# INDUSTRIAL
# DIESEL ENGINE

## AA-6SD1T
## MODEL

# WORKSHOP MANUAL

ISUZU MOTORS LIMITED

## 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

## CONTENTS


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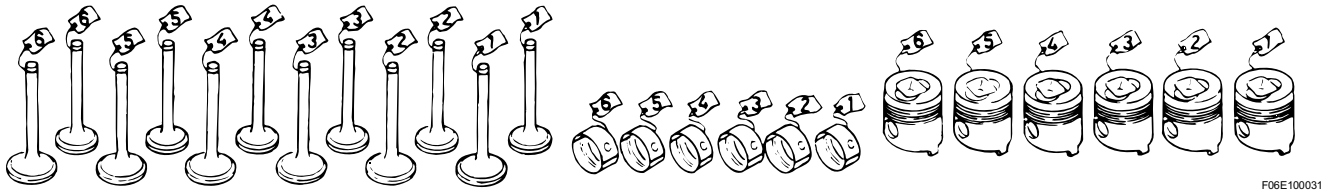
# GENERAL SERVICING PRECAUTIONS

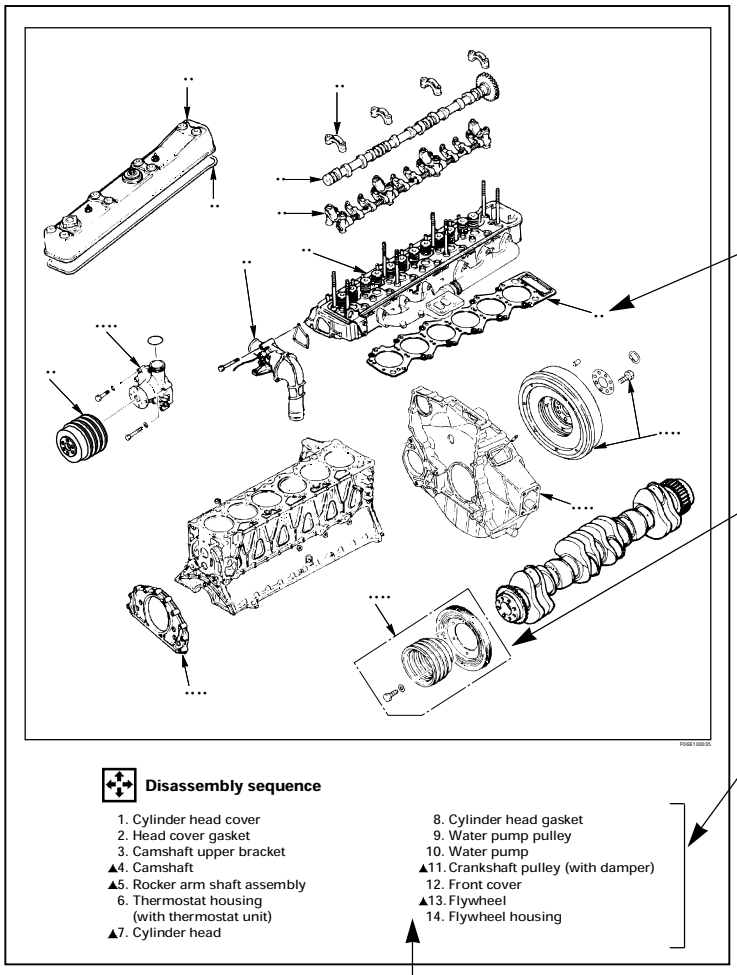
1. Before performing any inspections or maintenance work, disconnect the battery's ground cable to prevent any damage from shorted wires.
2. Always use the proper tool for the job.
   When a special tool is designated for a job, be sure to use only that special tool.
3. When replacement parts are required, consult the appropriate Isuzu parts catalog and use only "Genuine Isuzu Parts."
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.

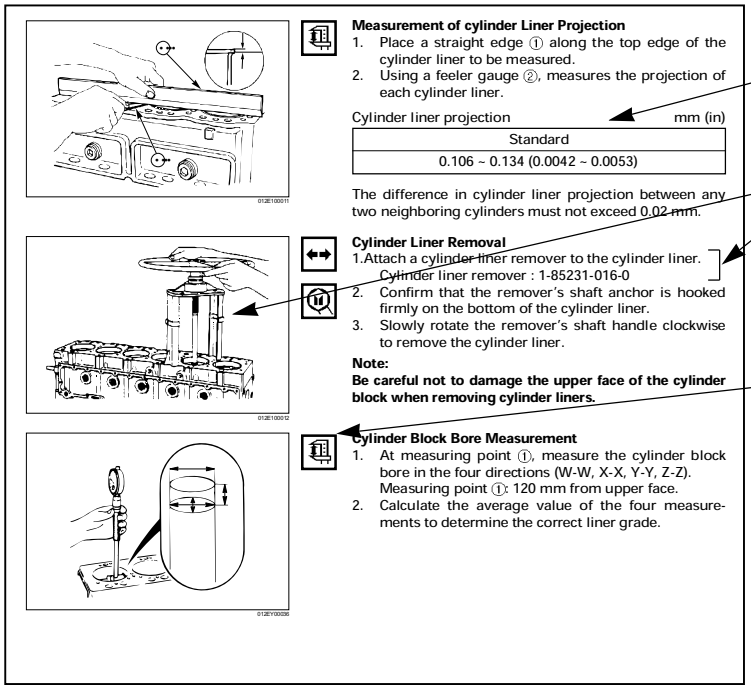


**Disassembly sequence**

1. Cylinder head cover
2. Head cover gasket
3. Camshaft upper bracket
▲4. Camshaft
▲5. Rocker arm shaft assembly
6. Thermostat housing (with thermostat unit)
▲7. Cylinder head
8. Cylinder head gasket
9. Water pump pulley
10. Water pump
▲11. Crankshaft pulley (with damper)
12. Front cover
▲13. Flywheel
14. Flywheel housing

- This number indicates the sequence of the procedure.
- Items enclosed in a frame are removed and installed as a single unit, and the order of disassembly and reassembly is indicated in the illustration.
- Parts listed beneath "Disassembly Steps" or "Assembly Steps" are listed in the sequence in which they are removed or assembled.
- The triangle mark ▲ indicates a particularly important part or operation, and is accompanied by detailed instructions in the text.

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



**Measurement of cylinder Liner Projection**

1. Place a straight edge ① along the top edge of the cylinder liner to be measured.
2. Using a feeler gauge ②, measures 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**

1. Attach a cylinder liner remover to the cylinder liner.
   Cylinder liner remover : 1-85231-016-0
2. Confirm that the remover's shaft anchor is hooked firmly on the bottom of the cylinder liner.
3. 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**

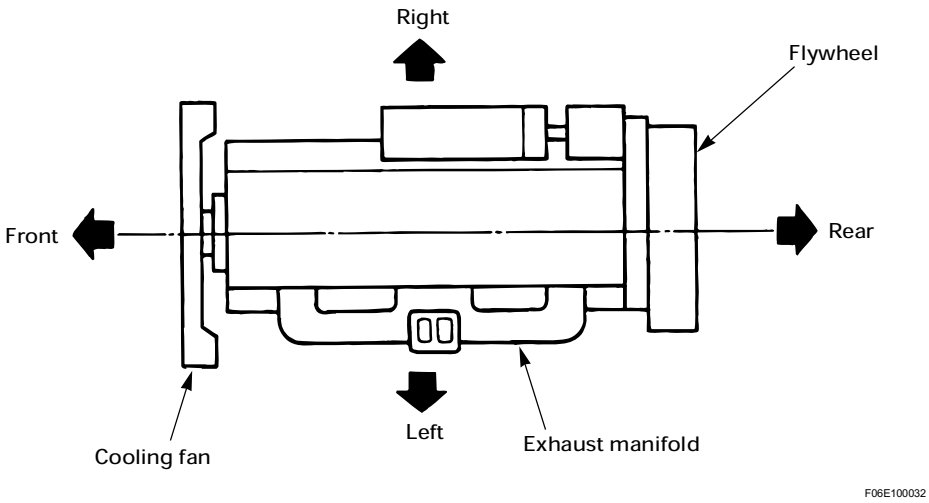
1. At measuring point ①, measure the cylinder block bore in the four directions (W-W, X-X, Y-Y, Z-Z). Measuring point ①: 120 mm from upper face.
2. Calculate the average value of the four measurements to determine the correct liner grade.

- 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 (Isuzu Tools) |
| .... | 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 form 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.




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

# ABOUT ANGULAR TIGHTENING

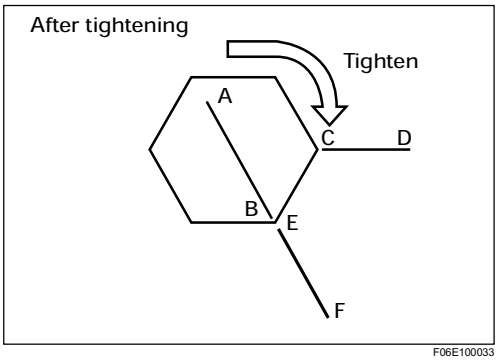
At present, the method most commonly used to tighten bolts is to specify a torque value to which the bolts should be tightened. This method, however, has the disadvantage of being characterized by considerable fluctuation in axial force for a given torque, with the result that when attempting to maintain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

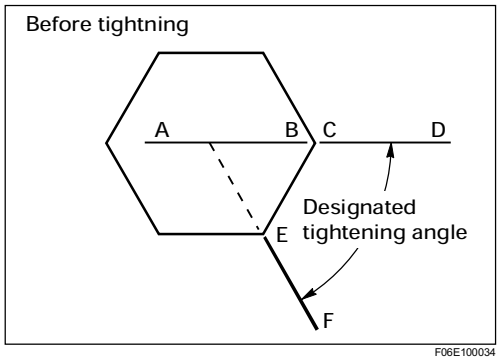
1. Apply molybdenum disulfide grease to the threads and setting faces of the nuts and bolts.
2. Tighten all bolts to the designated tightening torque values.
3. Next, make a mark at a point corresponding to one edge of the bolt as shown in the accompanying illustration, then tighten the bolt by turning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

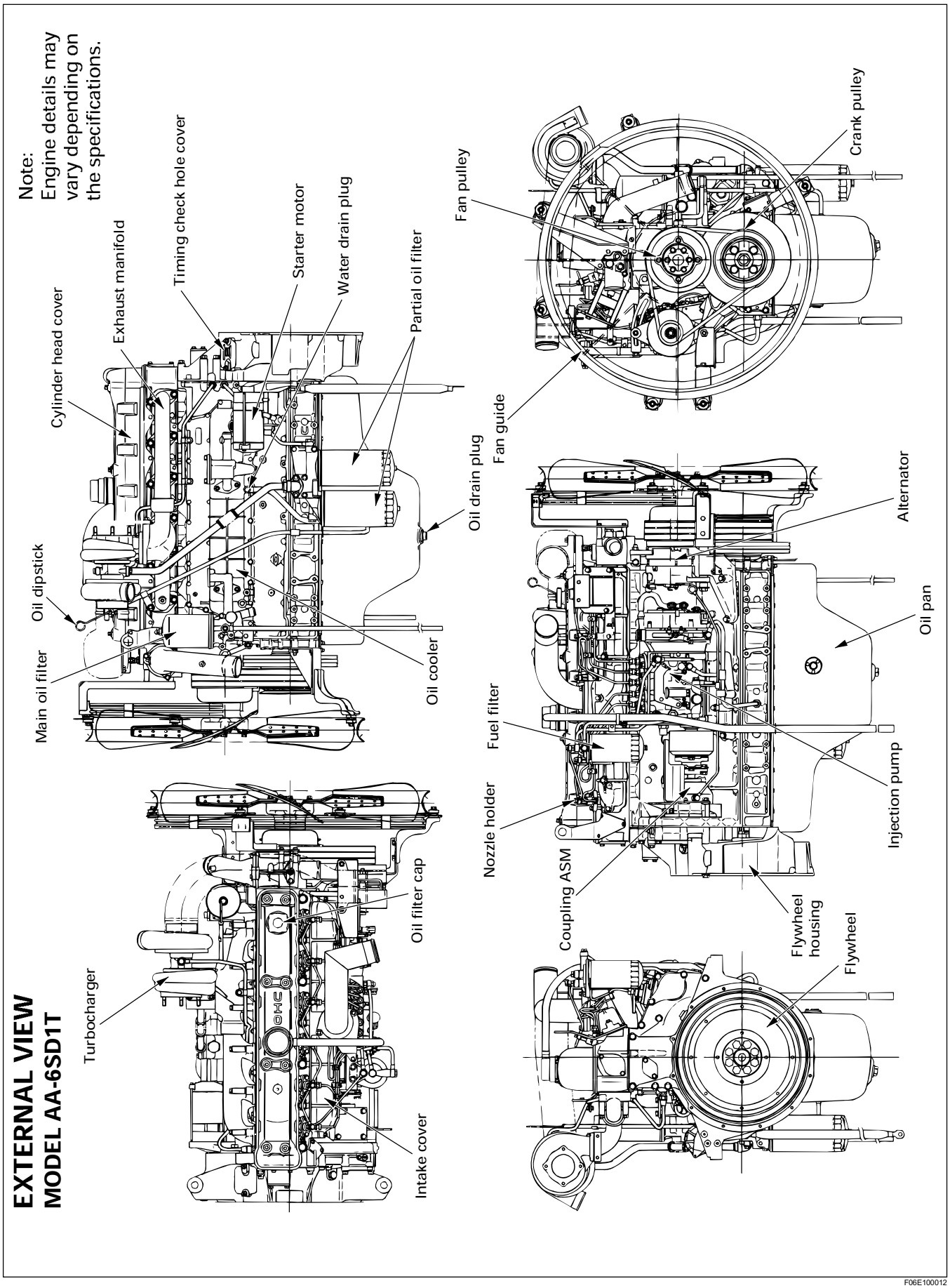
## LOCATIONS OF USE OF ANGULAR TIGHTENING METHOD

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

| Item \ Engine Model | | | | AA-6SD1T |
|---|---|---|---|---|
| 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.
Turbocharger
Oil filter cap
Intake cover
Main oil filter
Oil dipstick
Cylinder head cover
Exhaust manifold
Timing check hole cover
Starter motor
Water drain plug
Partial oil filter
Oil cooler
Fan pulley
Crank pulley
Fan guide
Oil drain plug
Alternator
Oil pan
Fuel filter
Nozzle holder
Coupling ASM
Flywheel housing
Injection pump
Flywheel

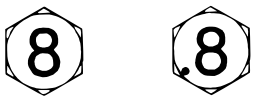
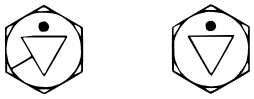
F06E100012

# TIGHTENING TORQUE SPECIFICATIONS

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

## STANDARD BOLT

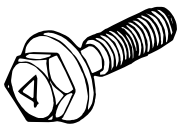
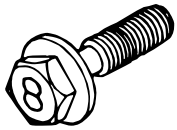
kgf·m (lb.ft/N·m)

| 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)

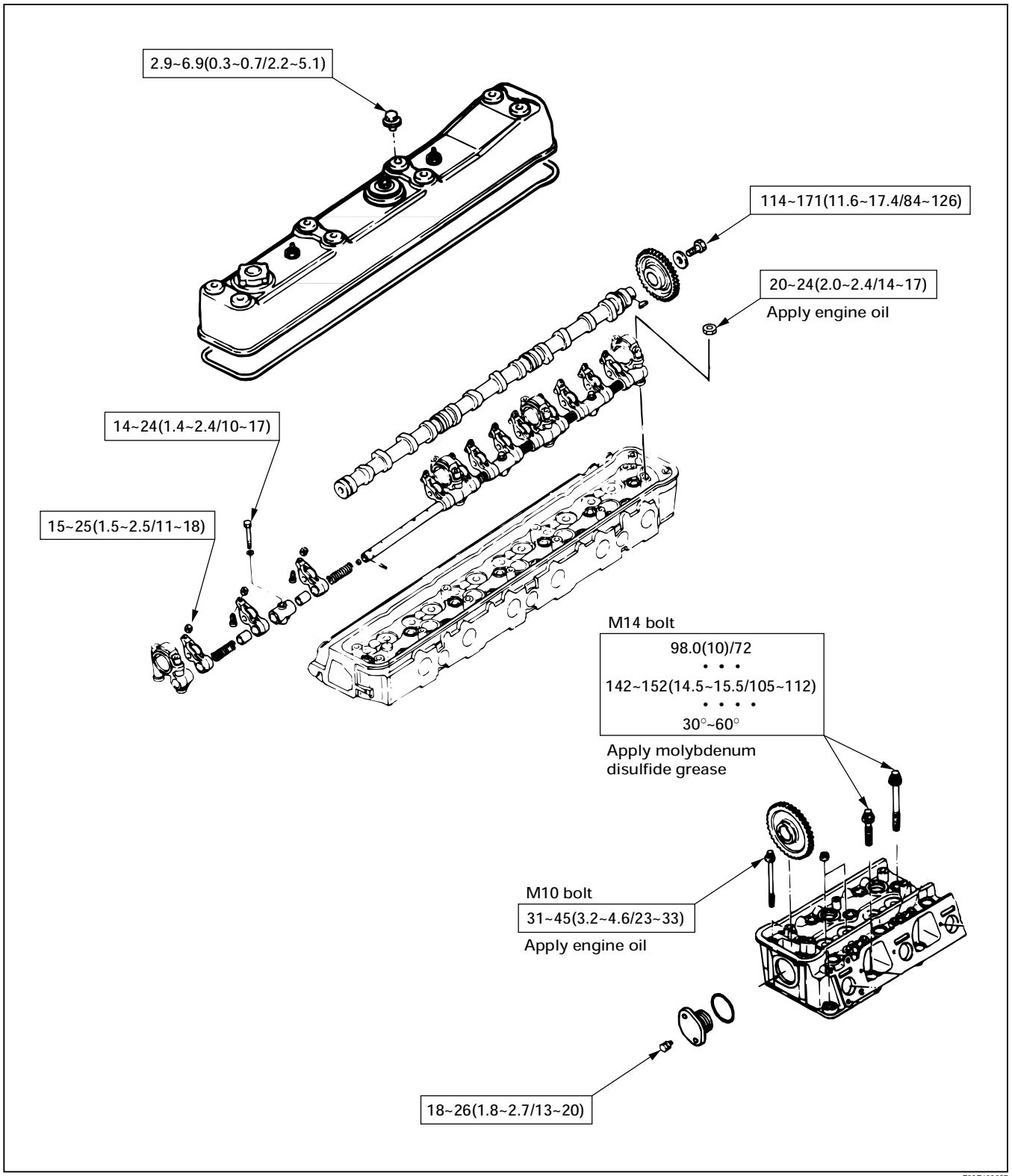
| Bolt Identification / Bolt Diameter × pitch (mm) |  |  |  |
|---|---|---|---|
| **M6 × 1.0** | 5 – 9 (0.5 – 0.9/4 – 7) | 6 – 12 (0.6 – 1.2/4 – 9) | ——— |
| **M8 × 1.25** | 11 – 20 (1.1 – 2.0/8 – 15) | 15 – 28 (1.6 – 2.9/12 – 21) | 18 – 34 (2.1 – 3.4/15 – 25) |
| **M10 × 1.25** | 23 – 39 (2.4 – 3.9/17 – 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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