

Toyota 1hd 1hz 1pz T Engine

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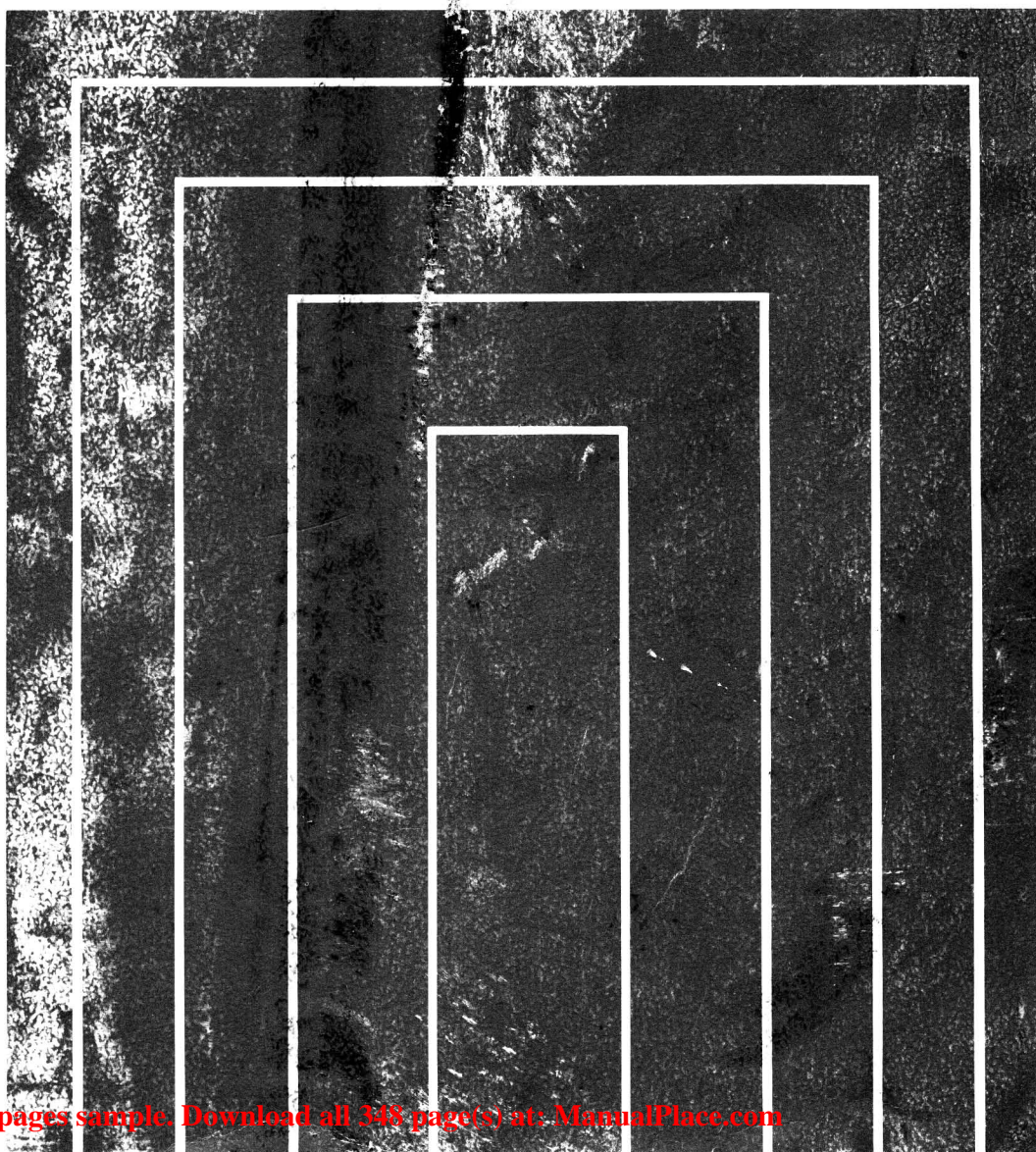
TOYOTA

1PZ, 1HZ, 1HD-T

ENGINE

REPAIR MANUAL

Feb., 1990



Pub.No.RM172E

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FOREWORD

This repair manual has been prepared to provide information covering general service repairs for the 1 PZ, 1 HZ and 1HD-T engines equipped on the TOYOTA LAND CRUISER and COASTER.

Applicable models:

PZJ70, 73, 75 series

HZJ70, 73, 75, 80 series

HDJ80 series

HZB30 series

HDB30 series

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

Manual Name	Pub. No.
● Land Cruiser (Wagon) New Car Features	NCF064E

All information in this manual is based on the latest product information at the time of publication. However, specifications and procedures are subject to change without notice.

TOYOTA MOTOR CORPORATION

CAUTION

This manual does not include all the necessary items about repair and service, this manual is made for the purpose of the use for the persons who have special techniques and certifications. In the cases that non-specialized or uncertified technicians perform repair or service only using this manual or without proper equipment or tool, that may cause severe injury to you or other people around and also cause damage to your customer's vehicle.

In order to prevent dangerous operation and damages to your customer's vehicle, be sure to follow the instruction shown below.

- Must read this manual thoroughly. It is especially important to have good understanding all the contents written in the PRECAUTION of "IN" section.
- The service method written in this manual is very effective to perform repair and service. When performing the operations following the procedures using this manual, be sure to use tools specified and recommended. If using non-specified or recommended tools and service method, be sure to confirm safety of the technicians and any possibility of causing personal injury or damage to the customer's vehicle before starting the operation.
- If part replacement is necessary, must replace the part with the same part number or equivalent part. Do not replace it with inferior quality.
- It is important to note that this manual contains various "Cautions" and "Notices" that must be carefully observed in order to reduce the risk of personal injury during service or repair, or the possibility that improper service or repair may damage the vehicle or render it unsafe. It is also important to understand that these "Cautions" and "Notices" are not exhaustive, because it is important to warn of all the possible hazardous consequences that might result from failure to follow these instructions.

TOYOTA 1PZ, 1HZ, 1HD-T ENGINE REPAIR MANUAL

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First Printing: Feb. 8, 1990 01-900208-00

34th Printing: Aug. 28, 2001 34-010828-06-2

INTRODUCTION

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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.

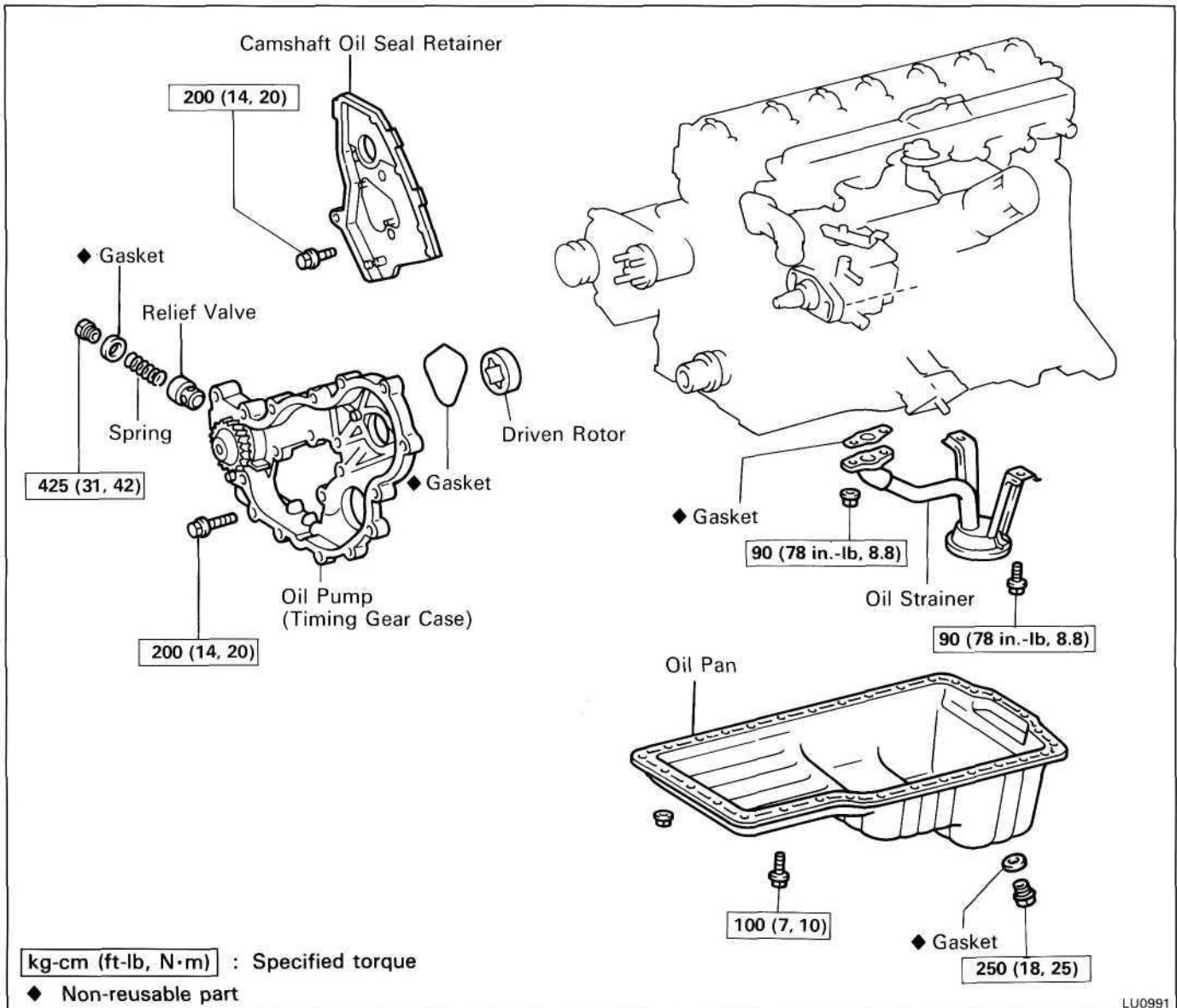
Read these precautions before starting any repair task.

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.

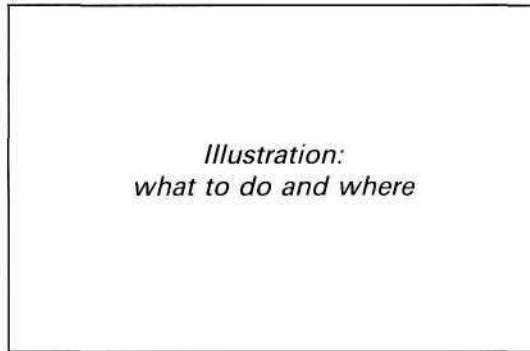
Example:



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:



Task heading: what to do

Detailed text: how to do task

13. INSTALL GOVERNOR LINK

(a) Using SST, install the governor link with new two gaskets and the two support bolts.

Torque: 140 kg-cm (10 ft-lb, 14 N·m)

SST 09260-54012 (09269-54040)

Set part No. Component part No. Specification

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

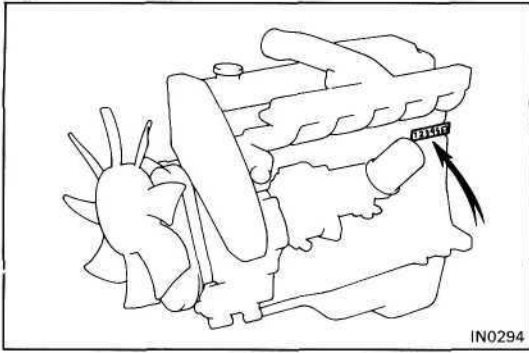
References have been kept to a minimum. However, when they are required, you are given the page to refer to.

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

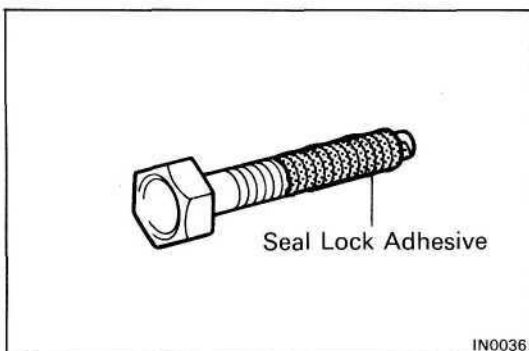
The engine serial number is stamped on the left side of the cylinder block.

GENERAL REPAIR INSTRUCTIONS

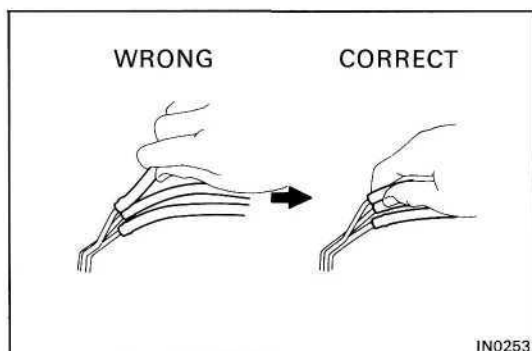
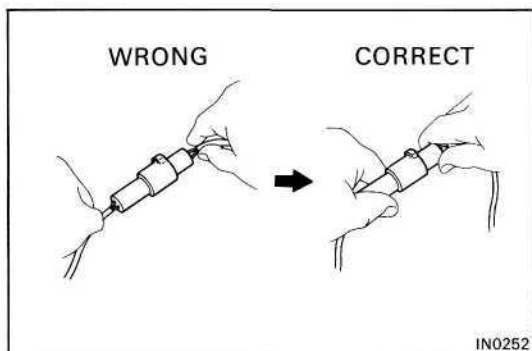
1. Use fender, seat and floor covers to keep the vehicle clean and prevent damage.
2. During disassembly, keep parts in order to facilitate reassembly.
3. Observe the following:
 - (a) Before performing electrical work, disconnect the negative (—) cable from the battery terminal.
 - (b) If it is necessary 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. that 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) To pull apart electrical connectors, pull on the connector itself, not the wires.
 - (c) To disconnect vacuum hoses, pull on the end, not the middle of the hose.

- (d) When steam cleaning an engine, protect the 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. After removing and reinstalling the injection pump and fuel hoses, clean off the fuel on engine components. In particular, be sure to check the radiator hose and by-pass hose, because they deteriorate easily if they come into contact with fuel.

ABBREVIATIONS USED IN THIS MANUAL

A/C	Air Conditioner
ACV	Air Control Valve
ACSD	Automatic Cold Start Device
Approx.	Approximately
A/T	Automatic Transmission
BACS	Boost and Altitude Compensation Stopper
BDC	Bottom Dead Center
Ex.	Except
FL	Fusible Link
FIPG	Formed in Place Gasket
HAC	High Altitude Compensator
LH	Left-Hand
LHD	Left-Hand Drive
LST	Load Sensing Timer
MP	Multipurpose
M/T	Manual Transmission
OHC	Over Head Cam
O/S	Oversized
PCS	Power Control System
PCV	Positive Crankcase Ventilation
RH	Right-Hand
RHD	Right-Hand Drive
SSM	Special Service Materials
SST	Special Service Tools
STD	Standard
SW	Switch
TDC	Top Dead Center
U/S	Undersize
w/	With
w/o	Without

ENGINE MECHANICAL

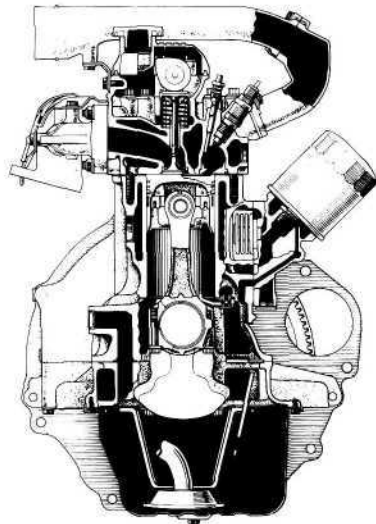
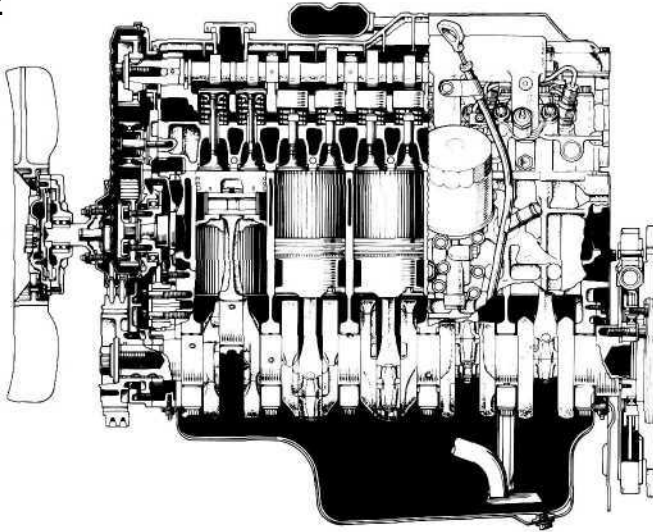
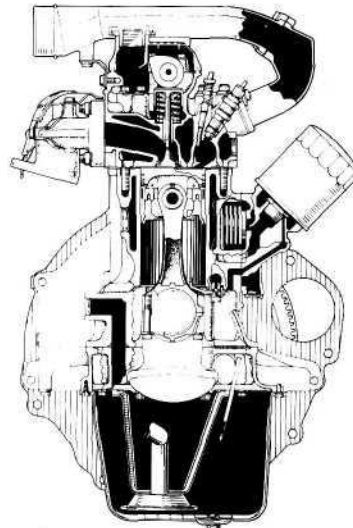
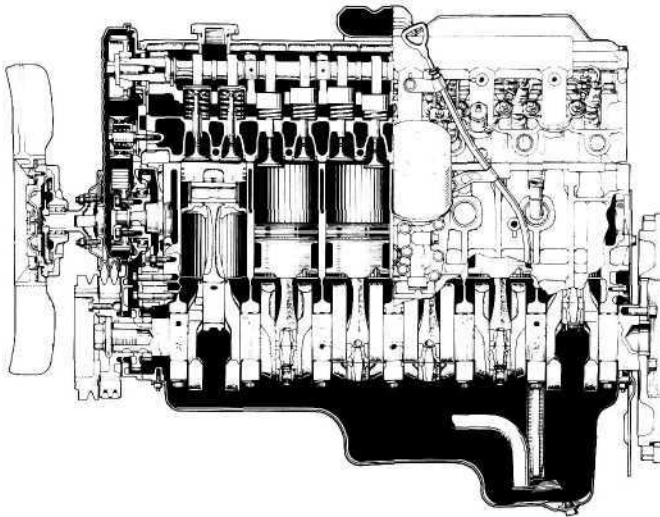
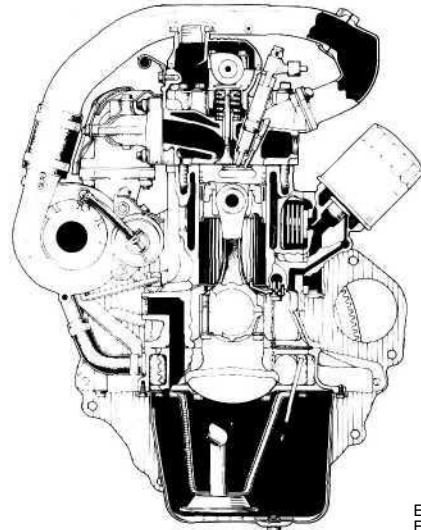
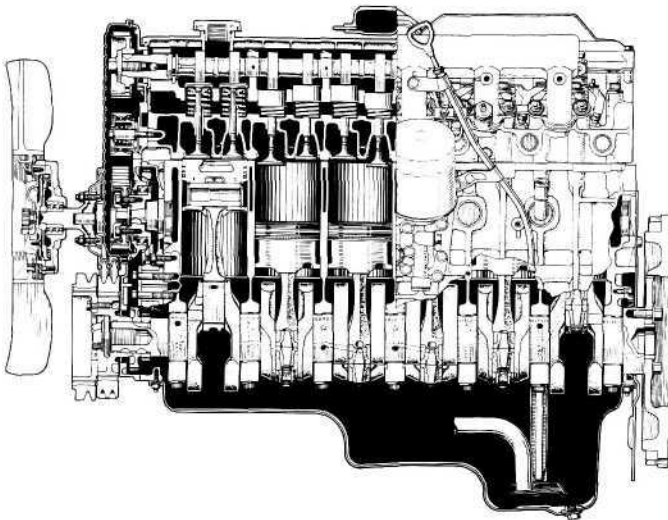
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DESCRIPTION

The 1 PZ engine is an in-line 5-cylinder 3.5 liter OHC engine.

The 1 HZ and 1 HD-T engines are an in-line 6-cylinder 4.2 liter OHC engine.

1PZ**1HZ****1HD-T**

The 1 PZ engine is an in-line 5-cylinder engine with the cylinders numbered 1 - 2 - 3 - 4 - 5 from the front. This engine's injection order is 1 - 2 - 4 - 5 - 3 .

The 1 HZ and 1HD-T engines are an in-line 6-cylinder engine with the cylinders numbered 1 - 2 - 3 - 4 - 5 - 6 from the front. This engine's injection order is 1 - 4 - 2 - 6 - 3 - 5 .

The crankshaft is supported by 6 (1 PZ) or 7 (1 HZ and 1HD-T) bearings on the inside of the crankcase. These bearings are made of aluminum alloy. The crankshaft is integrated with 10 weights (1 PZ) or 12 weights (1 HZ and 1HD-T) which are cast along with it for balancing. Oil holes are built into the crankshaft for supplying oil to the connecting rods, bearings and other components.

The crankshaft bearing cap is of ladder frame construction and is incorporated into the crank case.

The cylinder head is made of cast iron with a cross flow type intake and exhaust layout. The combustion chambers are swirl chamber type for the 1 PZ and 1 HZ engines and direct injection type for the 1 HD-T engine. The camshaft journal part of the cylinder head has camshaft caps made of aluminum alloy and is made of cast iron on the cylinder head side. The camshaft journal has no bearings (with the exception of the No.1 journal).

The 1 HZ and 1 HD-T engines has dual-type exhaust manifolds.

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. The camshaft journal is supported at 6 places (1 PZ) or 7 places (1 HZ and 1HD-T). Lubrication of the camshaft journal and cam is accomplished by oil being supplied through the oiler port in the No.6 (1 PZ) or No.7 (1 HZ and 1 HD-T) of the 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 camshaft.

Pistons are made of highly temperature-resistant aluminum alloy. As the 1 HD-T engine is the direct injection type, a deep combustion chamber has been provided. The No.1 piston ring groove has been strengthened using a fiber reinforced metal.

Piston pins are the full-floating type, with the pins fastened to neither the connecting rods nor the piston boss, but with a snap rings fitted to both ends of the pin to prevent the pin from slipping 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 5 cylinders (1 PZ) or 6 cylinders (1HZ and 1HD-T) which are approximately 1.7 times the length of the piston stroke. The top of the cylinders is closed off by the cylinder head and the lower end of the cylinders 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.

Plastic region tightening bolts are used for the cylinder head bolts, crankshaft bearing cap bolts and connecting rod cap bolts.

The oil pan is bolted onto the bottom of the crankshaft bearing cap with bolts and nuts. The oil pan is an oil reservoir made of pressed steel sheet.

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.

ENGINE WILL NOT CRANK**(Possible Cause)****(Check Procedure and Correction Method)**

1. LOOSE OR CORRODED BATTERY CABLES	Check cables from battery to starter and make necessary repairs.
2. DISCHARGED BATTERY	Check alternator output and drive belt. If necessary, repair. (See page CH-5)
3. INOPERATIVE STARTER	Check for battery voltage at starter terminals 30 and 50. If Okay, see STARTING SYSTEM for repair procedure, (see page ST-15)

ENGINE CRANKS SLOWLY-WILL NOT START**HINT: Minimum cranking speed:**

Cold	HZJ80 (A/T) and HDJ80 (A/T)	110 rpm
	Others	100 rpm
Hot		150 rpm

(Possible Cause)**(Check Procedure and Correction Method)**

1. LOOSE OR CORRODED BATTERY CABLES	Check cables from battery to starter and make necessary repairs.
2. DISCHARGED BATTERY	Check alternator output and drive belt. If necessary, repair. (See page CH-5)
3. IMPROPER ENGINE OIL	Check engine oil. If improper viscosity, drain and refill with oil of viscosity recommended by manufacturer. (See page LU-6)

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 PREHEATING 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-27)

Plunger stroke:

1PZ	0.82—0.88 mm (0.0323-0.0346 in.)
1HZ	1.03-1.09 mm (0.0406-0.0429 in.)
1HD-T	1.29-1.35 mm (0.0508-0.0531 in.)

If not as above, injection pump is improperly adjusted.

**8. (w/ACSD)
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. (See page FU-10 or 20)

Opening pressure:

1PZand1HZ **135-155 kg/cm²**
(1,920-2,205 psi)
(13,239-15,200 kPa)

1HD-T

No.1 opening pressure

180-190 kg/cm²
(2,560-2,702 psi)
(17,652 - 18,633 kPa)

No.2 opening pressure

(Inspection pressure)

132-138 kg/cm²
(1,877-1,963 psi)
(12,945-13,533 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

(Possible Cause)

(Check Procedure and Correction Method)

1. IMPROPER ADJUSTMENT OF ACCELERATOR CABLE

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.

2. IDLE SPEED TOO LOW

Check idle speed. (See page EM-27)

Idle speed:

1PZ	600-700 rpm
1HZM/T	600-700 rpm
1HZA/T	660-760 rpm
1HD-T M/T	600-700 rpm
1HD-T A/T	750 - 850 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 bolts, 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.

(See page FU-10 or 20)

Opening pressure:

IPZ and iHZ **135-155 kg/cm²**
 (1,920-2,205 psi)
 (13,239-15,200 kPa)

1HD-T**No.1 opening pressure**

180-190 kg/cm²
(2,560-2,702 psi)
(17,652 - 18,633 kPa)

No.2 opening pressure**(Inspection pressure)**

132-138 kg/cm²
(1,877-1,963 psi)
(12,945-13,533 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.