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SERVICE MANUAL 6SD1T ISUZU ENGINES

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Foreword

This Workshop Manual has been prepared as a guide for the service and repair of the Model AA-6SD1T diesel engine.

A general table of contents is shown on the following page, and more detailed subsections are listed at the beginning of each respective chapter.

This manual was first prepared in April, 2001, but subsequent changes in design may result in modifications to certain values and other information in this Manual.

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Note:

Before using this manual to perform maintenance and repairs, be sure to read the section "General Servicing Precautions" included in Chapter 1 (General Information).

CHAPTER 1

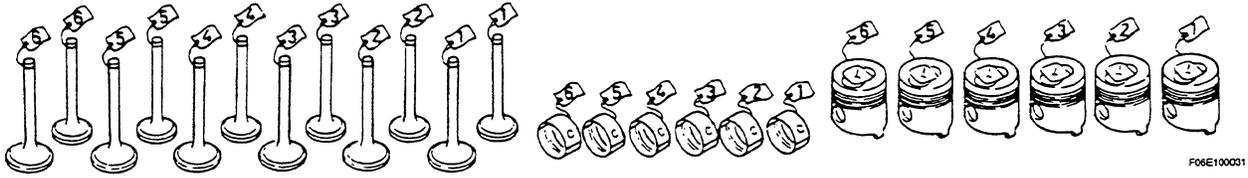
GENERAL INFORMATION

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GENERAL SERVICING PRECAUTIONS

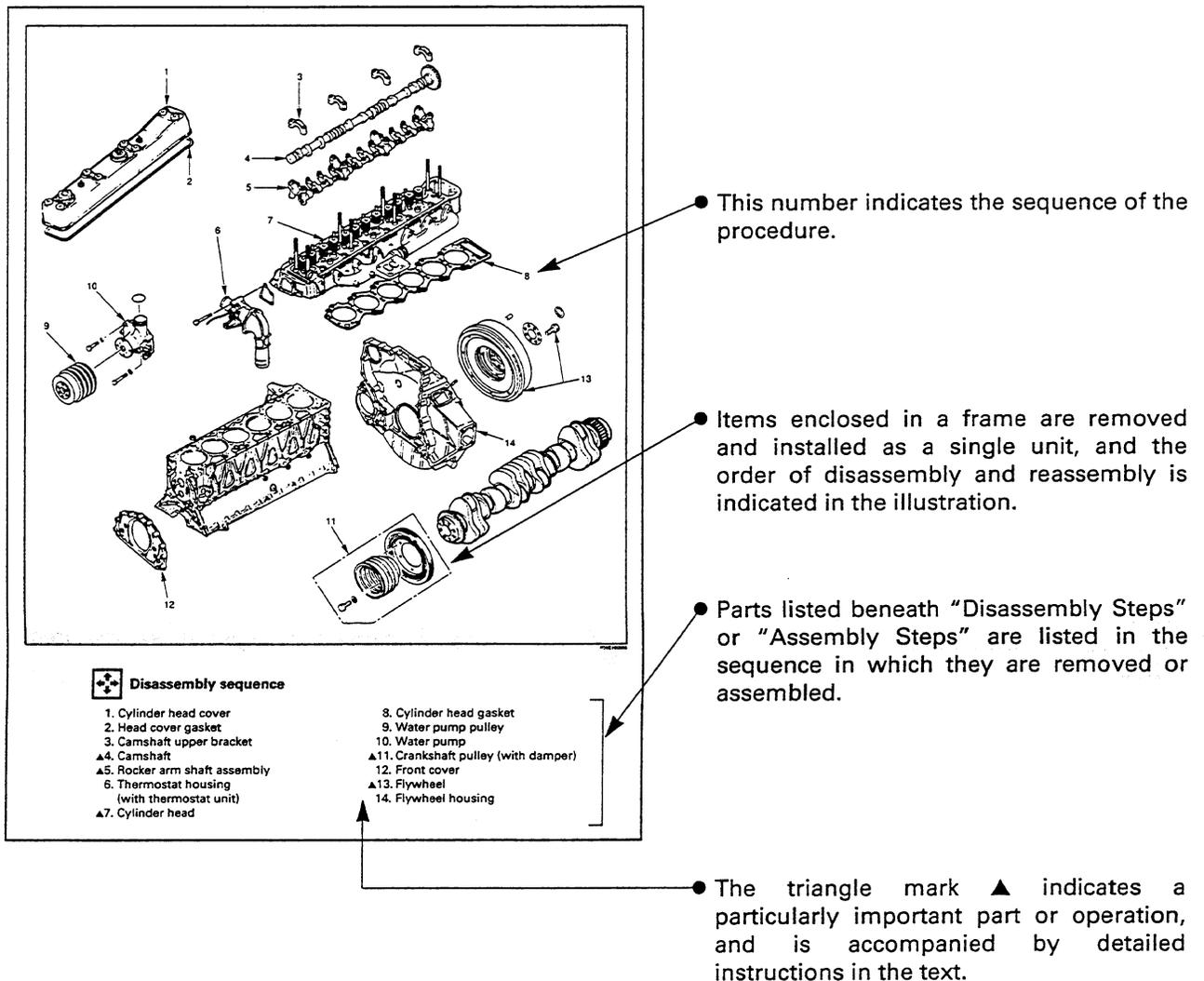
1. Before performing any inspections or maintenance work, disconnect the battery's ground cable to prevent any damage from shorted wires.
2. Always use the proper tool for the job.
When a special tool is designated for a job, be sure to use only that special tool.
3. When replacement parts are required, consult the appropriate parts catalog.
4. Never reuse any cotter pins, gaskets, seals, o-ring, lock washers, or self-locking nuts removed in the course of disassembly.
5. To facilitate reassembly, lay out engine parts in logical groups in the order in which they are removed. Be especially careful to replace nuts and bolts in their proper locations, since characteristics such as length and hardness may differ depending on the installation position.
6. Use identification labels or tags to mark valves, bearings, and pistons, to prevent confusing their proper order and sequence.



7. Clean all parts before inspection and reassembly.
Be particularly sure to use compressed air to blow out oil ports and openings, to assure that they are free of obstructions.
8. Be sure to apply oil or grease as appropriate to all rotating and sliding surfaces before reassembly.
9. Use sealants to prevent leaks where necessary.
10. Tighten all nuts and bolts to specified tightening torques.
11. After completing inspections and repairs, double check your work to confirm that the job has been done properly.

NOTES ON THE FORMAT OF THIS MANUAL

1. Use the Table of Contents at the beginning of the Manual to find the general areas required.
2. Common technical data such as general maintenance, repair specifications, and tightening torques are listed in the General Information chapter.
3. Each chapter is composed of "disassembly, inspection" and "repair, assembly" sections. the only exception is the treatment of the engine body itself, which is divided into three independent chapters for ease of explanation.
4. When similar maintenance procedures are applicable to multiple operations or parts, the manual will cross-reference the page where the appropriate information can be found.
5. To provide brevity and conciseness, simple disassembly and repair operations are omitted, while more space is devoted to explaining complex procedures such as adjustments and tightening torques.
6. The descriptions given in each chapter begin with an exploded diagram of the applicable parts, with numbers indicated as shown below.



7. The following is a sample of the text in the Workshop Manual.

Measurement of cylinder Liner Projection

- Place a straight edge 1 along the top edge of the cylinder liner to be measured.
- Using a feeler gauge 2, measure the projection of each cylinder liner.

Cylinder liner projection	mm (in)
Standard	0.106 - 0.134 (0.0042 - 0.0053)

The difference in cylinder liner projection between any two neighboring cylinders must not exceed 0.02 mm.

Cylinder Liner Removal

- Attach a cylinder liner remover to the cylinder liner. Cylinder liner remover : 1-85231-016-0
- Confirm that the remover's shaft anchor is hooked firmly on the bottom of the cylinder liner.
- Slowly rotate the remover's shaft handle clockwise to remove the cylinder liner.

Note:
Be careful not to damage the upper face of the cylinder block when removing cylinder liners.

Cylinder Block Bore Measurement

- At measuring point 1, measure the cylinder bore in the four directions (W-W, X-X, Y-Y, Z-Z). Measuring point 1 : 120 mm from upper face.
- Calculate the average value of the four measurements to determine the correct liner grade.

These tables indicate repair standards.

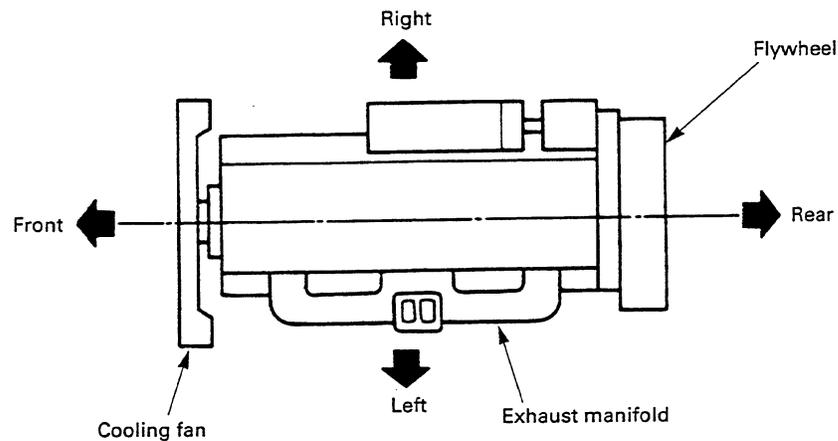
Special tools are identified by name and/or number. The illustration also indicates the proper procedure for using the special tool.

Symbols indicate the type of operation or sequence to be performed. A detailed explanation of these symbols is given below.

8. The following symbols appear throughout this Manual, indicating the type of service operation or procedure to be performed.

- | | | | |
|--|-----------------------------|--|---|
| | Removal | | Adjustment |
| | Installation | | Cleaning |
| | Disassembly | | Important operation; special care required |
| | Assembly | | Tighten to specified torque |
| | Alignment (marks) | | Special tool use required |
| | Directional indication | | Use commercially available special tool |
| | Inspection | | Lubrication with engine oil |
| | Measurement | | Apply grease |
| | Apply sealant | | |

9. Measurements are indicated by "standard" or "limit";
a "standard" value refers to the standard values at time of assembly.
A "limit" value is a maximum or minimum; measurements up to that value are usable.
Measurements falling beyond that value mean the part must be serviced, adjusted, or replaced.
10. Directional indications adopted within this manual are as follows;
Front: Toward the cooling fan when viewed from the flywheel side.
Right: Toward the fuel injection pump when viewed from the flywheel side.
Left: Toward the exhaust manifold when viewed from the flywheel side.
Rear: Toward the engine's flywheel side.
11. "Cylinder numbers" and "Engine rotation direction": Cylinder numbers are counted in sequence beginning from the front side of the engine.
As a result, the first cylinder at the very front of the engine is cylinder No. 1, while the last cylinder toward the rear is cylinder No. 6. The direction of engine rotation is clockwise when viewed from the cooling fan side.



F06E100032

12. "ASM" is an abbreviation for "assembly."

ABOUT ANGULAR TIGHTENING

At present, the method most commonly used to tighten bolts is to specify a torque value to which the bolts should be tightened. This method, however, has the disadvantage of being characterized by considerable fluctuation in axial force for a given torque, with the result that when attempting to maintain the minimum necessary axial force, the bolt may be sheared at its upper limit value.

In order to produce less fluctuation in axial force, the ideal method would be to tighten the bolt while measuring the amount of its stretch, but since this is impossible in practice, a substitute method was conceived, namely considering the relationship of thread pitch to bolt stretch. The angular tightening method thus focuses on the amount the bolt is turned — directly related to thread pitch — in order to allow tightening of the bolt up unto the region of plasticity, thus reducing the variation in axial force.

TIGHTENING METHOD

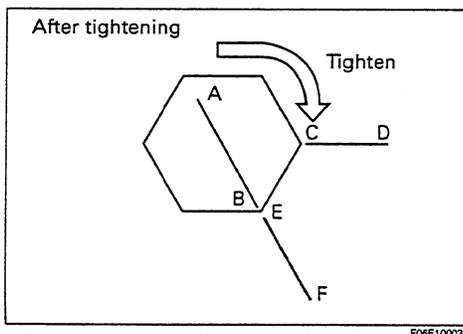
1. Apply molybdenum disulfide grease to the threads and setting faces of the nuts and bolts.
2. Tighten all bolts to the designated tightening torque values.
3. Next, make a mark at a point corresponding to one edge of the bolt as shown in the accompanying illustration, then tighten the bolt by turning it by the designated angle.

Afterwards, be sure to check the mark to confirm whether the bolt has been tightened to the specified angle.

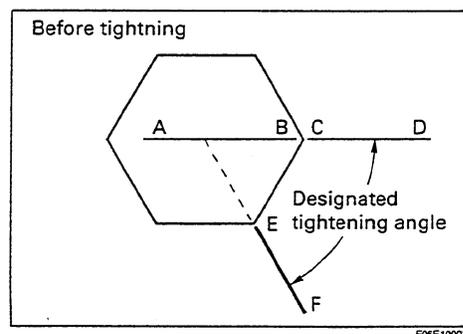
If this confirmation is not performed, and if the bolt is subsequently retightened using the angular tightening method, it may break.

Note:

1. Tighten bolts in their designated sequence.
2. When using the angular tightening method, do not retighten.



Use a wrench to rotate the bolt until the line (A — B) on the bolt is aligned with the designated angle line on the material (line E — F).



On the surface of the bolt and material to be tightened, draw a line extending through the center of the bolt (A — B on the bolt, C — D on the material), and a line on the material surface which is aligned with the center of the bolt at the designated tightening angle (line E — F).

LOCATIONS OF USE OF ANGULAR TIGHTENING METHOD

1. Cylinder head bolts (M14 bolts only)
2. Lower crankcase bolts (M14 bolts only)
3. Connecting rods, bearing cap nuts
4. Flywheel bolts
5. Idle gear shaft bolt (A)

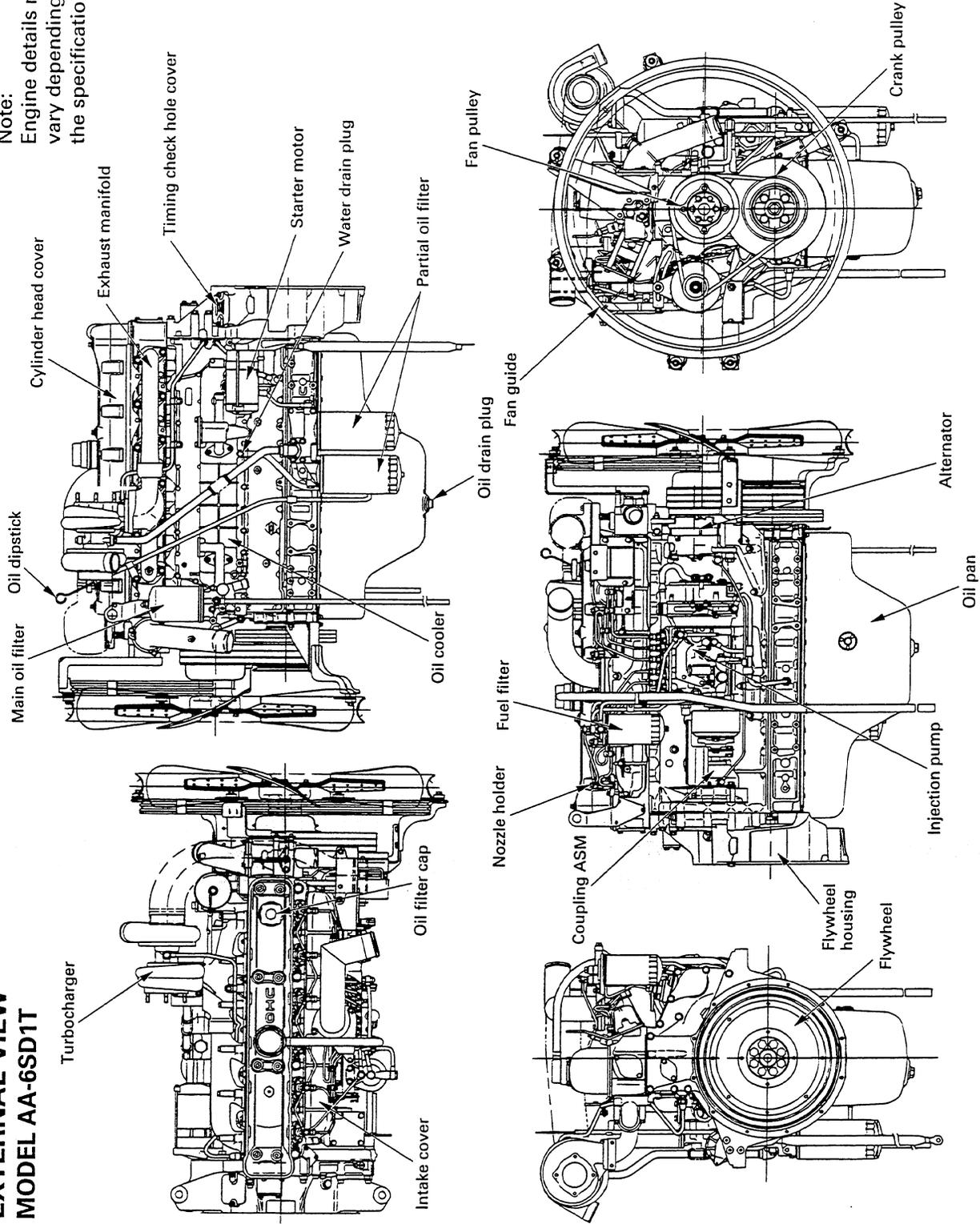
MAIN DATA AND SPECIFICATIONS

Engine Model		AA-6SD1T	
Item			
Engine type		4-cycle, water-cooled vertical in-line overhead camshaft	
Combustion chamber type		Direct injection	
Cylinder liner type		Dry type	
Number of cylinders; bore x stroke	mm	6 – 120 x 145	
Total exhaust displacement	L (cid)	9.839 (601)	
Compression ratio		16.8 : 1	
Dimensions (L x W x H)	mm	*	1379 x 859 x 1158
Weight	kg	*	693
Ignition sequence		1-5-3-6-2-4	
Fuel used		Diesel (2-D)	
Fuel-injection pump type		In-line Bosch	
Governor		Variable speed, mechanical, RSV type or electrically controlled type (Red IV)	
Injection nozzle type		Multi-hole type	
Injection starting pressure	MPa (kg/cm ² /psi)	*	17.7 – 22.1 (180 – 225/2570 – 3200)
Fuel injection timing (BTDC)		*	7°
Compression pressure (warm engine, 200 rpm)	MPa (kg/cm ² /psi)		2.84 (29/412)
Inlet valve	Open (BTDC)		15°
	Close (ATDC)		39°
Exhaust valve	Open (BTDC)		40°
	Close (ATDC)		14°
Valve clearance (cold engine)	Inlet valve	mm	0.4
	Exhaust valve		0.4
Lubricating system		Forced circulation type	
Engine oil capacity; Oil pan	L (qts)	*	Max 30 (31.7), Min 25 (26.4)
Total system capacity	L (qts)	*	Max 35 (37), Min 30 (31.7)
Lubricating engine oil		API service type CD, or Isuzu Besco S-3	
Oil cooler		Water-cooled, internally mounted	
Cooling method		Forced circulation, pressurized water-cooled type	
Cooling system volume	L (qts)		About 19 (20) (engine only)
Cooling fan		*	Dia. 850 mm, 6-blade, sucker type
Alternator	V-A	*	24 – 50
Starter	V-kW	*	24 – 5.5

Specifications marked with an asterisk (*) will vary according to engine application.

**EXTERNAL VIEW
MODEL AA-6SD1T**

Note:
Engine details may vary depending on the specifications.



TIGHTENING TORQUE SPECIFICATIONS

The tightening torque values given in the table below are applicable to the bolts unless otherwise specified.

STANDARD BOLT

kgf·m (lb.ft/N·m)

Bolt Identification Bolt Diameter × pitch (mm)				
				
M6 × 1.0	4 – 8 (0.4 – 0.8/3 – 6)	5 – 10 (0.5 – 1.0/4 – 7)		—————
M8 × 1.25	8 – 18 (0.8 – 1.8/6 – 13)	12 – 23 (1.2 – 2.3/9 – 17)		17 – 30 (1.7 – 3.1/12 – 22)
M10 × 1.25	21 – 34 (2.1 – 3.5/5 – 25)	28 – 46 (2.8 – 4.7/20 – 33)		37 – 62 (3.8 – 6.4/28 – 46)
* M10 × 1.5	20 – 33 (2.0 – 3.4/15 – 25)	28 – 45 (2.8 – 4.6/20 – 33)		36 – 60 (3.7 – 6.1/27 – 44)
M12 × 1.25	49 – 74 (5.0 – 7.5/36 – 54)	61 – 91 (6.2 – 9.3/45 – 67)		76 – 114 (7.7 – 11.6/56 – 84)
* M12 × 1.75	45 – 69 (4.6 – 7.0/33 – 51)	57 – 84 (5.8 – 8.6/42 – 62)		72 – 107 (7.3 – 10.9/53 – 79)
M14 × 1.5	77 – 115 (7.8 – 11.7/56 – 85)	93 – 139 (9.5 – 14.2/69 – 103)		114 – 171 (11.6 – 17.4/84 – 126)
* M14 × 2.0	72 – 107 (7.3 – 10.9/53 – 79)	88 – 131 (9.0 – 13.4/65 – 97)		107 – 160 (10.9 – 16.3/79 – 118)
M16 × 1.5	104 – 157 (10.6 – 16.0/77 – 116)	135 – 204 (13.8 – 20.8/100 – 150)		160 – 240 (16.3 – 24.5/118 – 177)
* M16 × 2.0	100 – 149 (10.2 – 15.2/74 – 110)	129 – 194 (13.2 – 19.8/96 – 143)		153 – 230 (15.6 – 23.4/113 – 169)
M18 × 1.5	151 – 226 (15.4 – 23.0/110 – 166)	195 – 293 (19.9 – 29.9/144 – 216)		230 – 345 (23.4 – 35.2/169 – 255)
* M18 × 2.5	151 – 226 (15.4 – 23.0/110 – 166)	196 – 294 (20.0 – 30.0/145 – 217)		231 – 346 (23.6 – 35.5/171 – 255)
M20 × 1.5	206 – 310 (21.0 – 31.6/152 – 229)	270 – 405 (27.5 – 41.3/199 – 299)		317 – 476 (32.3 – 48.5/234 – 351)
* M20 × 2.5	190 – 286 (19.4 – 29.2/140 – 211)	249 – 375 (25.4 – 38.2/184 – 276)		293 – 440 (29.9 – 44.9/216 – 325)
M22 × 1.5	251 – 414 (25.6 – 42.2/185 – 305)	363 – 544 (37.0 – 55.5/268 – 401)		425 – 637 (43.3 – 64.9/313 – 469)
* M22 × 2.5	218 – 328 (22.2 – 23.4/161 – 242)	338 – 507 (34.5 – 51.7/250 – 374)		394 – 592 (40.2 – 60.4/291 – 437)
M24 × 2.0	359 – 540 (36.6 – 55.0/265 – 398)	431 – 711 (43.9 – 72.5/318 – 524)		554 – 831 (56.5 – 84.7/409 – 613)
* M24 × 3.0	338 – 507 (34.5 – 51.7/250 – 374)	406 – 608 (41.4 – 62.0/299 – 448)		521 – 782 (53.1 – 79.7/384 – 576)

An asterisk (*) indicates that the bolts are used for female threaded parts that are made of soft materials such as casting. Those shown in parentheses in the strength class indicate the classification by the old standard.

FLANGED HEAD BOLT

kgf·m (lb.ft/N·m)

Bolt Identification Bolt Diameter × pitch (mm)			
M6 × 1.0	5 – 9 (0.5 – 0.9/4 – 7)	6 – 12 (0.6 – 1.2/4 – 9)	—————
M8 × 1.25	11 – 20 (1.1 – 2.0/8 – 15)	15 – 28 (1.6 – 2.9/12 – 21)	18 – 34 (2.1 – 3.4/15 – 25)
M10 × 1.25	23 – 39 (2.4 – 3.9/17 – 28)	35 – 59 (3.6 – 6.1/26 – 44)	42 – 71 (4.3 – 7.2/31 – 52)
* M10 × 1.5	22 – 37 (2.3 – 3.8/17 – 28)	35 – 58 (3.5 – 5.8/25 – 42)	40 – 67 (4.1 – 6.8/30 – 49)
M12 × 1.25	55 – 82 (5.6 – 8.4/40 – 61)	77 – 117 (7.9 – 11.9/57 – 86)	85 – 128 (8.7 – 13.0/63 – 94)
* M12 × 1.75	51 – 77 (5.2 – 7.8/38 – 56)	71 – 107 (7.3 – 10.9/53 – 79)	80 – 119 (8.1 – 12.2/59 – 88)
M14 × 1.5	83 – 125 (8.5 – 12.7/62 – 92)	115 – 172 (11.7 – 17.6/85 – 127)	123 – 185 (12.6 – 18.9/91 – 137)
* M14 × 2.0	77 – 116 (7.9 – 11.8/57 – 85)	108 – 162 (11.1 – 16.6/80 – 120)	116 – 173 (11.8 – 17.7/85 – 128)
M16 × 1.5	116 – 173 (11.8 – 17.7/85 – 128)	171 – 257 (17.4 – 26.2/126 – 190)	177 – 265 (18.0 – 17.1/130 – 196)
* M16 × 2.0	109 – 164 (11.2 – 16.7/81 – 121)	163 – 244 (16.6 – 24.9/120 – 180)	169 – 253 (17.2 – 25.8/124 – 187)

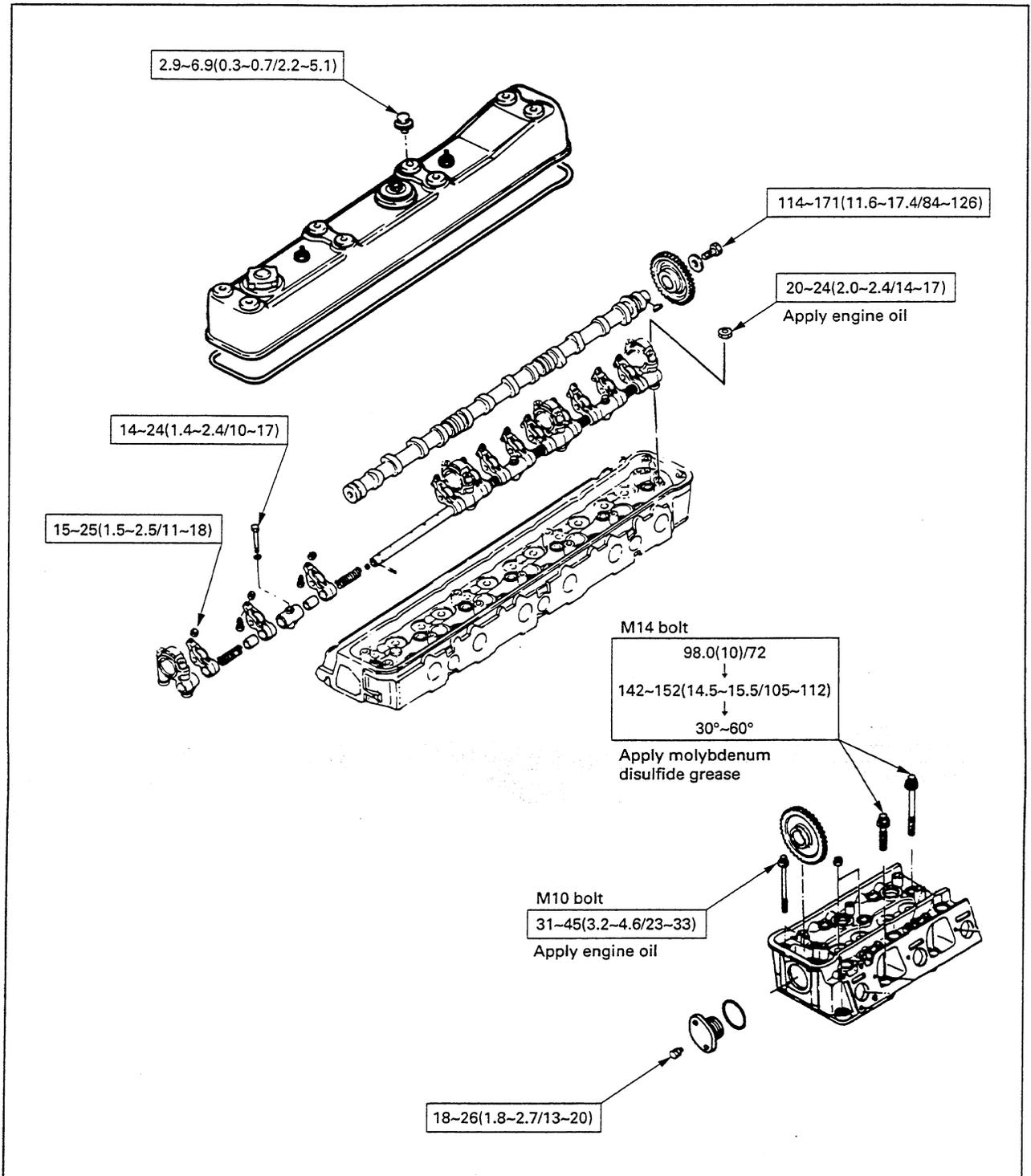
A bolt with an asterisk (*) is used for female screws of soft material such as cast iron.

TIGHTENING TORQUES FOR MAIN PARTS



Cylinder head cover, cylinder head, camshaft bracket, rocker arm shaft bracket

N·m (kgf·m/lb·ft)

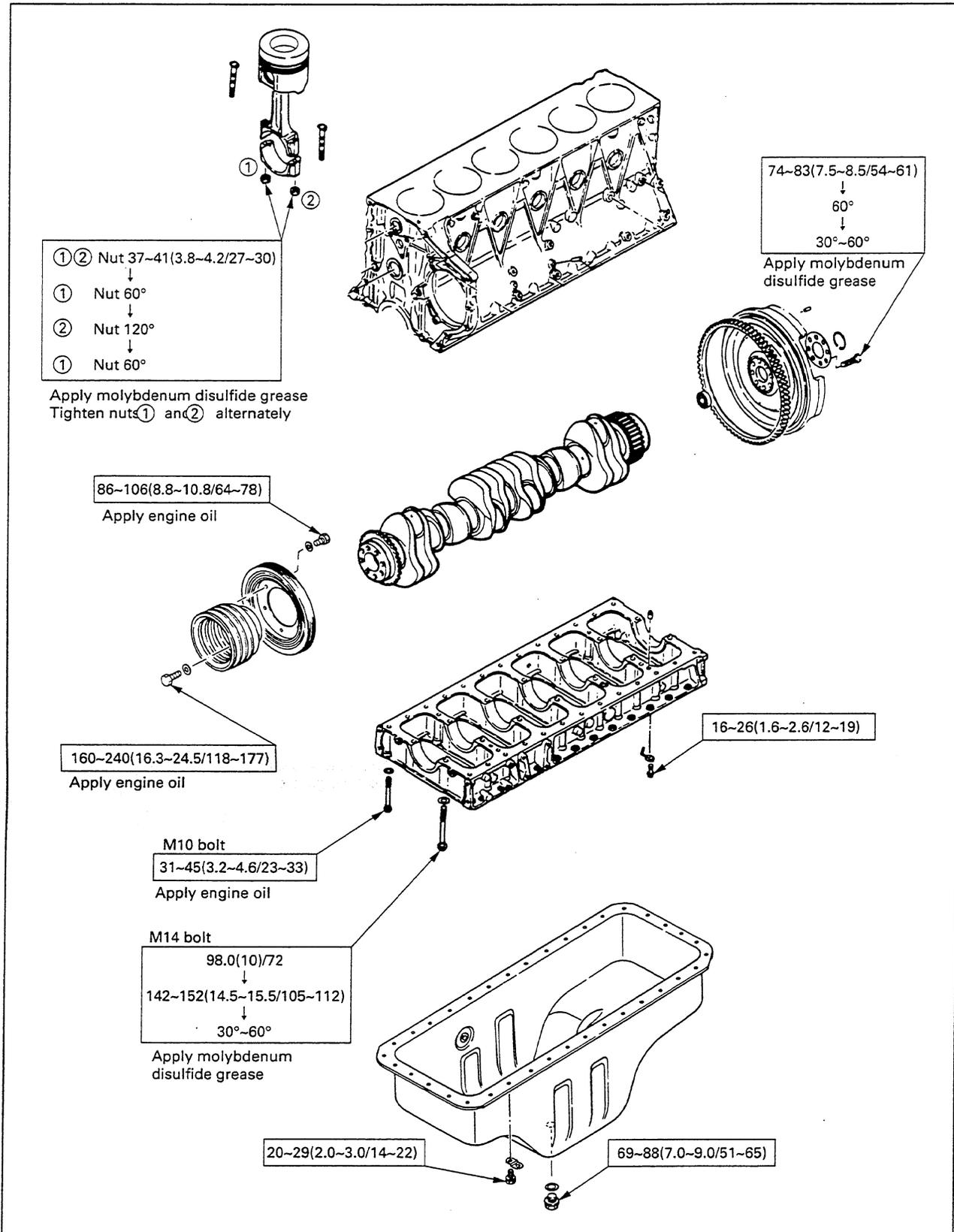


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Lower crankcase, connecting rod bearing caps, crank damper pulley, flywheel, oil pan

N·m (kgf·m/lb·ft)

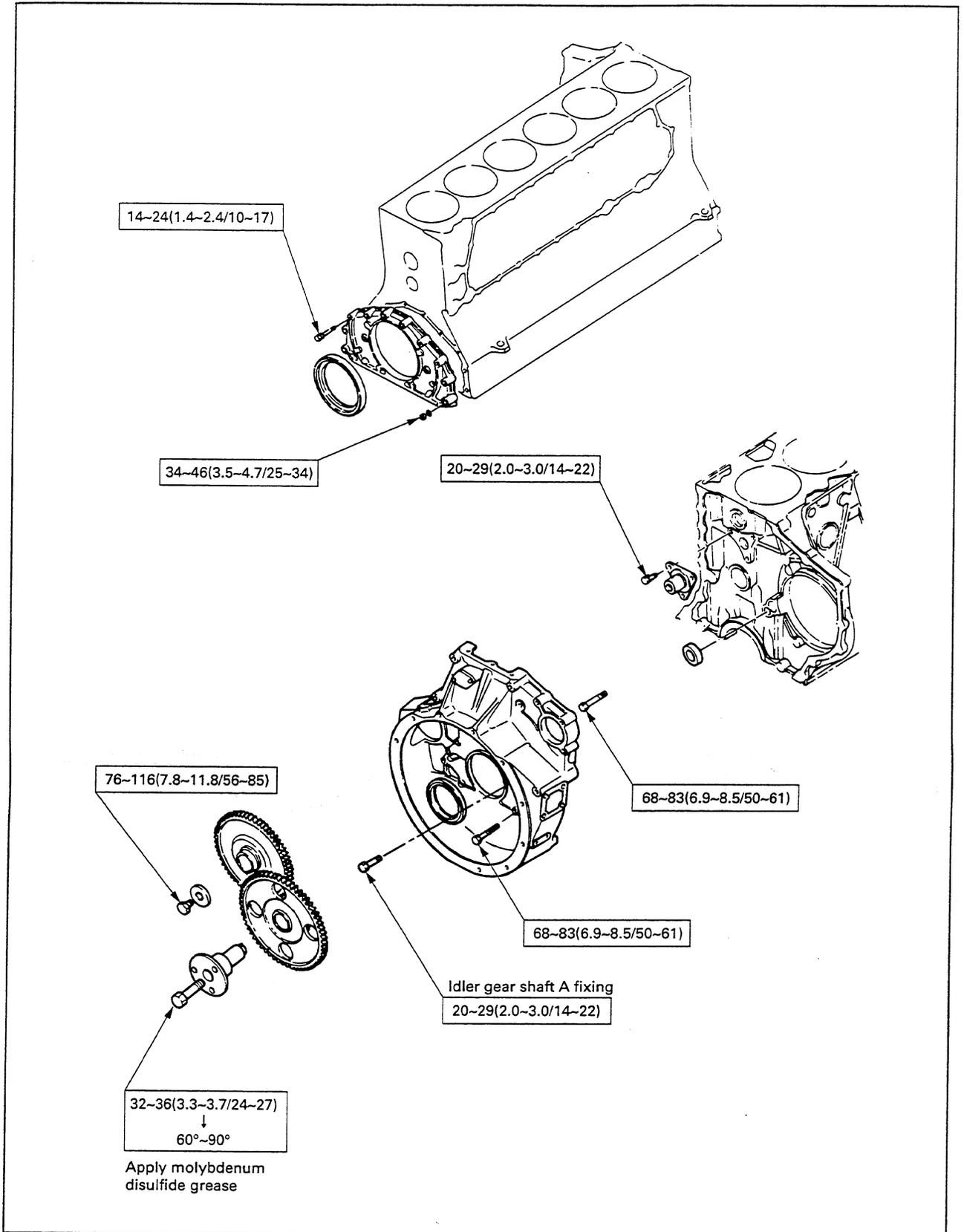


FOBE100051



Front cover, flywheel housing, idler gear

N·m (kgf·m/lb·ft)

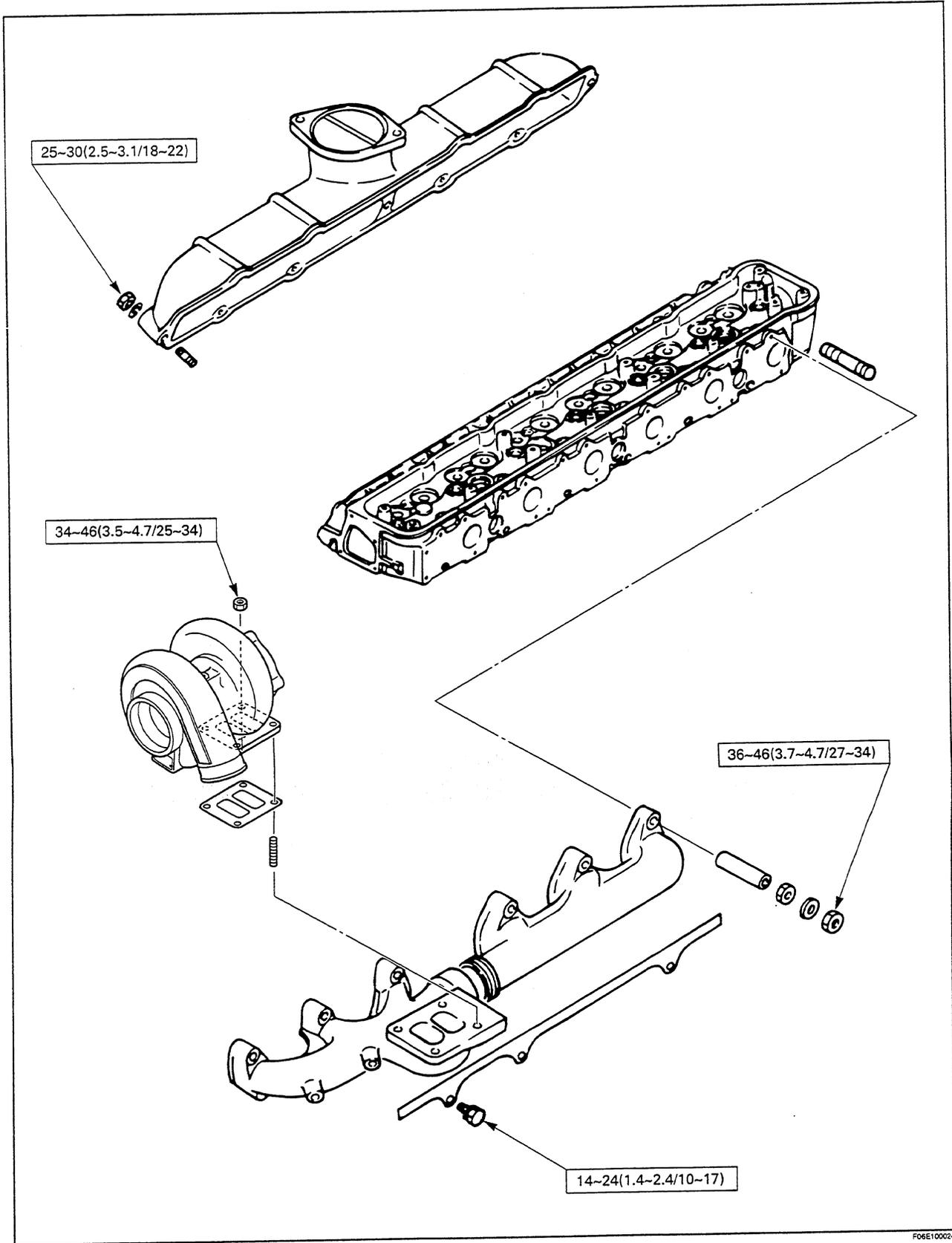


F06E10065



Intake manifold, exhaust manifold, turbocharger

N·m (kgf·m/lb·ft)

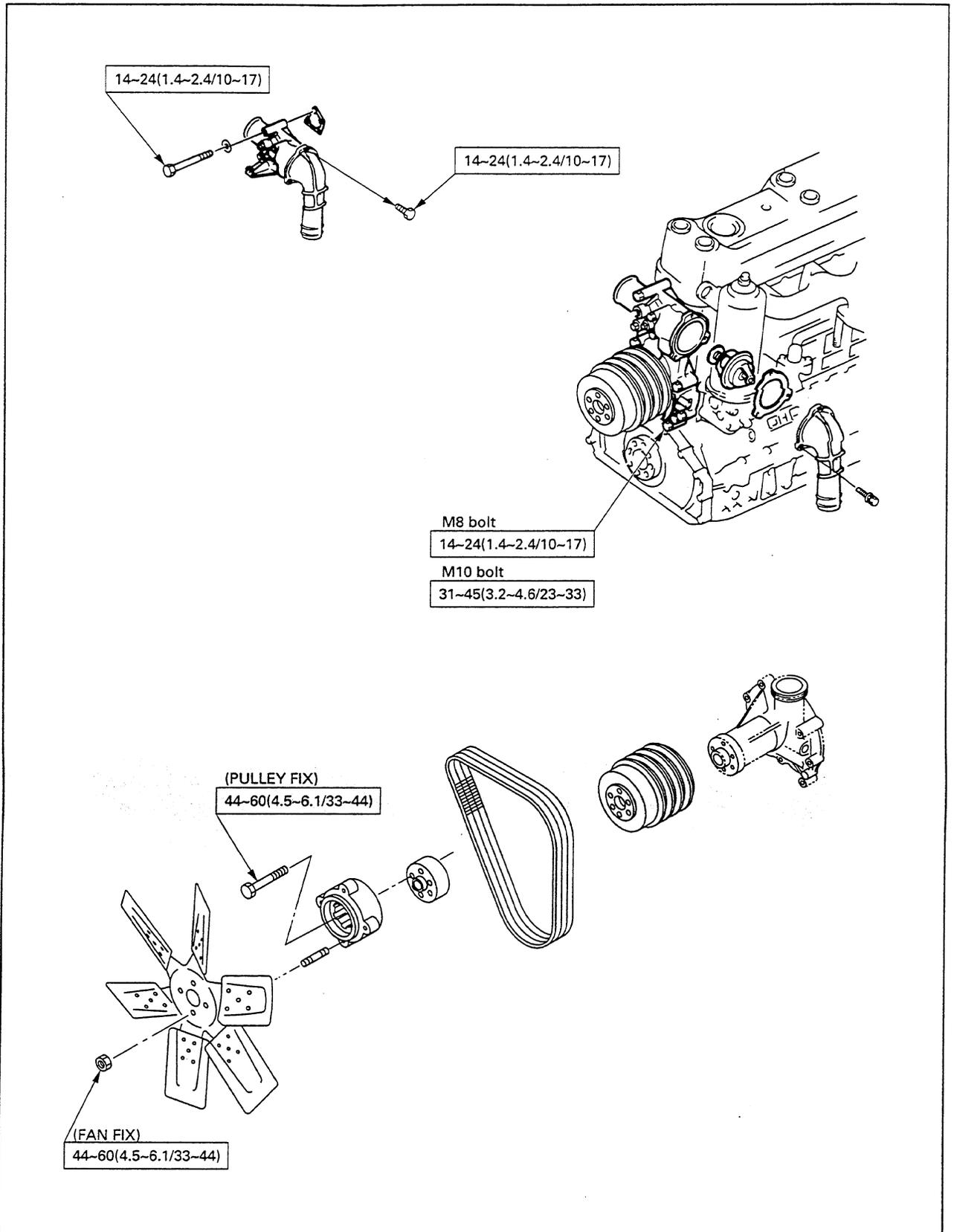


F06E100024



Cooling system

N·m (kgf·m/lb·ft)

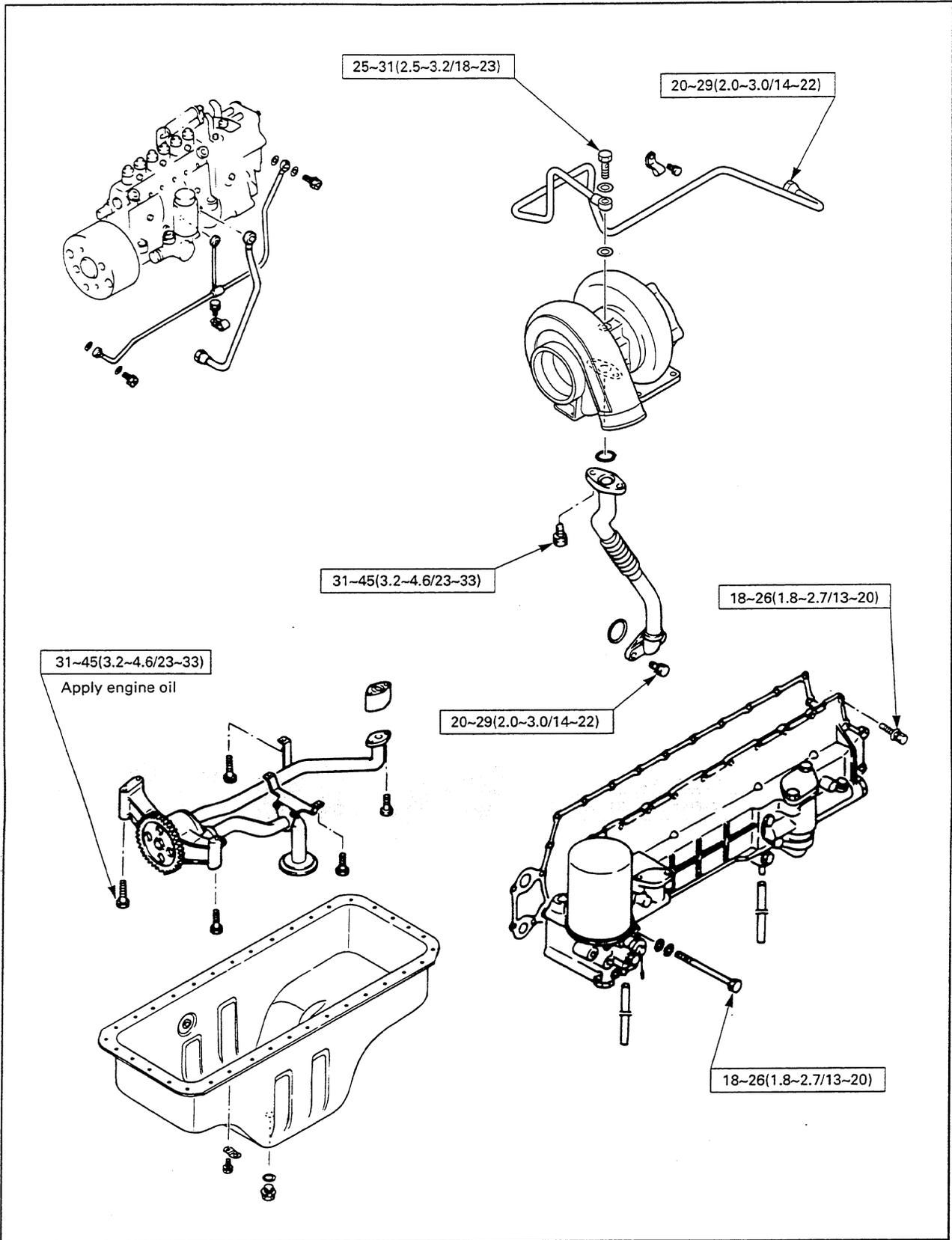


F06E100029



Lubricating system

N·m (kgf·m/lb·ft)

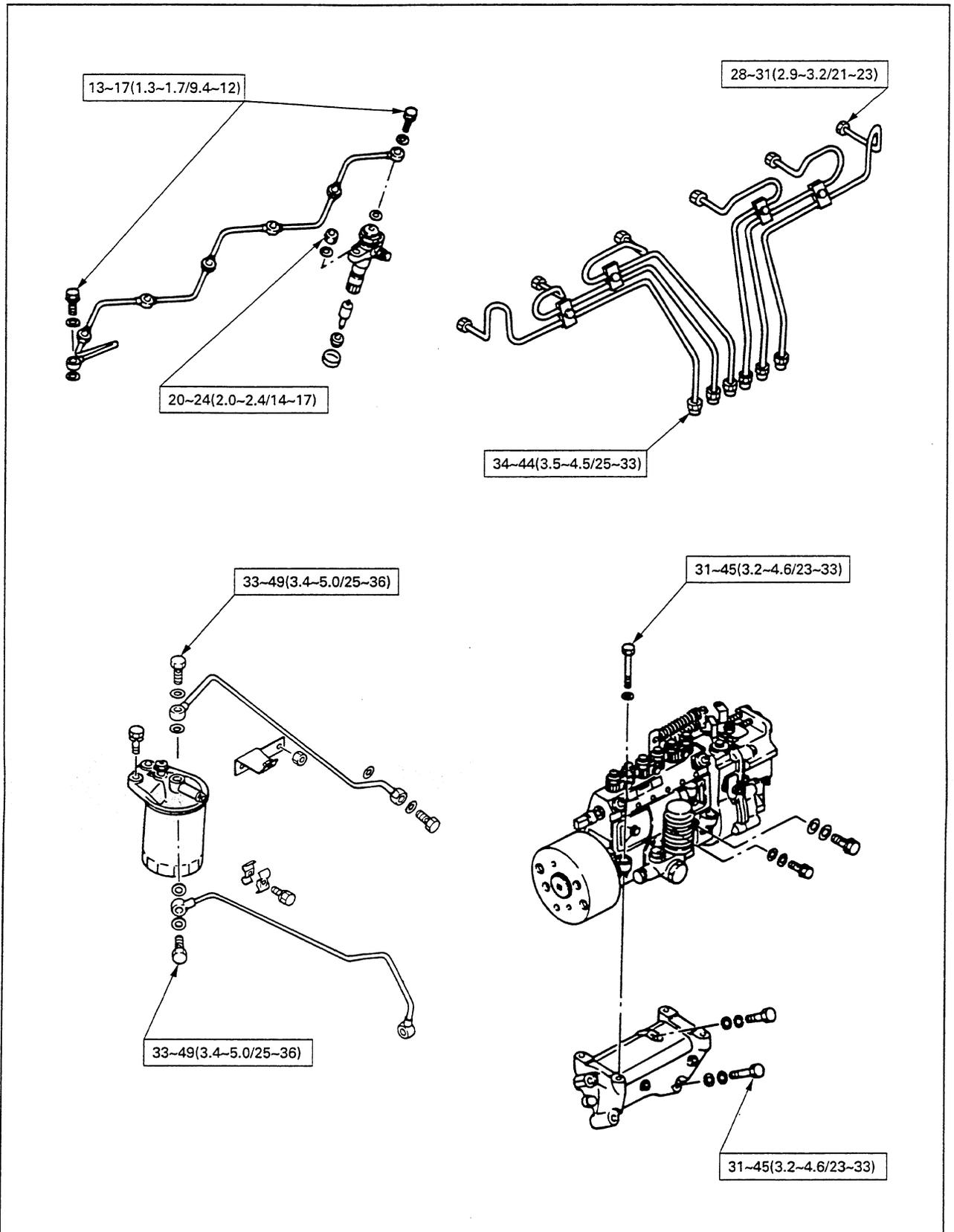


F06E100025



Fuel system

N·m (kgf·m/lb·ft)

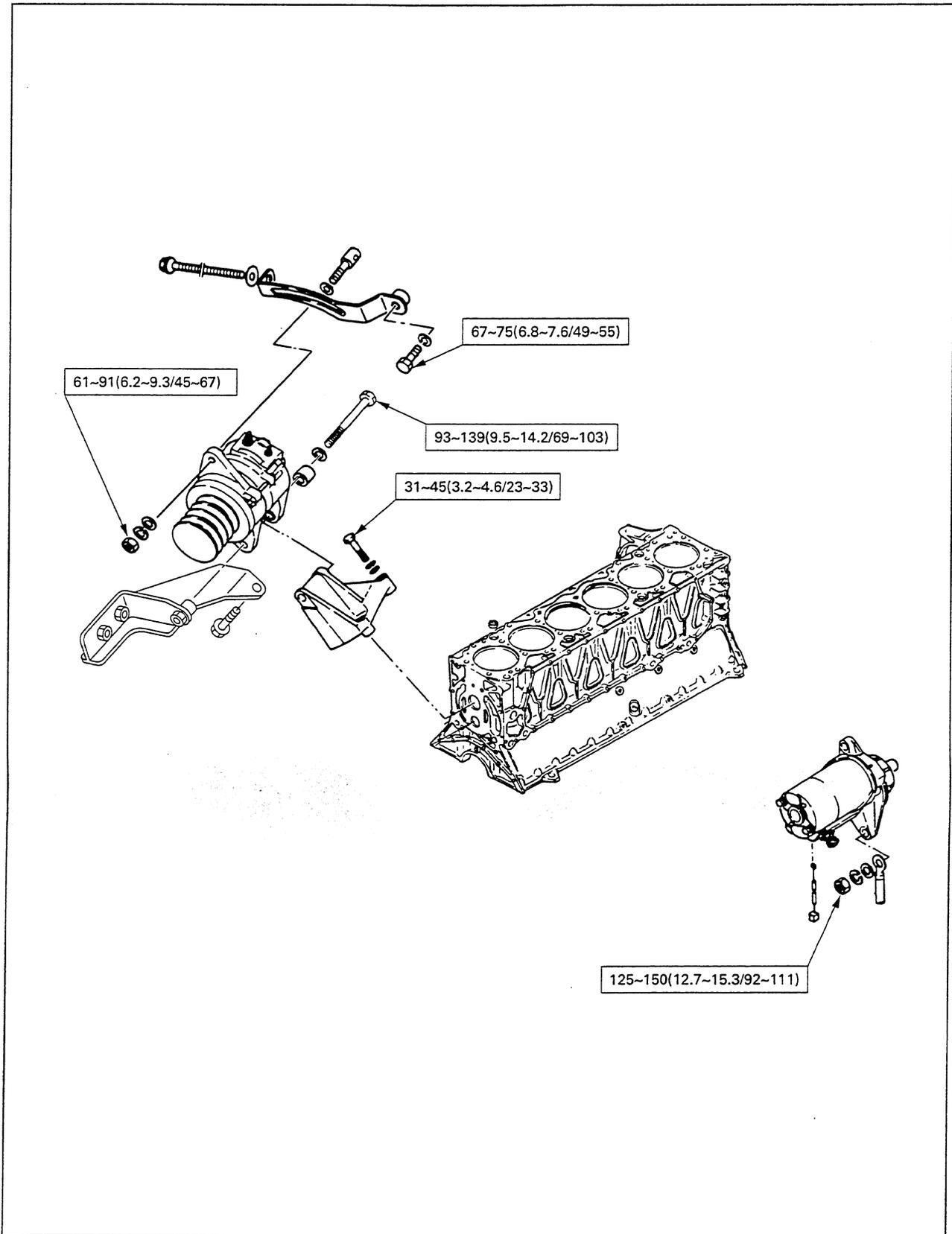


F06E100061



Engine electrical, mounting bracket

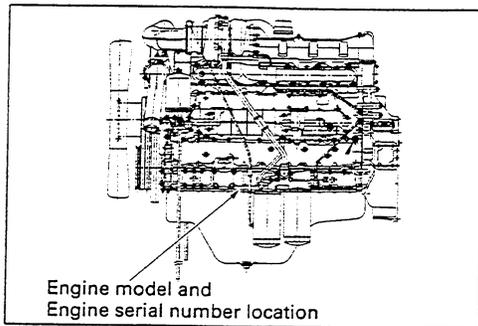
N·m (kgf·m/lb·ft)



FOSE100052

MODEL AND IDENTIFICATION SERIAL NUMBERS

ENGINE MODEL AND SERIAL NUMBER



The engine model and serial number are stamped in the middle of the lower left side of the cylinder block (crankcase).

MEMO

A series of horizontal dotted lines for writing.

CHAPTER 2

MAINTENANCE

CONTENTS

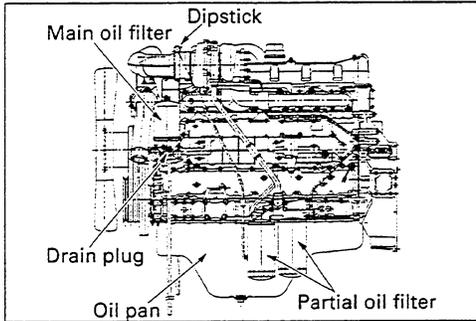
ITEM	PAGE
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Cooling system	27
Valve clearance adjustment	28
Fuel injection timing	30
Recommended lubricating oil	33
Cylinder compression pressure	34
Engine repair kit	35

Note:

See the "Operating Manual" for specifications regarding fuel filter and oil filter replacement periods.

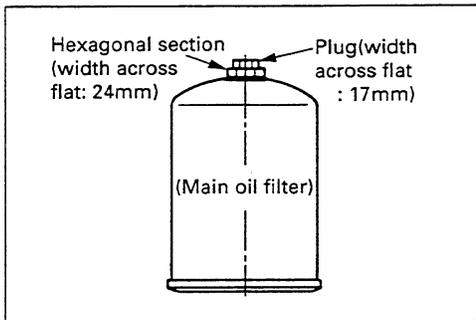
LUBRICATING SYSTEM

REPLACEMENT OF MAIN OIL FILTER ELEMENT (CARTRIDGE TYPE)



Removal

1. Remove the drain plug and drain the oil from the filter. Place a receptacle beneath the drain port to contain the drained oil. Removing the plug at the top of the main filter will facilitate draining the oil.



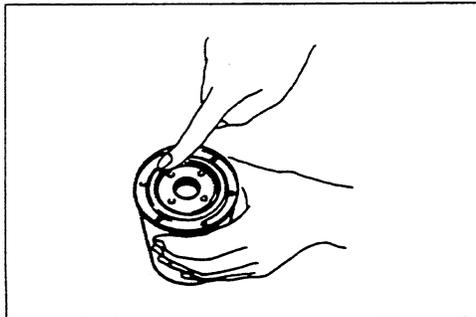
2. After draining the oil, replace the filter's drain plug.

Drain plug tightening torque

N·m (kgf·m/lb·ft)

First	Second	Third
22 ~ 31 (2.2 ~ 3.2/16 ~ 23)	Loosen	13 ~ 23 (1.3 ~ 2.3/9 ~ 17)

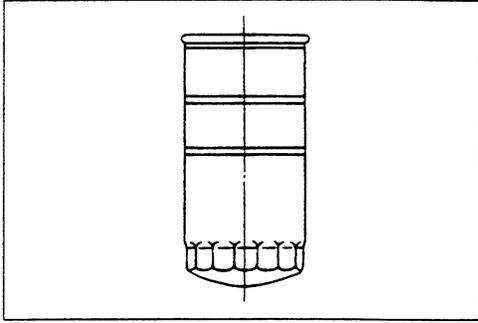
3. Place a wrench on the cartridge's second hex lug and rotate counter-clockwise to remove the cartridge. Discard the removed cartridge.



Installation

1. Clean the cartridge mounting surface on the engine.
2. Lightly apply a film of clean engine oil to the gasket on the new cartridge.
3. Screw the cartridge in lightly until the gasket surface contacts the mounting surface on the engine.
4. Using a filter wrench, tighten the filter by turning one revolution more.
5. After replenishing engine oil to the designated capacity, start the engine and check for leaks around the filter.
6. Stop the engine, wait for 10 — 20 minutes, then recheck the engine oil level and replenish if necessary.



REPLACEING THE PARTIAL FLOW OIL FILTER ELEMENT (CARTRIDGE TYPE)

050E100014

**Removal**

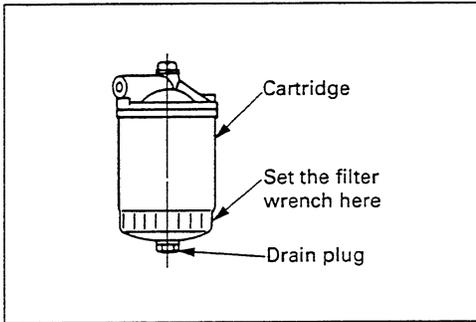
Use an oil filter wrench to rotate the filter cartridge counter-clockwise and remove. Be careful not to spill the oil contained in the filter.

**Installation**

1. Apply a thin film of clean engine oil to the new cartridge gasket.
2. Screw in the new filter element until its gasket contacts the mounting surface, then use the filter wrench to tighten the element by turning between 1 and 1 and 1/8 turns more.

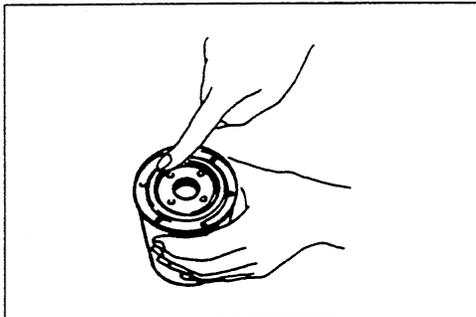
FUEL SYSTEM

REPLACING THE FUEL FILTER ELEMENT (CARTRIDGE TYPE)



Removal

1. Remove the drain plug at the bottom of the filter, and drain out any fuel inside the cartridge. Place a receptacle beneath the cartridge to prevent soiling surrounding engine parts.
2. Using a filter wrench, rotate the cartridge counter-clockwise to loosen. Discard the removed filter cartridge. Filter wrench: commercially available



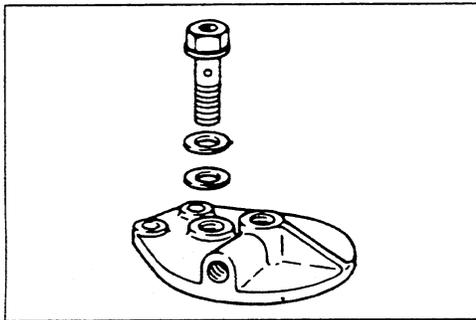
Installation



1. Clean the cartridge installation surface on the engine.
2. Apply a thin film of clean engine oil to gasket surface of the new filter cartridge.
3. To facilitate air bleeding, fill the filter with fuel.
4. Lightly screw in the filter cartridge until its gasket contacts the installation surface on the engine.
5. Using a filter wrench, tighten the cartridge by an additional 1/2 to 3/4 turn.

Note:

Be careful not to overtighten the cartridge, since it could twist and cause a fuel leak.



Inspection of overflow valve

Inspect the overflow valve for clogging. Check for suction leakage on the ball side.

Overflow valve opening pressure	kPa (kgf/cm ² /psi)
245 (2.5 / 36)	

041E10007