FOREWORD

This supplement has been prepared to provide information covering general service repairs for the 2L-T and 3L engines mounted on the TOYOTA LAND CRUISER, HILUX, and 4RUNNER.

Applicable models:
LJ70, 72, 73, 77, 79 series
LN106, 111, 130, 135 series

For basic engine service repair, refer to the following repair manual.

2L, 3L Engine Repair Manual (Pub. No. RM123E)

Please note that the publications below have also been prepared as relevant service manuals to the components and systems in this engine.

All information contained in this manual is the most up-to-date at the time of publication. However, specifications and procedures are subject to change without notice.

TOYOTA MOTOR CORPORATION
HOW TO USE THIS MANUAL

To assist you in finding your way through this manual, the Section Title and major heading are given at the top of every page. An INDEX is provided on the 1st page of each section to guide you to the item to be repaired.

At the beginning of each section, PRECAUTIONS are given that pertain to all repair operations contained in that section. Read these precautions before starting any repair task.

TROUBLESHOOTING tables are included for each system to help you diagnose the problem and find the cause. The repair for each possible cause is referenced in the remedy column to quickly lead you to the solution.

REPAIR PROCEDURES

Most repair operations begin with an overview illustration. It identifies the components and shows how the parts fit together.

Example:

---

**kg-cm (ft-lb, N·m)**: Specified torque

◆ Non-reusable part
The procedures are presented in a step-by-step format:
- The illustration shows what to do and where to do it.
- The task heading tells what to do.
- The detailed text tells how to perform the task and gives other information such as specifications and warnings.

Example:

**REMOVE CRANKSHAFT PULLEY**
Using SST, remove the pulley.
SST 09213-60017 (09213-00060)

*Set part No.*
*Component part No.*

**Detailed text: how to do task**
Install the four injection nozzles.
Torque: 650 kg-cm (47 ft-lb, 64 N·m)

This format provides the experienced technician with a FAST TRACK to the information needed. The upper case task heading can be read at a glance when necessary, and the text below it provides detailed information. Important specifications and warnings always stand out in bold type.

**REFERENCES**
References have been kept to a minimum. However, when they are required, you are given the page to refer to.

**SPECIFICATIONS**
Specifications are presented in bold type throughout the text where needed. You never have to leave the procedure to look up your specifications. They are also found in Appendix A for quick reference.

**CAUTIONS, NOTICES, HINTS:**
- CAUTIONS are presented in bold type, and indicate there is a possibility of injury to you or other people.
- NOTICES are also presented in bold type, and indicate the possibility of damage to the components being repaired.
- HINTS are separated from the text but do not appear in bold. They provide additional information to help you efficiently perform the repair.
IDENTIFICATION INFORMATION

ENGINE SERIAL NUMBER
The engine serial number is stamped on the left side of the cylinder block.

GENERAL REPAIR INSTRUCTIONS

1. Use fender, seat and floor covers to keep the vehicle clean and prevent damage.

2. During disassembly, keep parts in order to facilitate reassembly.

3. Observe the following.
   (a) Before performing electrical work, disconnect the negative (−) cable from the battery terminal.
   (b) If it is necessary to disconnect the battery for inspection or repair, always disconnect the cable from the negative (−) terminal which is grounded to the vehicle body.
   (c) To prevent damage to the battery terminal post, loosen the terminal nut and raise the cable straight up without twisting or prying it.
   (d) Clean the battery terminal posts and cable terminals with a shop rag. Do not scrape them with a file or other abrasive object.
   (e) Install the cable terminal to the battery post with the nut loose, and tighten the nut after installation. Do not use a hammer to tap the terminal onto the post.
   (f) Be sure the cover for the positive (+) terminal is properly in place.

4. Check hose and wiring connectors to make sure that they are secure and correct.

5. Non-reusable parts
   (a) Always replace cotter pins, gaskets, O-rings, oil seals, etc. with new ones.
   (b) Non-reusable parts are indicated in the component illustrations by the "◆" symbol.

6. Precoated parts
   Precoated parts are bolts and nuts, etc. These are coated with a seal lock adhesive at the factory.
   (a) If a precoated part is retightened, loosened or caused to move in any way, it must be recoated with the specified adhesive.
(b) Recoating of Precoated Parts
   (1) Clean off the old adhesive from the part's threads.
   (2) Dry with compressed air.
   (3) Apply the specified seal lock adhesive to the part's threads.

(c) Precoated parts are indicated in the component illustrations by the "★" symbol.

7. When necessary, use a sealer on gaskets to prevent leaks.

8. Carefully observe all specifications for bolt torques. Always use a torque wrench.

9. Use of special service tools (SST) and special service materials (SSM) may be required, depending on the nature of the repair. Be sure to use SST and SSM where specified and follow the proper work procedure. A list of SST and SSM can be found at the back of this manual.

10. When replacing fuses, be sure the new fuse is the correct amperage. DO NOT exceed the rating or use one of a lower rating.

11. Care must be taken when jacking up and supporting the vehicle. Be sure to lift and support the vehicle at the proper locations.
   (a) If the vehicle is to be jacked up only at the front or rear end, be sure to block the wheels in order to ensure safety.
   (b) After the vehicle is jacked up, be sure to support it on stands. It is extremely dangerous to do any work on the vehicle raised on a jack alone, even for a small job that can be finished quickly.

12. Observe the following precautions to avoid damaging the parts:
   (a) Be careful not to drop electrical components, such as sensors or relays. If they are dropped on a hard floor, they should be replaced and not reused.

(b) When separating electrical connectors, pull on the connector itself, not the wires.

(c) When disconnecting vacuum hoses, pull on the end of the hose, not the middle.
(d) When steam cleaning an engine, protect the distributor, coil, air filter, and injection pump from water.

(e) Never use an impact wrench to remove or install temp. switches or temp. sensors.

(f) When checking continuity at the wire connector, insert the tester probe carefully to prevent terminals from bending.

(g) When using a vacuum gauge, never force the hose onto a connector that is too large. Use a step-down adapter instead. Once the hose has been stretched, it may leak.

13. Tag hoses before disconnecting them:

(a) When disconnecting vacuum hoses, use tags to identify how they should be reconnected.

(b) After completing a job, double check that the vacuum hoses are properly connected. A label under the hood shows the proper layout.
### Abbreviations Used in This Manual

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>A/C</td>
<td>Air Conditioner</td>
</tr>
<tr>
<td>ACSD</td>
<td>Automatic Cold Start Device</td>
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<tr>
<td>Approx.</td>
<td>Approximately</td>
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<tr>
<td>EGR</td>
<td>Exhaust Gas Recirculation</td>
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<tr>
<td>EVRV</td>
<td>Electronic Vacuum Regulating Valve</td>
</tr>
<tr>
<td>EX</td>
<td>Exhaust (manifold, valve)</td>
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<tr>
<td>Ex.</td>
<td>Except</td>
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<tr>
<td>FIPG</td>
<td>Formed in Place Gasket</td>
</tr>
<tr>
<td>FL</td>
<td>Fusible Link</td>
</tr>
<tr>
<td>HAC</td>
<td>High Altitude Compensation</td>
</tr>
<tr>
<td>IN</td>
<td>Intake (manifold, valve)</td>
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<tr>
<td>LH</td>
<td>Left-Hand</td>
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<tr>
<td>O/S</td>
<td>Oversized</td>
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<tr>
<td>PIJ</td>
<td>Pilot Injection Device</td>
</tr>
<tr>
<td>RH</td>
<td>Right-Hand</td>
</tr>
<tr>
<td>SSM</td>
<td>Special Service Materials</td>
</tr>
<tr>
<td>SST</td>
<td>Special Service Tools</td>
</tr>
<tr>
<td>STD</td>
<td>Standard</td>
</tr>
<tr>
<td>TDC</td>
<td>Top Dead Center</td>
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<tr>
<td>U/S</td>
<td>Undersize</td>
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<tr>
<td>VSV</td>
<td>Vacuum Switching Valve</td>
</tr>
<tr>
<td>w/</td>
<td>With</td>
</tr>
<tr>
<td>w/o</td>
<td>Without</td>
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</table>
ENGINE MECHANICAL

REFER TO 2L, 3L ENGINE REPAIR MANUAL
(Pub. No. RM123E)

NOTE: The following pages contain only the points which differ from the above listed manual.

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<td>EM-4</td>
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<td>Diesel Electrical System Diagnosis [2L-T Austria]</td>
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<td>Diesel Electrical System Diagnosis [2L-T Others]</td>
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<td>CYLINDER BLOCK</td>
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DESCRIPTION
The 2L-T engine is an in-line 4-cylinder 2.4 liter OHC engine.
The 3L engine is an in-line 4-cylinder 2.8 liter OHC engine.
The 2L-T and 3L engines are in-line 4-cylinder engines with the cylinders numbered 1 – 2 – 3 – 4 from the front. The crankshaft is supported by 5 bearings on the inside of the crankcase. These bearings are made of aluminum. The crankshaft is integrated with 8 weights which are cast along with it for balancing. Oil holes are built into the center of the crankshaft for supplying oil to the connecting rods.

This engine's injection order is 1 – 3 – 4 – 2. The cylinder head is made of cast iron with a cross flow type intake and exhaust layout and with swirl type combustion chambers. The glow plugs are located in the combustion chambers.

Exhaust and intake valves are equipped with irregular pitch springs which are capable of following the valves even at high engine speeds.

The camshaft is driven by the timing belt. There are 2 types of camshaft bearing, No. 1 and No. 2. No. 1 bearing is integrated with the thrust washer. The camshaft journal is supported at 5 places between the valve lifters of each cylinder and on the cylinder head of front end. Lubrication of the camshaft journal and cam is accomplished by oil being supplied through the oiler port in the No. 1 camshaft journal.

Adjustment of the valve clearance is done by means of an outer shim type system, in which valve adjusting shims are located above the valve lifters. This permits replacement of the shims without removal of the camshafts.

Pistons are made of highly temperature-resistant aluminum alloy.

Piston pins are the full-floating type, with the pins fastened to neither the piston boss nor the connecting rods. Instead, snap rings are fitted on both ends of the pins, preventing the pins from falling out.

The No. 1 compression ring is made of steel and the No. 2 compression ring is made of cast iron. The oil ring is made of steel. The outer diameter of each piston ring is slightly larger than the diameter of the piston and the flexibility of the rings allows them to hug the cylinder walls when they are mounted on the piston. Compression rings No. 1 and No. 2 work to prevent the leakage of gas from the cylinder and the oil ring works to scrape oil off the cylinder walls to prevent it from entering the combustion chamber.

The cylinder block is made of cast iron. It has 4 cylinders which are approximately 2 times the length of the piston stroke. The top of each cylinder is closed off by the cylinder head and the lower end of cylinder becomes the crankcase, in which the crankshaft is installed. In addition, the cylinder block contains a water jacket, through which coolant is pumped to cool the cylinders.

The oil pan is bolted onto the bottom of the cylinder block. The oil pan is an oil reservoir made of pressed steel sheet. A dividing plate is included inside the oil pan to keep sufficient oil in the bottom of the pan even when the vehicle is tilted. This dividing plate also prevents the oil from making waves when the vehicle is stopped suddenly and thus shifting the oil away from the oil pump suction pipe.
TROUBLESHOOTING

Diesel Engine Diagnosis

GENERAL
1. Diesel engine problems are usually caused by the engine or fuel system. The injection pump is very rarely the cause of fuel system problems.
2. Before beginning fuel system tests, first check that the engine compression, valve timing and other major systems are within specifications.

PRELIMINARY CHECKS
1. Before performing fuel system checks, ensure that the engine is in good running condition. If necessary, first check the compression, timing and major components or systems.
2. Check the air filter, and clean or replace it if necessary.
3. Check that there is sufficient fuel in the tank.
4. Check if the fuel is contaminated with gasoline or other foreign elements. Only good-quality diesel fuel should be used.
5. Bleed air from the system by pumping the priming.
6. Check for water in the fuel filter and fuel tank, and drain as necessary.
7. If the engine will not crank or if it cranks slowly, first troubleshoot the electrical system.
**PRECAUTION:**

1. The basic troubleshooting procedures for the diesel engine (valve clearance, compression, bearings, valves, pistons, etc.) are the same checks you would make for gasoline engine.
2. Repair of the injection pump requires considerable skill and use of a special test bench.

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### ENGINE WILL NOT CRANK

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Check Procedure and Correction Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. LOOSE OR CORRODED BATTERY CABLES</td>
<td>Check cables from battery to starter and make necessary repairs.</td>
</tr>
<tr>
<td>2. DISCHARGED BATTERY</td>
<td>Check alternator output and drive belt. If necessary, repair. (See page CH-3)</td>
</tr>
<tr>
<td>3. INOPERATIVE STARTER</td>
<td>Check for battery voltage at starter terminals 30 and 50. If okay, see STARTING SYSTEM for repair procedure.</td>
</tr>
</tbody>
</table>

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### ENGINE CRANKS SLOWLY—WILL NOT START

**HINT:** Minimum cranking speed:
- Cold 100 rpm
- Hot 150 rpm

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</tr>
<tr>
<td>3. IMPROPER ENGINE OIL</td>
<td>Check engine oil. If improper viscosity, drain and refill with oil of viscosity recommended by manufacturer. (See page LU-4)</td>
</tr>
</tbody>
</table>
## ENGINE CRANKS NORMALLY BUT WILL NOT START

### (Possible Cause) | (Check Procedure and Correction Method)
---|---
1. **NO FUEL TO NOZZLE** | Loosen any one injection pipe union nut from its nozzle holder.  
Crank engine for about 5 seconds while confirming that fuel is being discharged from pipe.  
If fuel is coming out, begin diagnosis from item 4.  
If not, begin from item 2.

2. **NO FUEL CUT SOLENOID OPERATION** | With starter switch turned ON, check for fuel cut solenoid operation noise (clicking sound) while repeatedly connecting and disconnecting fuel cut solenoid.  
If no noise, check if there is battery voltage to solenoid when starter switch is ON.  
If battery voltage is confirmed, fuel cut solenoid is faulty and should be replaced. If no voltage, refer to ELECTRICAL DIAGNOSIS and make necessary repairs.

3. **NO FUEL INTO INJECTION PUMP** | Disconnect inlet hoses from fuel filter, and feed clean fuel from separate container directly into fuel pump.  
**HINT:** When feeding fuel tank directly into pump, keep container at same level as vehicle fuel tank.  
If engine starts, either fuel filter or line between fuel tank and filter is clogged and should be repaired accordingly.  
If engine still does not start (no fuel intake), check fuel line between filter and pump.  
If normal, pump is faulty and should be replaced.

4. **FUEL LEAKAGE FROM INJECTION PIPES** | Check for loose unions or cracks.  
If leaking, tighten to standard torque or, if necessary, replace pipe(s).

5. **INOPERATIVE PRE-HEATING OPERATION** | With starter switch turned ON and glow plug indicator light illuminated, check that there is voltage applied to glow plug.  
If not, refer to ELECTRICAL DIAGNOSIS and repair as necessary.
6. FAULTY GLOW PLUG OPERATION
Check glow plug for continuity. If no continuity, a broken wire is indicated and glow plug should be replaced.

7. IMPROPER INJECTION TIMING
Check injection timing. (See page EM-24 or 25)
Plunger stroke:
- 2L-T (Austria) Within the marks of belt case and pump flange. (See page EM-24)
- 2L-T (Others) 0.54 – 0.66 mm (0.0213 – 0.0260 in.)
- 3L 0.84 – 0.96 mm (0.0331 – 0.0378 in.)
If not as above, injection pump is improperly adjusted.

8. (2L-T) IMPROPER COLD START ADVANCE AND FAST IDLE
Check timer piston stroke and fast idle lever opening angle with an injection pump tester when cold start advance is operated.

9. FAULTY INJECTION NOZZLES
Check injection pressure with a nozzle tester.
Opening pressure: 145 – 155 kg/cm² (2,062 – 2,205 psi) (14,220 – 15,200 kPa)
If not as above, nozzle adjustment is improper and pressure should be readjusted. If pressure cannot be adjusted to specification, replace injection nozzle.
# ROUGH IDLE WITH WARM ENGINE

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Check Procedure and Correction Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. IMPROPER ADJUSTMENT OF ACCELERATOR CABLE</strong></td>
<td>With accelerator pedal released, check that adjusting lever is in contact with idle speed adjusting screw. Also check if accelerator cable or linkage is catching on something. If necessary, adjust so that lever is in contact with screw, or make other required repairs.</td>
</tr>
</tbody>
</table>
| **2. IDLE SPEED TOO LOW** | Check idle speed. (See page EM-27)  
Idle speed:  
- **2L-T**  
  700 – 800 rpm  
- **3L**  
  650 – 750 rpm  
HINT: If less than standard, idling would normally be rough. If not as above, adjust with idle speed adjusting screw. |
| **3. FUEL LEAKAGE** | Check for leaks at injection pump connections, pump distributive head bolt, injection nozzles and delivery valve holders. Tighten any loose connections to specified torque or replace parts as necessary. |
| **4. IMPROPER INJECTION TIMING** | Refer to step 7 of ENGINE CRANKS NORMALLY BUT WILL NOT START, above. |
| **5. IMPROPER OPERATION OF INJECTION NOZZLES OR DELIVERY VALVES** | With engine idling, loosen injection pipe to each cylinder in order, and check if idle speed changes. If no change, a faulty cylinder is indicated. Check according to following procedure.  
- Faulty injection nozzle  
  Check injection nozzle with a nozzle tester.  
  Opening pressure:  
  - 145 – 155 kg/cm²  
  - (2,062 – 2,205 psi)  
  - (14,220 – 15,200 kPa)  
If not as above, nozzle adjustment is improper and pressure should be readjusted. If pressure cannot be adjusted to specification, replace injection nozzle.  
- Faulty delivery valve  
  If injection pressure is as specified, delivery valve is defective and should be replaced. |
## ENGINE SUDDENLY STOPS

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<th>Possible Cause</th>
<th>Check Procedure and Correction Method</th>
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<tbody>
<tr>
<td><strong>1. ENGINE WILL NOT RE-START</strong></td>
<td>Check to see if engine re-starts according to prescribed procedure. If not, refer to ENGINE CRANKS NORMALLY BUT WILL NOT START, above, and repair as necessary.</td>
</tr>
<tr>
<td><strong>2. ROUGH IDLE</strong></td>
<td>Refer to ROUGH IDLE WITH WARM ENGINE and repair accordingly.</td>
</tr>
<tr>
<td><strong>3. MALFUNCTION OF FUEL CUT SOLENOID</strong></td>
<td>Refer to ENGINE CRANKS NORMALLY BUT WILL NOT START, above, and check accordingly. HINT: No operation noise from fuel cut solenoid may be due to loose electrical connections, so check connectors before proceeding with further repairs.</td>
</tr>
<tr>
<td><strong>4. NO FUEL INTO INJECTION PUMP</strong></td>
<td>Refer to step 3 of ENGINE CRANKS NORMALLY BUT WILL NOT START, above.</td>
</tr>
</tbody>
</table>

## LACK OF POWER

**HINT:**
- First check that the air cleaner is not clogged or the engine overheating.
- Not applicable if the customer desires an output power higher than specified for that vehicle. For accuracy, adjust with a chassis dynamo.

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Check Procedure and Correction Method</th>
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</thead>
<tbody>
<tr>
<td><strong>1. IMPROPER ADJUSTMENT OF ACCELERATOR CABLE</strong></td>
<td>With accelerator fully depressed, check that adjusting lever is in contact with maximum speed adjusting screw. Also check if accelerator cable or linkage is catching on something. If necessary, adjust so that lever is in contact with screw, or make other required repairs.</td>
</tr>
</tbody>
</table>
| **2. INSUFFICIENT MAXIMUM SPEED** | Check maximum speed. (See page EM-27) Maximum speed:  
- 2L-T 4,700 - 4,900 rpm  
- 3L (Hong Kong, Singapore and Malaysia) 4,300 - 4,500 rpm  
- 3L (Others) 4,500 - 4,700 rpm  
If not as above, adjust with maximum speed adjusting screw. |
3. INTERCHANGED OVERFLOW SCREW (OUT) AND INLET (NO MARK) FITTING
HINT: Overflow screw is marked “OUT” and has an inner jet. Although both fittings are same size, they must not be interchanged.

4. FUEL LEAKAGE
Refer to step 3 of ROUGH IDLE WITH WARM ENGINE.

5. CLOGGED FUEL FILTER
Disconnect inlet hose to fuel filter, and feed clean fuel directly into pump.
HINT: When feeding fuel directly into pump, keep container at same level as vehicle fuel tank.
If engine condition improves, fuel filter is clogged and should be replaced.
If no increase in engine condition after replacing fuel filter, check priming pump (hand pump) or perform other necessary repairs.

6. IMPROPER INJECTION TIMING
Refer to step 7 of ENGINE CRANKS NORMALLY BUT WILL NOT START.

7. FAULTY INJECTION NOZZLES
Refer to step 9 of ENGINE CRANKS NORMALLY BUT WILL NOT START.

EXCESSIVE EXHAUST SMOKE
HINT:
• Check that the air cleaner is not clogged.
• Check with the customer whether or not oil consumption has been excessive.

(Possible Cause) (Check Procedure and Correction Method)

1. IMPROPER INJECTION TIMING
Refer to step 7 of ENGINE CRANKS NORMALLY BUT WILL NOT START.
HINT: Black smoke indicates advanced timing while white smoke indicates retarded timing. Adjustments should be made accordingly.

2. CLOGGED FUEL FILTER
Refer to step 5 of LACK OF POWER.
HINT: At high speed (2,000 – 3,000 rpm), a clogged filter tends to make exhaust smoke white.

3. FAULTY INJECTION NOZZLES
Refer to step 9 of ENGINE CRANKS NORMALLY BUT WILL NOT START.
HINT: Excessive exhaust smoke is often caused by nozzle pressure being too low.
EXCESSIVE FUEL CONSUMPTION

HINT: Check whether clutch slipping, brakes grabbing, tires wrong size or air filter clogged.

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<tr>
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<th>Check Procedure and Correction Method</th>
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<tr>
<td>1. FUEL LEAKAGE</td>
<td>Refer to step 3 of ROUGH IDLE WITH WARM ENGINE.</td>
</tr>
<tr>
<td>2. IDLE SPEED TOO HIGH</td>
<td>After sufficiently warming up engine, check idle speed. (See page EM-27)</td>
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<tr>
<td></td>
<td>Idle speed: 2L-T 700 – 800 rpm</td>
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<tr>
<td></td>
<td>3L 650 – 750 rpm</td>
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<tr>
<td></td>
<td>If not as above, adjust with idle speed adjusting screw.</td>
</tr>
<tr>
<td>3. MAXIMUM SPEED TOO HIGH</td>
<td>Check maximum speed. (See page EM-27)</td>
</tr>
<tr>
<td></td>
<td>Maximum speed: 2L-T 4,700 – 4,900 rpm</td>
</tr>
<tr>
<td></td>
<td>3L (Hong Kong, Singapore and Malaysia) 4,300 – 4,500 rpm</td>
</tr>
<tr>
<td></td>
<td>3L (Others) 4,500 – 4,700 rpm</td>
</tr>
<tr>
<td></td>
<td>If not as above, adjust with maximum speed adjusting screw.</td>
</tr>
<tr>
<td>4. IMPROPER INJECTION TIMING</td>
<td>Refer to step 7 of ENGINE CRANKS NORMALLY BUT WILL NOT START.</td>
</tr>
<tr>
<td>5. FAULTY INJECTION NOZZLES</td>
<td>Refer to step 9 of ENGINE CRANKS NORMALLY BUT WILL NOT START.</td>
</tr>
</tbody>
</table>
## ENGINE NOISE WHEN WARM
(Cranking Noise with Excessive Vibration)

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<th>Possible Cause</th>
<th>Check Procedure and Correction Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. ENGINE COOLANT TEMPERATURE TOO LOW</strong></td>
<td>Check coolant temperature with water temperature gauge. If not sufficiently warm, thermostat is faulty and should be replaced.</td>
</tr>
<tr>
<td><strong>2. IMPROPER INJECTION TIMING</strong></td>
<td>Refer to step 7 of ENGINE CRANKS NORMALLY BUT WILL NOT START.</td>
</tr>
<tr>
<td><strong>3. FAULTY INJECTION NOZZLES</strong></td>
<td>Refer to step 9 of ENGINE CRANKS NORMALLY BUT WILL NOT START.</td>
</tr>
</tbody>
</table>

## ENGINE WILL NOT RETURN TO IDLE

<table>
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<tr>
<th>Possible Cause</th>
<th>Check Procedure and Correction Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>BINDING ACCELERATOR CABLE</strong></td>
<td>Operate adjusting lever on top of injection pump and check if engine returns to idle. (See page EM-27)</td>
</tr>
<tr>
<td></td>
<td>If so, accelerator cable is binding or improperly adjusted and should be repaired accordingly.</td>
</tr>
<tr>
<td></td>
<td>If engine does not return to idle, injection pump is faulty and should be replaced.</td>
</tr>
</tbody>
</table>

## ENGINE WILL NOT SHUT OFF WITH KEY

<table>
<thead>
<tr>
<th>Possible Cause</th>
<th>Check Procedure and Correction Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IMPROPER FUEL CUT SOLENOID OPERATION</strong></td>
<td>Disconnect connector of fuel cut solenoid, and check if engine stops. If so, starter switch is faulty and should be repaired as necessary or replaced. If engine does not stop, either fuel cut solenoid is faulty or there is interference by foreign particles. Repair as necessary.</td>
</tr>
</tbody>
</table>
Diesel Electrical System Diagnosis [2L-T Austria]

ENGINE DOES NOT START COLD

HINT:
• Battery voltage at least 12 V — starter switch OFF.
• Engine cranks normally.
• Fusible link okay.
• Check the voltage marked with an asterisk (*) just as the starter switch is placed at ON because the voltage will change.

1. Pre-Heating System (Super Glow Type)

Disconnect the water temperature sensor.

Check if indicator light lights up with starter switch ON. Light on: 5 - 6 seconds

No

Check fuse. (See page ST-2)

Fuse OK

Check indicator light bulb.

Bulb OK

Check for battery voltage to terminal B25 (LJ) or A4 (LN) of pre-heating timer connector (on wire harness side).

Yes

Check for battery voltage to terminal A6 (LJ) or A3 (LN) of pre-heating timer connector (on wire harness side).

Yes

Are terminals B15, B22 and B24 (LJ) or B11 and B14 (LN) of the timer grounded?

Yes

Replace timer.

No

Open circuit or ground faulty in wire harness between terminals of the timer and body ground.

Pre-Heating Timer (Emission Control ECU)

CONTINUED ON PAGE EM-14
CONTINUED FROM PAGE EM-13

*Place starter switch at ON and check if current flow to terminal B23(LJ) or A5(LN) of timer is in accordance.
Current flow: 120 seconds

Pre-heating duration differs from the specified duration.

OK

No Voltage

Timer is faulty and should be replaced.

*After completion of pre-heating, check for voltage at terminal B23(LJ) or A5(LN) again when starter switch is placed at START.

Voltage

Starter switch OFF.

*Place starter switch at ON and check for voltage to glow plug a few seconds later. Thereafter, voltage should drop about 1/2.

No Voltage at All

*Check for battery voltage at negative (-) side of glow plug resistor.
If no voltage, No. 1 glow plug relay is faulty and should be replaced.

OK

Check glow plug for resistance.

No Voltage Remains at Battery Voltage, or Falls to 0 V

*Check for battery voltage to positive (+) side of glow plug resistor.
If okay, replace the resistor.
If no voltage, No. 2 glow plug relay is faulty and should be replaced.

Infinity

Glow plug is faulty and should be replaced.

Approx. 0 Ω

Glow plug okay.

Connect water temperature sensor.
2. Fuel Cut Solenoid Valve

With starter switch turned ON, check for fuel cut solenoid valve operation noise (clicking sound) while repeatedly connecting and disconnecting fuel cut solenoid valve.

- Fuel cut solenoid valve okay.
- No Noise

Check fuse.

- Fuse OK
- Fuse Blown
  - Check for short circuit, and repair as necessary.

Apply battery voltage directly to solenoid, and check for noise.

- Noise
- No Noise
  - Check wire harness from fuse to fuel cut solenoid.

Replace fuel cut solenoid valve.
Diesel Electrical System Diagnosis [2L-T Others]

ENGINE DOES NOT START COLD

HINT:
- Battery voltage at least 12 V — starter switch OFF.
- Engine cranks normally.
- Fusible link okay.
- Check the voltage marked with an asterisk (*) just as the starter switch is placed at ON because the voltage will change.

1. Pre-Heating System (Super Glow Type)

   Disconnect the water temperature sensor.

   Check if indicator light lights up with starter switch ON.
   Light on: 6 – 7 seconds

   No
   Check fuse. (See page ST-2)
   Fuse Blown
   Check for short circuit and repair if necessary.
   Fuse OK
   Check indicator light bulb.
   Bulb No Good
   Replace bulb.
   Bulb OK
   Check for battery voltage to terminal 3 of pre-heating timer connector (on wire harness side).
   If okay, pre-heating timer is faulty and should be replaced.

   No
   *Check for battery voltage to terminal 1 of pre-heating timer with starter switch ON.
   Voltage

   No
   *Check that there is 1 V or less to terminal 9.
   If okay, timer is faulty and should be replaced.

   Voltage

   No
   *Check if voltage to terminal 1 of pre-heating timer is terminated after engine is started.

   Yes

   Starter switch OFF.

   CONTINUED ON PAGE EM-17

Pre-Heating Timer
CONTINUED FROM PAGE EM-16

*Place starter switch at ON and check if current flow to terminal 5 of timer is in accordance. Current flow: 15–29 seconds

Pre-heating duration differs from the specified duration.

OK

Timer is faulty and should be replaced.

No Voltage

*After completion of pre-heating, check for voltage at terminal 5 again when starter switch is placed at START.

Voltage

Starter switch OFF.

*Check for battery voltage at negative (−) side of glow plug resistor. If no voltage, No.1 glow plug relay is faulty and should be replaced.

No Voltage at All

*Place starter switch at ON and check for voltage to glow plug a few seconds later. Thereafter, voltage should drop about 1/2.

OK

*Check for battery voltage to positive (+) side of glow plug resistor. If okay, replace the resistor. If no voltage, No.2 glow plug relay is faulty and should be replaced.

Voltage Remains at Battery Voltage, of Falls to 0 V

Check glow plug for resistance.

Glow plug is faulty and should be replaced.

Infinity

Glow plug okay.

Connect water temperature sensor.
ENGINE TUNE-UP

INSPECTION OF ENGINE COOLANT
(See steps 1 and 2 on page CO-4)

INSPECTION OF ENGINE OIL
(See steps 1 and 2 on page LU-4)

INSPECTION OF BATTERY
(See pages 1 and 2 on page CH-3)
  Standard specific gravity:
  When fully charged at 20° C (68° F)
  1.27 — 1.29 (80D26R)
  1.25 — 1.27 (Others)

INSPECTION OF AIR FILTER
(Paper Filter Type)
1. INSPECT AIR FILTER
   Visually check that the filter element is not excessively dirty, damaged or oily.

2. CLEAN AIR FILTER
   Clean the filter element with compressed air.
   First blow from the inside thoroughly. Then blow off the outside of the filter element.

(Washable Type)
1. INSPECT AIR FILTER
   Visually check that the filter element is not excessively dirty, damaged or oily.

2. CLEAN AIR FILTER
   (a) Blow dirt off in the filter element with compressed air.
(b) Submerge the filter element in the water and agitate it up and down more than ten times.
(c) Repeat rinsing in clean water until rinse water is clear.

(d) Remove excess water by shaking the filter element or blowing with compressed air.

NOTICE: Do not beat or drop filter element.
(e) Wipe off dust on the air cleaner case interior.

INSPECTION OF ALTERNATOR DRIVE BELTS
(See step 3 on page CH-3)

Drive belt deflection:
New belt 7 – 10 mm (0.28 – 0.39 in.)
Used belt 10 – 15 mm (0.39 – 0.59 in.)

Drive belt tension (Reference):
New belt 40 – 60 kg
Used belt 20 – 35 kg

INSPECTION OF GLOW PLUGS
(See page ST-6)
ADJUSTMENT OF VALVE CLEARANCE

HINT: Adjust the valve clearance while the engine is cold.

1. (2L-T)
   REMOVE AIR CLEANER

2. (w/ Intake Pipe)
   REMOVE INTAKE PIPE

3. REMOVE CYLINDER HEAD COVER
   (See step 16 on page EM-38)

4. SET NO. 1 CYLINDER TO TDC/COMPRESSION
   (a) Turn the crankshaft pulley clockwise, and align its groove with the timing pointer.
   (b) Check that the valve lifters on the No. 1 cylinder are loose and valve lifters on the No. 4 cylinder are tight.

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

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

Valve clearance (Cold):
   Intake \(0.20 - 0.30\) mm (0.008 - 0.012 in.)
   Exhaust \(0.40 - 0.50\) mm (0.016 - 0.020 in.)

(b) Turn the crankshaft one revolution (360°), and align the mark as above (See procedure step 4).
(c) Check only the valves indicated in the illustration. Measure the valve clearance.
    (See procedure step (a))

(d) Remove the adjusting shim.
   - Turn the crankshaft to position the cam lobe of the camshaft on the adjusting valve upward.
   - Using SST, press down the valve lifter.

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HINT: Before pressing down the valve lifter, position the notch on the exhaust manifold side.
- Remove the adjusting shim with a small screwdriver and magnetic finger.

(e) Determine the replacement adjusting shim size by using the following formula or charts:
- Using a micrometer, measure the thickness of the shim which was removed.
- Calculate the thickness of the new shim so the valve clearance comes within specified value.
  \[ T \quad \text{Thickness of used shim} \]
  \[ A \quad \text{Measured valve clearance} \]
  \[ N \quad \text{Thickness of new shim} \]

  \[ \text{Intake side: } N = T + (A - 0.25 \text{ mm (0.010 in.)}) \]
  \[ \text{Exhaust side: } N = T + (A - 0.45 \text{ mm (0.018 in.)}) \]

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

HINT: Shims are available in seventeen sizes in increments of 0.050 mm (0.0020 in.), from 2.500 mm (0.0984 in.) to 3.300 mm (0.1299 in.).

(f) Install a new adjusting shim.
- Place a new adjusting shim on the valve lifter.
- Remove SST.

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(g) Recheck the valve clearance.

6. REINSTALL CYLINDER HEAD COVER
(See step 4 on page EM-43)

7. (w/ Intake Pipe)
REINSTALL INTAKE PIPE

8. (2L-T)
REINSTALL AIR CLEANER
## Adjusting Shim Selection Using Chart

### INTAKE

<table>
<thead>
<tr>
<th>Measured clearance (mm)</th>
<th>Installed thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.000 - 0.020 (0.0000 - 0.0008)</td>
<td>2.50 (0.0984)</td>
</tr>
<tr>
<td>0.021 - 0.040 (0.0008 - 0.0016)</td>
<td>2.52 (0.0992)</td>
</tr>
<tr>
<td>0.041 - 0.060 (0.0016 - 0.0024)</td>
<td>2.54 (0.0997)</td>
</tr>
<tr>
<td>0.061 - 0.080 (0.0024 - 0.0031)</td>
<td>2.56 (0.0998)</td>
</tr>
<tr>
<td>0.081 - 0.100 (0.0031 - 0.0039)</td>
<td>2.58 (0.0999)</td>
</tr>
<tr>
<td>0.101 - 0.120 (0.0039 - 0.0047)</td>
<td>2.60 (1.0000)</td>
</tr>
<tr>
<td>0.121 - 0.140 (0.0047 - 0.0055)</td>
<td>2.62 (1.0001)</td>
</tr>
<tr>
<td>0.141 - 0.160 (0.0055 - 0.0063)</td>
<td>2.64 (1.0002)</td>
</tr>
<tr>
<td>0.161 - 0.180 (0.0063 - 0.0071)</td>
<td>2.66 (1.0003)</td>
</tr>
<tr>
<td>0.181 - 0.200 (0.0071 - 0.0079)</td>
<td>2.68 (1.0004)</td>
</tr>
<tr>
<td>0.201 - 0.220 (0.0079 - 0.0087)</td>
<td>2.70 (1.0005)</td>
</tr>
<tr>
<td>0.221 - 0.240 (0.0087 - 0.0095)</td>
<td>2.72 (1.0006)</td>
</tr>
<tr>
<td>0.241 - 0.260 (0.0095 - 0.0103)</td>
<td>2.74 (1.0007)</td>
</tr>
<tr>
<td>0.261 - 0.280 (0.0103 - 0.0111)</td>
<td>2.76 (1.0008)</td>
</tr>
<tr>
<td>0.281 - 0.300 (0.0111 - 0.0119)</td>
<td>2.78 (1.0009)</td>
</tr>
<tr>
<td>0.301 - 0.320 (0.0119 - 0.0126)</td>
<td>2.80 (1.0010)</td>
</tr>
<tr>
<td>0.321 - 0.340 (0.0126 - 0.0134)</td>
<td>2.82 (1.0011)</td>
</tr>
<tr>
<td>0.341 - 0.360 (0.0134 - 0.0142)</td>
<td>2.84 (1.0012)</td>
</tr>
<tr>
<td>0.361 - 0.380 (0.0142 - 0.0150)</td>
<td>2.86 (1.0013)</td>
</tr>
<tr>
<td>0.381 - 0.400 (0.0150 - 0.0158)</td>
<td>2.88 (1.0014)</td>
</tr>
<tr>
<td>0.401 - 0.420 (0.0158 - 0.0165)</td>
<td>2.90 (1.0015)</td>
</tr>
<tr>
<td>0.421 - 0.440 (0.0165 - 0.0173)</td>
<td>2.92 (1.0016)</td>
</tr>
<tr>
<td>0.441 - 0.460 (0.0173 - 0.0181)</td>
<td>2.94 (1.0017)</td>
</tr>
<tr>
<td>0.461 - 0.480 (0.0181 - 0.0189)</td>
<td>2.96 (1.0018)</td>
</tr>
<tr>
<td>0.481 - 0.500 (0.0189 - 0.0197)</td>
<td>2.98 (1.0019)</td>
</tr>
<tr>
<td>0.501 - 0.520 (0.0197 - 0.0205)</td>
<td>3.00 (1.0020)</td>
</tr>
<tr>
<td>0.521 - 0.540 (0.0205 - 0.0213)</td>
<td>3.02 (1.0021)</td>
</tr>
<tr>
<td>0.541 - 0.560 (0.0213 - 0.0220)</td>
<td>3.04 (1.0022)</td>
</tr>
<tr>
<td>0.561 - 0.580 (0.0220 - 0.0227)</td>
<td>3.06 (1.0023)</td>
</tr>
<tr>
<td>0.581 - 0.600 (0.0227 - 0.0234)</td>
<td>3.08 (1.0024)</td>
</tr>
<tr>
<td>0.601 - 0.620 (0.0234 - 0.0242)</td>
<td>3.10 (1.0025)</td>
</tr>
<tr>
<td>0.621 - 0.640 (0.0242 - 0.0250)</td>
<td>3.12 (1.0026)</td>
</tr>
<tr>
<td>0.641 - 0.660 (0.0250 - 0.0258)</td>
<td>3.14 (1.0027)</td>
</tr>
<tr>
<td>0.661 - 0.680 (0.0258 - 0.0266)</td>
<td>3.16 (1.0028)</td>
</tr>
<tr>
<td>0.681 - 0.700 (0.0266 - 0.0274)</td>
<td>3.18 (1.0029)</td>
</tr>
<tr>
<td>0.701 - 0.720 (0.0274 - 0.0282)</td>
<td>3.20 (1.0030)</td>
</tr>
<tr>
<td>0.721 - 0.740 (0.0282 - 0.0290)</td>
<td>3.21 (1.0031)</td>
</tr>
<tr>
<td>0.741 - 0.760 (0.0290 - 0.0297)</td>
<td>3.23 (1.0032)</td>
</tr>
<tr>
<td>0.761 - 0.780 (0.0297 - 0.0305)</td>
<td>3.24 (1.0033)</td>
</tr>
<tr>
<td>0.781 - 0.800 (0.0305 - 0.0313)</td>
<td>3.26 (1.0034)</td>
</tr>
<tr>
<td>0.801 - 0.820 (0.0313 - 0.0321)</td>
<td>3.28 (1.0035)</td>
</tr>
<tr>
<td>0.821 - 0.840 (0.0321 - 0.0329)</td>
<td>3.30 (1.0036)</td>
</tr>
<tr>
<td>0.841 - 0.860 (0.0329 - 0.0337)</td>
<td>3.32 (1.0037)</td>
</tr>
<tr>
<td>0.861 - 0.880 (0.0337 - 0.0345)</td>
<td>3.34 (1.0038)</td>
</tr>
<tr>
<td>0.881 - 0.900 (0.0345 - 0.0353)</td>
<td>3.36 (1.0039)</td>
</tr>
<tr>
<td>0.901 - 0.920 (0.0353 - 0.0361)</td>
<td>3.38 (1.0040)</td>
</tr>
<tr>
<td>0.921 - 0.940 (0.0361 - 0.0369)</td>
<td>3.40 (1.0041)</td>
</tr>
<tr>
<td>0.941 - 0.960 (0.0369 - 0.0377)</td>
<td>3.42 (1.0042)</td>
</tr>
<tr>
<td>0.961 - 0.980 (0.0377 - 0.0385)</td>
<td>3.44 (1.0043)</td>
</tr>
<tr>
<td>0.981 - 1.000 (0.0385 - 0.0393)</td>
<td>3.46 (1.0044)</td>
</tr>
<tr>
<td>1.001 - 1.020 (0.0393 - 0.0402)</td>
<td>3.48 (1.0045)</td>
</tr>
<tr>
<td>1.021 - 1.040 (0.0402 - 0.0409)</td>
<td>3.50 (1.0046)</td>
</tr>
<tr>
<td>1.041 - 1.060 (0.0409 - 0.0417)</td>
<td>3.52 (1.0047)</td>
</tr>
<tr>
<td>1.061 - 1.080 (0.0417 - 0.0425)</td>
<td>3.54 (1.0048)</td>
</tr>
<tr>
<td>1.081 - 1.100 (0.0425 - 0.0433)</td>
<td>3.56 (1.0049)</td>
</tr>
</tbody>
</table>

### Intake valve clearance (Cold):

<table>
<thead>
<tr>
<th>Thickness (mm)</th>
<th>New shim thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.20 - 0.30</td>
<td>2.90 (0.1142)</td>
</tr>
<tr>
<td>0.20 - 0.30</td>
<td>2.95 (0.1161)</td>
</tr>
<tr>
<td>0.20 - 0.30</td>
<td>3.00 (0.1181)</td>
</tr>
<tr>
<td>0.20 - 0.30</td>
<td>3.05 (0.1201)</td>
</tr>
<tr>
<td>0.20 - 0.30</td>
<td>3.10 (0.1220)</td>
</tr>
<tr>
<td>0.20 - 0.30</td>
<td>3.15 (0.1240)</td>
</tr>
<tr>
<td>0.20 - 0.30</td>
<td>3.20 (0.1260)</td>
</tr>
<tr>
<td>0.20 - 0.30</td>
<td>3.25 (0.1280)</td>
</tr>
<tr>
<td>0.20 - 0.30</td>
<td>3.30 (0.1299)</td>
</tr>
</tbody>
</table>

### EXAMPLE:

The 2.800 mm (0.1102 in.) shim is installed and the measured clearance is 0.350 mm (0.0138 in.). Replace the 2.800 mm (0.1102 in.) shim with a No. 21 shim.
### Exhaust Valve Clearance

**0.40 – 0.50 mm (0.016 – 0.020 in.)**

**EXAMPLE:** The 2.800 mm (0.1102 in.) shim is installed and the measured clearance is 0.350 mm (0.0138 in.). Replace the 2.800 mm (0.1102 in.) shim with a No. 11 shim.

---
INSPECTION AND ADJUSTMENT OF INJECTION TIMING (2L-T Austria)

1. CHECK INJECTION TIMING

Using a mirror, check that the mark on the belt case and the center mark on the pump flange are correctly aligned with the amount of overlap as shown.

2. ADJUST INJECTION TIMING

(a) Loosen the following bolts and nuts:
   (1) Two bolts holding injection pump to injection pump stay.
   (2) Two nuts holding injection pump to timing belt case.

   HINT: Do not loosen the union nuts of injection pump more than 1/4 of a turn.

(b) Slightly tilt the injection pump body and align the belt case mark with the center mark on the pump flange to the correct overlap dimension.

(c) Tighten the following bolts and nuts:
   (1) Two nuts holding injection pump to timing belt case.
   Torque: 210 kg-cm (15 ft-lb, 21 N-m)
   (2) Two bolts holding injection pump to injection pump stay.
   Torque: 185 kg-cm (13 ft-lb, 18 N-m)

3. START ENGINE AND CHECK FOR LEAKS
ADJUSTMENT OF INJECTION TIMING (Others)

1. INSTALL SST AND DIAL INDICATOR
   (a) Remove the plug bolt and gasket from the distributive head plug of the injection pump.
   (b) Install SST (plunger stroke measuring tool) and a dial indicator to the plug bolt hole of distributive head plug.

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2. SET NO. 1 OR NO. 4 CYLINDER TO 25° OR MORE BTDC/COMPRESSION
   Turn the crankshaft pulley clockwise so the pulley groove is 25° or more from the timing pointer.

3. (2L-T)
   RELEASE ACSD ADVANCE
   (a) Using a screwdriver, turn the cold starting lever counterclockwise approx. 20°.
   (b) Put a metal plate (thickness of 8.5 – 10 mm (0.335 – 0.394 in.)) between the cold starting lever and thermo wax plunger.

4. ADJUST INJECTION TIMING
   (a) Set the dial indicator at 0 mm (0 in.).
   (b) Recheck to see that the dial indicator remains at 0 mm (0 in.) while slightly rotating the crankshaft pulley clockwise or counterclockwise.
   (c) Slowly rotate the crankshaft pulley clockwise until pulley groove is aligned with the timing pointer.
   (d) Measure the plunger stroke.

Plunger stroke:
   2L-T 0.54 – 0.66 mm (0.0213 – 0.0260 in.)
   3L 0.84 – 0.96 mm (0.0331 – 0.0378 in.)
(e) Loosen the following bolts and nuts:
   (1) Four union nuts of injection pipes at injection pump side.
   (2) Two bolts holding injection pump to injection pump stay.
   (3) Two nuts holding injection pump to timing belt case.

   HINT: Do not loosen the union nuts of injection pump more than 1/4 of a turn.

(f) Adjust plunger stroke by slightly tilting the injection pump body.

   If the stroke is less than specified, tilt the pump toward the engine.
   If the stroke is greater than specified, tilt the pump away from the engine.

(g) Tighten the following bolts and nuts:
   (1) Two nuts holding injection pump to timing belt case.

   Torque: 210 kg-cm (15 ft-lb, 21 N-m)
   - Recheck the plunger stroke.
   (2) Two bolts holding injection pump to injection pump stay.

   Torque: 185 kg-cm (13 ft-lb, 18 N-m)
   (3) Four union nuts of injection pipes.

   Torque: 250 kg-cm (18 ft-lb, 25 N-m)

5. (2L-T) REMOVE METAL PLATE

6. REMOVE SST AND DIAL INDICATOR
   (a) Remove SST and the dial indicator.

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   (b) Install a new gasket and the plug bolt of the distribu-
       tive head plug.

   Torque: 170 kg-cm (12 ft-lb, 17 N-m)

7. START ENGINE AND CHECK FOR LEAKS
ADJUSTMENT OF IDLE SPEED AND MAXIMUM SPEED

1. INITIAL CONDITIONS
   (a) Engine at normal operating temperature
   (b) Air cleaner installed
   (c) All accessories switched OFF
   (d) All vacuum lines properly connected
   (e) Valve clearance set correctly
   (f) Injection timing set correctly
   (g) Transmission in neutral range

2. CONNECT TACHOMETER

3. ADJUST IDLE SPEED
   (a) Check that the adjusting lever touches the idle speed adjusting screw when the accelerator pedal is released.
   If not, adjust the accelerator linkage.
   
   (b) Start the engine.
   (c) Check the idle speed.

   Idle speed:  
   2L-T  700 – 800 rpm  
   3L  650 – 750 rpm  

   (d) Adjust the idle speed.
      • Disconnect the accelerator linkage.
      • Loosen the lock nut of the idle speed adjusting screw.
      • Adjust the idle speed by turning the IDLE SPEED ADJUSTING SCREW.

   Idle speed:  
   2L-T  750 rpm  
   3L  700 rpm  

      • Securely tighten the lock nut, and recheck the idle speed.
      • Reconnect the accelerator linkage.
      • After adjustment, adjust the accelerator linkage.

4. ADJUST MAXIMUM SPEED
   (a) Check that the adjusting lever touches the maximum speed adjusting screw when the accelerator pedal is depressed all the way.
   If not, adjust the accelerator linkage.
   (b) Start the engine.
   (c) Depress the accelerator pedal all the way.
(d) Check the maximum speed.

Maximum speed:
- 2L-T: 4,700 – 4,900 rpm
- 3L (Hong Kong, Singapore and Malaysia): 4,300 – 4,500 rpm
- 3L (Others): 4,500 – 4,700 rpm

(e) Adjust the maximum speed.
- Disconnect the accelerator linkage.
- Cut out the seal wire of the maximum speed adjusting screw.
- (2L-T and w/ HAC)
  Using SST, loosen the lock nut of the maximum speed adjusting screw.

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- (w/o HAC)
  Loosen the lock nut of the maximum speed adjusting screw.

- Adjust the maximum speed by turning the MAXIMUM SPEED ADJUSTING SCREW.

Maximum speed:
- 2L-T: 4,800 rpm
- 3L (Hong Kong, Singapore and Malaysia): 4,400 rpm
- 3L (Others): 4,600 rpm

HINT: Adjust at idle speed. Then, raise engine speed and recheck the maximum speed.
- (2L-T and w/ HAC)
  Using SST, securely tighten the lock nut.

SST 09275-54020
- (w/o HAC)
  Securely tighten the lock nut.
- Recheck the maximum speed.
- Reconnect the accelerator linkage.
- After adjustment, adjust the accelerator linkage.
- Seal the maximum speed adjusting screw with a new seal wire.
ADJUSTMENT OF AIR CONDITIONER IDLE-UP SETTING SPEED

1. INITIAL CONDITIONS
   (a) Engine at normal operating temperature
   (b) Air cleaner installed
   (c) All vacuum lines properly connected
   (d) Valve clearance set correctly
   (e) Injection timing set correctly
   (f) Transmission in neutral range
   (g) Idle speed set correctly

2. CONNECT TACHOMETER

3. ADJUST AIR CONDITIONER IDLE-UP SETTING SPEED
   (a) Start the engine.
   (b) A/C switches ON.
   (c) Disconnect the vacuum hose from the idle-up actuator.
   (d) Apply vacuum to the idle-up actuator.
   (e) Race the engine to 2,500 rpm for a few seconds, release the throttle and check the idle-up setting speed.

A/C idle-up setting speed: 950 rpm

(f) Adjust the idle-up setting speed by turning the IDLE-UP SETTING SPEED ADJUSTING SCREW.
(g) Race the engine to 2,500 rpm for a few seconds, release the throttle and recheck the A/C idle-up setting speed.
(h) Reconnect the vacuum hose to the idle-up actuator.
INTAKE VENTURI SYSTEM  
(LN 2L-T only)  

ON-VEHICLE INSPECTION

NOTICE: Always stop the engine when installing or removing the vacuum gauges, or removing the vacuum hoses.

(Austria)

1. PREPARATION

Using two 3-way connectors, connect two vacuum gauges to hoses between the actuator and VSV.

2. CHECK THROTTLE VALVE (LOW ALTITUDE AREA)

HINT: Perform this check at an altitude below 800 m (2,600 ft) and at an atmospheric pressure above 700 mm Hg (94.5 kg/cm²).

(a) Start the engine and check that vacuum operates on diaphragm chamber B so that the rods are pulled up.

(b) Check that when the accelerator pedal is depressed, atmospheric air operates on both diaphragm chambers so that the rods return.

(c) Check that when the starter switch is turned OFF (engine stopped) from idling condition, vacuum operates on both diaphragm chambers so that the rods are pulled up.

(d) Check that after the starter switch is turned OFF, the rods gradually return.

3. CHECK THROTTLE VALVE (HIGH ALTITUDE AREA)

HINT: Perform this check at an altitude above 800 m (2,600 ft) and at an atmospheric pressure below 690 mm Hg (93.2 kg/cm²).

Check that during idling or with the starter switch OFF (engine stopped), vacuum is not operating on either diaphragm chamber.
(Others)

1. PREPARATION
   Using a 3-way connector, connect a vacuum gauge to hose between the actuator and VSV.

2. CHECK THROTTLE VALVE
   (a) Start the engine and check that the vacuum gauge indicates zero vacuum.
   (b) Check that when the starter switch is turned OFF (engine stopped) from idling condition, vacuum operates on the diaphragm chamber so that the rods return.
   (c) Check that after the starter switch is turned OFF, the rods gradually return.

INSPECTION OF INTAKE VENTURI SYSTEM COMPONENTS

1. INSPECT VENTURI
   (a) Fully close the throttle valve, and check that it returns smoothly.

   (b) (Austria)
   Using the hand-help vacuum pump, check that when vacuum is gradually applied to diaphragm chamber B of the actuator, the throttle valve opens half-way.

   (c) (Austria)
   Using the hand-help vacuum pump check that when vacuum is gradually applied to diaphragm chambers A and B of the actuator, the throttle valve fully opens.
(d) (Others)
Using the hand-help vacuum pump, check that when vacuum is gradually applied to the diaphragm chamber of the actuator, the throttle valve opens half-way.

2. **INSPECT VSV**

A. **Inspect VSV for open circuit**
Using an ohmmeter, check that there is continuity between the terminals.

**Resistance (Cold):** 37 – 44 $\Omega$

If there is no continuity, replace the VSV.

B. **Inspect VSV for ground**
Using an ohmmeter, check that there is no continuity between each terminal and the body.

If there is continuity, replace the VSV.

C. **Inspect VSV operation**

(a) Check that air flows from pipes E to G.

(b) Apply battery voltage across the terminals.

(c) Check that air flows from port E to the filter.

If operation is not as specified, replace the VSV.
COMPRESSION CHECK

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

1. WARM UP AND STOP ENGINE
   Allow the engine to reach normal operating temperature.

2. DISCONNECT INJECTION PUMP (FUEL CUT SOLENOID) CONNECTOR

3. REMOVE AIR CLEANER

4. (w/ Intake Pipe)
   REMOVE INTAKE PIPE

5. REMOVE GLOW PLUGS

6. CHECK CYLINDER COMPRESSION PRESSURE
   (a) Install SST (attachment) to the glow plug hole.
   SST 09992-00024 (09992-00121)

   (b) Connect SST (compression gauge) to SST (attachment).
   SST 09992-00024 (09992-00121, 09992-00211)
   (c) Fully open the throttle valve.
   (d) While cranking the engine, measure the compression pressure.
   HINT: Always use a fully charged battery to obtain engine revolution of 250 rpm or more.
   (e) Repeat steps (a) through (d) for each cylinder.

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

Compression pressure:
   2L-T  31.0 kg/cm² (441 psi, 3,040 kPa) or more
   3L    32.0 kg/cm² (455 psi, 3,138 kPa) or more

Minimum pressure:
   20.0 kg/cm² (284 psi, 1,961 kPa)

Difference between each cylinder:
   5.0 kg/cm² (71 psi, 490 kPa) or less
(f) If the cylinder compression in one or more cylinders is low, pour a small amount of engine oil into the cylinder through the glow plug hole and repeat steps (a) through (d) for the cylinder with low compression.

- If adding oil helps the compression, chances are that the piston rings and/or cylinder bore are worn or damaged.
- If pressure stays low, a valve may be sticking or seating improperly, or there may be leakage past the gasket.

7. REINSTALL GLOW PLUGS

8. (w/ Intake Pipe)
   REINSTALL INTAKE PIPE

9. REINSTALL AIR CLEANER

10. RECONNECT INJECTION PUMP (FUEL CUT SOLENOID) CONNECTOR
CYLINDER HEAD (2L-T)
COMPONENTS

- Oil Filler Cap
- Gasket
- Cylinder Heat Cover
- No. 2 Heat Insulator
- No. 1 Heat Insulator
- Exhaust Manifold
- Camshaft Bearing Cap
- Camshaft Bearing
- Camshaft
- 1st 800 (58, 78) 2nd 90° turns 3rd 90° turns
- Half Circular Plug
- Cylinder Head
- Engine Hanger
- Gasket
- Oil Seal
- Camshaft Oil Seal Retainer
- Shim
- Combustion Chamber
- Gasket
- EGR Valve and Pipe
- Austria
- EGR Control Valve Assembly
- Gasket
- Intake Manifold
- Gasket
- EGR Valve Adaptor
- Gasket
- Engine Hanger
- Gasket
- Water Outlet and Outlet Housing Assembly
- LN
- Venturi Assembly
- Air Pipe (Austria)

kg-cm (ft-lb, N-m) : Specified torque
* Non-reusable part
REMOVAL OF CYLINDER HEAD
(See page EM-35)

1. DRAIN ENGINE COOLANT (See page CO-4)

2. REMOVE TURBOCHARGER
   (See steps 2 to 7 on pages TC-10 and 11)

3. REMOVE TIMING BELT
   (See steps 2 to 7 on page FU-4)

4. REMOVE INJECTION PUMP
   (See steps 8 to 16 on pages FU-4 and 5)

5. REMOVE INJECTION NOZZLES

6. REMOVE CAMSHAFT TIMING PULLEY

7. REMOVE NO. 2 TIMING BELT COVER
   Remove the four bolts and belt cover.

8. REMOVE WATER OUTLET AND OUTLET HOUSING ASSEMBLY
   (a) Disconnect the water temperature switch connector.
   (b) Disconnect the by-pass hose from the thermo wax of the injection pump.
   (c) Remove the three bolts, water outlet, outlet housing assembly and gasket.

9. REMOVE LH ENGINE HANGER

10. (LN) REMOVE VENTURI ASSEMBLY
    (a) Disconnect the connector and vacuum hoses from the VSV.
    (b) Remove the venturi assembly and gasket.
    (c) Remove the two bolts and wire support.
11. (Austria) 
REMOVE EGR VALVE, PIPE, VALVE ADAPTOR AND CONTROL VALVE ASSEMBLY

(a) Remove the four nuts, air pipe (LN only), EGR valve adaptor and two gaskets.

(b) Disconnect the connectors from the VSV and EVRV.

(c) Remove the three bolts and EGR control valve assembly.

(d) Remove the two nuts, EGR valve with the pipe and gasket.

12. REMOVE INTAKE MANIFOLD

(a) Remove the nut and insulator of the glow plug resistor.

(b) Remove the six bolts, two nuts, intake manifold and gasket.

13. REMOVE EXHAUST MANIFOLD

(a) Remove the four bolts, nut and two heat insulators.
14. REMOVE RH ENGINE HANGER

15. REMOVE CYLINDER HEAD COVER
Remove the eight bolts, two nuts, cylinder head cover and gasket.

16. REMOVE CYLINDER HEAD
(a) Uniformly loosen and remove the eighteen cylinder head bolts in several passes in the sequence shown.
NOTICE: Head warpage or cracking could result from removing bolts in incorrect order.

(b) Lift the cylinder head from the dowels on the cylinder block and place the head on wooden blocks on a bench.
HINT: If the cylinder head is difficult to lift off, pry with a screwdriver between the cylinder head and block.
NOTICE: Be careful not to damage the cylinder head and cylinder block surfaces of cylinder head gasket side.
DISASSEMBLY OF CYLINDER HEAD
(See page EM-35)

INSPECTION, CLEANING AND REPAIR OF CYLINDER HEAD COMPONENTS

INSPECT CAMSHAFTS AND BEARINGS

B. Inspect cam lobes

Using a micrometer, measure the cam lobe height.

Standard cam lobe height:

- Intake 2L-T: 53.450 – 53.470 mm (2.1043 – 2.1051 in.)
- 3L: 54.290 – 54.310 mm (2.1374 – 2.1382 in.)
- Exhaust: 54.990 – 55.010 mm (2.1650 – 2.1657 in.)

Minimum cam lobe height:

- Intake 2L-T: 52.95 mm (2.0846 in.)
- 3L: 53.79 mm (2.1177 in.)
- Exhaust: 54.49 mm (2.1453 in.)

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

ASSEMBLY OF CYLINDER HEAD
(See page EM-35)

INSTALL HALF CIRCULAR PLUG

(a) Remove any old packing (FIPG) material.
(b) Apply seal packing to the half circular plug as shown.
   Seal packing: Part No. 08826-00080 or equivalent
(c) Install the half circular plug to the cylinder head.
INSTALLATION OF CYLINDER HEAD
(See page EM-35)

1. CHECK PISTON PROTRUSION AND SELECT CYLINDER HEAD GASKET

   A. Check protrusions of No. 1 and No. 4 pistons
      (a) Align the timing marks of the crankshaft timing pulley and timing belt case.

      (b) Place a dial indicator on the cylinder block, and set the dial indicator needle on the piston measuring point.

      (c) Find where the piston head protrudes most by slowly turning the crankshaft clockwise and counterclockwise.

      (d) Set the dial indicator at 0 mm (0 in.).

      (e) Measure the piston protrusion from the cylinder block by sliding the dial indicator.

         Protrusion: 0.68 – 0.97 mm
                      (0.0268 – 0.0382 in.)

         HINT: For each piston, measure the piston protrusion at two measuring points.

         (When removing piston and connecting rod assembly) If the protrusion is not as specified, remove the piston and connecting rod assembly and reinstall it.
B. Check protrusions of No. 2 and No. 3 pistons
   (a) Turn the crankshaft 1/2 of a revolution (180°).
   (b) Measure the piston protrusions.
   (See procedure steps A (b) to (e))

C. Select new cylinder head gasket
   HINT: There are three sizes of new cylinder head gasket, marked either “B”, “D” or “F”, or indicated by a cutout mark.
   New cylinder head gasket thickness:
   - Mark B 1.40 – 1.50 mm  
     (0.0551 – 0.0591 in.)
   - Mark D 1.50 – 1.60 mm  
     (0.0591 – 0.0630 in.)
   - Mark F 1.60 – 1.70 mm  
     (0.0630 – 0.0669 in.)
   When selecting a new cylinder head gasket, use the largest value from the eight measurements made of the piston protrusion.
   HINT: There are 6 types of cylinder head gasket (marks A to F) installed at the factory, but only 3 types for supply parts (mark B, D and F), so when replacing the gasket, choose from one of the 3 types above.

2. SET NO. 1 CYLINDER TO TDC/COMPRESSION
   HINT: Set the No. 1 cylinder to TDC/compression to avoid interference with the piston top and valve head.
   (a) (Camshaft Position)
      Set the camshaft by turning the hexagonal wrench head portion, facing the key groove upward.
   (b) (Crankshaft Position)
      Using the crankshaft pulley bolt, align the timing marks of the timing pulley and timing belt case by turning the crankshaft.
3. INSTALL CYLINDER HEAD

A. Place cylinder head on cylinder block
   (a) Place a new cylinder head gasket in position on the cylinder block.
   NOTICE: Be careful of the installation direction.
   (b) Place the cylinder head in position on the cylinder head gasket.

B. Install cylinder head bolts

   HINT:
   • The cylinder head bolts are tightened in three progressive steps.
   • If any of bolts break or deform, replace them.
   (a) Apply a light coat of engine oil on the threads and under the heads of the cylinder head bolts.
   (b) First, install and uniformly tighten the eighteen cylinder head bolts in several passes in the sequence shown.

   Torque: 800 kg-cm (58 ft-lb, 78 N-m)
   HINT: The bolt lengths for bolt types A and B shown in the illustration are:
   A 107 mm (4.12 in.)
   B 127 mm (5.00 in.)
   If any one of the bolts does not meet the torque specification, replace the bolt.

   (c) Mark the front of the cylinder head bolt with paint.

   (d) Second, retighten the cylinder head bolts 90° in the numerical order shown.
   (e) Third, retighten cylinder head bolts by an additional 90°.
   (f) Check that the painted mark is now facing rearward.
4. INSTALL CYLINDER HEAD COVER
   (a) Apply seal packing to the cylinder heads as shown in the illustration.
   Seal packing: Part No. 08826-00080 or equivalent

   (b) Install the gasket to the cylinder head cover.
   (c) Install the cylinder head cover with the eight bolts and two nuts.
   Torque: 50 kg-cm (43 in.-lb, 4.9 N-m)

5. INSTALL RH ENGINE HANGER
   Torque: 380 kg-cm (27 ft-lb, 37 N-m)

6. INSTALL EXHAUST MANIFOLD
   (a) Install a new gasket in direction as shown in the illustration.

   (b) Install the exhaust manifold with the four nuts and four bolts.
   Torque: 530 kg-cm (38 ft-lb, 52 N-m)

   (c) Install the two heat insulators with the four bolts and nut.
   Torque: 120 kg-cm (9 ft-lb, 12 N-m)
7. INSTALL INTAKE MANIFOLD
(a) Install a new gasket and the intake manifold with the six bolts and two nuts.

Torque: 240 kg-cm (17 ft-lb, 24 N-m)

HINT: Torque the three bolts on the bottom of the manifold together with the oil level gauge guide support and the clamp for the engine wires, as shown in the illustration.

(b) Install the insulator and nut to the glow plug resistor.

HINT: Install the insulator and engine wire terminals as shown in the illustration.

8. (Austria)
INSTALL EGR VALVE, PIPE, VALVE ADAPTOR AND CONTROL VALVE ASSEMBLY

(a) Place a new gasket in position on the intake manifold.

(b) Install the EGR valve and pipe with the two nuts.

Torque: 130 kg-cm (9 in.-lb, 13 N-m)

(c) Install the EGR control valve assembly with the three bolts.

(d) Connect the connectors to the VSV and EVRV.

(e) Install two new gaskets, the EGR valve adaptor and air pipe (LN only) with the four nuts.

Torque: 195 kg-cm (14 ft-lb, 19 N-m)
9. (LN)
INSTALL VENTURI ASSEMBLY
(a) Install the wire support with the two bolts.
(b) Install a new gasket and the venturi assembly.
(c) Connect the connector and vacuum hoses to the VSV.

10. INSTALL LH ENGINE HANGER
Torque: 380 kg-cm (27 ft-lb, 37 N-m)

11. INSTALL WATER OUTLET AND OUTLET HOUSING ASSEMBLY
(a) Install a new gasket, the water outlet and outlet housing assembly with the three bolts.
Torque: 195 kg-cm (14 ft-lb, 19 N-m)
(b) Connect the by-pass hose to the thermo wax of the injection pump.
(c) Connect the water temperature switch connector.

12. INSTALL NO. 2 TIMING BELT COVER
Install the timing belt cover with the four bolts.
Torque: 185 kg-cm (13 ft-lb, 18 N-m)

13. INSTALL CAMSHAFT TIMING PULLEY

14. INSTALL INJECTION NOZZLES

15. INSTALL INJECTION PUMP
(See steps 2 to 11 on pages FU-46 and 47)

16. INSTALL TIMING BELT
(See steps 12 to 18 on page FU-48)

17. INSTALL TURBOCHARGER
(See steps 3 to 8 on pages TC-13 and 14)

18. FILL WITH ENGINE COOLANT (See page CO-5)

19. START ENGINE AND CHECK FOR LEAKS

20. RECHECK ENGINE COOLANT LEVEL AND OIL LEVEL
Cylindrical Block

Inspection of Cylindrical Block

Hint: There are three sizes of the standard cylinder bore diameter, marked “1”, “2” and “3” accordingly. The mark is stamped on the lower left rear of the cylinder block.

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

Standard diameter:
- 2L-T STD mark “1” 92.000 – 92.010 mm (3.6220 – 3.6224 in.)
- STD mark “2” 92.010 – 92.020 mm (3.6224 – 3.6228 in.)
- STD mark “3” 92.020 – 92.030 mm (3.6228 – 3.6232 in.)
- 3L STD mark “1” 96.000 – 96.010 mm (3.7795 – 3.7799 in.)
- STD mark “2” 96.010 – 96.020 mm (3.7799 – 3.7803 in.)
- STD mark “3” 96.020 – 96.030 mm (3.7803 – 3.7807 in.)

Maximum diameter:
- 2L-T STD 92.23 mm (3.6311 in.)
- O/S 0.50 92.73 mm (3.6508 in.)
- 3L STD 96.23 mm (3.7886 in.)
- O/S 0.50 96.73 mm (3.8083 in.)

If the diameter is greater than maximum, rebore all four cylinders. If necessary, replace the cylinder block.

Inspection of Piston and Connecting Rod Assemblies

1. Inspect Piston Diameter and Oil Clearance

Hint: There are three sizes of the standard piston diameter, marked “1”, “2” and “3” accordingly. The mark is stamped on the top of the piston.

(a) Using a micrometer, measure the piston diameter at right angles to the piston pin center line, the indicated distance from the piston head.

Distance:
- 2L-T 58.27 – 58.33 mm (2.2941 – 2.2965 in.)
- 3L 56.27 – 56.33 mm (2.2153 – 2.2177 in.)
Piston diameter:
2L-T  STD mark “1”  91.940 – 91.950 mm  
            (3.6197 – 3.6201 in.)
STD mark “2”  91.950 – 91.960 mm  
            (3.6201 – 3.6205 in.)
STD mark “3”  91.960 – 91.970 mm  
            (3.6205 – 3.6209 in.)
O/S 0.50  92.440 – 92.470 mm  
            (3.6394 – 3.6405 in.)

Piston diameter:
3L  STD mark “1”  95.940 – 95.950 mm  
            (3.7772 – 3.7776 in.)
STD mark “2”  95.950 – 95.960 mm  
            (3.7776 – 3.7779 in.)
STD mark “3”  95.960 – 95.970 mm  
            (3.7779 – 3.7783 in.)
O/S 0.50  96.440 – 96.470 mm  
            (3.7968 – 3.7980 in.)

(b) Measure the cylinder bore diameter in the thrust directions. (See page EM-46)
(c) Subtract the piston diameter measurement from the cylinder bore diameter measurement.

Standard oil clearance:  0.050 – 0.070 mm  
                        (0.0020 – 0.0028 in.)

Maximum oil clearance:  0.14 mm (0.0055 in.)

If the oil clearance is greater than maximum, replace all four pistons and rebore all four cylinders. If necessary, replace the cylinder block.

HINT (Use cylinder block subassembly): When installing a standard piston, install one with the same number mark as the standard bore diameter mark on the cylinder block.

2. INSPECT CLEARANCE BETWEEN WALL OF RING GROOVE AND NEW PISTON RING
(No. 1 Ring)
Install a No. 1 piston ring to the piston. Using a feeler gauge, measure the clearance between the piston ring and wall of the piston ring groove.

Standard ring groove clearance:  
No. 1  0.028 – 0.077 mm (0.0011 – 0.0030 in.)

Maximum ring groove clearance:  0.20 mm (0.008 in.)

If the clearance is greater than maximum, replace the piston.
(No.2 and Oil Rings)

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

Standard ring groove clearance:
- No. 2  2L-T  0.070 - 0.115 mm  
  (0.0028 - 0.0045 in.)
- 3L  0.060 - 0.105 mm  
  (0.0024 - 0.0041 in.)
- Oil  0.030 - 0.070 mm  
  (0.0012 - 0.0028 in.)

Maximum ring groove clearance:  0.20 mm (0.008 in.)

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

3. INSPECT CONNECTING ROD

A. Inspect connecting rod alignment

Using a rod aligner, check the connecting rod alignment.
- Check for bending.

Maximum bending:
  0.05 mm (0.0020 in.) per 100 mm (3.94 in.)

If bent is greater than maximum, replace the connecting rod assembly.
- Check for twist.

Maximum twist:
  0.15 mm (0.0059 in.) per 100 mm (3.94 in.)

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

B. Inspect connecting rod bolts

Using vernier calipers, measure the minimum diameter of the compressed bolt at the measuring point.

Standard diameter:  8.400 - 8.600 mm  
  (0.3307 - 0.3386 in.)

Minimum diameter:  8.20 mm (0.3228 in.)

If the diameter is less than minimum, replace the connecting rod bolt.
C. Inspect piston pin oil clearance
   (a) Using a caliper gauge, measure the inside diameter of the connecting rod bushing.

   Bushing inside diameter:
   \[ 29.008 - 29.020 \text{ mm} \ (1.1420 - 1.1425 \text{ in.}) \]

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

   Piston pin diameter:
   \[ 29.000 - 29.012 \text{ mm} \ (1.1417 - 1.1422 \text{ in.}) \]

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

   Standard oil clearance: \[ 0.004 - 0.012 \text{ mm} \]
   \[ (0.0002 - 0.0005 \text{ in.}) \]

   Maximum oil clearance: \[ 0.05 \text{ mm} \]
   \[ (0.0020 \text{ in.}) \]

BORING OF CYLINDERS

HINT:

- Bore all four cylinders for the oversized piston outside diameter.
- Replace the piston rings with ones to match the oversized pistons.

1. KEEP OVERSIZED PISTONS

   Oversized (O/S 0.50) piston diameter:
   \[ 2L\cdot T \quad 92.440 - 92.470 \text{ mm} \ (3.6394 - 3.6405 \text{ in.}) \]
   \[ 3L \quad 96.440 - 96.470 \text{ mm} \ (3.7968 - 3.7980 \text{ in.}) \]

2. CALCULATE AMOUNT TO BORE CYLINDER

   (a) Using a micrometer, measure the piston diameter at right angles to the piston pin center line, the indicated distance from the piston head.

   Distance:
   \[ 2L\cdot T \quad 58.27 - 58.33 \text{ mm} \ (2.2941 - 2.2965 \text{ in.}) \]
   \[ 3L \quad 56.27 - 56.33 \text{ mm} \ (2.2153 - 2.2177 \text{ in.}) \]

   (b) Calculate the amount each cylinder is to be rebored as follows:

   \[ \text{Size to be rebored} = P + C - H \]
   \[ P = \text{Piston diameter} \]
   \[ C = \text{Piston oil clearance} \]
   \[ 0.05 - 0.07 \text{ mm} \]
   \[ (0.0020 - 0.0028 \text{ in.}) \]
   \[ H = \text{Allowance for honing} \]
   \[ 0.02 \text{ mm} \]
   \[ (0.0008 \text{ in.}) \] or less

3. BORE AND HONE CYLINDERS TO CALCULATED DIMENSIONS

   Maximum honing: \[ 0.02 \text{ mm} \]
   \[ (0.0008 \text{ in.}) \]

   NOTICE: Excess honing will destroy the finished roundness.
INSPECTION AND REPAIR OF CRANKSHAFT

1. INSPECT CRANKSHAFT FOR RUNOUT
   (a) Place the crankshaft on V-blocks.
   (b) Using a dial indicator, measure the circle runout at the center journal.

   Maximum circle runout: 0.06 mm (0.0024 in.)
   If the circle runout is greater than maximum, replace the crankshaft.

2. INSPECT MAIN JOURNALS AND CRANK PINS
   (a) Using a micrometer, measure the diameter of each main journal and crank pin.

   Main journal diameter:
   STD 61.985 − 62.000 mm
        (2.4403 − 2.4409 in.)
   U/S 0.25 61.745 − 61.755 mm
            (2.4309 − 2.4313 in.)
   U/S 0.50 61.495 − 61.505 mm
            (2.4211 − 2.4215 in.)

   Crank pin diameter:
   STD 54.988 − 55.000 mm
        (2.1649 − 2.1654 in.)
   U/S 0.25 54.745 − 54.755 mm
            (2.1553 − 2.1557 in.)
   U/S 0.50 54.495 − 54.505 mm
            (2.1455 − 2.1459 in.)

   If the diameter is not as specified, check the oil clearance.
   (b) Check each main journal and crank pin for taper and out-of-round as shown.

   Maximum taper and out-of-round: 0.02 mm
           (0.0008 in.)
   If the taper or out-of-round is greater than maximum, grind or replace the crankshaft.

3. IF NECESSARY, GRIND AND HONE MAIN JOURNALS AND/OR CRANK PINS
   Grind and hone the main journals and/or crank pins to the finished undersized diameter (See procedure step 2).
   Install new main journal and/or crank pin undersized bearings.

ASSEMBLY OF CYLINDER BLOCK

The connecting rod cap nut tightening torque has been changed as follows:

<table>
<thead>
<tr>
<th>Torque</th>
<th>1st</th>
<th>2nd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous</td>
<td>550 kg-cm (40 ft-lb, 54 N-m)</td>
<td>90° turns</td>
</tr>
<tr>
<td>New</td>
<td>350 kg-cm (25 ft-lb, 34 N-m)</td>
<td>120° turns</td>
</tr>
</tbody>
</table>
TURBOCHARGER SYSTEM

DESCRIPTION .................................................. TC-2
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TROUBLESHOOTING ............................................ TC-5
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  DIAGNOSIS .................................................. TC-7
  TURBOCHARGER ............................................. TC-8
Systems which increase the amount of air sent to the engine are either turbocharger type (using exhaust gas to turn the turbine) or supercharger type (using the engine crankshaft, etc. to mechanically turn the pump, etc.). For LAND CRUISER and 4RUNNER 2L-T engine, the turbocharger type has been adopted.

The turbocharger is a device which increases engine output by introducing a greater amount of air to the engine. This allows a proportional increase in the fuel that can be burned and hence raises the potential power output.

In other words, by installing a special turbocharger and providing a higher air than usual, engine output can be increased by increasing the average combustion pressure without increasing the engine speed.
Operation of Turbocharger

Exhaust gas acts on the turbine wheel inside the turbine housing, causing it to revolve. When the turbine wheel revolves, the impeller wheel which is located on the same shaft also revolves, compressing the intake air which has passed through the air cleaner. When expelled from the compressor housing the compressed air is supplied to the cylinders. When the engine speed increases, the exhaust gas volume increases and the turbine wheel revolutions increase (approx. 20,000 – 115,000 rpm), thus the turbocharged air pressure grows greater and engine output increases.

Waste Gate Valve

If the turbocharged air pressure exceeds the prescribed air pressure, the flow of exhaust gas by-passes the turbine, controlling turbine wheel revolutions and turbocharged air pressure. This by-pass valve which controls the quantity of exhaust gas flowing to the turbine is called the waste gate valve. When the charged air pressure exceeds the prescribed pressure, the actuator operates, the waste gate valve opens and part of the exhaust gas by-passes the turbine. This causes a drop in the turbine revolution rate and controls the charged air pressure within the prescribed limits.
PRECAUTIONS

1. Do not stop the engine immediately after pulling a trailer or high speed or uphill driving. Idle the engine for 20 – 120 seconds, depending on the severity of the driving condition.

2. Avoid sudden racing or acceleration immediately after starting a cold engine.

3. If the turbocharger is defective and must be replaced, first check for the cause of the defect in reference to the following items and replace parts if necessary:
   - Engine oil level and quality
   - Conditions under which the turbocharger was used
   - Oil lines leading to the turbocharger

4. Use caution when removing and reinstalling the turbocharger assembly. Do not drop it or bang it against anything or grasp it by easily-deformed parts, such as the actuator or rod, when moving it.

5. Before removing the turbocharger, plug the intake and exhaust ports and oil inlet to prevent entry of dirt or other foreign material.

6. If replacing the turbocharger, check for accumulation of sludge particles in the oil pipes and, if necessary, replace the oil pipes.

7. Completely remove the gasket adhered to the lubrication oil pipe flange and turbocharger oil flange.

8. If replacing bolts or nuts, do so only with the specified new ones to guard against breakage or deformation.

9. If replacing the turbocharger, put 20 cc (1.2 cu in.) of oil into the turbocharger oil inlet and turn the impeller wheel by hand to spread oil to the bearing.

10. If overhauling or replacing the engine, cut the fuel supply after reassembly and crank the engine for 30 seconds to distribute oil throughout the engine. Allow the engine to idle for 60 seconds.
11. If the engine is running with the air cleaner, case cover and hose removed, entry of foreign particles will damage the wheels which run at extremely high speed.

**TROUBLESHOOTING**

**HINT:** Before troubleshooting the turbocharger, first check the engine itself. (Valve clearance, engine compression, injection timing etc.)

**INSUFFICIENT ACCELERATION, LACK OF POWER OR EXCESSIVE FUEL CONSUMPTION**

<table>
<thead>
<tr>
<th>(Possible Cause)</th>
<th>(Check Procedure and Correction Method)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. TURBOCHARGING PRESSURE TOO LOW</td>
<td>Check turbocharging pressure. (See page TC-8)</td>
</tr>
<tr>
<td></td>
<td><strong>Turbocharging pressure:</strong> 0.61 – 0.81 kg/cm² (8.7 – 11.5 psi, 60 – 79 kPa)**</td>
</tr>
<tr>
<td></td>
<td>If the pressure is below specification, begin diagnosis from item 2.</td>
</tr>
<tr>
<td>2. RESTRICTED INTAKE AIR SYSTEM</td>
<td>Check intake air system, and repair or replace parts as necessary. (See page TC-8)</td>
</tr>
<tr>
<td>3. LEAK IN INTAKE AIR SYSTEM</td>
<td>Check intake air system, and repair or replace parts as necessary. (See page TC-8)</td>
</tr>
<tr>
<td>4. RESTRICTED EXHAUST SYSTEM</td>
<td>Check exhaust system, and repair or replace parts as necessary. (See page TC-8)</td>
</tr>
<tr>
<td>5. LEAK IN EXHAUST SYSTEM</td>
<td>Check exhaust system, and repair or replace parts as necessary. (See page TC-8)</td>
</tr>
<tr>
<td>6. ERRATIC TURBOCHARGER OPERATION</td>
<td>Check rotation of impeller wheel. If it does not turn or turns with a heavy drag, replace the turbocharger assembly.</td>
</tr>
<tr>
<td></td>
<td>Check plays of turbine shaft. (See page TC-12)</td>
</tr>
<tr>
<td></td>
<td><strong>Axial play:</strong> 0.13 mm (0.0051 in.) or less</td>
</tr>
<tr>
<td></td>
<td><strong>Radial play:</strong> 0.18 mm (0.0071 in.) or less</td>
</tr>
<tr>
<td></td>
<td>If not within specification, replace the turbocharger assembly.</td>
</tr>
</tbody>
</table>
## ABNORMAL NOISE

<table>
<thead>
<tr>
<th>(Possible Cause)</th>
<th>(Check Procedure and Correction Method)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. TURBOCHARGER INSULATOR RESONANCE</td>
<td>Check for loose, improperly installed or deformed insulator mounting bolts and nuts, and repair or replace as necessary.</td>
</tr>
<tr>
<td>2. EXHAUST PIPE LEAKING OR VIBRATING</td>
<td>Check for exhaust pipe deformation, loose mounting bolts or a damaged gasket, and repair or replace as necessary.</td>
</tr>
<tr>
<td>3. ERRATIC TURBOCHARGER OPERATION</td>
<td>Refer to item 6 of INSUFFICIENT ACCELERATION, LACK OF POWER OR EXCESSIVE FUEL CONSUMPTION.</td>
</tr>
</tbody>
</table>

## EXCESSIVE OIL CONSUMPTION OR WHITE EXHAUST

<table>
<thead>
<tr>
<th>(Possible Cause)</th>
<th>(Check Procedure and Correction Method)</th>
</tr>
</thead>
</table>
| FAULTY TURBOCHARGER OIL SEAL                         | Check for oil leakage in exhaust system.  
- Remove the turbine elbow from the turbocharger and check for excessive carbon deposits on the turbine wheel. Excessive carbon deposits would indicate a faulty turbocharger.  
- Check plays of turbine shaft, and replace the turbocharger if necessary. (See page TC-12)  
Axial play: 0.13 mm (0.0051 in.) or less  
Radial play: 0.18 mm (0.0071 in.) or less |


TURBOCHARGER ELECTRICAL SYSTEM DIAGNOSIS

TROUBLESHOOTING OF TURBOCHARGER INDICATOR LIGHT AND WARNING LIGHT OPERATION

1. Do both green indicator light and amber warning light light when ignition switch is turned to ON?
   - NO: Check GAUGE fuse blown. Check for short circuit and repair as necessary.
   - OK: Check CHARGE and ENGINE fuses blown. Check for short circuit and repair as necessary.

2. Is charge warning light out?
   - NO: Faulty charging system.
   - YES: Faulty combination meter.

3. Are indicator and warning lights out during engine idle?
   - YES: Both lights stay on.
     - Is charge warning light out?
       - NO:Faulty charging system.
       - OK: Check for open circuit in wire harness between pressure switch and tachometer.
     - Green light stays on:
       - Amber light comes on:
         - Check for open circuit in wire harness between high pressure switch and tachometer and check for ground connection of switch.

4. Does green indicator light come on when 0.14 kg/cm² (2.0 psi, 13.7 kPa) pressure is applied to both pressure switches?
   - NO: Check for short circuit in wire harness between low pressure switch and tachometer.
   - OK: Faulty low pressure switch.

5. Does green indicator light come on when 0.85 kg/cm² (12.1 psi, 83 kPa) of pressure is applied to both switches? SST 09992-00241
   - NO: Faulty high pressure switch.
   - YES: Faulty combination meter.

6. Does amber indicator light come on when 0.85 kg/cm² (12.1 psi, 83 kPa) pressure is applied to both switches?
   - NO: Faulty high pressure switch.
   - YES: Check for short circuit in wire harness between high pressure switch and tachometer.

Turbocharger indicator light and warning light operation okay.
TURBOCHARGER

ON-VEHICLE INSPECTION OF TURBOCHARGER

1. INSPECT INTAKE AIR SYSTEM
   Check for leakage or clogging between the air cleaner and turbocharger inlet and between the turbocharger outlet and cylinder head.
   - Clogged air cleaner .... Clean or replace the element
   - Hoses collapsed or deformed .... Check each connection and repair
   - Cracks in components .... Check and replace

2. INSPECT EXHAUST SYSTEM
   Check for leakage or clogging between the cylinder head and turbocharger inlet and between the turbocharger outlet and exhaust pipe.
   - Deformed components .... Repair or replace
   - Foreign material in passages .... Remove
   - Leakage from components .... Repair or replace
   - Cracks in components .... Check and replace

3. CHECK TURBOCHARGING PRESSURE
   (a) Warm up the engine.
   (b) Connect a 3-way union to the intake pipe pressure hose and install SST (turbocharger pressure gauge) to it.
       SST 09992-00241
   (b) Press in the clutch pedal, then press the accelerator pedal down as far as it will go. Measure the turbocharging pressure at 2,400 rpm or more.
       Standard pressure: 0.61 – 0.81 kg/cm²
       (8.7 – 11.5 psi, 60 – 79 kPa)
   If the pressure is less than specification, check the intake air and exhaust systems for leakage. If there is no leakage, replace the turbocharger assembly.
   If the pressure is above specification, check if the actuator hose is disconnected or cracked. If not, replace the turbocharger assembly.

4. INSPECT IMPELLER WHEEL ROTATION
   (a) Disconnect the air cleaner hose.
   (b) Grasp the edge of the impeller wheel and turn it.
       Check that it turns smoothly.
   If it does not turn or if it turns with a drag, replace the turbocharger assembly.
REMOVAL OF TURBOCHARGER
(See page TC-9)

1. DRAIN ENGINE COOLANT (See page CO-4)

2. REMOVE INTAKE PIPE
   (a) Disconnect the vacuum hoses for the boost compensator.
   (b) Disconnect the air hose clamp bolt.
   (c) Remove the three nuts, intake pipe and gasket.

3. DISCONNECT WATER BY-PASS HOSES

4. REMOVE TURBO HEAT INSULATORS
   Remove the four bolts and three heat insulators.

5. REMOVE EXHAUST MANIFOLD STAY
   Remove the two bolts, two nuts and exhaust manifold stay.

6. REMOVE TURBO OIL PIPE
   (a) Remove the union bolt and two gaskets holding the turbo oil pipe to the cylinder block.
   (b) Disconnect the turbo oil hose.
   (c) Remove the two nuts, turbo oil pipe and gasket.
7. REMOVE TURBOCHARGER FROM EXHAUST MANIFOLD
Remove the four nuts, turbocharger and gasket.

8. REMOVE TURBO WATER PIPE
Remove the bolt and two nuts, turbo water pipe and gasket.

9. REMOVE TURBINE OUTLET ELBOW
Remove the four nuts, turbine outlet elbow and gasket.

INSPECTION OF TURBOCHARGER

1. INSPECT IMPELLER WHEEL ROTATION
   Grasp the edge of the turbine wheel and turn it. Check that the impeller wheel turns smoothly.
   If the impeller wheel does not turn or if it turns with a drag, replace the turbocharger assembly.

2. INSPECT AXIAL PLAY OF IMPELLER WHEEL
   Insert a dial indicator into the intake side, hold the turbine wheel edge by hand and check the axial play.
   Axial play: 0.13 mm (0.0051 in.) or less
   If the axial play is not as specified, replace the turbocharger assembly.
3. **INSPECT RADIAL PLAY OF TURBINE SHAFT**
   
   (a) From the oil outlet hole, insert the dial indicator through the hole in the spacer bearing and set it in the center of the turbine shaft.
   
   (b) Moving the turbine shaft in a radial direction, measure the radial play of the shaft.
   
   Radial play: 0.18 mm (0.0071 in.) or less
   
   If the radial play is not as specified, replace the turbocharger assembly.

4. **INSPECT ACTUATOR OPERATION**
   
   (a) Disconnect the actuator hose.
   
   (b) Using SST (turbocharger pressure gauge), apply approx. 0.81 kg/cm² (11.5 psi, 79 kPa) of pressure to the actuator and check that the rod moves.
   
   SST 09992-00241
   
   If the rod does not move, replace the turbocharger assembly.
   
   NOTICE: Never apply more than 0.95 kg/cm² (13.5 psi, 94 kPa) of pressure to the actuator.

**INSTALLATION OF TURBOCHARGER**

(See page TC-9)

NOTICE: After replacing the turbocharger assembly, pour approx. 20 cc (1.2 cu in.) of new oil into the oil inlet and turn the impeller wheel by hand to splash oil on the bearing.

1. **INSTALL TURBINE OUTLET ELBOW**

   Install a new gasket and the turbine outlet elbow with the four nuts.
   
   Torque: 260 kg-cm (19 ft-lb, 25 N-m)
2. INSTALL TURBO WATER PIPE
   Install a new gasket and the water pipe with the two nuts and bolt.
   Torque: 80 kg-cm (69 in.-lb, 7.8 N-m)

3. INSTALL TURBOCHARGER TO EXHAUST MANIFOLD
   (a) Install a new gasket to the exhaust manifold.

   (b) Install the turbocharger with the four nuts.
   Torque: 530 kg-cm (38 ft-lb, 52 N-m)

4. INSTALL TURBO OIL PIPE
   (a) Install a new gasket and the turbo oil pipe with the two nuts.
   Torque: 195 kg-cm (14 ft-lb, 19 N-m)
   (b) Connect the turbo oil hose.
   (c) Install two new gaskets and the union bolt of the turbo oil pipe.
   Torque: 260 kg-cm (19 ft-lb, 25 N-m)

5. INSTALL EXHAUST MANIFOLD STAY
   Install the exhaust manifold stay with the two bolts and two nuts.
   Torque: 195 kg-cm (14 ft-lb, 19 N-m)
6. INSTALL TURBOCHARGER HEAT INSULATOR
   Install the three heat insulators with the four bolts.
   Torque: 120 kg-cm (9 ft-lb, 12 N-m)

7. CONNECT WATER BY-PASS HOSES

8. INSTALL INTAKE PIPE
   (a) Connect the air hose and install a new gasket and the intake pipe with the three nuts.
   Torque: 120 kg-cm (9 ft-lb, 12 N-m)
   (b) Connect boost compensator vacuum hoses.

9. FILL ENGINE WITH COOLANT (See page CO-5)

10. START ENGINE AND CHECK FOR LEAKS

11. CHECK ENGINE OIL LEVEL
FUEL SYSTEM

REFER TO 2L, 3L ENGINE REPAIR MANUAL
(Pub. No. RM123E)

NOTE: The following pages contain only the points which differ from the above listed manual.

<table>
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<tr>
<th>Page</th>
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<th>Injection Pump</th>
</tr>
</thead>
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<td>FU-2</td>
<td>Fuel Heater System (LJ)</td>
<td></td>
</tr>
<tr>
<td>FU-3</td>
<td>Injection Pump</td>
<td></td>
</tr>
</tbody>
</table>
INSPECTION OF COMPONENTS

Fuel Heater

INSPECT FUEL HEATER

(a) Apply a vacuum of 285 ± 50 mmHg (11.22 ± 1.97 in. Hg, 38.0 ± 6.7 kPa) or more to the vacuum switch port.

(b) Using an ohmmeter, measure the resistance between terminal 1 and the switch body.

Resistance: Approx. 0.7 Ω at 20°C (68°F)

If the resistance is not as specified, replace the fuel heater and vacuum switch assembly.

Vacuum Switch

1. INSPECT SWITCH CONTINUITY
   Using an ohmmeter, check that there is no continuity between terminal 1 and the switch body.
   If continuity is not as specified, replace the fuel heater and vacuum switch assembly.

2. INSPECT SWITCH OPERATION
   (a) Apply a vacuum of 285 ± 50 mmHg (11.22 ± 1.97 in. Hg, 38.0 ± 6.7 kPa) or more to the vacuum switch port.
   (b) Using an ohmmeter, check that there is continuity between terminal 1 and the switch body.
   If operation is not as specified, replace the fuel heater and vacuum switch assembly.
INJECTION PUMP

REMOVAL OF INJECTION PUMP

Turbo Water Hose (2L-T)
Thermo Wax Water By-Pass Hose (2L-T)
Fuel Hose
Fuel Outlet Pipe
Fuel Hose
Fuel Outlet Pipe
Fuel Hose
Fuel Inlet Pipe
Injection Pipe
Injection Pump Stay
Injection Pump
Gasket
Gasket
Gasket
Gasket
Clamp
Injection Pipe

No. 1 Timing Belt Cover
Accelerator Linkage
Timing Belt

Drive Belt
Crankshaft Pulley
Water Pump Pulley
Fan

1,700 (123, 167)
650 (47, 64)

w/o HAC
Fuel Outlet Pipe

kg-cm (ft-lb, N-m) : Specified torque
◆ Non-reusable part
1. (2L-T) 
DRAIN ENGINE COOLANT (See page CO-4)
2. (2L-T) 
REMOVE TURBO WATER HOSE
3. REMOVE DRIVE BELTS, FAN AND WATER PUMP PULLEY
4. REMOVE CRANKSHAFT PULLEY
5. REMOVE NO. 1 TIMING BELT COVER
6. SET NO. 1 CYLINDER TO TDC/COMPRESSION
7. REMOVE TIMING BELT
8. REMOVE INJECTION PUMP DRIVE PULLEY
9. REMOVE ACCELERATOR LINKAGE
10. (2L-T) 
DISCONNECT BOOST COMPENSATOR HOSE
11. (w/ A/C) 
DISCONNECT A/C IDLE-UP VACUUM HOSE
12. (2L-T) 
DISCONNECT WATER BY-PASS HOSES FROM THERMO WAX
13. DISCONNECT INJECTION PUMP CONNECTOR(S)
14. DISCONNECT FUEL HOSES FROM INJECTION PUMP

15. REMOVE INJECTION PIPES
(a) Loosen the union nuts of the injection pipes from the injection nozzles.
(b) Loosen the union nuts of the injection pipes from the injection pump.
(c) Remove the four clamps and injection pipes.
NOTICE: On vehicles with PIJ (2L-T Austria), do not interfere with the PIJ actuator with the spanner. Use a 14 mm spanner when loosening the union nut of the No. 2 injection pipe.

16. REMOVE INJECTION PUMP
(a) Remove the four bolts and pump stay.
(b) Before removing the injection pump, check if the period lines are aligned.
If not, place new matchmarks for reinstallation.

(c) Remove the two nuts and injection pump.

NOTICE:
- Do not hold or carry the injection pump by the adjusting lever.
- Do not put the injection pump (2L-T and w/ HAC) at an angle more than 45° from the horizontal.

17. REMOVE FUEL INLET AND OUTLET PIPES FROM INJECTION PUMP
COMPONENTS (Cont’d)

w/ HAC

Pneumatic Bellows Cover
Rubber
Cap
Pneumatic Bellows

Shim
Push Rod
Pneumatic Bellows Spring

Connecting Pin
◆ Gasket
◆ O-Ring

Lever Control Spring

Control Lever Support Pin
◆ Gasket

Adjusting Lever
Lever Return Spring
Maximum Speed Adjusting Screw
Full-Load Set Screw
Idle Speed Adjusting Screw

Governor Cover
◆ O-Ring
Washer

Speed Control Spring
Spring Seat
Damper Spring

Adjusting Lever Shaft

Pickup Sensor
Regulator Valve
Fuel Inlet Hollow Screw
◆ Gasket
◆ O-Ring
◆ O-Ring
◆ O-Ring

Set Key

Pump Body

◆ Non-reusable part
DISASSEMBLY OF INJECTION PUMP
(See pages FU-6 to 8)

1. MOUNT PUMP ASSEMBLY TO SST (STAND)
   SST 09241-76022 and 09245-54010

2. REMOVE SET KEY OF DRIVE PULLEY FROM DRIVE SHAFT

3. (w/ A/C) REMOVE IDLE-UP ACTUATOR

4. (w/ Tachometer) REMOVE PICKUP SENSOR
   (a) Disconnect the lead wires from the connector.
   (b) Remove the pickup sensor and O-ring.

5. (2L-T Austria) REMOVE THROTTLE POSITION SENSOR
   Using a 5 mm hexagonal wrench, remove the three bolts and throttle position sensor.

6. (2L-T) REMOVE IDLE-UP LEVER
   Using a 5 mm hexagonal wrench, remove the three bolts and idle-up lever.

7. (2L-T) REMOVE THERMO WAX
   (a) Using a screwdriver, turn the cold starting lever counterclockwise approx. 20°.
   (b) Put a metal plate (thickness of 8.5 - 10 mm (0.335 - 0.394 in.)) between the cold starting lever and thermo wax plunger.
(c) Using a 5 mm hexagonal wrench, remove the two bolts, thermo wax and O-ring.

8. (2L-T) REMOVE DASH POT
Remove the dash pot and gasket.

9. REMOVE FUEL CUT SOLENOID
(a) Using a 6 mm hexagonal wrench, remove the bolt and connector bracket.
(b) Disconnect the lead wire connector from the bracket.
(c) Disconnect the dust cover from the fuel cut solenoid.
(d) Remove the nut, lead wire and dust cover.
(e) Remove the fuel cut solenoid, O-ring, spring, valve, strainer and wave washer.

10. REMOVE ADJUSTING LEVER
Remove the bolt, nut, adjusting lever and return spring.
11. REMOVE GOVERNOR COVER
   (a) (2L-T and w/ HAC)
       Remove the idle speed adjusting screw.
   (b) Using a 5 mm hexagonal wrench, remove the four bolts.
   (c) (2L-T)
       Disconnect the adjusting shaft assembly from the governor link and remove the governor cover and gasket.
   (d) (3L)
       Disconnect the speed control spring from the spring seat, and remove the spring seat, damper spring, speed control spring, governor cover, adjusting lever shaft assembly and gasket.

12. REMOVE GOVERNOR ADJUSTING LEVER SHAFT FROM GOVERNOR COVER
    Remove the following parts from the governor cover.
    (1) Adjusting lever shaft, O-ring and washer assembly
    (2) O-ring
    (3) Washer

13. (2L-T)
    DISASSEMBLE BOOST COMPENSATOR
    A. Remove boost compensator diaphragm
       (a) Using a 5 mm hexagonal wrench, remove the four bolts, and diaphragm cover.
(b) Place the matchmarks on the diaphragm and governor cover.

(c) Remove the following parts:
   1. Boost compensator shim B (Austria only)
   2. Sub spring (Austria only)
   3. Diaphragm and push rod
   4. Main spring
   5. Boost compensator shim A

B. Remove guide bushing

C. Remove control lever
   (a) Using a 4 mm hexagonal wrench, remove the two bolts and gaskets.

   (b) Using a small screwdriver, push out the support pin and remove the control lever.

   (c) Using a 4 mm hexagonal wrench, remove the plug and gasket.
(d) Using needle nose pliers, remove the connecting pin. 
**NOTICE:** Be careful not to damage the connecting pin. Tape the tip of the pliers.

D. Remove No. 2 overflow screw
Remove the cover and No. 2 overflow screw.

14. **(2L-T Austria)**
**REMOVE PILOT INJECTION (PIJ) ACTUATOR**
Using the PIJ socket, remove the PIJ actuator.
Part No. 95096-10380 (NIPPONDENSO)

15. **(2L-T Austria)**
**PIJ INJECTION PRESSURE TEST**
(a) Using the PIJ retaining socket, remove the plug bolt and gasket.
Part No. 95096-10390 (NIPPONDENSO)

(b) Using the PIJ socket, install the PIJ actuator on the PIJ connector, and torque.
Part No. 95096-10380 and 95096-10400 (NIPPONDENSO)
Torque: 675 kg-cm (49 ft-lb, 66 N·m)
(c) Install the PIJ actuator to the injection hand tester and pump the tester handle a few times.

HINT: After the PIJ valve opens (making a clicking sound as the pressure is raised), wait until injection occurs (the pressure gradually decreases and stops at a certain pressure), then raise the pressure again.

(d) Pump the tester handle slowly and observe the pressure gauge.

HINT: Increase the pressure at a steady pace so that the PIJ opens at the end of one stroke.

(e) Read the pressure gauge just as the injection pressure begins to drop.

Opening pressure: 123 – 127 kg/cm² (1,749 – 1,806 psi) (12,054 – 12,446 kPa)

If the opening pressure is not as specified, disassemble the PIJ actuator and change the adjusting shim on the top of the pressure spring.

<table>
<thead>
<tr>
<th>Adjusting shim thickness</th>
<th>mm (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.500 (0.0197)</td>
<td>1.025 (0.0404)</td>
</tr>
<tr>
<td>0.550 (0.0217)</td>
<td>1.050 (0.0413)</td>
</tr>
<tr>
<td>0.600 (0.0236)</td>
<td>1.075 (0.0423)</td>
</tr>
<tr>
<td>0.650 (0.0256)</td>
<td>1.100 (0.0433)</td>
</tr>
<tr>
<td>0.700 (0.0276)</td>
<td>1.125 (0.0443)</td>
</tr>
<tr>
<td>0.750 (0.0295)</td>
<td>1.150 (0.0453)</td>
</tr>
<tr>
<td>0.800 (0.0315)</td>
<td>1.175 (0.0463)</td>
</tr>
<tr>
<td>0.850 (0.0335)</td>
<td>1.200 (0.0472)</td>
</tr>
<tr>
<td>0.900 (0.0354)</td>
<td>1.225 (0.0482)</td>
</tr>
<tr>
<td>0.950 (0.0374)</td>
<td>1.250 (0.0492)</td>
</tr>
<tr>
<td>1.000 (0.0394)</td>
<td>1.275 (0.0502)</td>
</tr>
</tbody>
</table>

HINT:
- Varying the adjusting shim thickness by 0.025 mm (0.0010 in.) changes the injection pressure by about 2.7 kg/cm² (38.4 psi, 245 kPa).
- For the second measurement or more, wait until the PIJ has injected first (the pressure drops to a certain level).

16. (2L-T Austria)
DISASSEMBLE PILOT INJECTION (PIJ) ACTUATOR

(a) Using the PIJ body socket and PIJ retaining socket, remove the retaining nut.

Part No. 95096-10390 and 95096-10400 (NIPPONDENSO)

NOTICE: Do not drop the accumulator.
(b) Remove the following parts from the holder body.
   
   1. Accumulator assembly
   2. Distance piece
   3. Pressure pin
   4. Pressure spring
   5. Adjusting shim (for opening pressure)
   6. Stopper
   7. Adjusting shim (for piston lift gap)

   HINT: The shims in (5) and (7) are the same shape so keep them separate to distinguish between them.

INSPECTION OF INJECTION PUMP COMPONENTS

1. INSPECT SPRING LENGTH

   Using vernier calipers, measure the free length of each spring.

   Spring free length:
   - Delivery valve spring: 24.4 mm (0.961 in.)
   - Plunger spring: 30.0 mm (1.181 in.)
   - Coupling spring: 16.0 mm (0.630 in.)
   - Pneumatic bellows spring (w/ HAC): 35.0 mm (1.378 in.)
   - Boost compensator main spring
     - 2L-T (Austria): 24.1 mm (0.949 in.)
     - 2L-T (Others): 19.4 mm (0.764 in.)
   - Boost compensator sub spring (2L-T Austria): 22.3 mm (0.878 in.)

   If the free length is not as specified, replace the spring(s).

2. (2L-T Austria)
   INSPECT ACCUMULATOR ASSEMBLY

   (a) Wash the accumulator in clean diesel oil.

   NOTICE: Do not touch the accumulator mating surfaces with your fingers.

   (b) Tilt the accumulator guide about 60 degrees and pull the piston out about one third of its length.

   (c) When released, the piston should sink down into the guide vent smoothly by its own weight.

   (d) Repeat this test, rotating the piston slightly each time.

   If the piston does not sink freely, replace the accumulator assembly.
ASSEMBLY OF INJECTION PUMP
(See pages FU-6 to 8)

1. ADJUST PLUNGER SPRING SHIM
   (a) Install the following parts to the distributive head:
       (1) Two plunger spring guides
       (2) Two upper spring seats
       (3) Two plunger springs
       (4) Lower spring seat
       (5) Upper plunger plate
       (6) Lower plunger plate
       (7) Pump plunger
   HINT: Do not assemble the plunger spring shims at this time.
   (b) Using vernier calipers, measure clearance A indicated in the illustration.
   (c) Determine the plunger spring shim size by using the following formula and chart.

2L-T (Austria)
   New plunger spring shim thickness = 6.1 - A

2L-T (Others) and 3L
   New plunger spring shim thickness = 5.9 - A
   A ... Measured plunger position

Plunger spring shim selection chart for 2L-T (Austria)

<table>
<thead>
<tr>
<th>Measured clearance</th>
<th>Shim thickness</th>
<th>Measured clearance</th>
<th>Shim thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 4.6 (0.181)</td>
<td>1.5 (0.059)</td>
<td>3.6 - 3.8 (0.142 - 0.150)</td>
<td>2.5 (0.098)</td>
</tr>
<tr>
<td>4.3 - 4.5 (0.169 - 0.177)</td>
<td>1.8 (0.071)</td>
<td>3.3 - 3.5 (0.130 - 0.138)</td>
<td>2.8 (0.110)</td>
</tr>
<tr>
<td>4.1 - 4.2 (0.161 - 0.165)</td>
<td>2.0 (0.079)</td>
<td>Less than 3.2 (0.126)</td>
<td>3.0 (0.118)</td>
</tr>
<tr>
<td>3.9 - 4.0 (0.154 - 0.157)</td>
<td>2.2 (0.087)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Plunger spring shim selection chart for 2L-T (Others) and 3L

<table>
<thead>
<tr>
<th>Measured clearance</th>
<th>Shim thickness</th>
<th>Measured clearance</th>
<th>Shim thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 5.3 (0.209)</td>
<td>0.5 (0.020)</td>
<td>4.3 - 4.5 (0.169 - 0.177)</td>
<td>1.5 (0.059)</td>
</tr>
<tr>
<td>5.0 - 5.2 (0.196 - 0.205)</td>
<td>0.8 (0.031)</td>
<td>4.0 - 4.2 (0.157 - 0.165)</td>
<td>1.8 (0.071)</td>
</tr>
<tr>
<td>4.8 - 4.9 (0.189 - 1.193)</td>
<td>1.0 (0.039)</td>
<td>Less than 3.9 (0.154)</td>
<td>2.0 (0.079)</td>
</tr>
<tr>
<td>4.6 - 4.7 (0.181 - 0.185)</td>
<td>1.2 (0.047)</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

HINT:
- For a measurement between listed sizes, use the next larger size. Ex. If thickness is 1.1 mm (0.043 in.) by calculation, use a 1.2 mm (0.047 in.) shim.
- Select two shims which have the same thickness.
2. (2L-T Austria)  
ASSEMBLY AND ADJUSTING PILOT INJECTION (PIJ) ACTUATOR

(a) Install the following parts to the holder body.
   (1) Adjusting shim (for piston lift gap)
   (2) Stopper
   (3) Adjusting shim (for opening pressure)
   (4) Pressure spring
   (5) Pressure pin
   (6) Distance piece
   (7) Accumulator assembly

NOTICE: Do not mix up the shims in (1) and (3) above.

(b) Using the PIJ body socket and PIJ retaining socket, install the retaining nut.

Part No. 95096-10390 and 95096-10400 (NIPPONDENSO)
Torque: 675 kg·cm (49 ft-lb, 66 N·m)

(c) Place the PIJ actuator and magnet stand on top of the surface place, insert the measure attachment in the thread hole in the plug bolt, and set the dial gauge.

Part No. 95096-10420 (NIPPONDENSO)

(d) Set the dial indicator scale to 0 mm (0 in.) on top of the measure attachment.

(e) Press down on the edges of the measure attachment and measure the piston lift gap.

Piston lift gap: 0.175 – 0.475 mm
(0.00689 – 0.01870 in.)

If the piston lift gap is not as specified, change the shim. (See page FU-14)
3. (2L-T Austria)
CHECK PLUNGER STROKE

NOTICE: Perform this only when overhauling the injection pump itself.

(a) Using SST, install the conventional distributive head plug.

SST 09260-54012 (09262-54010)
Torque: 700 kg-cm (51 ft-lb, 69 N-m)

(b) Remove the plug bolt from the distributive head plug and gasket of the injection pump.

(c) Install SST (plunger stroke measuring tool) and a dial indicator to the plug bolt hole of distributive head plug.

SST 09275-54010

(d) Install the marking guide to the drive shaft, align the plunger with lower dead center and set the dial indicator at 0 mm (0 in.).

Part No. 95096-10430 (NIPPONDENSO)

(e) Rotate the drive shaft in the pump rotation direction and use a punch to engrave the flange when the plunger lift (plunger stroke) is at maximum valve.

Part No. 95096-10440 (NIPPONDENSO)
Plunger stroke: 0.60 – 0.80 mm (0.0236 – 0.0315 in.)

NOTICE: If the old mark and new mark are located in different positions, file off the old mark.

(f) Using SST, remove the distributive head plug.

SST 09260-54012 (09262-54010)
4. **(2L-T Austria)**

**INSTALL PILOT INJECTION (PIJ) ACTUATOR**

(a) Install a new O-ring to the PIJ actuator.

(b) Using the PIJ socket, install the PIJ actuator.

Part No. 95096-10380 (NIPPONDENSO)

Torque: 900 kg-cm (65 ft-lb, 88 N·m)

NOTICE: Check that the PIJ actuator and injection are clean and free of foreign material.

5. **(2L-T)**

**ASSEMBLE BOOST COMPENSATOR**

A. **Install No. 2 overflow screw**

Install the No. 2 overflow screw and cover.

B. **Install control lever**

(a) Insert the connecting pin into the governor cover.

(b) Using a 4 mm hexagonal wrench, install the plug with a new gasket.

(c) Using a small screwdriver, install the control lever with the support pin.
(d) Using a 4 mm hexagonal wrench, install two new gaskets and the two bolts.

C. Install guide bushing

D. Install boost compensator diaphragm
   (a) Install the attachment measure to the governor cover. Part No. 95096-10330 (NIPPONDENSO)

(b) Measure the distance between the end surface of the control lever and the attachment measure.
   (1) Install the shim and diaphragm.

HINT: Do not assemble the spring.

(2) With the push rod against the ※ surface (flat part), measure dimension “L2” with vernier calipers as shown.

Dimension “L2”:
- Austria: Approx. 10.75 mm (0.4232 in.)
- Others: Approx. 10.39 mm (0.4091 in.)

HINT: Dimension “L1” of attachment measure is 10 mm (0.39 in.).
(3) With the push rod pushed in to the maximum, measure dimension “L3” with vernier calipers as shown. Select shim A to adjust “ΔL1” obtained as the difference between “L3” and “L2” obtained in (2) above.

Difference “ΔL1”:
- Austria 0.67 – 0.97 mm (0.0264 – 0.0382 in.)
- Others 1.23 – 1.33 mm (0.0484 – 0.0524 in.)

Adjusting shim thickness:
- 1.1 mm (0.043 in.)
- 1.3 mm (0.051 in.)
- 1.5 mm (0.059 in.)
- 1.7 mm (0.067 in.)
- 1.9 mm (0.075 in.)
- 2.1 mm (0.083 in.)
- 2.3 mm (0.090 in.)
- 2.5 mm (0.098 in.)
- 2.7 mm (0.106 in.)
- 2.9 mm (0.114 in.)
- 3.1 mm (0.122 in.)
- 3.3 mm (0.130 in.)

(4) Remove the diaphragm and push rod.

(c) Insert 1.5 – 2.5 cc (0.09 – 0.15 cu in.) of engine oil into the bushing hole.

(d) Install the following parts:
1. Boost compensator shim A
2. Main spring
3. Diaphragm and push rod
4. Sub spring (Austria only)
5. Boost compensator shim B (Austria only)

(e) Using a 5 mm hexagonal wrench, install the four bolts and governor cover.
(f) Measure the distance between the control lever end surface and the attachment measure.

(Austria)

1. Measure dimension “L4” with vernier calipers as shown.
   Adjust the difference “ΔL2” between “L2” measured in (b) and “L4” by rotating the guide bushing.

Difference “ΔL2”: 1.30 – 1.50 mm (0.0512 – 0.0591 in.)

2. Apply 350 mmHg (13.8 in. Hg, 46.7 kPa) of absolute pressure to the boost compensator and measure dimension “L5” with vernier calipers as shown. Select shim B to adjust “ΔL3” obtained as the difference between “L5” and “L2” measured in (b).

Difference “ΔL3”: 1.70 – 1.94 mm (0.0669 – 0.0764 in.)

Adjusting shim thickness: 12.90 mm (0.508 in.)
                          13.15 mm (0.518 in.)
                          13.40 mm (0.528 in.)

(Others)

Apply 0.27 kg/cm² (3.8 psi, 26 kPa) of pressure to the boost compensator and measure dimension “L4” with vernier calipers as shown.
Adjust “L4” by rotating the guide bushing.

Dimension “L4”: 9.85 – 9.95 mm (0.3878 – 0.3917 in.)

(g) Remove the attachment measure.

Part No. 95096 – 10030 (NIPPONDENSO)
6. INSTALL ADJUSTING LEVER SHAFT TO GOVERNOR SHAFT
   Install the following parts to the governor cover:
   (1) Plate washer
   (2) New O-ring
   (3) Adjusting lever shaft, O-ring and plate washer assembly

7. INSTALL GOVERNOR COVER
   (a) Install a new gasket to the groove of the governor cover.
   (b) (2L-T)
       Connect the adjusting lever shaft to the governor link and twist the shaft lightly.
   (c) (3L)
       Install the speed control spring to the adjusting lever shaft.
   (d) (3L)
       Install the damper spring and spring seat, and connect the speed control spring to the spring seat.
   (e) Using a 5 mm hexagonal wrench, install the governor cover with the four bolts.
   Torque: 85 kg-cm (74 in.-lb, 8.3 N-m)
   HINT: Use the bolt which is 35 mm (1.38 in.) length.
   (f) (2L-T and w/ HAC)
       Install the idle speed adjusting screw.

8. INSTALL ADJUSTING LEVER
   (a) Place the return spring on the governor cover.
(b) Hook the return spring to the adjusting lever, and turn and place the adjusting lever on the governor shaft.
(c) Align the lines of the adjusting lever shaft and adjusting lever.

(d) Install the adjusting lever with the nut.

9. INSTALL FUEL CUT SOLENOID
   (a) Install a new O-ring on the fuel cut solenoid.
   (b) Install the strainer, valve, spring, a new gasket and the fuel cut solenoid.
   Torque: 225 kg-cm (16 ft-lb, 22 N-m)
   (c) Install the lead wire to the fuel cut solenoid with the nut.
   (d) Install the dust cover to the fuel cut solenoid.
   (e) Install the lead wire connector to bracket.
   (f) Using a 6 mm hexagonal wrench, install the connector bracket with the bolt.

10. (2L-T)
    INSTALL DASH POT
    Install a new gasket and the dash pot.
11. (2L-T)
INSTALL THERMO WAX
(a) Using a screwdriver, turn the cold starting lever counterclockwise approx. 20°.
(b) Put a metal plate (thickness of 8.5 – 10 mm (0.335 – 0.384 in.)) between the cold starting lever and thermo wax plunger.
(c) Install a new O-ring to the pump body.
(d) Using a 5 mm hexagonal wrench, install the thermo wax with the two bolts.

12. (2L-T)
INSTALL IDLE-UP LEVER
Using a 5 mm hexagonal wrench, install the idle-up lever with the three bolts.

13. (2L-T Austria)
INSTALL AND CHECK THROTTLE POSITION SENSOR
(a) Using a 5 mm hexagonal wrench, install the throttle position sensor with the three bolts.
(b) Using an ohmmeter, check that there is continuity between the terminals VC and E2.
14. (w/ Tachometer)
INSTALL PICKUP SENSOR
(a) Install a new O-ring and pickup sensor.
(b) Connect the two lead wires to the connector.
Torque: 210 kg-cm (15 ft-lb, 21 N-m)

15. (w/ A/C)
INSTALL IDLE-UP ACTUATOR

16. REMOVE INJECTION PUMP FROM SST (STAND)
SST 09241-76022 and 09245-54010

17. PERFORM AIR TIGHT TEST
(a) Install a bolt to the overflow port.
(b) Connect an air hose to the fuel inlet pipe and place the injection pump into diesel fuel.
NOTICE: On vehicles with the throttle position sensor (2L-T Austria), be careful not to immerse sensor in diesel fuel.
(c) Apply 0.5 kg/cm² (7 psi, 49 kPa) of pressure and confirm that there are no leaks.
(d) Next check that there are no leaks with 5.0 kg/cm² (71 psi, 490 kPa) of pressure applied.

18. INSTALL SET KEY OF INJECTION PUMP DRIVE PULLEY ON DRIVE SHAFT
ADJUSTMENT OF INJECTION PUMP

1. PRE-TEST CHECK AND PREPARATION
   (a) The specifications for test nozzle and nozzle holders are as follows.

   Test nozzle: DN12SD12 (NIPPONDENSO)
   Test nozzle opening pressure:
   145 – 155 kg/cm²
   (2,062 – 2,205 psi, 14,220 – 15,200 kPa)

   (b) Check the accuracy of the tachometer.
   Allowable error: ± 40 rpm

   (c) Install the angle gauge stand.

   (d) Mount the injection pump body on the pump tester.
   HINT: Place a mark on the key groove portion of the coupling.

   (e) Install an injection pipe with the following specifications.
   Outer diameter: 6.0 mm (0.236 in.)
   Inner diameter: 2.0 mm (0.079 in.)
   Length: 840 mm (33.07 in.)
   Minimum bending radius: 25 mm (0.98 in.) or more

   (f) Remove the fuel inlet hollow screw.

   (g) Connect the fuel inlet pipe with an adapter.
(h) Install the overflow hose with the overflow screw.
HINT: Always use the overflow screw installed on the pump to be adjusted.

(i) Using a 5 mm hexagonal wrench, remove the two bolts and RH timer cover.

(j) Install the inner pressure gauge with the timer measuring device.
Part No. 95095-10220 and 95095-10231 (NIPPONDENSO)
HINT: Bleed air by the air bleed screw.

(k) (2L-T)
Connect SST (turbocharger pressure gauge) to the boost compensator.

SST 09992-00241
(l) Apply about 6 volts of DC power to the fuel cut solenoid.

NOTICE:
- When applying voltage to the solenoid, position the battery as far away from the solenoid as possible so that a spark does not occur.
- When connecting the battery cable, connect the solenoid side first.

(m) The pressure for feeding fuel to the injection pump should be 0.2 kg/cm² (2.8 psi, 20 kPa). The fuel temperature for pump testing should be 40 – 45°C (104 – 113°F).

(n) Install an angle gauge to the stand and set it to the adjusting lever.

(o) Secure the adjusting lever fully on the maximum speed side.

(p) Check the installation direction of the camplate as follows:
- Disconnect the injection pipe from the position marked “C” on the distributive head.
- Using SST, remove the delivery valve holder.

SST 09260-54012 (09269-54020)

- Check that fuel is flowing out when the mark is in the position shown in the illustration. If not, it is improperly assembled.
- Disassemble and change the camplate position 180° in the opposite direction.

HINT: At this time, disconnect the fuel cut solenoid wire harness.
• Using SST, install the delivery valve holder.
   SST 09260-54012 (09269-54020)
• Connect the injection pipe.

(q) Bleed the air from the injection pipes.

(r) Race the injection pump for 5 minutes at 2,000 rpm.
NOTICE: Check that there is no fuel leakage or abnormal noise.

HINT:
• Measure the volume of each injection cylinder with a measuring cylinder.
• Before measuring the injection volume, first hold the cylinder tilted for at least 30 seconds to discard all the fuel.
2. PRE-SET FULL LOAD INJECTION VOLUME
   (a) Set the adjusting lever to maximum position.
   (b) (2L-T Austria)
       Apply 0.68 kg/cm² (9.6 psi, 66 kPa) of pressure to the boost compensator.
   (c) (2L-T Others)
       Apply 0.63 kg/cm² (9.0 psi, 62 kPa) of pressure to the boost compensator.
   (d) Measure the injection volume.

<table>
<thead>
<tr>
<th>Item</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>1,400</td>
<td>200</td>
<td>14.04 – 14.36 (0.86 – 0.88)</td>
</tr>
<tr>
<td>Others</td>
<td>1,200</td>
<td>200</td>
<td>13.94 – 14.26 (0.85 – 0.87)</td>
</tr>
<tr>
<td>3L</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hong Kong, Singapore, Malaysia</td>
<td>1,200</td>
<td>200</td>
<td>10.96 – 11.28 (0.67 – 0.69)</td>
</tr>
<tr>
<td>Others</td>
<td>1,200</td>
<td>200</td>
<td>11.56 – 11.88 (0.71 – 0.72)</td>
</tr>
</tbody>
</table>

(e) Remove the collar seal as follows:
   - Hold the full load set screw, and release the collar seal from the spot weld by turning the lock nut counterclockwise 90° or more.

   - Using a screwdriver, remove the collar seal.

(f) Adjust by turning the full load set screw.

HINT: The injection volume will increase about 3 cc (0.18 cu in.) with each 1/2 turn of the screw.
3. (2L-T and w/o HAC) 
**PRE-SETTING OF LOAD SENSING TIMER**
Using a 5 mm hexagonal wrench, adjust the protrusion of the governor shaft.
Protrusion: 0.5 – 2.0 mm (0.020 – 0.079 in.)

4. **PRE-SET MAXIMUM SPEED**
(a) Set the adjusting lever to maximum position.
(b) (2L-T Austria)
   Apply 0.68 kg/cm² (9.6 psi, 66 kPa) of pressure to the boost compensator.
(c) (2L-T Others)
   Apply 0.63 kg/cm² (9.0 psi, 62 kPa) of pressure to the boost compensator.
(d) Measure the injection volume.

<table>
<thead>
<tr>
<th>Item</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T Austria</td>
<td>2,450</td>
<td>200</td>
<td>4.3 – 6.3 (0.26 – 0.38)</td>
</tr>
<tr>
<td>Others</td>
<td>2,400</td>
<td>200</td>
<td>4.3 – 6.3 (0.26 – 0.38)</td>
</tr>
<tr>
<td>3L Hong Kong, Singapore, Malaysia</td>
<td>2,200</td>
<td>200</td>
<td>4.6 – 6.2 (0.28 – 0.38)</td>
</tr>
<tr>
<td>Others</td>
<td>2,300</td>
<td>200</td>
<td>4.6 – 6.2 (0.28 – 0.38)</td>
</tr>
</tbody>
</table>

(e) Cut off the seal wire.
(f) Adjust the injection volume with the maximum speed adjusting screw.

5. **ADJUST PUMP INNER PRESSURE**
(a) Measure the pump inner pressure at the below listed rpm.

<table>
<thead>
<tr>
<th>Pump rpm</th>
<th>Inner pressure kg/cm² (psi, kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>500</td>
<td>3.2 – 3.8 (46 – 54, 314 – 373)</td>
</tr>
<tr>
<td>2,100</td>
<td>6.6 – 7.2 (94 – 102, 647 – 706)</td>
</tr>
</tbody>
</table>
(b) If the pressure is low, adjust by lightly tapping the regulator valve piston while watching the pressure gauge.

HINT: If the pressure is too high or if the regulator valve was tapped in too far, the regulator valve must be replaced.

6. CHECK OVERFLOW VOLUME
Measure the overflow volume at the below listed rpm.

<table>
<thead>
<tr>
<th>Pump rpm</th>
<th>Overflow volume cc/min. (cu in./min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,200</td>
<td>370 – 800 (22.6 – 48.8)</td>
</tr>
</tbody>
</table>

HINT: Always use the overflow screw installed on the pump to be adjusted.

7. (2L-T)
RELEASE COLD STARTING SYSTEM FOR NEXT INSPECTIONS

(a) Using a screwdriver, turn the cold starting lever counterclockwise approx. 20°.

(b) Put a metal plate (thickness of 8.5 – 10 mm (0.33 – 0.39 in.)) between the cold starting lever and thermo wax plunger.

HINT: Keep the cold starting system released until all measurements and adjustments are finished.

8. ADJUST TIMER

(a) Set the timer measuring device at zero.

(b) Measure the piston stroke at the below listed rpm.

<table>
<thead>
<tr>
<th>Item</th>
<th>Pump rpm</th>
<th>Piston stroke mm (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td>800</td>
<td>1.2 – 2.0 (0.047 – 0.079)</td>
</tr>
<tr>
<td></td>
<td>1,200</td>
<td>2.5 – 3.3 (0.098 – 0.130)</td>
</tr>
<tr>
<td></td>
<td>2,000</td>
<td>5.4 – 6.0 (0.213 – 0.236)</td>
</tr>
<tr>
<td></td>
<td>2,300</td>
<td>5.4 – 6.0 (0.213 – 0.236)</td>
</tr>
<tr>
<td></td>
<td>800</td>
<td>1.4 – 2.2 (0.055 – 0.087)</td>
</tr>
<tr>
<td></td>
<td>1,200</td>
<td>3.0 – 3.8 (0.118 – 0.150)</td>
</tr>
<tr>
<td></td>
<td>1,800</td>
<td>5.5 – 6.3 (0.217 – 0.248)</td>
</tr>
<tr>
<td></td>
<td>2,300</td>
<td>6.7 – 7.5 (0.264 – 0.296)</td>
</tr>
<tr>
<td>Austria</td>
<td>800</td>
<td>0.6 – 1.4 (0.024 – 0.055)</td>
</tr>
<tr>
<td></td>
<td>1,200</td>
<td>1.8 – 2.6 (0.071 – 0.102)</td>
</tr>
<tr>
<td></td>
<td>2,000</td>
<td>4.4 – 5.2 (0.173 – 0.205)</td>
</tr>
<tr>
<td></td>
<td>2,300</td>
<td>4.7 – 5.5 (0.185 – 0.217)</td>
</tr>
</tbody>
</table>
HINT: Check that the hysteresis is within 0.3 mm (0.012 in.).
(c) Using a 5 mm hexagonal wrench, adjust by the timer adjusting screw.
HINT: The stroke will decrease with turn to clockwise and increase with turn to counterclockwise.

9. (2L-T)
CHECK AIR TIGHTNESS OF BOOST COMPENSATOR
(a) Apply 1.36 kg/cm² (19.3 psi, 133 kPa) of pressure to the boost compensator.
(b) Measure the time it takes for the pressure to drop to 1.33 kg/cm² (18.9 psi, 130 kPa).
Pressure drop: 10 seconds or more

10. ADJUST FULL LOAD INJECTION VOLUME
(a) The adjusting lever angle for the adjustment below should be as shown in the illustration.

<table>
<thead>
<tr>
<th>Adjusting lever angle</th>
<th>A (Maximum speed side)</th>
<th>B (Idle speed side)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plus 23.5 – 33.5°</td>
<td>Minus 12.5 – 22.5°</td>
<td></td>
</tr>
</tbody>
</table>

(b) (2L-T Austria)
Apply 0.68 kg/cm² (9.6 psi, 66 kPa) of pressure to the boost compensator.
(c) (2L-T Others)
Apply 0.63 kg/cm² (9.0 psi, 62 kPa) of pressure to the boost compensator.
(d) Measure the full load injection volume.

<table>
<thead>
<tr>
<th>Item</th>
<th>Adjusting lever angle position</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T Austria</td>
<td>Plus 23.5 – 33.5°</td>
<td>1,400</td>
<td>200</td>
<td>14.04 – 14.36 (0.86 – 0.88)</td>
</tr>
<tr>
<td>Others</td>
<td>Plus 23.5 – 33.5°</td>
<td>1,200</td>
<td>200</td>
<td>13.94 – 14.26 (0.85 – 0.87)</td>
</tr>
<tr>
<td>Hong Kong, Singapore, Malaysia</td>
<td>Plus 23.5 – 33.5°</td>
<td>1,200</td>
<td>200</td>
<td>10.96 – 11.28 (0.67 – 0.69)</td>
</tr>
<tr>
<td>Others</td>
<td>Plus 23.5 – 33.5°</td>
<td>1,200</td>
<td>200</td>
<td>11.56 – 11.88 (0.71 – 0.72)</td>
</tr>
</tbody>
</table>
(e) Adjust by turning the full load set screw.

HINT: The injection volume will increase about 3 cc (0.18 cu in.) with each 1/2 turn of the screw.

11. ADJUST MAXIMUM SPEED

(a) (2L-T Austria)
Apply 0.68 kg/cm² (9.6 psi, 66 kPa) of pressure to the boost compensator.

(b) (2L-T Others)
Apply 0.63 kg/cm² (9.0 psi, 62 kPa) of pressure to the boost compensator.

(c) Measure the injection volume at each pump rpm.

<table>
<thead>
<tr>
<th>Item</th>
<th>Adjusting lever angle position</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td>Plus 23.5 – 33.5°</td>
<td>2,450</td>
<td>200</td>
<td>4.3 – 6.3 (0.26 – 0.38)</td>
<td>Adjust</td>
</tr>
<tr>
<td>Austria</td>
<td></td>
<td>2,250</td>
<td></td>
<td>8.3 – 10.5 (0.51 – 0.64)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,750</td>
<td></td>
<td>1.3 (0.8) or less</td>
<td>–</td>
</tr>
<tr>
<td>Others</td>
<td>Plus 23.5 – 33.5°</td>
<td>2,400</td>
<td>200</td>
<td>4.3 – 6.3 (0.26 – 0.38)</td>
<td>Adjust</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,250</td>
<td></td>
<td>7.1 – 9.3 (0.43 – 0.57)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,750</td>
<td></td>
<td>1.3 (0.8) or less</td>
<td>–</td>
</tr>
<tr>
<td>Hong Kong, Singapore,</td>
<td>Plus 23.5 – 33.5°</td>
<td>2,200</td>
<td>200</td>
<td>4.6 – 6.2 (0.28 – 0.38)</td>
<td>Adjust</td>
</tr>
<tr>
<td>Malaysia</td>
<td></td>
<td>2,000</td>
<td></td>
<td>8.44 – 10.44 (0.52 – 0.64)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,400</td>
<td></td>
<td>1.3 (0.8) or less</td>
<td>–</td>
</tr>
<tr>
<td>3L</td>
<td></td>
<td>2,300</td>
<td>200</td>
<td>4.6 – 6.2 (0.28 – 0.38)</td>
<td>Adjust</td>
</tr>
<tr>
<td>Others</td>
<td>Plus 23.5 – 33.5°</td>
<td>2,100</td>
<td></td>
<td>9.08 – 11.08 (0.55 – 0.68)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,550</td>
<td></td>
<td>1.3 (0.8) or less</td>
<td>–</td>
</tr>
</tbody>
</table>

(d) Adjust by turning the maximum speed adjusting screw.
If the injection volume at 100 rpm is not as specified, replace the governor sleeve plug as follows:
- Using SST and a press, press out the sleeve plug assembly from the governor sleeve.
SST 09236-00101 (09237-00070)

- Remove the E-ring and following parts from the sleeve plug:
(1) Stop ring
(2) Bearing and two bearing retainers

- Measure the head thickness of the sleeve plug, and select a new sleeve plug.

<table>
<thead>
<tr>
<th>Sleeve plug head thickness</th>
<th>mm (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0 (0.118)</td>
<td>3.5 (0.138)</td>
</tr>
<tr>
<td>3.1 (0.122)</td>
<td>3.6 (0.142)</td>
</tr>
<tr>
<td>3.2 (0.126)</td>
<td>3.7 (0.146)</td>
</tr>
<tr>
<td>3.3 (0.130)</td>
<td>3.8 (0.150)</td>
</tr>
<tr>
<td>3.4 (0.134)</td>
<td>3.9 (0.154)</td>
</tr>
</tbody>
</table>

HINT: Lengthening the plug 0.1 mm (0.004 in.) will increase injection volume by 0.6 cc (0.04 cu in.).
- Install the following parts to the new sleeve plug with a new E-ring:
(1) Bearing and two retainers
(2) Stop ring

12. (2L-T)
CHECK AND ADJUST FULL LOAD MINIMUM INJECTION VOLUME

(a) (Austria)
Using the hand-help vacuum pump, apply 200 mmHg of (7.9 in.Hg, 26.7 kPa) absolute pressure to the boost compensator.
(b) Measure the injection volume

<table>
<thead>
<tr>
<th>Item</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>1,400</td>
<td>200</td>
<td>8.8 – 10.0 (0.54 – 0.61)</td>
</tr>
<tr>
<td>Others</td>
<td>500</td>
<td>200</td>
<td>10.6 – 11.4 (0.65 – 0.70)</td>
</tr>
</tbody>
</table>

(c) (Austria)
If the injection volume is not as specified, adjust by using shim B. (See page FU-22)

(d) (Others)
Using a 3 mm hexagonal wrench, adjust the timer slide stopper.

13. (2L-T)
ADJUST BOOST COMPENSATOR CHARACTERISTIC

(Others)
(a) Apply pressure to the boost compensator.
(b) Measure the injection volume bushing.

<table>
<thead>
<tr>
<th>Item</th>
<th>Pump rpm</th>
<th>Boost pressure kg/cm² (psi, kPa)</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>500</td>
<td>0 (0, 0)</td>
<td>200</td>
<td>10.8 – 11.6 (0.65 – 0.71)</td>
</tr>
<tr>
<td>Others</td>
<td>1,200</td>
<td>0.41 (5.9, 40)</td>
<td>200</td>
<td>12.9 – 13.5 (0.79 – 0.82)</td>
</tr>
</tbody>
</table>

(c) Using a screwdriver, adjust the guide bushing.
HINT: When the guide bushing is turned clockwise, as seen from above, the injection volume will increase.
14. (2L-T)  
INSPECT AND ADJUST BOOST COMPENSATOR  
CHARACTERISTIC TENDENCY  
(a) Apply pressure to the boost compensator.  
(b) Measure injection volume.

<table>
<thead>
<tr>
<th>Item</th>
<th>Pump rpm</th>
<th>Boost pressure kg/cm² (psi, kPa)</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>500</td>
<td>0.41 (5.9, 40)</td>
<td>200</td>
<td>14.6 – 15.4 (0.89 – 0.93)</td>
</tr>
<tr>
<td>Others</td>
<td>1,200</td>
<td>0.14 (1.9, 13)</td>
<td>200</td>
<td>11.2 – 12.0 (0.68 – 0.73)</td>
</tr>
</tbody>
</table>

(c) (Austria)  
If the injection volume is not as specified, replace the sub spring of the boost compensator with one with different spring constant.  

Spring constant:  
1.2 kg/cm (1.04 lb/in.)  
1.4 kg/cm (1.22 lb/in.)
15. **(2L-T)**

**CHECK HYSTERESIS**

**(Austria)**

Compare the injection volume when the boost compensator pressure is lowered from 0.74 kg/cm² (10.5 psi, 73 kPa) to 0 kg/cm² (0 psi, 0 kPa) and, conversely, when it is raised from zero.

**(Others)**

Compare the injection volume when the boost compensator pressure is lowered from 0.78 kg/cm² (11.1 psi, 77 kPa) to 0.14 kg/cm² (2.0 psi, 14 kPa) and, conversely, when it is raised from zero.

**HINT:** Make measurements after moving the adjusting lever between idle and maximum three times for each lowering of the pressure.

<table>
<thead>
<tr>
<th>Item</th>
<th>Pump rpm</th>
<th>Boost pressure kg/cm² (psi, kPa)</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
<th>Hysteresis cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Austria</strong></td>
<td>1,400</td>
<td>0.74 (10.5, 73)</td>
<td>200</td>
<td>13.84 — 14.36 (0.84 — 0.88)</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>1,400</td>
<td>0.68 (9.6, 66)</td>
<td></td>
<td>13.94 — 14.26 (0.85 — 0.87)</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>0.41 (5.9, 40)</td>
<td></td>
<td>14.60 — 15.40 (0.89 — 0.94)</td>
<td>0.3 (0.02) or less</td>
</tr>
<tr>
<td></td>
<td>500</td>
<td>0 (0, 0)</td>
<td></td>
<td>10.80 — 11.60 (0.66 — 0.71)</td>
<td>—</td>
</tr>
<tr>
<td><strong>Others</strong></td>
<td>1,200</td>
<td>0.74 (10.5, 73)</td>
<td>200</td>
<td>13.84 — 14.36 (0.84 — 0.88)</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>1,200</td>
<td>0.63 (9.0, 62)</td>
<td></td>
<td>13.94 — 14.26 (0.85 — 0.87)</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>1,200</td>
<td>0.41 (5.9, 40)</td>
<td></td>
<td>12.90 — 13.50 (0.79 — 0.82)</td>
<td>0.3 (0.02) or less</td>
</tr>
<tr>
<td></td>
<td>1,200</td>
<td>0.14 (2.0, 14)</td>
<td></td>
<td>11.20 — 12.00 (0.68 — 0.73)</td>
<td>—</td>
</tr>
</tbody>
</table>

*If not within standard value, check each sliding part of the boost compensator and check whether or not there is any oil.*

16. **(2L-T and w/o HAC)**

**ADJUST LOAD SENSING TIMER**

(a) Using a 5 mm hexagonal wrench, adjust the starting and end points of the load sensing timer by turning the governor shaft.

(b) Measure the injection volume.

<table>
<thead>
<tr>
<th>Adjusting lever position</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum speed side</td>
<td>1,200</td>
<td>200</td>
</tr>
</tbody>
</table>
(e) Slowly move the adjusting lever from the maximum speed side to the idle speed side, and secure it at the point where the pump inner pressure begins to drop.

(f) Measure the injection volume at the drop point (starting point).

<table>
<thead>
<tr>
<th>Item</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume (mm cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td>1,200</td>
<td>200</td>
<td>Measured value at step (b) minus 0.6 (0.04) ± 0.4 (0.02)</td>
</tr>
<tr>
<td>3L</td>
<td>1,200</td>
<td>200</td>
<td>Measured value at step (b) minus 1.0 (0.06) ± 0.4 (0.02)</td>
</tr>
</tbody>
</table>

(g) Using a 5 mm hexagonal wrench, adjust the load sensing timer by turning the governor shaft, and perform the measurement again as specified.

HINT: The injection volume will increase approx. 3 cc (0.2 cu in.) with each 1/2 turn of the governor shaft.

(h) Check the end point injection volume by slowly moving the adjusting lever from the maximum speed side to the idle speed side, and secure it at the point where the pump inner pressure stops dropping.

<table>
<thead>
<tr>
<th>Item</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td>1,200</td>
<td>200</td>
<td>8.10 – 8.50 (0.49 – 0.52)</td>
</tr>
<tr>
<td>Hong Kong, Singapore, Malaysia</td>
<td>1,200</td>
<td>200</td>
<td>8.12 – 8.52 (0.50 – 0.52)</td>
</tr>
<tr>
<td>Others</td>
<td>1,200</td>
<td>200</td>
<td>8.72 – 9.12 (0.52 – 0.56)</td>
</tr>
</tbody>
</table>

(i) Check the timer piston fluctuation when the adjusting lever is moved from the maximum speed side to the idle speed side.

<table>
<thead>
<tr>
<th>Item</th>
<th>Pump rpm</th>
<th>Timer piston fluctuation mm (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td>1,200</td>
<td>1.44 – 1.84 (0.057 – 0.072)</td>
</tr>
<tr>
<td>3L</td>
<td>1,200</td>
<td>0.62 – 1.02 (0.024 – 0.040)</td>
</tr>
</tbody>
</table>

(j) Check the protrusion of the governor shaft.
Protrusion: 0.5 – 2.0 mm (0.020 – 0.079 in.)
17. CHECK INJECTION VOLUME

(a) (2L-T Austria)
Apply 0.68 kg/cm² (9.6 psi, 66 kPa) of pressure to the boost compensator.

(b) (2L-T Others)
Apply 0.63 kg/cm² (9.0 psi, 62 kPa) of pressure to the boost compensator.

(c) Measure the injection volume for each pump rpm.

<table>
<thead>
<tr>
<th>Item</th>
<th>Adjusting lever angle position</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
<th>Variation limit cc (cu in.)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td>Austria Plus 23.5 – 33.5°</td>
<td>1,400</td>
<td>200</td>
<td>13.94 – 14.26 (0.85 – 0.87)</td>
<td>0.4 (0.02)</td>
<td>Basic full-load injection volume</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100</td>
<td></td>
<td>13.60 – 18.40 (0.83 – 1.12)</td>
<td>1.2 (0.07)</td>
<td>Volume during starting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,200</td>
<td></td>
<td>13.70 – 15.10 (0.84 – 0.92)</td>
<td>0.5 (0.03)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,800</td>
<td></td>
<td>12.30 – 13.70 (0.75 – 0.84)</td>
<td>0.5 (0.03)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,000</td>
<td></td>
<td>11.60 – 12.80 (0.71 – 0.78)</td>
<td>0.5 (0.03)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Others Plus 23.5 – 33.5°</td>
<td>1,200</td>
<td>200</td>
<td>13.94 – 14.26 (0.85 – 0.87)</td>
<td>0.4 (0.02)</td>
<td>Basic full-load injection volume</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100</td>
<td></td>
<td>13.60 – 18.40 (0.83 – 1.12)</td>
<td>1.2 (0.07)</td>
<td>Volume during starting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,800</td>
<td></td>
<td>12.10 – 13.10 (0.74 – 0.80)</td>
<td>0.5 (0.03)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Hong Kong, Singapore, Malaysia</td>
<td>1,200</td>
<td>200</td>
<td>10.96 – 11.28 (0.67 – 0.69)</td>
<td>0.4 (0.02)</td>
<td>Basic full-load injection volume</td>
</tr>
<tr>
<td></td>
<td>Plus 23.5 – 33.5°</td>
<td>100</td>
<td></td>
<td>11.60 – 16.40 (0.71 – 1.00)</td>
<td>1.2 (0.07)</td>
<td>Volume during starting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>500</td>
<td></td>
<td>9.64 – 11.04 (0.59 – 0.67)</td>
<td>0.5 (0.03)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,900</td>
<td></td>
<td>9.39 – 10.69 (0.57 – 0.65)</td>
<td>0.5 (0.03)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Others Plus 23.5 – 33.5°</td>
<td>1,200</td>
<td>200</td>
<td>11.56 – 11.88 (0.71 – 0.72)</td>
<td>0.4 (0.02)</td>
<td>Basic full-load injection volume</td>
</tr>
<tr>
<td></td>
<td></td>
<td>100</td>
<td></td>
<td>11.60 – 16.40 (0.71 – 1.00)</td>
<td>1.2 (0.07)</td>
<td>Volume during starting</td>
</tr>
<tr>
<td></td>
<td></td>
<td>500</td>
<td></td>
<td>10.44 – 11.44 (0.64 – 0.70)</td>
<td>0.5 (0.03)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,000</td>
<td></td>
<td>10.19 – 11.09 (0.62 – 0.68)</td>
<td>0.5 (0.03)</td>
<td>–</td>
</tr>
</tbody>
</table>
18. ADJUST IDLE SPEED

(a) (2L-T)
Using pliers, remove the dash pot cover.

(b) (2L-T)
Fully loosen the dash pot adjusting screw.

(c) Measure the injection volume for each pump rpm.

<table>
<thead>
<tr>
<th>Item</th>
<th>Adjusting lever angle position</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
<th>Variation limit cc (cu in.)</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td>Austria</td>
<td>Minus 13.5 – 21.5°</td>
<td>375</td>
<td>200</td>
<td>q = 2.4 – 2.6 (0.15 – 0.16)</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>350</td>
<td>q plus 0.5 (0.03) or more</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>450</td>
<td>q minus 1.1 – 2.1 (0.07 – 0.13)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>Minus 13.5 – 21.5°</td>
<td>375</td>
<td>200</td>
<td>q = 1.5 – 2.5 (0.09 – 0.15)</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>350</td>
<td>q plus 0.5 (0.03) or more</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>450</td>
<td>q minus 0.7 – 1.7 (0.04 – 0.10)</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>3L</td>
<td>Minus 12.5 – 22.5°</td>
<td>350</td>
<td>200</td>
<td>1.8 – 2.8 (0.11 – 0.17)</td>
<td>0.34 (0.02)</td>
<td>Adjust</td>
</tr>
<tr>
<td></td>
<td></td>
<td>525</td>
<td></td>
<td>1.2 (0.07) or less</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

(d) Adjust by turning the idle speed adjusting screw.
(e) (2L-T)
Set the adjusting lever to the angle for the injection volume shown below.

<table>
<thead>
<tr>
<th>Item</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>600</td>
<td>200</td>
<td>q = 0.5 – 0.7 (0.03 – 0.04)</td>
</tr>
<tr>
<td>Others</td>
<td>600</td>
<td>200</td>
<td>q = 0.6 – 0.8 (0.04 – 0.05)</td>
</tr>
</tbody>
</table>

(f) (2L-T)
Adjust the injection volume with the dash pot adjusting screw.

HINT: The stroke will decrease with turn to clockwise and increase with turn to counterclockwise.

<table>
<thead>
<tr>
<th>Item</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>600</td>
<td>200</td>
<td>q plus 0.2 – 0.4 (0.01 – 0.02)</td>
</tr>
<tr>
<td>Others</td>
<td>600</td>
<td>200</td>
<td>q plus 0.2 – 0.4 (0.01 – 0.02)</td>
</tr>
</tbody>
</table>

(g) (2L-T)
Readjust by turning the idle speed adjusting screw.

<table>
<thead>
<tr>
<th>Item</th>
<th>Adjusting lever angle position</th>
<th>Pump rpm</th>
<th>Injection volume cc (cu in.)</th>
<th>Variation limit cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>Minus 13.5 – 21.5°</td>
<td>375</td>
<td>3.0 – 4.0 (0.18 – 0.24)</td>
<td>0.34 (0.02)</td>
</tr>
<tr>
<td>Others</td>
<td>Minus 13.5 – 21.5°</td>
<td>375</td>
<td>1.8 – 2.8 (0.11 – 0.17)</td>
<td>0.34 (0.02)</td>
</tr>
</tbody>
</table>

(h) (2L-T)
Install the dash pot cover.

19. (2L-T)
ADJUST COLD STARTING SYSTEM

(a) Remove the overflow screw and check the fuel temperature in the fuel pump.

Fuel temperature: 15 – 35°C (59 – 95°F)

(b) Set the set key of the pump drive shaft in a vertical or horizontal position.

(c) Set the scale of the timer measuring device to zero.

(d) Check the adjusting lever opening angle and consider this angle as zero.
(e) Remove the metal plate between the cold starting lever and thermo wax plunger.

(f) Torque the cold starting lever clockwise to approx. 50 kg·cm (43 in.-lb, 4.9 N·m) and keep the lever tightened for about 10 seconds. Then release the torque.

(g) Measure the timer piston stroke.

(h) Adjust by turning the timer adjusting screw.

Hint: Screw in for stroke decrease.

20. (2L-T)
ADJUST FAST IDLE

(a) Measure the clearance between the adjusting lever and idle speed adjusting screw.

<table>
<thead>
<tr>
<th>Fuel temperature</th>
<th>Clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>20°C (68°F)</td>
<td>2.5 mm (0.098 in.)</td>
</tr>
<tr>
<td>50°C (122°F)</td>
<td>0 mm (0 in.)</td>
</tr>
</tbody>
</table>
(b) Adjust by turning the fast idle adjusting screw.

21. POST ADJUSTMENT CHECK
(a) Check that injection stops when the fuel cut solenoid harness is removed.
Pump revolution: 100 rpm

(b) Check the adjusting lever movement.
Adjusting lever angle: 2L-T 41 – 51°
3L 43 – 49°

22. SEAL PARTS
Seal the maximum speed adjusting screw and full load set screws with new lead seals.
INSTALLATION OF INJECTION PUMP
(See page FU-3)

NOTICE: Do not put the injection pump (2L-T and w/ HAC) at an angle more than 45° from the horizontal.

1. INSTALL FUEL INLET AND OUTLET PIPES TO INJECTION PUMP
   Torque: 250 kg-cm (18 ft-lb, 25 N-m)

2. INSTALL INJECTION PUMP
   (a) Align the period lines (or matchmarks) of the injection pump and timing belt case.

   (b) Install the two nuts holding the injection pump to the timing belt case.
   Torque: 210 kg-cm (15 ft-lb, 21 N-m)

   (c) Install the pump stay with the four bolts.
   Torque: 185 kg-cm (13 ft-lb, 18 N-m)

3. CHECK INJECTION TIMING (See page EM-24 or 25)

4. INSTALL INJECTION PIPES
   (a) Place the two lower clamps on the intake manifold.
   (b) Install the four injection pipes.
   Torque: 250 kg-cm (18 ft-lb, 25 N-m)

   NOTICE: On vehicles with the PIJ (2L-T Austria), do not interfere with the PIJ actuator with the spanner. Use a 14 mm spanner when tightening the union nut of No. 2 injection pipe.

   (c) Secure the injection pipes with the two upper clamps and bolts.
5. CONNECT FUEL HOSES TO INJECTION PUMP
6. CONNECT INJECTION PUMP CONNECTOR(S)
7. (2L-T)
   CONNECT WATER BY-PASS HOSES TO THERMO WAX
8. (w/ A/C)
   CONNECT A/C IDLE-UP VACUUM HOSE
9. (2L-T)
   CONNECT BOOST COMPENSATOR HOSE
10. INSTALL ACCELERATOR LINKAGE
11. INSTALL INJECTION PUMP DRIVE PULLEY
    Torque: 650 kg-cm (47 ft-lb, 64 N-m)
12. SET NO. 1 CYLINDER TO TDC/COMPRESSION
13. INSTALL TIMING BELT
14. CHECK VALVE TIMING
15. INSTALL NO. 1 TIMING BELT COVER
16. INSTALL CRANKSHAFT PULLEY
    Torque: 1,700 kg-cm (123 ft-lb, 167 N-m)
17. INSTALL WATER PUMP PULLEY, FLUID COUPLING AND FAN
18. (2L-T)
    INSTALL TURBO WATER HOSE
19. (2L-T)
    FILL WITH ENGINE COOLANT (See page CO-5)
20. START ENGINE AND CHECK FOR FUEL LEAKS
21. CHECK IDLE SPEED AND MAXIMUM SPEED
    (See page EM-27)
# COOLING SYSTEM

REFER TO 2L, 3L ENGINE REPAIR MANUAL  
(Pub. No. RM123E)

NOTE: The following pages contain only the points which differ from the above listed manual.

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>DESCRIPTION</td>
<td>CO-2</td>
</tr>
<tr>
<td>TROUBLESHOOTING</td>
<td>CO-4</td>
</tr>
<tr>
<td>CHECK AND REPLACEMENT OF ENGINE</td>
<td></td>
</tr>
<tr>
<td>COOLANT</td>
<td>CO-4</td>
</tr>
<tr>
<td>THERMOSTAT (2L-T)</td>
<td>CO-6</td>
</tr>
</tbody>
</table>
DESCRIPTION

This engine utilizes a pressurized water forced circulation cooling system which includes a thermostat equipped with a by-pass valve mounted on the inlet side.
The cooling system is composed of the water jacket (inside the cylinder block and cylinder head), radiator, water pump, thermostat, cooling fan, hoses and other components. Coolant which is heated in the water jacket is pumped to the radiator, where it is cooled by the cooling fan and the vehicle windstream. Coolant which has been cooled is then sent back to the engine by the water pump, where it cools the engine. The water jacket is a network of channels in the shell of the cylinder block and cylinder head through which coolant passes. It is designed to provide adequate cooling of the cylinders and combustion chambers which become the hottest during engine operation.

RADIATOR

The radiator performs the function of cooling the coolant which has passed through the water jacket and become hot, and it is mounted in the front of the vehicle. The radiator consists of an upper tank and lower tank, and a core which connects the two tanks. The upper tank contains an inlet for coolant from the water jacket and a filler inlet. It also has a hose through which excess coolant or steam can flow. The lower tank has an outlet and drain cock for the coolant. The core contains many tubes and cooling fins through which coolant flows from the upper tank to the lower tank so that coolant has been heated up as it passes through the water jacket is cooled here by the air sucked through the radiator by the cooling fan, as well as by the wind generated by the vehicle’s travel. Models with an automatic transmission include an automatic transmissions fluid cooler built into the lower tank of the radiator.

RADIATOR CAP

The radiator cap is a pressure type cap which seals the radiator, resulting in pressurization of the radiator as the coolant expands. The pressurization prevents the coolant from boiling even when the coolant temperature exceeds 100°C (212°F). A relief valve (pressurization valve) and a vacuum valve (negative pressure valve) are built into the radiator cap. When the pressure generated inside the cooling system exceeds the limit (coolant temperature: 110 – 120°C, 230 – 248°F, pressure; 0.3 – 1.0 kg/cm², 4.3 – 14.2 psi, 29.4 – 98.1 kPa) the relief valve is opened by the pressure and lets steam escape through the overflow pipe. The vacuum valve opens to allow atmospheric air to enter to alleviate the vacuum which develops in the cooling system after the engine is stopped and the coolant temperature drops. The valve’s opening allows the pressure in the cooling system to return to the reservoir tank.

RESERVOIR TANK

The reservoir tank is used to catch coolant which overflows the cooling system as a result of volumetric expansion when the coolant is heated. When the coolant temperature drops, the coolant in the reservoir tank returns to the radiator, thus keeping the radiator full at all times and avoiding needless coolant loss. To find out if the coolant needs to be replenished, check the reservoir tank level.

WATER PUMP

The water pump is used for forced circulation of coolant through the cooling system. It is mounted on the front of the cylinder block and driven by a drive belt.

THERMOSTAT

The thermostat has a wax type by-pass valve and is mounted in the water outlet housing. The thermostat is a type of automatic valve operated by fluctuations in the coolant temperature. This valve closes when the coolant temperature drops, preventing the circulation of coolant through the radiator and thus permitting the engine to warm up rapidly. The valve opens when the coolant temperature has risen, allowing the circulation of coolant. Wax inside the thermostat expands when heated and contracts when cooled. Heating the wax thus generates pressure which overpowers the force of the spring which keeps the valve closed, thus opening the valve. When the wax cools, its contraction causes the force of the spring to take effect once more, closing the valve. The thermostat in this engine operates at a temperature of 88°C (191°F).
TROUBLESHOOTING

<table>
<thead>
<tr>
<th>Problem</th>
<th>Possible cause</th>
<th>Remedy</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine overheats</td>
<td>Fan belt loose or missing</td>
<td>Adjust or replace belts</td>
<td>CH-3</td>
</tr>
<tr>
<td></td>
<td>Dirt, leaves or insects on radiator or condenser</td>
<td>Clean radiator or condenser</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hoses, water pump, thermostat housing, radiator, heater, core plugs or head</td>
<td>Repair as necessary</td>
<td></td>
</tr>
<tr>
<td></td>
<td>gasket leakage</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Thermostat faulty</td>
<td>Check thermostat</td>
<td>CO-6</td>
</tr>
<tr>
<td></td>
<td>Injection timing retarded</td>
<td>Adjust timing</td>
<td>EM-24</td>
</tr>
<tr>
<td></td>
<td>Fluid coupling faulty</td>
<td>Replace fluid coupling</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>Radiator hose plugged or rotten</td>
<td>Replace hose</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water pump faulty</td>
<td>Replace water pump</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Radiator plugged or cap faulty</td>
<td>Check radiator</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Cylinder head or block cracked or plugged</td>
<td>Repair as necessary</td>
<td></td>
</tr>
</tbody>
</table>

HINT: Removal of the thermostat would have an adverse effect, causing a lowering of cooling efficiency. Do not remove the thermostat, even if the engine tends to overheat.

CHECK AND REPLACEMENT OF ENGINE COOLANT

1. CHECK ENGINE COOLANT LEVEL AT RESERVOIR TANK
   The coolant level should be between the "LOW" and "FULL" lines.
   If low, check for leaks and add coolant up to the "FULL" line.

2. CHECK ENGINE COOLANT QUALITY
   There should not be any excessive deposits of rust or scales around the radiator cap or radiator filler hole, and the coolant should be free from oil.
   If excessively dirty, replace the coolant.

3. REPLACE ENGINE COOLANT
   (a) Remove the radiator cap.
   CAUTION: To avoid the danger of being burned, do not remove it while the engine and radiator are still hot, as fluid and steam can be blown out under pressure.
   (b) Drain the coolant from the radiator and engine drain cocks.
   (c) Close the drain cocks.
   Torque (Engine drain cock): 300 kg-cm (22 ft-lb, 29 N-m)
(d) Fill the system with coolant. Use a good brand of ethylene-glycol or TOYOTA radiator conditioner or equivalent anticorrosive, mixed according to the manufacturer's directions.

Ethylene-glycol type: This type has an antifreeze and anticorrosive effect.

TOYOTA radiator conditioner: This has only an anticorrosive effect.

NOTICE:

- Do not use alcohol type coolant.
- The coolant should be mixed with demineralized water or distilled water.

Capacity (w/o Heater):

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LJ</td>
<td>10.0 liters (10.6 US qts, 8.8 Imp. qts)</td>
<td></td>
</tr>
<tr>
<td>LN</td>
<td>8.2 liters (8.7 US qts, 7.2 Imp. qts)</td>
<td></td>
</tr>
<tr>
<td>3L</td>
<td>8.1 liters (8.6 US qts, 7.1 Imp. qts)</td>
<td></td>
</tr>
</tbody>
</table>

Capacity (w/ Heater):

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LJ</td>
<td>10.9 liters (11.5 US qts, 9.6 Imp. qts)</td>
<td></td>
</tr>
<tr>
<td>LN</td>
<td>9.1 liters (9.6 US qts, 8.8 Imp. qts)</td>
<td></td>
</tr>
<tr>
<td>3L</td>
<td>9.0 liters (9.5 US qts, 7.9 Imp. qts)</td>
<td></td>
</tr>
</tbody>
</table>

Capacity (w/ Front and rear heaters):

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LJ</td>
<td>11.5 liters (12.2 US qts, 10.1 Imp. qts)</td>
<td></td>
</tr>
<tr>
<td>LN</td>
<td>9.4 liters (9.9 US qts, 8.3 Imp. qts)</td>
<td></td>
</tr>
<tr>
<td>3L</td>
<td>9.3 liters (9.8 US qts, 8.2 Imp. qts)</td>
<td></td>
</tr>
</tbody>
</table>

(e) Reinstall the radiator cap.

(f) Warm up the engine and check for leaks.

(g) Recheck the coolant level and refill as necessary.
THERMOSTAT (2L-T)

REMOVAL OF THERMOSTAT

1. DRAIN ENGINE COOLANT (See page CO-4)

2. REMOVE WATER OUTLET
   Remove the three bolts and water outlet from the water outlet housing.

3. REMOVE THERMOSTAT

INSPECTION OF THERMOSTAT

INSPECT THERMOSTAT

HINT: The thermostat is numbered with the valve opening temperature.

(a) Immerse the thermostat in water and gradually heat the water.
(b) Check the valve opening temperature.
Valve opening temperature: 86 – 90°C (187 – 194°F)
   If the valve opening temperature is not as specified, replace the thermostat.

(c) Check the valve lift.
   Valve lift: 8 mm (0.31 in.) or more at 100°C (212°F)
   If the valve lift is not as specified, replace the thermostat.
(d) Check that the valve spring is tight when the thermostat is fully closed.
   If necessary, replace the thermostat.
INSTALLATION OF THERMOSTAT

1. PLACE THERMOSTAT IN WATER OUTLET HOUSING
   (a) Install a new gasket to the thermostat.
   (b) Install the thermostat with the jiggle valve upward.

2. INSTALL WATER OUTLET TO WATER OUTLET HOUSING
   Install the water outlet with the three bolts.
   Torque: 195 kg-cm (14 ft-lb, 19 N-m)

3. FILL WITH ENGINE COOLANT (See page CO-5)

4. START ENGINE AND CHECK FOR LEAKS
LUBRICATION SYSTEM

REFER TO 2L, 3L ENGINE REPAIR MANUAL
(Pub. No. RM123E)

NOTE: The following pages contain only the points which differ from the above listed manual.

<table>
<thead>
<tr>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>DESCRIPTION</td>
<td>LU-2</td>
</tr>
<tr>
<td>OIL PRESSURE CHECK</td>
<td>LU-4</td>
</tr>
<tr>
<td>REPLACEMENT OF ENGINE OIL AND</td>
<td>LU-5</td>
</tr>
<tr>
<td>OIL FILTER</td>
<td></td>
</tr>
<tr>
<td>OIL COOLER AND RELIEF VALVES (2L-T)</td>
<td>LU-7</td>
</tr>
</tbody>
</table>
DESCRIPTION

A fully pressurized, fully filtered lubrication system has been adopted for this engine.
A pressure feeding lubrication system has been adopted to supply oil to the moving parts of this engine. The lubrication system consists of an oil pan, oil pump, oil filter and other external parts which supply oil to the moving parts in the engine block. The oil circuit is shown in the illustration at the top of the previous page. Oil from the oil pan is pumped up by the oil pump. After it passes through the oil filter, it is fed through the various oil holes in the crankshaft and cylinder block. After passing through the cylinder block and performing its lubricating function, the oil is returned by gravity to the oil pan. A dipstick on the center left side of the cylinder block is provided to check the oil level.

OIL PUMP

The oil pump pumps up oil from the oil pan and sends it under pressure to the various parts of the engine. An oil strainer is mounted in front of the inlet to the oil pump to remove impurities. The oil pump itself is a trochoid type pump, which uses a drive rotor and driven rotor inside the pump body. When the drive rotor rotates, the driven rotor rotates in the same direction. The axis of the drive rotor shaft is different from the center of the driven rotor, so when both rotors rotate, the space between the two rotors changes. Oil is drawn in when the space widens and is discharged when the space becomes narrow.

OIL PRESSURE REGULATOR (RELIEF VALVE)

At high engine speeds, the oil pump supplies more oil to each part that is necessary. For this reason, an oil pressure regulator which works to prevent oversupply of oil is installed on the oil pump. During normal oil supply, a coil spring and valve keep the by-pass closed, but when too much oil is being supplied, the pressure becomes extremely high, overpowering the force of the spring and opening the valves. This allows the excess oil to flow through the valve and return to the inlet of the oil pump.

OIL FILTER

There are two types of oil filter, a full flow type and a by-pass element type. A full flow type has a relief valve built into the paper filter element. Particles of metal from wear, airborne dirt, carbon and other impurities can get in the oil during use and could cause accelerated wear or seizing if allowed to circulate through the engine. The oil filter, integrated into the oil line, removes these impurities as the oil passes through it. The filter is mounted outside the engine to simplify replacement of the filter element. A relief valve is also included ahead of the filter element to relieve the high oil pressure in case the filter element becomes clogged with impurities. The relief valve opens when the oil pressure overpowers the force of the spring. Oil passing through the relief valve bypasses the oil filter and flows directly into the main oil hole in the engine.
OIL PRESSURE CHECK

1. CHECK ENGINE OIL QUALITY
   Check the oil for deterioration, entry of water, discoloring or thinning.
   If the quality is poor, replace the oil.
   (2L-T)
   • Use API grade CD or better and recommended viscosity oil.
   (3L)
   • Use API grade CC, CD or better and recommended viscosity oil.

2. CHECK ENGINE OIL LEVEL
   The oil level should be between the “L” and “F” marks on the dipstick.
   If low, check for leakage and add oil up to “F” mark.
   NOTICE: Do not fill with engine oil above the “F” mark.

3. REMOVE OIL PRESSURE SWITCH OR SENDER GAUGE
   HINT (w/ Sender gauge): Use SST.
   SST 09027-12140

4. INSTALL OIL PRESSURE GAUGE

5. WARM UP ENGINE
   Allow the engine to reach normal operating temperature.

6. CHECK OIL PRESSURE
   Oil pressure:
   At idling 0.3 kg/cm² (4.3 psi, 29 kPa)
   or more
   At 3,000 rpm 3.0 – 5.5 kg/cm²
   (43 – 78 psi, 294 – 539 kPa)

7. REMOVE OIL PRESSURE GAUGE

8. REINSTALL OIL PRESSURE SWITCH OR SENDER GAUGE
   Apply adhesive to two or three threads.
   Adhesive: Part No. 08833-00080, THREE BOND 1344, LOCTITE 242 or equivalent

9. START ENGINE AND CHECK FOR LEAKS
REPLACEMENT OF ENGINE OIL AND OIL FILTER

CAUTION:

- Prolonged and repeated contact with mineral oil will result in the removal of natural fats from the skin, leading to dryness, irritation and dermatitis. In addition, used engine oil contains potentially harmful contaminants which may cause skin cancer. Adequate means of skin protection and washing facilities should be provided.

- Care should be taken, therefore, when changing engine oil, to minimize the frequency and length of time your skin is exposed to used engine oil. Protective clothing and gloves, that cannot be penetrated by oil, should be worn. The skin should be thoroughly washed with soap and water, or use waterless hand cleaner, to remove any used engine oil. Do not use gasoline, thinners, or solvents.

- In order to preserve the environment, used oil and used oil filters must be disposed of only at designated disposal sites.

1. DRAIN ENGINE OIL
   
   (a) Remove the oil filler cap.
   
   (b) Remove the oil drain plug, and drain the oil into a container.

2. REPLACE OIL FILTER
   
   (a) Using SST, remove the oil filter.
   
   SST 09228-10001 (w/ By-pass element type)
   09228-40011 (Full flow type)

   (b) Clean and check the oil filter installation surface.
(c) Apply clean engine oil to the gasket of a new oil filter.

(d) Lightly screw the oil filter into place, and tighten it until the gasket contacts the seat.
(e) Using SST, tighten it additional 3/4 turn.
SST 09228-10001 (w/ By-pass element type)
09228-44011 (Full flow type)

3. FILL WITH ENGINE OIL
(a) Clean and install the oil drain plug with a new gasket.
   Torque: 400 kg-cm (29 ft-lb, 39 N-m)
(b) Fill with new engine oil (API grade CC (3L only), CD or better and recommended viscosity oil).
   Capacity:

<table>
<thead>
<tr>
<th>Item</th>
<th>w/ Oil filter change</th>
<th>w/o Oil filter change</th>
<th>Dri fill</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>liters (US qts, Imp. qts)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LJ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2L-T</td>
<td>6.7 (7.1, 5.9)</td>
<td>5.7 (6.0, 5.0)</td>
<td>7.4 (7.8, 6.5)</td>
</tr>
<tr>
<td>3L</td>
<td>6.7 (7.1, 5.9)</td>
<td>5.7 (6.0, 5.0)</td>
<td>7.4 (7.8, 6.5)</td>
</tr>
<tr>
<td>LN</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2L-T</td>
<td>6.8 (7.2, 6.0)</td>
<td>5.8 (6.1, 5.1)</td>
<td>7.5 (7.9, 6.6)</td>
</tr>
<tr>
<td>3L</td>
<td>5.8 (6.1, 5.1)</td>
<td>4.8 (5.1, 4.2)</td>
<td>6.5 (6.9, 5.7)</td>
</tr>
</tbody>
</table>

(c) Reinstall the oil filler cap.

4. START ENGINE AND CHECK FOR LEAKS

5. RECHECK ENGINE OIL LEVEL (See page LU-4)
OIL COOLER AND RELIEF VALVES
(2L-T)

COMPONENTS

* This valve is used as a dummy plug to prevent oil from flowing to main oil hole.

REMOVAL OF OIL COOLER AND RELIEF VALVES

1. DRAIN ENGINE COOLANT (See page CO-4)

2. REMOVE TURBOCHARGER
   (See steps 2 to 7 on pages TC-10 and 11)

3. (Austria)
   REMOVE EGR VALVE, PIPE, VALVE ADAPTOR AND
   CONTROL VALVE ASSEMBLY
   (See step 11 on page EM-37)

4. REMOVE EXHAUST MANIFOLD
   (See step 13 on page EM-38)

5. REMOVE ALTERNATOR

6. (LJ)
   REMOVE UNION BOLT

7. REMOVE OIL FILTER (See page LU-5)
8. **REMOVE UNION**
Using SST, remove the union.
SST 09326-20011

9. **REMOVE RELIEF VALVES**
Remove the plug, gasket, spring and relief valve. Remove the two relief valves.

**HINT:** Arrange the spring and relief valves in correct order.

10. **REMOVE OIL COOLER AND OIL FILTER BRACKET ASSEMBLY**
Remove the nine bolts (LN) or ten bolts (LJ), two nuts, the oil cooler, filter bracket assembly and gasket.

11. **SEPARATE OIL COOLER AND OIL FILTER BRACKET**
Remove the four nuts, the oil cooler and two gaskets from the filter bracket.
INSPECTION OF OIL COOLER AND RELIEF VALVES

1. INSPECT RELIEF VALVE
   Coat the valve with engine oil and check that it falls smoothly into the oil filter bracket by its own weight.
   If not, replace the relief valve. If necessary, replace the oil filter bracket.

2. INSPECT OIL COOLER
   Check the oil cooler for damage or clogging.
   If necessary, replace the oil cooler.

INSTALLATION OF OIL COOLER AND RELIEF VALVES
(See page LU-7)

1. ASSEMBLE OIL COOLER AND OIL FILTER BRACKET
   Install new gaskets and the oil cooler to the filter bracket with the four nuts.
   Torque: 145 kg-cm (10 ft-lb, 14 N-m)

2. INSTALL OIL COOLER AND OIL FILTER BRACKET ASSEMBLY
   Install a new gasket, the oil cooler and filter bracket assembly with the nine bolts (LN) or ten bolts (LJ) and two nuts.
   Torque: Bolt 195 kg-cm (14 ft-lb, 19 N.m)  
             Nut 210 kg-cm (15 ft-lb, 21 N.m)
   HINT: The bolt lengths for bolt types B and C shown in the illustration are:
   B 35 mm (1.38 in.)
   C 25 mm (0.98 in.)
3. INSTALL RELIEF VALVES
   Install the relief valve, spring and a new gasket with the plug. Install the two relief valves.
   Torque: 370 kg·cm (27 ft·lb, 36 N·m)

4. INSTALL UNION
   (a) Apply adhesive to two or three threads (oil cooler side of the union).
   Adhesive: Part No. 08833-00070, THREE BOND 1324 or equivalent
   
   (b) Using SST, install and torque the union.
   SST 09326-20011
   Torque: 430 kg·cm (31 ft·lb, 42 N·m)
   HINT: Use a torque wrench with a fulcrum length of 300 mm (11.81 in.).

5. INSTALL OIL FILTER (See page LU-5)

6. (LJ) INSTALL UNION BOLT
   (a) Apply adhesive to two or three threads of the union bolt.
   Adhesive: Part No. 08833-00070, THREE BOND 1324 or equivalent
   
   (b) Install and torque the union bolt.
   Torque: 200 kg·cm (14 ft·lb, 20 N·m)
7. INSTALL ALTERNATOR
  Torque:
  12 mm head bolt  130 kg-cm (9 ft-lb, 12 N-m)
  14 mm head bolt  510 kg-cm (37 ft-lb, 50 N-m)

8. INSPECT DRIVE BELTS
   (See step 3 on page CH-3)

9. INSTALL EXHAUST MANIFOLD
   (See step 6 on page EM-43)

10. (Austria)
    INSTALL EGR VALVE, PIPE, VALVE ADAPTOR AND
        CONTROL VALVE ASSEMBLY
    (See step 8 on page EM-44)

11. INSTALL TURBOCHARGER
    (See steps 3 to 8 on pages TC-13 and 14)

12. FILL WITH ENGINE COOLANT (See page CO-5)

13. START ENGINE AND CHECK FOR LEAKS

14. CHECK ENGINE OIL LEVEL (See page LU-4)
STARTING SYSTEM

REFER TO 2L, 3L ENGINE REPAIR MANUAL
(Pub. No. RM123E)

NOTE: The following pages contain only the points which differ from the above listed manual

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<td>STARTER RELAY (LJ)</td>
<td>ST-9</td>
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</tbody>
</table>
PRE-HEATING SYSTEM
Super Glow Type [2L-T]
SYSTEM CIRCUIT

LJ (Austria)

LJ (Others)
INSTRUCTION OF PRE-HEATING SYSTEM

HINT: Refer to Diesel Electrical System Diagnosis for inspection procedures. (See page EM-13)

INSPECT LIGHTING TIME OF GLOW INDICATOR LIGHT

Turn the starter switch ON, measure the light lighting time.

Light lighting time: Refer to chart
INSPECTION OF COMPONENTS

Pre-Heating Timer

LOCATION: In the cowl on the passenger side.

INSPECT PRE-HEATING TIMER CIRCUIT

Disconnect the connector from the pre-heating timer, and check the connector on the wire harness side as shown in the following chart.

<table>
<thead>
<tr>
<th>Check for</th>
<th>Tester connection</th>
<th>Condition</th>
<th>Specified value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LJ</td>
<td>LN</td>
<td></td>
</tr>
<tr>
<td>Continuity</td>
<td>B12</td>
<td>A1</td>
<td>Ground</td>
</tr>
<tr>
<td>Voltage</td>
<td>A2</td>
<td>A7</td>
<td>Ground</td>
</tr>
<tr>
<td>Voltage</td>
<td>B14</td>
<td>B12</td>
<td>Ground</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Turn starter switch ON</td>
</tr>
<tr>
<td>Voltage</td>
<td>A6</td>
<td>A3</td>
<td>Ground</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Turn starter switch ON</td>
</tr>
<tr>
<td>Continuity</td>
<td>B23</td>
<td>A5</td>
<td>Ground</td>
</tr>
<tr>
<td>Continuity</td>
<td>B15</td>
<td>B11</td>
<td>Ground</td>
</tr>
<tr>
<td>Continuity</td>
<td>B22</td>
<td>B14</td>
<td>Ground</td>
</tr>
<tr>
<td>Continuity</td>
<td>B24</td>
<td></td>
<td>Ground</td>
</tr>
<tr>
<td>Continuity</td>
<td>B3</td>
<td>B3</td>
<td>-B16(LJ), -B9(LN)</td>
</tr>
<tr>
<td>Continuity</td>
<td>B16</td>
<td>B9</td>
<td>Ground</td>
</tr>
<tr>
<td>Voltage</td>
<td>A4</td>
<td>A6</td>
<td>Ground</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ground</td>
</tr>
</tbody>
</table>
No. 1 Glow Plug Relay (LJ)

LOCATION: In the engine compartment on the left side.

1. INSPECT RELAY CONTINUITY
   (a) Using an ohmmeter, check that there is continuity between terminals E and g.
   (b) Check that there is no continuity between terminals B and G.
   If continuity is not as specified, replace the relay.

2. INSPECT RELAY OPERATION
   (a) Apply battery voltage across terminals E and g.
   (b) Using an ohmmeter, check that there is continuity between terminals B and G.
   If operation is not as specified, replace the relay.

No. 2 Glow Plug Relay (LJ)

LOCATION: In the engine compartment on the left side.

1. INSPECT RELAY CONTINUITY
   (a) Using an ohmmeter, check that there is continuity between terminals e and g.
   (b) Check that there is no continuity between terminals B and G.
   If continuity is not as specified, replace the relay.
2. **INSPECT RELAY OPERATION**
   
   (a) Apply battery voltage across terminals e and g.

   (b) Using an ohmmeter, check that there is continuity between terminals B and G.

   If operation is not as specified, replace the relay.

---

**Glow Plug**

**INSPECT GLOW PLUG**

Using an ohmmeter, check that there is continuity between the glow plug terminal and ground.

If there is no continuity, replace the glow plug.

---

**HINT:**

- Be careful not to damage the glow plug pipes as it could cause an open circuit or shorten life of the plugs.

- Avoid getting oil and gasoline on the glow plug when cleaning.

- During inspection, be sure to wipe any oil off the glow plug terminal and bakelite washer with a dry cloth.

- Be careful to apply more than 11 volts to the glow plug as it could cause an open circuit.

---

**Glow Plug Resistor**

**INSPECT GLOW PLUG RESISTOR**

Using an ohmmeter, check that there is continuity between the resistor terminals.

If there is no continuity, replace the resistor.
Water Temperature Sensor

INSPECT TEMPERATURE SENSOR

Using an ohmmeter, measure the resistance between the sensor terminals.

Resistance: Refer to chart

If the resistance is not as specified, replace the sensor.

WATER TEMP. SENSOR

Thermistor
Fixed Delay Type [3L]
SYSTEM CIRCUIT

INSPECTION OF PRE-HEATING SYSTEM

INSPECT LIGHTING TIME OF GLOW INDICATOR LIGHT

Turn the starter switch GLOW, measure the light lighting time.

Light lighting time: Approx. 6 seconds
STARTER RELAY (LJ)

LOCATION: In the engine compartment on the left side.

INSPECTION OF STARTER RELAY

1. INSPECT RELAY CONTINUITY
   (a) Using an ohmmeter, check that there is continuity between terminals E and ST.
   (b) Check that there is no continuity between terminals B and Mg.
       If continuity is not as specified, replace the relay.

2. INSPECT RELAY OPERATION
   (a) Apply battery voltage across terminals E and ST.
   (b) Using an ohmmeter, check that there is continuity between terminals B and Mg.
       If operation is not as specified, replace the relay.
CHARGING SYSTEM

REFER TO 2L, 3L ENGINE REPAIR MANUAL
(Pub. No. RM123E)

NOTE: The following pages contain only the points which differ from the above listed manual.

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<td>ON-VEHICLE INSPECTION</td>
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</tbody>
</table>
CHARGING SYSTEM CIRCUIT

LJ (w/ Hi-Speed Compact Type Alternator (w/ IC Regulator))

LN (w/ Conventional Type Alternator (w/o IC Regulator))

55A Type
ON-VEHICLE INSPECTION

1. INSPECT BATTERY SPECIFIC GRAVITY AND ELECTROLYTE LEVEL
   (a) Check the specific gravity of each cell.
   
   Standard specific gravity:
   When fully charged at 20°C (68°F)
   1.27 – 1.29 (80D26R)
   1.25 – 1.27 (Others)
   
   If not as specified, charge the battery.
   (b) Check the electrolyte quantity of each cell.
   If insufficient, refill with distilled (or purified) water.

2. CHECK BATTERY TERMINALS, FUSIBLE LINKS AND FUSES
   (a) Check that the battery terminals are not loose or corroded.
   (b) Check the fusible links and fuses for continuity.

3. INSPECT DRIVE BELTS
   (a) Visually check each belt for cracks, oiliness or wear.
   Check that the belt does not touch the bottom of the pulley groove.

   If one belt has any of the above defects, replace both belts.

   (b) Check the drive belt deflection by pressing on the belt at the points indicated in the illustration with 10 kg (22.0 lb, 98 N) of pressure.

   Drive belt deflection:
   New belt  7 – 10 mm (0.28 – 0.39 in.)
   Used belt  10 – 15 mm (0.39 – 0.59 in.)

   If the deflection is not as specified, adjust it.

HINT:
- “New belt” refers to a belt which has been used for 5 minutes or less on a running engine.
- “Used belt” refers to a belt which has been used for 5 minutes or more on a running engine.
- After installing a new belt, run the engine for about 5 minutes and recheck the deflection.
(c) (Reference)
Using SST, measure the drive belt tension.

SST 09216-00020 and 09216-00030

Drive belt tension: New belt 40 – 60 kg
Used belt 20 – 35 kg

If the belt tension is not as specified, adjust it.

4. VISUALLY CHECK ALTERNATOR WIRING AND LISTEN FOR ABNORMAL NOISES

(a) Check that the wiring is in good condition.
(b) Check that there is no abnormal noise from the alternator while the engine is running.

5. INSPECT DISCHARGE WARNING LIGHT CIRCUIT

(a) Warm up the engine and then turn it off.
(b) Turn off all accessories.
(c) Turn the starter switch to "ON". Check that the discharge warning light is lit.
(d) Start the engine. Check that the light goes out.

If the light does not operate as specified, troubleshoot the discharge light circuit.

6. INSPECT CHARGING CIRCUIT WITHOUT LOAD

HINT: If a battery/alternator tester is available, connect the tester to the charging circuit as per manufacturer’s instructions.

(a) If a tester is not available, connect a voltmeter and ammeter to the charging circuit as follows:
• Disconnect the wire from terminal B of the alternator and connect it to the negative (−) lead of the ammeter.
• Connect the positive (+) lead of the ammeter to terminal B of the alternator.
• Connect the positive (+) lead of the voltmeter to terminal B of the alternator.
• Ground the negative (−) lead of the voltmeter.
(b) Check the charging circuit as follows:
With the engine running from idling to 2,000 rpm, check the reading on the ammeter and voltmeter.

**w/o IC Regulator**

Standard amperage: 10 A or less
Standard voltage: 13.8 – 14.4 V at 25°C (77°F)

If the reading is not as standard voltage, adjust the regulator. If necessary, replace regulator.

**w/ IC Regulator**

Standard amperage: 10 A or less
Standard voltage: 13.9 – 15.1 V at 25°C (77°F)
13.5 – 14.3 V at 115°C (239°F)

If the voltmeter reading is greater than standard voltage, replace the IC regulator.

If the voltmeter reading is less than standard voltage, check the IC regulator and alternator as follows:

- With terminal F grounded, start the engine and check the voltmeter reading of terminal B.
- If the voltmeter reading is greater than standard voltage, replace the IC regulator.
- If the voltmeter reading is less than standard voltage, check the alternator.
7. INSPECT CHARGING CIRCUIT WITH LOAD
   (a) With the engine running at 2,000 rpm, turn on the high beam headlights and place the heater blower switch at "HI".
   (b) Check the reading on the ammeter.

   **Standard amperage:** 30 A or more

   If the ammeter reading is less than standard amperage, repair the alternator.

   **HINT:** With the battery fully charged, the indication will sometimes be less than standard amperage.
SERVICE SPECIFICATIONS

REFER TO 2L, 3L ENGINE REPAIR MANUAL
(Pub. No. RM123E)

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<td>FUEL SYSTEM</td>
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## ENGINE MECHANICAL

### Specifications

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<th>LN 3L</th>
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<th>Coolant capacity (w/ Heater)</th>
<th>Coolant capacity (w/ Front and rear heaters)</th>
<th>Engine oil capacity (LJ 2L-T)</th>
<th>Engine oil capacity (LJ 3L)</th>
<th>Engine oil capacity (LN 2L-T)</th>
<th>Engine oil capacity (LN 3L)</th>
<th>Engine oil API grade 2L-T</th>
<th>Engine oil API grade 3L</th>
<th>Alternator drive belt</th>
<th>Battery specific gravity</th>
<th>Injection nozzle opening pressure</th>
<th>Valve clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>10.0 liters</td>
<td>10.6 US qts</td>
<td>8.8 Imp. qts</td>
<td>10.9 liters</td>
<td>11.5 US qts</td>
<td>9.6 Imp. qts</td>
<td>9.1 liters</td>
<td>9.6 US qts</td>
<td>8.8 Imp. qts</td>
<td>9.0 liters</td>
<td>9.5 US qts</td>
<td>7.9 Imp. qts</td>
<td>New nozzle</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.2 liters</td>
<td>8.7 US qts</td>
<td>7.2 Imp. qts</td>
<td>8.1 liters</td>
<td>8.6 US qts</td>
<td>7.1 Imp. qts</td>
<td>9.1 liters</td>
<td>9.6 US qts</td>
<td>8.8 Imp. qts</td>
<td>9.0 liters</td>
<td>9.5 US qts</td>
<td>7.9 Imp. qts</td>
<td>Reused nozzle</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.1 liters</td>
<td>8.6 US qts</td>
<td>7.1 Imp. qts</td>
<td>10.9 liters</td>
<td>11.5 US qts</td>
<td>9.6 Imp. qts</td>
<td>9.1 liters</td>
<td>9.6 US qts</td>
<td>8.8 Imp. qts</td>
<td>9.0 liters</td>
<td>9.5 US qts</td>
<td>7.9 Imp. qts</td>
<td></td>
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<th>Engine tune-up</th>
<th>New valve adjusting shim thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Cont’d)</td>
<td>2.50 mm 0.0984 in.</td>
</tr>
<tr>
<td></td>
<td>2.55 mm 0.1004 in.</td>
</tr>
<tr>
<td></td>
<td>2.60 mm 0.1024 in.</td>
</tr>
<tr>
<td></td>
<td>2.65 mm 0.1043 in.</td>
</tr>
<tr>
<td></td>
<td>2.70 mm 0.1063 in.</td>
</tr>
<tr>
<td></td>
<td>2.75 mm 0.1083 in.</td>
</tr>
<tr>
<td></td>
<td>2.80 mm 0.1102 in.</td>
</tr>
<tr>
<td></td>
<td>2.85 mm 0.1122 in.</td>
</tr>
<tr>
<td></td>
<td>2.90 mm 0.1142 in.</td>
</tr>
<tr>
<td></td>
<td>2.95 mm 0.1161 in.</td>
</tr>
<tr>
<td></td>
<td>3.00 mm 0.1181 in.</td>
</tr>
<tr>
<td></td>
<td>3.05 mm 0.1201 in.</td>
</tr>
<tr>
<td></td>
<td>3.10 mm 0.1220 in.</td>
</tr>
<tr>
<td></td>
<td>3.15 mm 0.1240 in.</td>
</tr>
<tr>
<td></td>
<td>3.20 mm 0.1260 in.</td>
</tr>
<tr>
<td></td>
<td>3.25 mm 0.1280 in.</td>
</tr>
<tr>
<td></td>
<td>3.30 mm 0.1299 in.</td>
</tr>
</tbody>
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New valve adjusting shim thickness (cont’d)

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<thead>
<tr>
<th>Injection timing</th>
<th>Plunger stroke</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2L-T Austria</td>
</tr>
<tr>
<td></td>
<td>Others</td>
</tr>
<tr>
<td></td>
<td>3L</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Idle speed</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td></td>
</tr>
<tr>
<td>3L</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum speed</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td></td>
</tr>
<tr>
<td>3L Hong Kong, Singapore, Malaysia</td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td></td>
</tr>
</tbody>
</table>

A/C idle-up setting speed

<table>
<thead>
<tr>
<th>Injection order</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>750 rpm</td>
<td></td>
</tr>
<tr>
<td>700 rpm</td>
<td></td>
</tr>
<tr>
<td>4,800 rpm</td>
<td></td>
</tr>
<tr>
<td>4,400 rpm</td>
<td></td>
</tr>
<tr>
<td>4,600 rpm</td>
<td></td>
</tr>
<tr>
<td>950 rpm</td>
<td></td>
</tr>
</tbody>
</table>

1 – 3 – 4 – 2 (A – B – C – D)

<table>
<thead>
<tr>
<th>Compression pressure</th>
<th>Engine revolution at 250 rpm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2L-T STD 32.0 kg/cm² (455 psi, 3,138 kPa) or more</td>
</tr>
<tr>
<td></td>
<td>3L STD 31.0 kg/cm² (441 psi, 3,040 kPa) or more</td>
</tr>
<tr>
<td></td>
<td>2L-T, 3L Limit 20.0 kg/cm² (284 psi, 1,961 kPa) or more</td>
</tr>
<tr>
<td>Difference of pressure between each cylinder</td>
<td>5.0 kg/cm² (71 psi, 490 kPa) or less</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cylinder head</th>
<th>New cylinder head gasket thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mark “B” 1.40 – 1.50 mm 0.0551 – 0.0591 in.</td>
</tr>
<tr>
<td></td>
<td>Mark “D” 1.50 – 1.60 mm 0.0591 – 0.0630 in.</td>
</tr>
<tr>
<td></td>
<td>Mark “F” 1.60 – 1.70 mm 0.0630 – 0.0669 in.</td>
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<table>
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<th>Camshaft</th>
<th>Cam lobe height</th>
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<td>2L-T STD Limit</td>
<td>Intake 53.450 – 53.470 mm 2.1043 – 2.1051 in.</td>
</tr>
<tr>
<td></td>
<td>Exhaust 54.990 – 55.010 mm 2.1650 – 2.1657 in.</td>
</tr>
<tr>
<td>3L STD Limit</td>
<td>Intake 54.290 – 54.310 mm 2.1374 – 2.1382 in.</td>
</tr>
<tr>
<td></td>
<td>Exhaust 54.990 – 55.010 mm 2.1650 – 2.1657 in.</td>
</tr>
<tr>
<td></td>
<td>Intake 53.79 mm 2.1177 in.</td>
</tr>
<tr>
<td></td>
<td>Exhaust 54.49 mm 2.1453 in.</td>
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<tbody>
<tr>
<td></td>
<td>Limit</td>
<td>STD</td>
<td></td>
<td></td>
<td>92.23 mm</td>
<td>3.6311 in.</td>
<td>O/S 0.50</td>
<td>92.73 mm</td>
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Torque Specifications

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<tr>
<th>Part tightened</th>
<th>kg-cm</th>
<th>ft-lb</th>
<th>N-m</th>
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<tr>
<td>Camshaft bearing cap x Cylinder head</td>
<td>255</td>
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<td>Camshaft oil seal retainer x Cylinder head</td>
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<td>18</td>
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<td>Cylinder head x Cylinder block 1st</td>
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<td>Cylinder head x Cylinder block 2nd</td>
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<tr>
<td>Cylinder head x Cylinder block 3rd</td>
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<td>Cylinder head cover x Cylinder head</td>
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<td>43 in.-lb</td>
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<td>RH engine hanger x Cylinder head</td>
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<tr>
<td>Exhaust manifold x Cylinder head</td>
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<tr>
<td>Heat insulator x Exhaust manifold</td>
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<td>Intake manifold x Cylinder head</td>
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<td>EGR pipe x Intake manifold (Austria)</td>
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<td>EGR valve adaptor x EGR valve (Austria)</td>
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<td>LH engine hanger x Cylinder head</td>
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<td>Water outlet housing x Cylinder head</td>
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<td>No. 2 timing belt cover x Cylinder head</td>
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**TURBOCHARGER SYSTEM**

**Specifications**

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<tr>
<th>Turbocharger</th>
<th>Turbocharging pressure</th>
<th>0.61 – 0.81 kg/cm²</th>
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<tr>
<td></td>
<td></td>
<td>(8.7 – 11.5 psi, 60 – 79 kPa)</td>
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<td></td>
<td>Impeller wheel axial play</td>
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<td></td>
<td>Impeller wheel radial play</td>
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**Torque Specifications**

<table>
<thead>
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<th>Part tightened</th>
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<th>ft-lb</th>
<th>N-m</th>
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<td>Turbo water pipe x Turbocharger</td>
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<td>Turbocharger x Exhaust manifold</td>
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<td>Turbo oil pipe x Turbocharger</td>
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<td>Turbo oil pipe x Cylinder block</td>
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<tr>
<td>Exhaust manifold stay x Cylinder block</td>
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<tr>
<td>Exhaust manifold stay x Turbocharger</td>
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<td>Turbocharger heat insulator x Turbocharger</td>
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<td>Intake pipe x Intake manifold</td>
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## FUEL SYSTEM

### Specifications

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<th>Fuel heater</th>
<th>Resistance at 20°C (68°F)</th>
<th>Approx. 0.7 Ω</th>
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<td>Others</td>
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<td>Direction of rotation</td>
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<td>Injection order</td>
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<td>PIJ opening pressure (2L-T Austria only)</td>
<td>123 – 127 kg/cm²</td>
<td>(1,749 – 1,806 psi, 12,054 – 12,446 kPa)</td>
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<td>1.625 mm 0.0640 in.</td>
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</tr>
<tr>
<td></td>
<td>1.650 mm 0.0650 in.</td>
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</tr>
<tr>
<td></td>
<td>1.675 mm 0.0659 in.</td>
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</tr>
<tr>
<td></td>
<td>1.700 mm 0.0669 in.</td>
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</tr>
<tr>
<td></td>
<td>1.725 mm 0.0679 in.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.750 mm 0.0689 in.</td>
<td></td>
</tr>
</tbody>
</table>
### Specifications (Cont’d)

<table>
<thead>
<tr>
<th>Injection pump (cont’d)</th>
<th>PIJ adjusting shim thickness (2L-T Austria only) (cont’d)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.775 mm                            0.0699 in.</td>
</tr>
<tr>
<td></td>
<td>1.800 mm                            0.0709 in.</td>
</tr>
<tr>
<td></td>
<td>1.825 mm                            0.0719 in.</td>
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<tr>
<td></td>
<td>1.850 mm                            0.0728 in.</td>
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<tr>
<td></td>
<td>1.875 mm                            0.0738 in.</td>
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<tr>
<td></td>
<td>1.900 mm                            0.0748 in.</td>
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<td></td>
<td>1.925 mm                            0.0758 in.</td>
</tr>
<tr>
<td></td>
<td>1.950 mm                            0.0768 in.</td>
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<tr>
<td></td>
<td>1.975 mm                            0.0778 in.</td>
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<tr>
<td></td>
<td>2.000 mm                            0.0787 in.</td>
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<tr>
<td></td>
<td>2.050 mm                            0.0807 in.</td>
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<tr>
<td></td>
<td>2.100 mm                            0.0827 in.</td>
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<td></td>
<td>2.150 mm                            0.0846 in.</td>
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<td></td>
<td>2.200 mm                            0.0866 in.</td>
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<tr>
<td></td>
<td>2.250 mm                            0.0886 in.</td>
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<tr>
<td></td>
<td>2.300 mm                            0.0906 in.</td>
</tr>
<tr>
<td></td>
<td>2.350 mm                            0.0925 in.</td>
</tr>
<tr>
<td></td>
<td>2.400 mm                            0.0945 in.</td>
</tr>
<tr>
<td></td>
<td>2.450 mm                            0.0965 in.</td>
</tr>
<tr>
<td></td>
<td>2.500 mm                            0.0984 in.</td>
</tr>
</tbody>
</table>

**Spring free length**

- **Delivery valve spring**
  - 24.4 mm 0.961 in.
- **Plunger spring**
  - 30.0 mm 1.181 in.
- **Coupling spring**
  - 16.0 mm 0.630 in.
- **Pneumatic bellows spring (w/ HAC only)**
  - 35.0 mm 1.378 in.
- **Boost compensator spring (2L-T only)**
  - **Austria**
    - 22.3 mm 0.878 in.
  - **Sub Main**
    - 24.1 mm 0.949 in.
  - **Others**
    - 19.4 mm 0.764 in.
  - **PIJ piston lift gap (2L-T Austria only)**
    - 0.175 – 0.475 mm 0.00689 – 0.01870 in.
    - 0.60 – 0.80 mm 0.0236 – 0.0315 in.
- **Plunger stroke (2L-T Austria only)**
  - 1.1 mm 0.039 in.
  - 1.3 mm 0.051 in.
  - 1.5 mm 0.059 in.
  - 1.7 mm 0.067 in.
  - 1.9 mm 0.075 in.
  - 2.1 mm 0.083 in.
  - 2.3 mm 0.090 in.
  - 2.5 mm 0.098 in.
  - 2.7 mm 0.106 in.
  - 2.9 mm 0.114 in.
  - 3.1 mm 0.122 in.
  - 3.3 mm 0.130 in.
- **Boost compensator adjusting shim A thickness (2L-T only)**
  - 12.90 mm 0.508 in.
  - 13.15 mm 0.518 in.
  - 13.40 mm 0.528 in.
- **Boost compensator adjusting shim B thickness (2L-T Austria only)**
  - 1.2 kg/cm² 1.04 lb/in.
  - 1.4 kg/cm² 1.22 lb/in.

**Boost compensator sub spring constant (2L-T Austria only)**
## Injection Pump Adjustment

<table>
<thead>
<tr>
<th>Preparation of pump tester</th>
<th>Test nozzle type</th>
<th>Test nozzle opening pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Injection pipe</td>
<td>Outer diameter</td>
<td>6.0 mm 0.236 in.</td>
</tr>
<tr>
<td></td>
<td>Inner diameter</td>
<td>2.0 mm 0.079 in.</td>
</tr>
<tr>
<td></td>
<td>Length</td>
<td>840 mm 33.07 in.</td>
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<tr>
<td></td>
<td>Minimum bending radius</td>
<td>25 mm (0.98 in.) or more</td>
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<tr>
<td></td>
<td>Fuel temperature</td>
<td>40 – 45°C</td>
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<tr>
<td></td>
<td>Fuel feeding pressure</td>
<td>0.2 kg/cm² (2.8 psi, 20 kPa)</td>
</tr>
<tr>
<td></td>
<td>Fuel cut solenoid voltage</td>
<td>6 V</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Full load injection volume pre-setting</th>
<th>Item</th>
<th>Adjusting lever position</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td>Austria</td>
<td>Maximum speed side</td>
<td>1,400</td>
<td>200</td>
<td>14.04 – 14.36 (0.86 – 0.88)</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>Maximum speed side</td>
<td>1,200</td>
<td>200</td>
<td>13.94 – 14.26 (0.85 – 0.87)</td>
</tr>
<tr>
<td>3L</td>
<td>Hong Kong, Singapore, Malaysia</td>
<td>Maximum speed side</td>
<td>1,200</td>
<td>200</td>
<td>10.96 – 11.28 (0.67 – 0.69)</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>Maximum speed side</td>
<td>1,200</td>
<td>200</td>
<td>11.56 – 11.88 (0.71 – 0.72)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum speed pre-setting</th>
<th>Item</th>
<th>Adjusting lever position</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td>Austria</td>
<td>Maximum speed side</td>
<td>2,450</td>
<td>200</td>
<td>4.3 – 6.3 (0.26 – 0.38)</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>Maximum speed side</td>
<td>2,400</td>
<td>200</td>
<td>4.3 – 6.3 (0.26 – 0.38)</td>
</tr>
<tr>
<td>3L</td>
<td>Hong Kong, Singapore, Malaysia</td>
<td>Maximum speed side</td>
<td>2,200</td>
<td>200</td>
<td>4.6 – 6.2 (0.28 – 0.38)</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>Maximum speed side</td>
<td>2,300</td>
<td>200</td>
<td>4.6 – 6.2 (0.28 – 0.38)</td>
</tr>
</tbody>
</table>

### Pump inner pressure

<table>
<thead>
<tr>
<th></th>
<th>Pump rpm</th>
<th>Inner pressure kg/cm² (psi, kPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>500</td>
<td>3.2 – 3.8 (46 – 54, 314 – 373)</td>
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<tr>
<td></td>
<td>2,100</td>
<td>6.6 – 7.2 (94 – 102, 647 – 706)</td>
</tr>
</tbody>
</table>

### Overflow volume

<table>
<thead>
<tr>
<th></th>
<th>Pump rpm</th>
<th>Overflow volume cc/min. (cu in./min.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2,200</td>
<td>370 – 800 (22.6 – 48.8)</td>
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</table>
## Injection Pump Adjustment (Cont’d)

<table>
<thead>
<tr>
<th>Automatic timer</th>
<th>Item</th>
<th>Pump rpm</th>
<th>Piston stroke mm (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2L-T</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Austria</td>
<td>800</td>
<td>1.2 – 2.0 (0.047 – 0.079)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,200</td>
<td>2.5 – 3.3 (0.098 – 0.130)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,000</td>
<td>5.4 – 6.0 (0.213 – 0.236)</td>
</tr>
<tr>
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<td></td>
<td>2,300</td>
<td>5.4 – 6.0 (0.213 – 0.236)</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>800</td>
<td>1.4 – 2.2 (0.055 – 0.087)</td>
</tr>
<tr>
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<td>1,200</td>
<td>3.0 – 3.8 (0.118 – 0.150)</td>
</tr>
<tr>
<td></td>
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<td>1,800</td>
<td>5.5 – 6.3 (0.217 – 0.248)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2,300</td>
<td>6.7 – 7.5 (0.264 – 0.295)</td>
</tr>
<tr>
<td></td>
<td>3L</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>800</td>
<td>0.6 – 1.4 (0.024 – 0.055)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,200</td>
<td>1.8 – 2.6 (0.071 – 0.102)</td>
</tr>
<tr>
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<td>2,000</td>
<td>4.4 – 5.2 (0.173 – 0.205)</td>
</tr>
<tr>
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<td></td>
<td>2,300</td>
<td>4.7 – 5.5 (0.185 – 0.217)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Full load injection volume</th>
<th>Item</th>
<th>Adjusting lever angle position</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2L-T</td>
<td>Plus 23.5–33.5°</td>
<td>1,400</td>
<td>200</td>
<td>14.04 – 14.36 (0.86 – 0.88)</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>Plus 23.5–33.5°</td>
<td>1,200</td>
<td>200</td>
<td>13.94 – 14.26 (0.85 – 0.87)</td>
</tr>
<tr>
<td></td>
<td>Hong Kong, Singapore, Malaysia</td>
<td>Plus 23.5–33.5°</td>
<td>1,200</td>
<td>200</td>
<td>10.96 – 11.28 (0.67 – 0.69)</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>Plus 23.5–33.5°</td>
<td>1,200</td>
<td>200</td>
<td>11.56 – 11.88 (0.71 – 0.72)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum speed</th>
<th>Item</th>
<th>Adjusting lever angle position</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2L-T</td>
<td>Plus 23.5–33.5°</td>
<td>2,450</td>
<td>200</td>
<td>4.3 – 6.3 (0.26 – 0.38)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2,250</td>
<td></td>
<td>8.3 – 10.5 (0.51 – 0.64)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2,750</td>
<td></td>
<td>1.3 (0.8) or less</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>Plus 23.5–33.5°</td>
<td>2,400</td>
<td>200</td>
<td>4.3 – 6.3 (0.26 – 0.38)</td>
</tr>
<tr>
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<td>2,250</td>
<td></td>
<td>7.1 – 9.3 (0.43 – 0.57)</td>
</tr>
<tr>
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<td>2,750</td>
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<td>1.3 (0.8) or less</td>
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<tr>
<td></td>
<td>Hong Kong, Singapore, Malaysia</td>
<td>Plus 23.5–33.5°</td>
<td>2,200</td>
<td>200</td>
<td>4.6 – 6.2 (0.28 – 0.38)</td>
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<tr>
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<td>8.44 – 10.44 (0.52 – 0.64)</td>
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<td></td>
<td>1.3 (0.8) or less</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>Plus 23.5–33.5°</td>
<td>2,300</td>
<td>200</td>
<td>4.6 – 6.2 (0.28 – 0.38)</td>
</tr>
<tr>
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<td>9.08 – 11.08 (0.55 – 0.68)</td>
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<td>1.3 (0.8) or less</td>
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## Injection Pump Adjustment (Cont’d)

<table>
<thead>
<tr>
<th>Injection volume</th>
<th>Item</th>
<th>Adjusting lever angle position</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
<th>Variation limit cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2L-T</strong></td>
<td>Austria</td>
<td>Plus 23.5—33.5°</td>
<td>1,400</td>
<td></td>
<td>13.94 — 14.26 (0.85 — 0.87)</td>
<td>0.4 (0.02)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>100</td>
<td></td>
<td>13.60 — 18.40 (0.83 — 1.12)</td>
<td>1.2 (0.07)</td>
</tr>
<tr>
<td></td>
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<td>1,200</td>
<td>200</td>
<td>13.70 — 15.10 (0.84 — 0.92)</td>
<td>0.5 (0.03)</td>
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<tr>
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<td>1,800</td>
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<td>12.30 — 13.70 (0.75 — 0.84)</td>
<td>0.5 (0.03)</td>
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<tr>
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<td>2,000</td>
<td></td>
<td>11.60 — 12.80 (0.71 — 0.78)</td>
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</tr>
<tr>
<td><strong>Others</strong></td>
<td></td>
<td>Plus 23.5—33.5°</td>
<td>1,200</td>
<td>200</td>
<td>13.94 — 14.26 (0.85 — 0.87)</td>
<td>0.4 (0.02)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>100</td>
<td></td>
<td>13.60 — 18.40 (0.83 — 1.12)</td>
<td>1.2 (0.07)</td>
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<tr>
<td></td>
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<td>1,800</td>
<td></td>
<td>12.10 — 13.10 (0.74 — 0.80)</td>
<td>0.5 (0.03)</td>
</tr>
<tr>
<td><strong>Hong Kong, Singapore, Malaysia</strong></td>
<td></td>
<td>Plus 23.5—33.5°</td>
<td>1,200</td>
<td>200</td>
<td>10.96 — 11.28 (0.67 — 0.69)</td>
<td>0.4 (0.02)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>100</td>
<td></td>
<td>11.60 — 16.40 (0.71 — 1.00)</td>
<td>1.2 (0.07)</td>
</tr>
<tr>
<td></td>
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<td></td>
<td>500</td>
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<td>9.64 — 11.04 (0.59 — 0.67)</td>
<td>0.5 (0.03)</td>
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<tr>
<td></td>
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<td>1,900</td>
<td></td>
<td>9.39 — 10.69 (0.57 — 0.65)</td>
<td>0.5 (0.03)</td>
</tr>
<tr>
<td><strong>3L</strong></td>
<td></td>
<td>Plus 23.5—33.5°</td>
<td>1,200</td>
<td>200</td>
<td>11.56 — 11.88 (0.71 — 0.72)</td>
<td>0.4 (0.02)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>100</td>
<td></td>
<td>11.60 — 16.40 (0.71 — 1.00)</td>
<td>1.2 (0.07)</td>
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<tr>
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<td></td>
<td></td>
<td>500</td>
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<td>10.44 — 11.44 (0.64 — 0.70)</td>
<td>0.5 (0.03)</td>
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<tr>
<td></td>
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<td>2,000</td>
<td></td>
<td>10.19 — 11.09 (0.62 — 0.68)</td>
<td>0.5 (0.03)</td>
</tr>
<tr>
<td><strong>Governor sleeve plug head thickness</strong></td>
<td></td>
<td></td>
<td>3.0 mm</td>
<td></td>
<td>0.118 in.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.1 mm</td>
<td></td>
<td>0.122 in.</td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>3.2 mm</td>
<td></td>
<td>0.126 in.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td>3.3 mm</td>
<td></td>
<td>0.130 in.</td>
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<tr>
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<td>3.4 mm</td>
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<td>0.134 in.</td>
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</tr>
<tr>
<td></td>
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<td></td>
<td>3.5 mm</td>
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<td>0.138 in.</td>
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<td></td>
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<td>3.6 mm</td>
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<td>0.142 in.</td>
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<tr>
<td></td>
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<td>3.7 mm</td>
<td></td>
<td>0.146 in.</td>
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<tr>
<td></td>
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<td>3.8 mm</td>
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<td>0.150 in.</td>
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<td>3.9 mm</td>
<td></td>
<td>0.154 in.</td>
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<td>4.0 mm</td>
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<td>4.1 mm</td>
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<td>4.2 mm</td>
<td></td>
<td>0.165 in.</td>
<td></td>
</tr>
</tbody>
</table>
### Injection Pump Adjustment (Cont’d)

<table>
<thead>
<tr>
<th>Full-load minimum injection volume</th>
<th>Item</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td>Austria</td>
<td>1,400</td>
<td>200</td>
<td>8.8 – 10.0 (0.54 – 0.61)</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>500</td>
<td>200</td>
<td>10.6 – 11.4 (0.65 – 0.70)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boost compensator characteristic</th>
<th>Item</th>
<th>Pump rpm</th>
<th>Boost pressure kg/cm² (psi, kPa)</th>
<th>No. of measuring stroke</th>
<th>Injection volume cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td>Austria</td>
<td>500</td>
<td>0 (0, 0)</td>
<td>200</td>
<td>10.8 – 11.6 (0.65 – 0.71)</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>1,200</td>
<td>0.41 (5.9, 40)</td>
<td>200</td>
<td>12.9 – 13.5 (0.79 – 0.82)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Boost compensator characteristic tendency</th>
<th>Item</th>
<th>Pump rpm</th>
<th>Boost pressure kg/cm² (psi, kPa)</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
<th>Hysteresis cc (cu in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td>Austria</td>
<td>1,400</td>
<td>0.74 (10.5, 73)</td>
<td>200</td>
<td>13.84 – 14.36 (0.84 – 0.88)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,400</td>
<td>0.68 (9.6, 66)</td>
<td></td>
<td>13.94 – 14.26 (0.85 – 0.87)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>500</td>
<td>0.41 (5.9, 40)</td>
<td></td>
<td>14.60 – 15.40 (0.89 – 0.94)</td>
<td>0.3 (0.02) or less</td>
</tr>
<tr>
<td></td>
<td></td>
<td>500</td>
<td>0 (0, 0)</td>
<td></td>
<td>10.80 – 11.60 (0.66 – 0.71)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Others</td>
<td>1,200</td>
<td>0.74 (10.5, 73)</td>
<td>200</td>
<td>13.84 – 14.36 (0.84 – 0.88)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,200</td>
<td>0.63 (9.0, 62)</td>
<td></td>
<td>13.94 – 14.26 (0.85 – 0.87)</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,200</td>
<td>0.41 (5.9, 40)</td>
<td></td>
<td>12.90 – 13.50 (0.79 – 0.82)</td>
<td>0.3 (0.02) or less</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1,200</td>
<td>0.14 (2.0, 14)</td>
<td></td>
<td>11.20 – 12.00 (0.68 – 0.73)</td>
<td>–</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Load sensing timer (w/o HAC)</th>
<th>Item</th>
<th>Pump rpm</th>
<th>No. of measuring stroke .</th>
<th>Injection volume cc (cu in.)</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td>1,200</td>
<td>200</td>
<td>Measured value at step at (b) minus 0.6 (0.04) ± 0.4 (0.02)</td>
<td>Set to starting point</td>
<td></td>
</tr>
<tr>
<td>3L</td>
<td>1,200</td>
<td>200</td>
<td>Measured value at step at (b) minus 1.0 (0.06) ± 0.4 (0.02)</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td>1,200</td>
<td>200</td>
<td>8.10–8.50 (0.49–0.52)</td>
<td>Check ending point</td>
</tr>
<tr>
<td>3L</td>
<td>Hong Kong, Singapore, Malaysia</td>
<td>1,200</td>
<td>200</td>
<td>8.12–8.52 (0.50–0.52)</td>
</tr>
<tr>
<td>Others</td>
<td>1,200</td>
<td>200</td>
<td>8.72–9.12 (0.52–0.56)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Item</th>
<th>Pump rpm</th>
<th>Timer piston fluctuation mm (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td>1,200</td>
<td>1.44 – 1.84 (0.057 – 0.072)</td>
</tr>
<tr>
<td>3L</td>
<td>1,200</td>
<td>0.62 – 1.02 (0.024 – 0.040)</td>
</tr>
</tbody>
</table>
## Injection Pump Adjustment (Cont’d)

<table>
<thead>
<tr>
<th>Idle speed</th>
<th>Item</th>
<th>Adjusting lever angle position</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
<th>Variation limit cc (cu in.)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Austria</td>
<td>Minus 13.5 – 21.5°</td>
<td>375</td>
<td>200</td>
<td>q = 2.4 – 2.6 (0.15 – 0.16)</td>
<td>–</td>
<td>Pre-set</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>350</td>
<td></td>
<td>q plus 0.5 (0.03) or more</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>450</td>
<td></td>
<td>q minus 1.1–2.1 (0.07 – 0.13)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>375</td>
<td></td>
<td>3.0 – 4.0 (0.18 – 0.24)</td>
<td>0.34 (0.02)</td>
<td>Adjust</td>
</tr>
<tr>
<td>2L-T</td>
<td>Others</td>
<td>Minus 13.5 – 21.5°</td>
<td>375</td>
<td>200</td>
<td>q = 1.5 – 2.5 (0.09 – 0.15)</td>
<td>–</td>
<td>Pre-set</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>350</td>
<td></td>
<td>q plus 0.5 (0.03) or more</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>450</td>
<td></td>
<td>q minus 0.7–1.7 (0.04 – 0.10)</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>375</td>
<td></td>
<td>1.8 – 2.8 (0.11 – 0.17)</td>
<td>0.34 (0.02)</td>
<td>Adjust</td>
</tr>
<tr>
<td></td>
<td>3L</td>
<td>Minus 12.5 – 22.5°</td>
<td>350</td>
<td>200</td>
<td>1.8 – 2.8 (0.11 – 0.17)</td>
<td>0.34 (0.02)</td>
<td>Adjust</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>525</td>
<td></td>
<td>1.2 (0.07) or less</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

### Dash pot

<table>
<thead>
<tr>
<th>Item</th>
<th>Pump rpm</th>
<th>No. of measuring strokes</th>
<th>Injection volume cc (cu in.)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>600</td>
<td>200</td>
<td>q = 0.5 – 0.7 (0.03 – 0.04)</td>
<td>Lever set</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>200</td>
<td>q plus 0.2 – 0.4 (0.01 – 0.02)</td>
<td>Adjust</td>
</tr>
<tr>
<td>Others</td>
<td>600</td>
<td>200</td>
<td>q = 0.6 – 0.8 (0.04 – 0.05)</td>
<td>Lever set</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>200</td>
<td>q plus 0.2 – 0.4 (0.01 – 0.02)</td>
<td>Adjust</td>
</tr>
</tbody>
</table>

### Cold start system

<table>
<thead>
<tr>
<th>Item</th>
<th>Fuel temp. °C (°F)</th>
<th>Timer piston stroke mm (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Austria</td>
<td>25 (77)</td>
<td>0.7 – 0.9 (0.028 – 0.035)</td>
</tr>
<tr>
<td>Others</td>
<td>25 (77)</td>
<td>1.3 – 1.5 (0.051 – 0.059)</td>
</tr>
</tbody>
</table>

### Fast idle

<table>
<thead>
<tr>
<th>Item</th>
<th>Fuel temp. °C (°F)</th>
<th>Clearance mm (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>20 (68)</td>
<td>2.5 (0.098)</td>
</tr>
<tr>
<td></td>
<td>50 (122)</td>
<td>0 (0)</td>
</tr>
</tbody>
</table>

### Adjusting lever

<table>
<thead>
<tr>
<th>Item</th>
<th>Lever moving angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>2L-T</td>
<td>41 – 51°</td>
</tr>
<tr>
<td>3L</td>
<td>43 – 49°</td>
</tr>
</tbody>
</table>
Torque Specifications

<table>
<thead>
<tr>
<th>Part tightened</th>
<th>kg-cm</th>
<th>ft-lb</th>
<th>N-m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retaining nut x Holder body (2L-T Austria)</td>
<td>675</td>
<td>49</td>
<td>66</td>
</tr>
<tr>
<td>Distributive head plug x Distributive head</td>
<td>700</td>
<td>51</td>
<td>69</td>
</tr>
<tr>
<td>Pilot injection actuator x Distributive head (2L-T Austria)</td>
<td>900</td>
<td>65</td>
<td>88</td>
</tr>
<tr>
<td>Governor cover x Injection pump body</td>
<td>85</td>
<td>74 in.-lb</td>
<td>8.3</td>
</tr>
<tr>
<td>Fuel cut solenoid x Distributive head</td>
<td>225</td>
<td>16</td>
<td>22</td>
</tr>
<tr>
<td>Pickup sensor x Injection pump body</td>
<td>210</td>
<td>15</td>
<td>21</td>
</tr>
<tr>
<td>Fuel inlet pipe x Injection pump</td>
<td>250</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>Fuel outlet pipe x Injection pump</td>
<td>250</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>Injection pump x Timing belt case</td>
<td>210</td>
<td>15</td>
<td>21</td>
</tr>
<tr>
<td>Pump stay x Injection pump</td>
<td>185</td>
<td>13</td>
<td>18</td>
</tr>
<tr>
<td>Pump stay x Cylinder block</td>
<td>185</td>
<td>13</td>
<td>18</td>
</tr>
<tr>
<td>Injection pipe x Injection nozzle</td>
<td>250</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>Injection pipe x Injection pump</td>
<td>250</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>Injection pump drive pulley x Injection pump</td>
<td>650</td>
<td>47</td>
<td>64</td>
</tr>
<tr>
<td>Crankshaft timing pulley x Crankshaft</td>
<td>1,700</td>
<td>123</td>
<td>167</td>
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</table>

COOLING SYSTEM

Specifications

<table>
<thead>
<tr>
<th>Engine coolant capacity</th>
<th>See page A-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiator cap</td>
<td>Relief valve opening pressure</td>
</tr>
<tr>
<td></td>
<td>Limit</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Thermostat</td>
<td>Valve opening temperature</td>
</tr>
<tr>
<td></td>
<td>Valve lift at 100°C (212°F)</td>
</tr>
<tr>
<td></td>
<td>8 mm (0.31 in.) or more</td>
</tr>
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</table>

Torque Specifications

<table>
<thead>
<tr>
<th>Part tightened</th>
<th>kg-cm</th>
<th>ft-lb</th>
<th>N-m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinder block x Drain plug</td>
<td>300</td>
<td>22</td>
<td>29</td>
</tr>
<tr>
<td>Water outlet x Water outlet housing</td>
<td>195</td>
<td>14</td>
<td>19</td>
</tr>
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</table>
LUBRICATION SYSTEM

Specifications

<table>
<thead>
<tr>
<th>Engine oil capacity</th>
<th>See page A-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil pressure</td>
<td>at idling</td>
</tr>
<tr>
<td></td>
<td>at 3000 rpm</td>
</tr>
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Torque specifications

<table>
<thead>
<tr>
<th>Part tightened</th>
<th>kg-cm</th>
<th>ft-lb</th>
<th>N-m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine oil drain plug</td>
<td>400</td>
<td>29</td>
<td>39</td>
</tr>
<tr>
<td>Oil cooler x Oil filter bracket</td>
<td>145</td>
<td>10</td>
<td>14</td>
</tr>
<tr>
<td>Oil cooler bracket x Cylinder block Bolt</td>
<td>195</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td>Oil cooler bracket x Cylinder block Nut</td>
<td>210</td>
<td>15</td>
<td>21</td>
</tr>
<tr>
<td>Relief valve plug x Oil filter bracket</td>
<td>370</td>
<td>27</td>
<td>36</td>
</tr>
<tr>
<td>Union x Oil filter bracket (2L-T)</td>
<td>500</td>
<td>36</td>
<td>49</td>
</tr>
<tr>
<td>Union bolt x Oil filter bracket (LJ 2L-T)</td>
<td>200</td>
<td>14</td>
<td>20</td>
</tr>
<tr>
<td>Alternator x Engine RH mounting bracket 14 mm head bolt</td>
<td>510</td>
<td>37</td>
<td>50</td>
</tr>
<tr>
<td>Alternator x Fan belt adjusting bar 12 mm head bolt</td>
<td>130</td>
<td>9</td>
<td>12</td>
</tr>
</tbody>
</table>

STARTING SYSTEM

<table>
<thead>
<tr>
<th>Pre-heating system</th>
<th>Light lighting time</th>
<th>See page ST-3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Supper glow type</td>
<td>Approx. 6 seconds</td>
</tr>
<tr>
<td></td>
<td>Fixed delay type</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water temp. sensor resistance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>at −20°C (−4°F)</td>
<td>10 – 20 kΩ</td>
</tr>
<tr>
<td></td>
<td>at 0°C (32°F)</td>
<td>4 – 7 kΩ</td>
</tr>
<tr>
<td></td>
<td>at 20°C (68°F)</td>
<td>2 – 3 kΩ</td>
</tr>
<tr>
<td></td>
<td>at 40°C (104°F)</td>
<td>0.9 – 1.3 kΩ</td>
</tr>
<tr>
<td></td>
<td>at 60°C (140°F)</td>
<td>0.4 – 0.7 kΩ</td>
</tr>
<tr>
<td></td>
<td>at 80°C (176°F)</td>
<td>0.2 – 0.4 kΩ</td>
</tr>
</tbody>
</table>

CHARGING SYSTEM

<table>
<thead>
<tr>
<th>Drive belt deflection and tension</th>
<th>See page A-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery specific gravity when fully charged at 20°C (68°F)</td>
<td>See page A-2</td>
</tr>
<tr>
<td>80D26R</td>
<td>1.27 – 1.29</td>
</tr>
<tr>
<td>Others</td>
<td>1.25 – 1.27</td>
</tr>
<tr>
<td>Alternator regulator</td>
<td>Regulating voltage</td>
</tr>
<tr>
<td>w/o IC regulator</td>
<td>at 25°C (77°F)</td>
</tr>
<tr>
<td></td>
<td>13.8 – 14.4 V</td>
</tr>
<tr>
<td>w/ IC regulator</td>
<td>at 25°C (77°F)</td>
</tr>
<tr>
<td></td>
<td>13.9 – 15.1 V</td>
</tr>
<tr>
<td></td>
<td>at 115°C (239°F)</td>
</tr>
<tr>
<td></td>
<td>13.5 – 14.3 V</td>
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</table>
# STANDARD BOLT TORQUE SPECIFICATIONS

## HOW TO DETERMINE BOLT STRENGTH

<table>
<thead>
<tr>
<th>Mark</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>4—</td>
<td>4T</td>
</tr>
<tr>
<td>5—</td>
<td>5T</td>
</tr>
<tr>
<td>6—</td>
<td>6T</td>
</tr>
<tr>
<td>7—</td>
<td>7T</td>
</tr>
<tr>
<td>8—</td>
<td>8T</td>
</tr>
<tr>
<td>9—</td>
<td>9T</td>
</tr>
<tr>
<td>10—</td>
<td>10T</td>
</tr>
<tr>
<td>11—</td>
<td>11T</td>
</tr>
</tbody>
</table>

- **Hexagon head bolt**
  - Bolt head No.
  - Stud bolt
    - No mark
    - Grooved
  - Welded bolt
    - Three protruding lines
    - Four protruding lines

- **Hexagon flange bolt w/ washer hexagon bolt**
  - No mark
    - Grooved
    - Welded bolt
      - Three protruding lines
      - Four protruding lines
## Specified Torque for Standard Bolts

<table>
<thead>
<tr>
<th>Class</th>
<th>Diameter mm</th>
<th>Pitch mm</th>
<th>Specified torque</th>
<th>Hexagon head bolt</th>
<th>Hexagon flange bolt</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>kg-cm</td>
<td>ft-lb</td>
<td>N·m</td>
</tr>
<tr>
<td>4T</td>
<td>6</td>
<td>1</td>
<td>55</td>
<td>48 in.-lb</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>1.25</td>
<td>130</td>
<td>9</td>
<td>12.5</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>1.25</td>
<td>260</td>
<td>19</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>1.25</td>
<td>480</td>
<td>35</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>1.5</td>
<td>760</td>
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SST AND SSM

REFER TO 2L, 3L ENGINE REPAIR MANUAL
(Pub. No. RM123E)

NOTE: The following pages contain only the points which differ from the above listed manual.

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### SSM (SPECIAL SERVICE MATERIALS)

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