil pan mounting face.
- a. Remove mounting bolts for engine sub-attachment shown by arrows in the figure.
- b. Loosen and remove mounting bolts in the reverse order shown in the figure.

c. Insert flat-bladed screwdriver into 5 locations shown by arrows in the figure. Lift lower cylinder block evenly, and remove liquid gasket.

CAUTION:

Prevent mating faces from being damaged.

- d. When removing lower cylinder block, use slot to prevent dowel pin from interfering with engine sub-attachment.
 - No part No. is given to lower cylinder block, because it is machined with the cylinder block.
- 13. Remove crankshaft.


14. Remove main bearings and thrust bearings from cylinder block and lower cylinder block. **CAUTION:**

Check mounting positions. Keep them to avoid confusion.

- 15. Remove oil jet.
- 16. Remove oil jet relief valve.

ASSEMBLY

- 1. Blow air sufficiently to inside coolant passage, oil passage, crankcase, and cylinder bore to remove foreign matter.
- 2. Install oil jet relief valve.
- 3. Install oil jet.
 - Align knock pin on back of oil jet with pin on block when installing oil jet.



Engine FRONT

 \Diamond

- 4. Install main bearings and thrust bearings.
- a. Remove contamination, dust and oil from bearing mounting positions on cylinder block and main bearing caps.
- b. Install thrust bearings on both sides of No. 4 housing on cylinder block.
 - Install thrust bearings with oil groove facing to crankshaft arm (outside).
- c. Being careful with the direction, install main bearings.
 - Install main bearings with the oil holes and grooves onto the cylinder block side, and those without oil holes and grooves onto the lower cylinder block side.
 - While installing bearings, apply engine oil to bearing surfaces (inside). Do not apply oil to rear surfaces, but clean them completely.
 - Align stopper notches on bearings to install them.
 - Check that the oil holes on the cylinder block body are mated with the oil hole positions on the bearings.
- 5. Install crankshaft to cylinder block.
 - While rotating crankshaft by hand, check for smooth rotation.
- 6. Install lower cylinder block.
 - Apply a continuous bead of liquid gasket to lower cylinder block as shown in the figure.
 - Using slots on engine sub-attachment, install the lower cylinder block to the cylinder block, avoiding interference of dowel pins.



Face Oil Groove

to the outside

Thrust Bearing Installation Position

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Tighten lower cylinder mounting bolts to the torque shown below in 3 consecutive steps in the order shown in the figure. Unit: N·m (ka-m, ft-lb)

	Main bolt (Nos. 1 - 10)	Sub-bolt (Nos. 11 - 20)
1st	19.6 (2.0, 14)	9.8 (1.0, 7)
2nd	98.1 (10, 72)	19.6 (2.0, 14)
3rd	167 - 177 (17 - 18 123 - 130)	392-461(40-4729-33)

- Sub-bolt No. 17 has shorter length than that of other subbolts.
- 8. Install mounting bolts for engine sub-attachment shown by arrows in the figure.
 - After tightening bolts to the specified torque, check crankshaft for smooth rotation.
 - Check crankshaft side clearance.
 Refer to <u>EM-185, "Crankshaft Side Clearance"</u>.





- 9. Install pistons to connecting rod.
- a. Using long nose pliers, install snap rings to grooves on piston rear side.
 - Fit snap rings correctly into grooves.
- b. Install pistons to connecting rods.
 - Using industrial dryer, heat pistons up to approx. 60 to 70°C (140 to 158°F) until piston pin can be
 pressed down by finger touch. Then insert piston pins into piston and connecting rod from front side of
 piston toward rear.
 - Assemble piston and connecting rod with front mark of piston crown and cylinder No. stamped on connecting rod being positioned as shown in the figure.
- c. Install snap rings to front side of pistons.
 - Refer to above 1) for precaution on snap ring installation.
 - After installation, check connecting rods for smooth movement.
- 10. Use piston ring expander to install piston rings.

CAUTION:

When installing, prevent piston from being damaged.

 Install top ring and second ring with stamped surfaces facing upward.

Identification stamp:

Top ring: R Second ring: RN



[ZD30DD]

- 11. Install connecting rod bearings to connecting rods and caps. **FRONT Mark** А • While installing connecting rod bearings, apply engine oil to bearing surfaces (inside). Do not apply oil to rear surfaces, but clean them completely. Cylinder • Align stoppers on connecting rod bearings with connecting ΕM Number rod stopper notches to install connecting rod bearings. Luas Engine FRONT Lug , Cylinder Recess Number FEM133 P 12. Install piston and connecting rod assembly to crankshaft. 01 Move crankshaft pin to be removed to BDC. • Align cylinder position with cylinder No. on connecting rod to Ε install piston and connecting rod assembly. • Using piston ring compressor, install piston and connecting rod assembly with front mark on piston crown facing toward F the front side of engine. **CAUTION:** When installing piston and connecting rod assembly, pre-Piston Ring vent the big end of connecting rod from interfering with oil Compressor FEM134 13. Install connecting rod caps and mounting nuts. Н FRONT • Align cylinder No. stamped on connecting rod with that on cap Mark to install connecting rod cap. • After tightening nuts, check crankshaft for smooth rotation. Check connecting rod side clearance. Refer to EM-186, "Connecting Rod Side Clearance". Cylinder Engine Number FRONT **FEM131** 2.0 - 3.0 mm (0.079 - 0.118 in) dia. Μ FEM053 Drift PBIC0390E **EM-183**
- 14. Install rear oil seal and retainer assembly.

jet.

• Apply a continuous bead of liquid gasket to rear oil seal and retainer assembly as shown in the figure.

- 15. Press fit pilot bushing into flywheel.
 - Using drift with outer diameter of 20 mm (0.79 in), press fit pilot bushing by the length shown in the figure.

[ZD30DD]

- 16. Install rear plate.
- 17. Install removed parts to engine in the reverse order of disassembly.
- 18. Remove engine from engine stand.
- 19. Install flywheel.
 - Using the same method as disassembly, secure crankshaft and tighten mounting bolts.



 Tighten mounting bolts for flywheel in order shown in the figure.



How to Select Piston DESCRIPTION

Connecting points	Connecting parts	Selection items	Selection methods
Between cylinder block to pis- ton	Piston and piston pin assembly. The piston is available together with piston pin as an assembly.	Piston grade (piston outer diameter)	Refer to selection table

- The identification grade stamped on each part is the grade for the dimension measured in new condition. This grade cannot apply to reused parts.
- For reused or repaired parts, measure the dimension accurately. Determine the grade by comparing the measurement with the values of each selection table.
- For details of the measurement method of each part, the reuse standards, and the selection method of the selective fitting parts, refer to the text.

SELECTIVE PISTON COMBINATION

When Using New Cylinder Block

- Confirm cylinder bore grade (1, 2, 3) on left upper surface of cylinder block, and refer to "Selective combination chart" below to select appropriate piston.
- Part No. is given to a piston and piston pin as a set.



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When Re-using an Old Cylinder Block

- 1. Measure cylinder block bore inner diameter.
- 2. Referring to "Cylinder block bore inner diameter" in "Selective combination chart", select appropriate piston according to cylinder bore grade.



Selective combination chart

				Unit: mm (ir	n) _F
		Piston grade			
O: Preferable combination			1	2	_
Allowable combination X: NG combination		95.950 – 95.960 (3.7776 – 3.7779)	95.960 – 95.970 (3.7779 – 3.7783)	F	
	1	96.000 – 96.010 (3.7795 – 3.7799)	0	x	G
Cylinder bore grade (Cylinder block bore inner diameter)	2	96.010 – 96.020 (3.7799 – 3.7803)	Δ	0	_
	3	96.020 – 96.030 (3.7803 – 3.7807)	Δ	0	H

• Piston grade 3 (95.980/95.970) is applicable at factory only.

INSPECTION AFTER DISASSEMBLY

Crankshaft Side Clearance

- Using dial indicator, measure crankshaft travel amount by moving the crankshaft forward or backward.
- Or using feeler gauge, measure crankshaft travel amount with the lower cylinder block removed.

Standard	: 0.055 - 0.140 mm (0.0022 - 0.0055 in)
Limit	: 0.250 mm (0.0098 in)



 If measured value exceeds the limit, select appropriate thrust bearings.
 Unit: mm (in)

	Offic: filling (in
Grade symbol	Thickness of thrust bearing
А	2.275 - 2.325 (0.0896 - 0.0915)
В	2.300 - 2.350 (0.0906 - 0.0925)
C	2.325 - 2.375 (0.0915 - 0.0935)
OS 020	2.475 - 2.525 (0.0974 - 0.0994)

• OS 020 has part No. of 12280 2W215 and OS 0.20 marked on bearing surface.



Connecting Rod Side Clearance

• Using feeler gauge, measure side clearance between connecting rod and crank arm.

Standard : 0.10 - 0.22 (0.0039 - 0.0087 in) Limit : 0.22 mm (0.0087 in)

 If measured value exceeds the limit, replace connecting rod and repeat measurement.

If measured value still exceeds the limit, replace crankshaft.

Piston to Piston Pin Clearance

Piston pin outer diameter

 Piston pin hole inner diameter Using inside micrometer, measure piston pin hole inner diameter.

Using micrometer, measure piston pin outer diameter.

Standard : 32.993 - 33.000 mm (1.2989 - 1.2992 in) dia.

Standard : 32.997 - 33.005 mm (1.2991 - 1.2994 in) dia.



• If clearance is exceeds specification, replace either or both piston/piston pin assembly.

Piston Ring Side Clearance

 Using feeler gauge, measure clearance between piston ring and piston ring groove.
 Unit: mm (in)

	Standard	Limit
Top ring	0.05 - 0.07 (0.0020 - 0.0028)	0.5 (0.020)
Second ring	0.04 - 0.08 (0.0016 - 0.0031)	0.3 (0.012)
Oil ring	0.02 - 0.06 (0.0008 - 0.0024)	0.15 (0.0059)









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- Align top ring and external surface of piston. Measure lower side clearance of top ring with top ring pressed onto upper side of ring groove.
- If side clearance exceeds the limit, replace piston ring.
- Check clearance again. If side clearance still exceeds the limit, replace piston.



Piston Ring End Gap

- Check that cylinder bore diameter is within specifications. Refer to <u>EM-189</u>, "Piston to Cylinder Bore Clearance".
- Using piston, press piston ring to cylinder mid point, and measure end gap.
 Unit: mm (in)

	Standard	Limit
Top ring	0.25 - 0.45 (0.0098 - 0.0177)	
Second ring	0.50 - 0.65 (0.0197 - 0.0256)	1.5 (0.059)
Oil ring	0.25 - 0.45 (0.0098 - 0.0177)	

Connecting Rod Bend and Torsion

Use connecting rod aligner to check bend and torsion.

Bend limit:

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

Torsion limit:

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





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Connecting Rod Big End Inner Diameter

• Install connecting rod caps without connecting rod bearings and tighten connecting rod nuts to the specified torque. Using inside micrometer, measure connecting rod big end inner diameter.

Standard : 59.987 - 60.000 mm (2.3617 - 2.3622 in) dia.



Connecting Rod Bushing Oil Clearance (Small End)

Connecting rod small end inner diameter
 Use inside micrometer to measure small end inner diameter.

Standard : 33.025 - 33.038 mm (1.3002 - 1.3007 in) dia.





Use micrometer to measure piston pin outer diameter. Standard : 32.993 - 33.000 mm (1.2989 - 1.2992 in) dia.

 Calculation of connecting rod bushing clearance (Connecting rod small end bushing clearance) = (Connecting rod small end inner diameter) – (Piston pin outer diameter)

Standard : 0.025 - 0.045 mm (0.0010 - 0.0018 in)

- If out of specifications, replace connecting rod and/or piston and piston pin assembly.

Cylinder Block Top Surface Distortion

Piston pin outer diameter

• Using scraper, remove gasket installed onto cylinder block surface. Remove contamination such as oil, scale, and carbon.

CAUTION:

Keep broken pieces of gasket clear of oil and coolant passages.

 Use straightedge and feeler gauge to check block upper surface for distortion.

Limit : 0.1 mm (0.004 in)



Main Bearing Housing Inner Diameter

- Install lower cylinder block without main bearings. Tighten mounting bolts to the specified torque.
- Use bore gauge to measure main bearing housing inner diameter.

Standard : 74.981 - 75.000 mm (2.9520 - 2.9528 in) dia.

 If out of specification, replace cylinder block and lower cylinder block.

Piston to Cylinder Bore Clearance

...

- Cylinder bore inner diameter
- Using bore gauge, measure cylinder inner diameters at 6 positions; top, middle, and bottom (A, B, C) in 2 directions (X, Y).

Cylinder inner diameter (S	Standard)
	: 96.000 - 96.030 mm (3.7795 - 3.7807 in) dia.
Wear limit	: 0.2 mm (0.008 in)
Out-of-round limit (X - Y)	: 0.02 mm (0.0008 in)
Taper limit (A - C)	: 0.02 mm (0.0008 in)

 If clearance exceeds the limit, or any flaws or seizures are found on inner surface of cylinder, horn or bore the applicable cylinder.

Piston outer diameter
 Use micrometer to measure piston skirt outer diameter.
 Measurement position:

10 mm (0.39 in) upper from the lower end of piston Standard: 95.950 - 95.980 mm (3.7776 - 3.7787 in) dia.



- Calculation of piston to piston bore clearance
- Calculate using piston skirt outer diameter and cylinder inner diameter (direction X, position B).
 (Clearance) = (Cylinder inner diameter) (Piston skirt outer diameter)

Specifications at room temperature [20°C (68°F)]: 0.040 - 0.060 mm (0.0016 - 0.0024 in)

- If out of specification, replace piston and piston pin assembly.







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Crankshaft Journal Outer Diameter

Use micrometer to measure journal outer diameter.

Standard : 70.907 - 70.920 mm (2.7916 - 2.7921 in) dia.



Crankshaft Pin Outer Diameter

Use micrometer to measure pin outer diameter.

Standard : 56.913 - 56.926 mm (2.2407 - 2.2412 in) dia.

Crankshaft Out-of-Round and Taper

- Using micrometer, measure each journal and pin at 4 points shown in the figure.
- Out-of-round value is indicated by difference in dimensions between directions A and B at points 1 and 2.
- Taper value is indicated by difference in dimensions between points 1 and 2 in directions A and B.

 Out-of-round limit
 : 0.01 mm (0.0004 in)

 Taper limit
 : 0.01 mm (0.0004 in)

Crankshaft Runout

- Place V-block onto surface plate to support journals at both ends of crankshaft.
- Position dial indicator vertically onto No. 3 journal.
- Rotate crankshaft to read needle movement on dial indicator. (Total indicator reading)

Limit : 0.06 mm (0.0024 in)





Connecting Rod Bearing Oil Clearance

Method by measurement

 Install connecting rod bearings to connecting rods and caps, and tighten connecting nuts to the specified torque. Use inside micrometer to measure connecting rod bearing inner diameter. (Bearing clearance) = (Connecting rod bearing inner diameter) – (Crankshaft pin outer diameter)

Standard : 0.035 - 0.077 mm (0.0014 - 0.0030 in)

If out of specifications, check connecting rod big end inner diameter and crankshaft pin outer diameter, and select appropriate connecting rod bearing to adjust clearance to specifications.
 Refer to "Connecting rod bearing undersize list" on the next page.



Method using plastigage

- Remove contamination such as oil, dust completely from crankshaft pins and each bearing surface.
- Cut plastigage slightly shorter than bearing width, place it in crankshaft direction, avoiding oil holes.
- Install connecting rod bearings to caps, and tighten connecting rod nuts to the specified torque.

CAUTION:

Never rotate crankshaft.

 Remove connecting rod caps and bearings, and measure plastigage width using scale on plastigage bag.

CAUTION:

If out of specification, take same action mentioned in "Method by measurement".

Undersize bearing usage

- If bearing clearance is out of specifications for connecting rod bearings in standard size, use undersize bearings.
- When using undersize bearings, measure bearing inner diameter with bearing installed, and grind pins to F adjust clearance to specification.

Connecting rod bearing undersize list

	Unit: mm (in)
Size	Thickness
US 025	1.630 - 1.638 (0.0642 - 0.0645)
US 050	1.755 - 1.763 (0.0691 - 0.0694)
US 075	1.880 - 1.888 (0.0740 - 0.0743)
US 100	2.005 - 2.013 (0.0789 - 0.0793)



CAUTION:

When grinding crank pins to use undersize bearings, keep corners radius of fillet.

Corner radius dimension (Standard):

Pin 3.3 - 3.7 mm (0.130 - 0.146 in) Journal

oumai

2.8 - 3.2 mm (0.110 - 0.126 in)

Main Bearing Oil Clearance

Method by measurement

 Install main bearings to cylinder block and lower cylinder block, and tighten lower cylinder block bolts to the specified torque. Measure main bearing inner diameter. (Bearing clearance) = (Bearing inner diameter) – (Crankshaft journal outer diameter)

Standard : 0.035 - 0.083 mm (0.0014 - 0.0033 in)

 If out of specification, check main bearing housing inner diameter and crankshaft journal outer diameter, and select appropriate main bearing to adjust clearance to specifications. Refer to "Main bearing undersize list" on the next page.



[ZD30DD]

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Method using plastigage

- Remove contamination such as oil, dust completely from crankshaft journals and each bearing surface.
- Cut plastigage slightly shorter than bearing width, place it in . crankshaft direction, avoiding oil holes.
- Install lower cylinder block, and tighten to the specified torque. CAUTION:

Never rotate crankshaft.

Remove lower cylinder block and bearings, and measure plasti-• gage width using scale on plastigage bag. CAUTION:

If out of specification, take same action mentioned in "Method by measurement".

Undersize bearing usage

- If bearing clearance is out of specifications for main bearings in standard size, use undersize bearings.
- When using undersize bearings, measure bearing inner diameter with bearing installed, and grind crank journals to adjust clearance to specification.

I Init[.] mm (in)

Main bearing undersize list

	Sine min (iii)
Size	Thickness
US 025	2.130 - 2.138 (0.0839 - 0.0842)
US 050	2.255 - 2.263 (0.0888 - 0.0891)
US 075	2.380 - 2.388 (0.0937 - 0.0940)
US 100	2.505 - 2.513 (0.0986 - 0.0989)



CAUTION:

When grinding crank journals to use undersize bearings, keep corners radius of fillet.

Corner radius dimension (Standard):

Pin

3.3 - 3.7 mm (0.130 - 0.146 in)

Journal

2.8 - 3.2 mm (0.110 - 0.126 in)

Main Bearing Crush Height

Tighten lower cylinder block to the specified torque with main bearings installed, and remove lower cylinder block. The bearing end must then be higher than the flat surface.

Standard : Crush height must exist.

If out of specification, replace main bearings.





[ZD30DD]

[ZD30DD]



- Check nozzle for deformation and damage.
- Blow compressed air from nozzle, and check for clogs.

Standard : **Deformation and damage.**

If it out of the standard, replace oil jet.



Oil Jet Relief Valve

 Using a clean plastic stick, press check valve in oil jet relief valve. Make sure that valve moves smoothly with proper reaction force.

Standard : Valve moves smoothly with proper reaction force.

• If it is out of the standard, replace oil jet relief valve.



Flywheel Runout

Measurement position is approximately 240 mm (9.45 in) from the crankshaft center.

Runout (Total indicator reading): Limit: 0.1 mm (0.004 in)

• If it is out of the standard, replace flywheel.



[ZD30DD]

SERVICE DATA AND SPECIFICATIONS (SDS)

Standard and Limit GENERAL SPECIFICATIONS

Cylinder arrangement		In-line 4
Displacement	2,953 (180.19)	
Bore and stroke	mm (in)	96 x 102 (3.78 x 4.02)
Valve arrangement		DOHC
Firing order		1-3-4-2
Number of nieton rings	Compression	2
Number of piston migs	Oil	1
Number of main bearings		5
Compression ratio		18.5
	Standard	2,942 (29.4, 30.0, 427)
(bar kg/cm ² psi)/200 rpm	Minimum	2,452 (24.5, 25.0, 356)
	Differential limit between cylinders	294 (2.94, 3.0, 43)
Valve timing	on the set of the set	OS NS PBIC0517E

				onit: degree
а	b	с	d	е
232	232	6	46	50

INTAKE MANIFOLD AND EXHAUST MANIFOLD

		Limit
	Intake manifold collector	0.2 (0.008)
Surface distortion	Intake manifold	0.2 (0.008)
	Exhaust manifold	0.2 (0.008)
DRIVE BELTS		

Tension of drive belts	Auto adjustment by auto tensioner

PFP:00030

EBS006FU

Unit: mm (in)

[ZD30DD]

CYLINDER HEAD

Unit: mm (in)

	Standard	Limit
Head surface distortion	Less than 0.03 (0.0012)	0.2 (0.008)
	Nominal cylinder bead beight:	
	H = 156.9 - 157.1 mm (6.177 - 6.185 in) SEM368G	
VALVE Valve		
		Unit: mm (in)
	ba	
	PBIC0/13E	
	PBIC0413E	113.5 (4.4685)
Valve length "a"	PBIC0413E	113.5 (4.4685)
Valve length "a"	PBIC0413E Intake Exhaust Intake	113.5 (4.4685) 113.5 (4.4685) 3.8 - 4.2 (0.150 - 0.165)
Valve length "a" "b"	PBIC0413E Intake Exhaust Intake Exhaust	113.5 (4.4685) 113.5 (4.4685) 3.8 - 4.2 (0.150 - 0.165) 3.8 - 4.2 (0.150 - 0.165)
Valve length "a" "b"	PBIC0413E Intake Exhaust Exhaust Intake Intake Intake Intake Intake	113.5 (4.4685) 113.5 (4.4685) 3.8 - 4.2 (0.150 - 0.165) 3.8 - 4.2 (0.150 - 0.165) 1.5 (0.059)
Valve length "a" "b" Valve margin "c"	PBIC0413E Intake Exhaust Intake Intake Exhaust Intake Exhaust Intake Exhaust	113.5 (4.4685) 113.5 (4.4685) 3.8 - 4.2 (0.150 - 0.165) 3.8 - 4.2 (0.150 - 0.165) 1.5 (0.059) 1.5 (0.059)
Valve length "a" "b" Valve margin "c"	PBIC0413E Intake Exhaust Intake Exhaust Intake Exhaust Intake Intake Intake Intake Intake Intake	113.5 (4.4685) 113.5 (4.4685) 3.8 - 4.2 (0.150 - 0.165) 3.8 - 4.2 (0.150 - 0.165) 1.5 (0.059) 1.5 (0.059) 6.962 - 6.977 (0.2741 - 0.2747)
Valve length "a" "b" Valve margin "c" Valve stem diameter "d"	PBIC0413E Intake Exhaust Intake Exhaust Intake Exhaust Intake Exhaust Exhaust Exhaust Exhaust Exhaust Exhaust	113.5 (4.4685) 113.5 (4.4685) 3.8 - 4.2 (0.150 - 0.165) 3.8 - 4.2 (0.150 - 0.165) 1.5 (0.059) 1.5 (0.059) 6.962 - 6.977 (0.2741 - 0.2747) 6.945 - 6.960 (0.2734 - 0.2740)
Valve length "a" "b" Valve margin "c" Valve stem diameter "d"	PBIC0413E Intake Exhaust Intake Exhaust Intake Exhaust Intake Exhaust Intake Exhaust Intake Intake Intake Intake Intake Intake Intake Intake	113.5 (4.4685) 113.5 (4.4685) 3.8 - 4.2 (0.150 - 0.165) 3.8 - 4.2 (0.150 - 0.165) 1.5 (0.059) 1.5 (0.059) 6.962 - 6.977 (0.2741 - 0.2747) 6.945 - 6.960 (0.2734 - 0.2740) 31.9 - 32.1 (1.256 - 1.264)
Valve length "a" "b" Valve margin "c" Valve stem diameter "d" Valve head diameter "D"	PBIC0413E	$\begin{array}{r} 113.5 (4.4685) \\ 113.5 (4.4685) \\ \hline 3.8 - 4.2 (0.150 - 0.165) \\ \hline 3.8 - 4.2 (0.150 - 0.165) \\ \hline 1.5 (0.059) \\ \hline 1.5 (0.059) \\ \hline 6.962 - 6.977 (0.2741 - 0.2747) \\ \hline 6.945 - 6.960 (0.2734 - 0.2740) \\ \hline 31.9 - 32.1 (1.256 - 1.264) \\ \hline 29.9 - 30.1 (1.177 - 1.185) \end{array}$
Valve length "a" "b" Valve margin "c" Valve stem diameter "d" Valve head diameter "D"	PBIC0413E Intake Exhaust Intake Intake Intake Intake Intake	113.5 (4.4685) 113.5 (4.4685) 3.8 - 4.2 (0.150 - 0.165) 3.8 - 4.2 (0.150 - 0.165) 1.5 (0.059) 1.5 (0.059) 6.962 - 6.977 (0.2741 - 0.2747) 6.945 - 6.960 (0.2734 - 0.2740) 31.9 - 32.1 (1.256 - 1.264) 29.9 - 30.1 (1.177 - 1.185)

	Cold*
Intake & Exhaust	0.30 - 0.40 (0.012 - 0.016)

*: Approximately 20°C (68°F)

Available Shims			
Thickness mm (in)	Identification mark		
2.35 (0.0925)	2.35		
2.40 (0.0945)	2.40		
2.45 (0.0965)	2.45		
2.50 (0.0984)	2.50		
2.55 (0.1004)	2.55		
2.60 (0.1024)	2.60		
2.65 (0.1043)	2.65		
2.70 (0.1063)	2.70		
2.75 (0.1083)	2.75		
2.80 (0.1102)	2.80		
2.85 (0.1122)	2.85		
2.90 (0.1142)	2.90		
2.95 (0.1161)	2.95		
3.00 (0.1181)	3.00		
3.05 (0.1201)	3.05		



Valve Spring

Free height	mm (in)	55.43 (2.1823)
Pressure	N (kg, lb) at height mm (in)	180 - 206 (18.4 - 21.0, 40.6 - 46.3) at 40.8 (1.6063)
Out-of-square	mm (in)	2.4 (0.094)

Valve Lifter

Unit: mm (in)

	Standard
Valve lifter outer diameter	34.450 - 34.465 (1.3563 - 1.3569)
Lifter guide inner diameter	34.495 - 34.515 (1.3581 - 1.3589)
Clearance between lifter and lifter guide	0.030 - 0.065 (0.0012 - 0.0026)

[ZD30DD]

Valve Guide

Unit: mm (in) A

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		Standard	E	
	Outer diameter	11.023 - 11.034 (0.4340 - 0.4344)		
valve guide	Inner diameter (Finished size)	7.000 - 7.015 (0.2756 - 0.2762)	•	
Cylinder head valve guide hole diameter		10.996 - 10.975 (0.4329 - 0.4321)	F	
Interference fit of valve guide		0.027 - 0.059 (0.0011 - 0.0023)		
Stem to guide clearance	Intake	0.023 - 0.053 (0.0009 - 0.0021)	G	
	Exhaust	0.040 - 0.070 (0.0016 - 0.0028)	. 0	
Value deflection limit	Intake	0.18 (0.0071)		
	Exhaust	0.10 (0.0039)	Н	
Projection length		12.8 - 13.2 (0.5309 - 0.5197)	•	

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EM-197

Valve Seat

Unit: mm (in)



EM-198

[ZD30DD]

Height (b)	Intake	6.75 - 6.85 (0.2657 - 0.2697)	6.75 - 6.85 (0.2657 - 0.2697)	_
Height (II)	Exhaust	7.35 - 7.45 (0.2894 - 0.2933)	7.35 - 7.45 (0.2894 - 0.2933)	- /-
Depth (I)	Intake	43.65 - 44.35 (*	1.7185 - 1.7461)	-
Deptil (L)	Exhaust	43.65 - 44.35 (*	1.7185 - 1.7461)	E

CAMSHAFT AND CAMSHAFT BEARING

Unit: mm (in)

	Standard	Limit
Camshaft journal clearance	0.045 - 0.090 (0.0018 - 0.0035)	0.09 (0.0035)
Inner diameter of camshaft bearing	30.000 - 30.021 (1.1811 - 1.1819)	_
Outer diameter of camshaft journal	29.931 - 29.955 (1.1784 - 1.1793)	_
Camshaft runout [TIR*]	—	0.04 (0.0016)
Camshaft end play	0.065 - 0.169 (0.0026 - 0.0067)	0.2 (0.008)
*: Total indicator reading		



Cam height "A"	Intake & Exhaust	40.98 - 41.02 (1.6134 - 1.6150)	J
Wear limit of cam height		0.15 (0.0059)	0

CYLINDER BLOCK



Surface flatness	Limit			0.1 (0.004)
Cylinder bore	Inner diameter	Standard	Grade No. 1	96.000 - 96.010 (3.7795 - 3.7799)
			Grade No. 2	96.010 - 96.020 (3.7799 - 3.7803)
			Grade No. 3	96.020 - 96.030 (3.7803 - 3.7807)
		Wear limit		0.20 (0.0079)
Out-of-round (X – Y)			Less than 0.02 (0.0008)	
Taper (A – B – C)			Less than 0.02 (0.0008)	
Main journal inner diameter (Without bearing)			74.981 - 75.000 (2.9520 - 2.9528)	

Unit: mm (in) K

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[ZD30DD]

Crankshaft journal bearing inner diameter (With bearing) 70.955 - 70.990 (2.7935 - 2.7949)

Difference in inner diameter between cylinders

Limit

Less than 0.05 (0.0020)

PISTON, PISTON RING AND PISTON PIN Available Piston

Unit: mm (in)



Piston skirt diameter "A" Standard		Grade No. 1	95.950 - 95.960 (3.7776 - 3.7779)		
Grade		Grade No. 2	95.960 - 95.970 (3.7779 - 3.7783)		
		Grade No. 3	95.970 - 95.980 (3.7783 - 3.7787)		
"a" dimension			10 (0.39)		
Piston pin bore diameter			32.997 - 33.005 (1.2991 - 1.2994)		
Piston clearance to cylinder block			0.040 - 0.060 (0.0016 - 0.0024)		

Piston Ring

Unit: mm (in)

		Standard	Limit
Side clearance	Тор	0.05 - 0.07 (0.0020 - 0.0028)	0.5 (0.020)
	2nd	0.04 - 0.08 (0.0016 - 0.0031)	0.3 (0.012)
	Oil ring	0.02 - 0.06 (0.0008 - 0.0024)	0.15(0.0059)
	Тор	0.25 - 0.45 (0.0098 - 0.0177)	1.5 (0.059)
End gap	2nd	0.50 - 0.65 (0.0197 - 0.0256)	1.5 (0.059)
	Oil (rail ring)	0.25 - 0.45 (0.0098 - 0.0177)	1.5 (0.059)

Piston Pin

Unit: mm (in)

Piston pin outer diameter	32.993 - 33.000 (1.2989 - 1.2992)	
Interference fit of piston pin to piston		
Diston hin to connecting red bushing clearance	Standard	0.025 - 0.045 (0.0010 - 0.0018)
Pision pin to connecting for busining clearance	Limit	0.045 (0.0018)

*: Values measured at ambient temperature of 20°C (68°F)

[ZD30DD]

CONNECTING ROD		Unit: mm (in)	А	
Center distance		154.5 (6.083)		
Bend [per 100 (3.94)]	Limit	0.05 (0.0020)	ΕM	
Torsion [per 100 (3.94)] Limit		0.05 (0.0020)		
Connecting rod small end in	ner diameter	35.087 - 36.000 (1.3814 - 1.4173)		
Piston pin bushing inner dia	meter*	33.025 - 33.038 (1.3002 - 1.3007)	С	
Connecting rod big end inne	er diameter*	59.987 - 60.000 (2.3617 - 2.3622)		
Side electrones	Standard	0.10 - 0.22 (0.0039 - 0.0087)	D	
Side clearance	Limit	0.22 (0.0087)		
*: After installing in connecting	g rod			
CRANKSHAFT		Unit: mm (in)	E	
Main journal dia. "Dm"		70.907 - 70.920 (2.7916 - 2.7921)	_	
Pin journal dia. "Dp" Grade No. 0		56.913 - 56.926 (2.2407 - 2.2412)		
Center distance "r"		50.95 - 51.05 (2.0059 - 2.0098)		
Out-of-round (X – Y)	Standard	Less than 0.01 (0.0004)		
Taper (A – B)	Standard	Less than 0.01 (0.0004)		
Runout [TIR*]	Limit	0.06 (0.0024)		
Side electrones	Standard	0.055 - 0.140 (0.0022 - 0.0055)		
Side clearance	Limit	0.25 (0.0098)		
		Out-of-round $(x) - (Y)$ Taper $(a) - (B)$	J	
	SEM645	SEM715	L	

*: Total indicator reading

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AVAILABLE MAIN BEARING Undersize

Unit: mm (in)

[ZD30DD]

	Cylinder Block Side Oil Groove Oil Hole Oil Hole Cylinder Lugs Lower Cylinder Block Side FEM127		
Size	Thickness "T" mm (in)	Main journal diameter "Dm"	
Standard	2.005 - 2.013 (0.0789 - 0.0793)		
US 025	2.130 - 2.138 (0.0839 - 0.0842)		
US 050	2.255 - 2.263 (0.0888 - 0.0891)	Grind so that bearing clearance is the specified value.	
US 075	2.380 - 2.388 (0.0937 - 0.0940)		
US 100	2.505 - 2.513 (0.0986 - 0.0989)	1	

AVAILABLE CONNECTING ROD BEARING Connecting Rod Bearing

Grade number	Thickness "T" mm (in)	Width "W" mm (in)	
Standard	1.505 - 1.513 (0.0593 - 0.0596)		
US 025	1.630 - 1.638 (0.0642 - 0.0645)		
US 050	1.755 - 1.763 (0.0691 - 0.0694)	25.9 - 26.1 (1.020 - 1.028)	
US 075	1.880 - 1.888 (0.0740 - 0.0743)		
US 100	2.005 - 2.013 (0.0789 - 0.0793)		

Balance Shaft Bush

Unit: mm (in)

Palanaar aboft jaurnal autor diamatar	Front	50.875 - 50.895 (2.0029 - 2.0037)	
balancer shart journal outer diameter	Rear	50.675 - 50.695 (1.9951 - 1.9959)	
	Front	50.940 - 51.010 (2.0055 - 2.0083)	
balancer shart journal inner diameter	Rear	50.740 - 50.810 (1.9976 - 2.0004)	
	Standard	0.045 - 0.135 (0.0018 - 0.0053)	
Balancer shart journal oil clearance	Limit	0.180 (0.0071)	
Balancer shaft end play		0.07 - 0.22 (0.0028 - 0.0087)	

MISCELLANEOUS COMPONENTS

Flywheel runout [TIR]*	Less than 0.10 (0.004)

*: Total indicator reading

Bearing Clearance

Unit: mm (in)

Unit: mm (in)

Main bearing clearance	Standard	0.035 - 0.083 (0.0014 - 0.0033)
Connecting rod bearing clearance	Standard	0.035 - 0.077 (0.0014 - 0.0030)

M8 bolt

M10 bolt

Nut

Bolt

M6 bolt

M8 bolt

Nozzle side

Pump side

Nozzle side

Cylinder head side

1)

2)

1)

53.9 - 58.8 (5.5 - 6.0, 40 - 43)

24.5 - 28.4 (2.5 - 2.9, 18 - 20)

24.5 - 28.4 (2.5 - 2.9, 18 - 20) 24.5 - 28.4 (2.5 - 2.9, 18 - 20)

9.8 - 11.8 (1.0 - 1.2, 87 - 104)*2

24.5 - 28.4 (2.5 - 2.9, 18 - 20)

21.6 - 24.5 (2.2 - 2.5, 16 - 18)

26.5 - 29.4 (2.7 - 3.0, 20 - 21)

22.6 - 26.5 (2.3 - 2.7, 17 - 19)

14.7 - 16.7 (1.5 - 1.7, 11 - 12)

10.7 - 12.7 (1.1 - 1.3, 8 - 9)

10.7 - 12.7 (1.1 - 1.3, 8 - 9)

2.5 - 3.4 (0.25 - 0.35, 23 - 30)*² 44.1 - 53.9 (4.5 - 5.5, 33 - 39)

35.3 - 40.2 (3.5 - 4.1, 26 - 29)

24.5 - 28.4 (2.5 - 2.9, 18 - 20)

24.5 - 28.4 (2.5 - 2.9, 18 - 20)

24.5 - 28.4 (2.5 - 2.9, 18 - 20)

14.7 - 19.6 (1.5 - 2.0, 11 - 14)

24.5 - 28.4 (2.5 - 2.9, 18 - 20)

60.8 - 65.7 (6.2 - 6.7, 45 - 48) 19.6 - 29.4 (2.0 - 3.0, 15 - 21)

24.5 - 28.4 (2.5 - 2.9, 18 - 20)

9.8 - 14.7 (1.0 - 1.5, 87 - 130)*2

Tightening torque

Auto tensioner

Intake manifold

EGR tube

*1

*1

*1

*1

*1

*1: Parts to be tightened in particular orders.

Intake manifold collector cover

Intake manifold collector support

EGR volume control valve cover

Intake manifold collector

Throttle control actuator

EGR volume control valve

Exhaust manifold cover

Exhaust manifold

Oil pan drain plug Oil strainer

Vacuum pump

Vacuum pipe

Injection tube

Nozzle support

Spill connector Injection tube clamp

Chain cover

Timing chain tensioner

Timing chain slack guide

Camshaft sprocket

Camshaft bracket

Water outlet

*1

Timing chain tensioner guide

Engine coolant temperature sensor

Electronic control fuel injection pump Fuel injection pump gear and sprocket

Fuel injection pump rear bracket

Spill tube

Oil level gauge guide

Rocker cover

Oil pan

1)-: Order of tightening when tightening two or more times separately.

[ZD30DD]

EBS006FV



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[ZD30DD]

			2)	19.6 - 23.5 (2.0 - 2.4, 15 - 17)
	Gear case			24.5 - 28.4 (2.5 - 2.9, 18 - 20)
	Front plate			35.3 - 40.2 (3.6 - 4.1, 26 - 29)
	Idler gear (A)			28.4 - 33.3 (2.9 - 3.4, 21 - 24)
	Idler gear (B)			28.4 - 33.3 (2.9 - 3.4, 21 - 24)
	Balancer shaft			20.6 - 23.5 (2.1 - 2.4, 16 - 17)
	Crankshaft pulley			373 - 402 (38 - 41, 276 - 296)
	TDC sensor			9.8 - 11.8 (1.0 - 1.2, 87 - 104)* ²
	TDC sensor bracket			24.5 - 28.4 (2.5 - 2.9, 18 - 20)
*1	Cylinder head		1)	98.1 - 103 (10.0 - 10.5, 73 - 75)
			2)	0 (0, 0)
			3)	39.2 - 44.1 (4.0 - 4.5, 29 - 32)
			4)	90° (angle tightening)
			5)	90° (angle tightening)
	Idler gear			49.0 - 57.9 (5.0 - 5.9, 37 - 42)
	Glow plug			14.7 - 19.6 (1.5 - 2.0, 11 - 14)
	Glow plug oil seal			2.5 - 2.9 (0.25 - 0.3, 23 - 25)* ²
	Glow nut			1.5 - 2.0 (0.15 - 0.20, 14 - 17)* ²
	Rear engine slinger			35.3 - 45.1 (3.6 - 4.6, 26 - 33)
	Thermal trans miter			7.8 - 11.8 (0.8 - 1.2, 69 - 104)* ²
*1	Flywheel			167 - 186 (17 - 19, 124 - 137)
	Connecting rod nut			78.5 - 83.4 (8.0 - 8.5, 58 - 61)
*1	Lower cylinder block	Main bolt	1)	19.6 (2.0, 14)
		Sub bolt	2)	9.8 (1.0, 87)* ²
		Main bolt	3)	98.1 (10, 72)
		Sub bolt	4)	19.6 (2.0, 14)
		Main bolt	5)	167 - 177 (17 - 18, 124 - 130)
		Sub bolt	6)	39.2 - 46.1 (4.0 - 4.7, 29 - 34)
	Oil pressure switch			12.3 - 17.2 (1.25 - 1.75, 9 - 12)
	Oil jet			29.4 - 39.2 (3.0 - 4.0, 22 - 28)
	Oil jet relief valve			29.4 - 39.2 (3.0 - 4.0, 22 - 28)
	Rear oil seal retainer			20.6 - 23.5 (2.1 - 2.4, 16 - 17)