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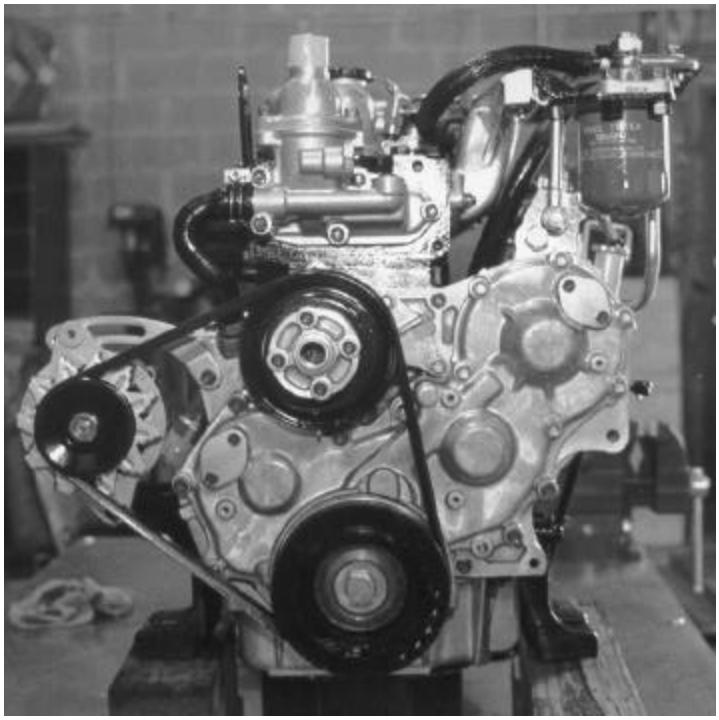
Revised (10-12)

Foreword

This book is designed to cover the J-series engines. J-series engines currently in production are the 4JA1, 4JB1, 4JC1, 4JE1, 4JG1 and the 4JG2. This training manual is divided into six sections to make referencing information easier.

The introduction covers engine application notes and maintenance schedule. Section two is the engine component section that provides in-depth descriptions of each component. This will include component operation and important points that are critical to the disassembly, inspection and reassembly of the engine. Section three is the engine service section, which illustrates important information regarding fuel injection operation and routine fuel injection service items. Section four provides a listing of some of the critical engine specifications for the 4J engines. A broad range of component failures are illustrated in section five. Non-J-Series specific service information on various topics is placed in the appendix.

Due to the similarities among the 4J family of engines, we have created a single technician guide to cover all J-series engines. This training manual outlines the important aspects of the repair manual; *however, it is not a stand-alone manual*. It must be used in conjunction with the appropriate Workshop Manuals.



I. Introduction – Application Notes

Courtesy: Ingersoll-Rand Company

The J series engines are used in a variety of industrial applications ranging from small excavators, aerial lifts, generators and air compressors to forklifts, as well as automotive applications in overseas markets. These engines were designed to have low noise, low fuel consumption and be compact in size. Internally, the 4J engines share many similar parts.

The main difference between these engines is their displacement and horsepower output. Four cylinder J-family engines are available in both indirect injected (IDI) and Direct Injected (DI) variants. Additionally, the 4JB1 and 4JG1 engines have the option of being turbocharged.

I. Introduction – Maintenance Schedule

The following maintenance schedule is a comprehensive service program that takes a preventative approach to engine repair. Isuzu has established these standards with maintenance as the basis for prolonged product life. Isuzu highly recommends that if a routine maintenance schedule is not part of your customer support service, one should be implemented to better serve the needs of your customers.

Maintenance Item	Daily	500 hrs	1000 hrs	1500 hrs
Oil level	✓			
Oil leaks	✓			
Proper oil pressure	✓			
Low oil warning lamp	✓			
Oil filter replacement ①		✓	✓	✓
Engine oil ①		✓	✓	✓
Fuel leaks	✓			
Contaminated fuel	✓			
Fuel filter replacement		✓	✓	✓
Injector nozzle check		✓	✓	✓
Feed pump strainer clean			✓	
Coolant level	✓			
Coolant leaks	✓			
Fan belt tension	✓			
Coolant temperature	✓			
Coolant replace	Replace every 6 months			
Water Pump Grease pack				✓
Electrolyte levels	✓			
Radiator fin cleaning		✓		✓
Radiator cap fitting check	✓			
Radiator cleaning			✓	
Radiator cap function test	There is no service interval specification provided by Isuzu			
Air cleaner check/replace	Refer to element manufacturer for interval			
Wire/Connector integrity	There is no service interval specification provided by Isuzu			
Battery charge %	Refer to battery manufacturer or battery test tool for interval			
Electrolyte gravity %	Refer to battery manufacturer for interval			
Starter cleaning				✓
Generator cleaning				✓
Battery cleaning	✓			
Pre-heat condition	✓			
Abnormal engine noises	✓			
Exhaust color	✓			
Cylinder compression			✓	
Valve lash check & set				✓

① Remove and replace after initial 50 hrs of engine operation. Then follow the regular maintenance schedule thereafter.

I. Introduction – General Engine Family Information

J-Series Engines

Below is a brief description of the application/development criteria and design characteristics of the J engine family:

Clean
- Optimized direct injection system and EPA Emissions Certification*
- Steel laminated head gasket and liquid gasket for other sealing surfaces means no more asbestos
- Blow-by gases recirculated into intake with use of PCV valve

Quiet
- Two-stage injection pump cam
- Dampened crank pulley
- 8 counter balance crankshaft with a fine module gear
- Large mesh area on gear driven components
- Auto-thermatic pistons that reduce engine noise at start up and after warm up.

Small size
- Overhead valve to reduce engine height
- Full siamese engine block design reduces length

Ease of Maintenance
- All service points of engine are placed on the same side
  (oil fill, dipstick, filter, injection pump, nozzles and glow plugs).

* See individual engine specification sheets or application data to verify.

Identification

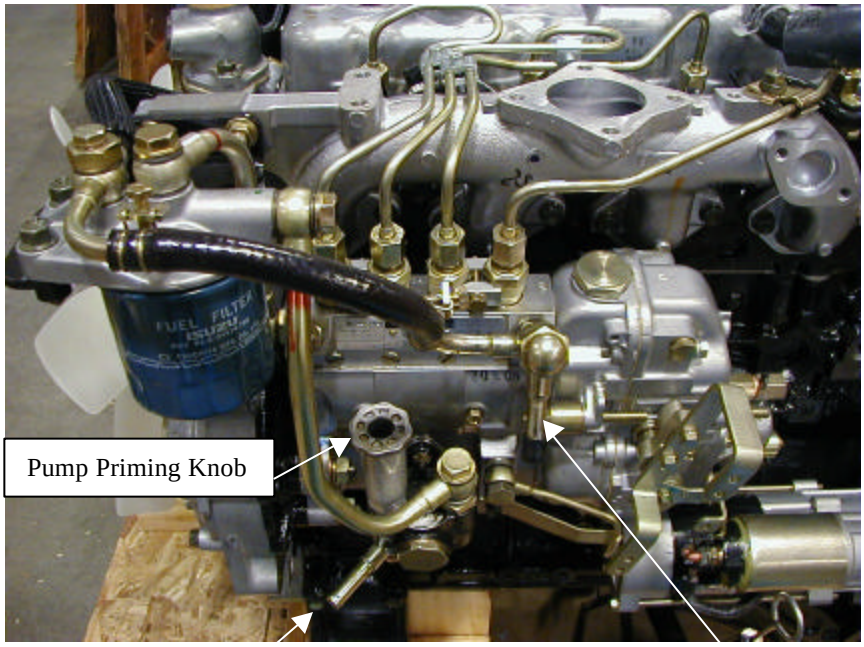
The production date for any Isuzu engine can be obtained be reading the letter codes on the ID tag (usually located on the head cover) and using the table below.

A	B	C	D	E	F	G	H	I	J
0	1	2	3	4	5	6	7	8	9

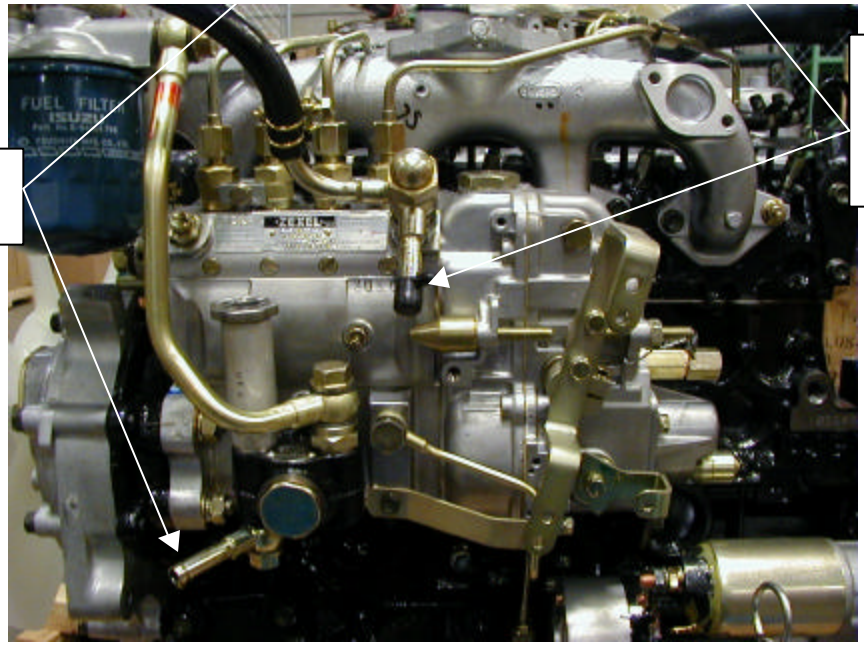
Example: BA/JB=10/91 (Engine produced October, 1991).

II. Engine Component Description

Pump Description

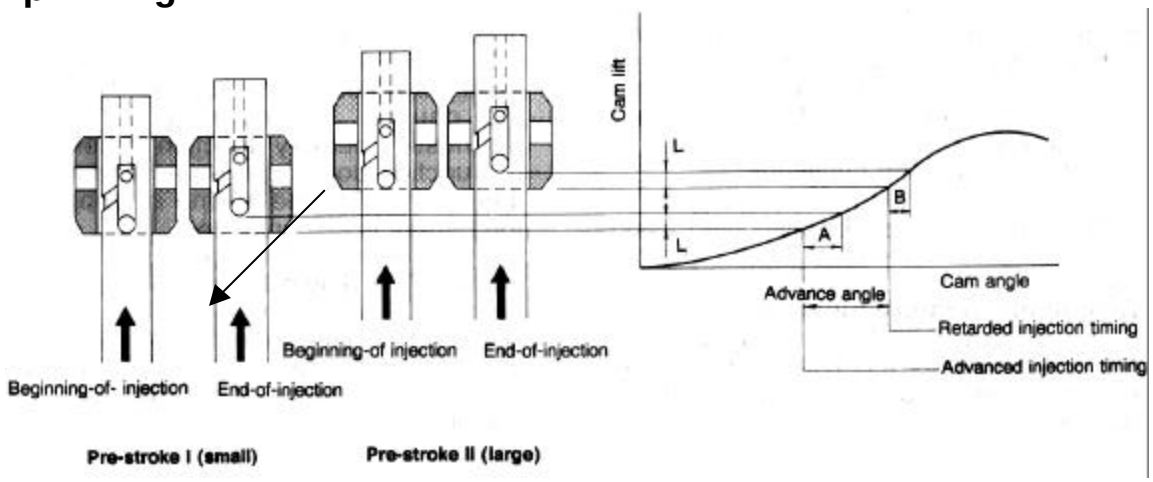


Front of Engine



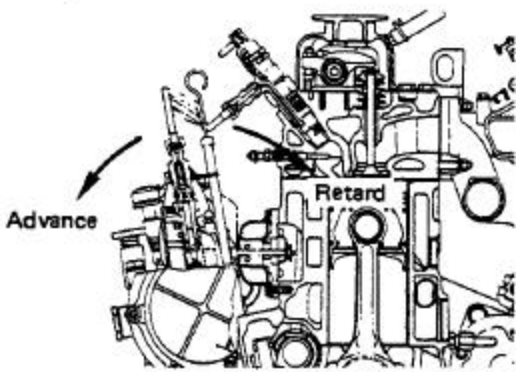
The J-series engines use a gear-driven in-line injection pump to supply fuel to the injection nozzles. The injection pump is mounted to a cradle that is mounted to the engine block.

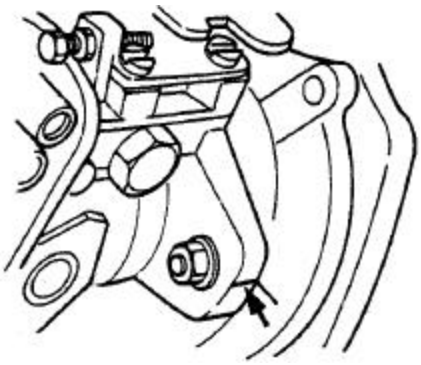
Pump Timing



This drawing shows the relationship between injector pump cam lift and cam angle when pre-stroke length is changed. The stroke length represented as "L" is always constant. When the injection pump is advanced by moving the pump away from the block, the timing sleeve is lowered sooner and the start of injection occurs at the beginning of the cam lift.

Conversely, when the pump is retarded by pushing the pump towards the block, the pre-stroke is lengthened because the timing sleeve is raised sooner. Retarding the injector changes the start of injection to the last half of the cam lift. It also reduces the total number of cam degrees to complete one injection.



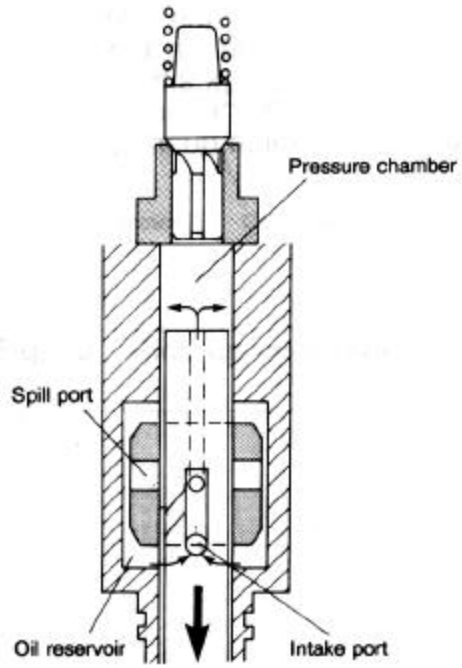


Pump timing is determined by the angle at which it is placed in the pump cradle (relative to the engine block). An orientation mark is notched into the pump and cradle for reference.

At this setting, the injection pump should be timed perfectly. Spill port timing of the injection ports is necessary to verify. Should pump timing need to be adjusted, loosen the pump fixing bolts to the cradle and adjust the pump angle. Pulling the pump away from the block advances timing, pushing in towards the block retards timing.

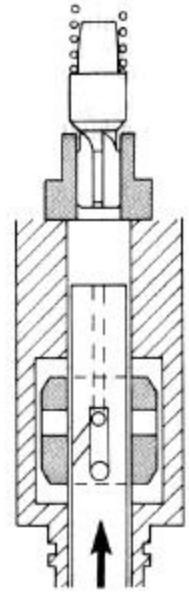
There is also another reference timing mark at the pump fixing flange on the back side of the timing gear case.

Pump Injection Sequence



Intake

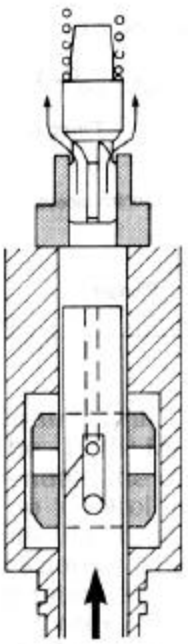
Intake
Fuel enters the high-pressure chamber from the intake port. However, even though the plunger begins to rise, pressure inside the chamber does not increase because the fuel from the inlet port flows back into the fuel reservoir via the spill-port hole



Beginning-of-injection

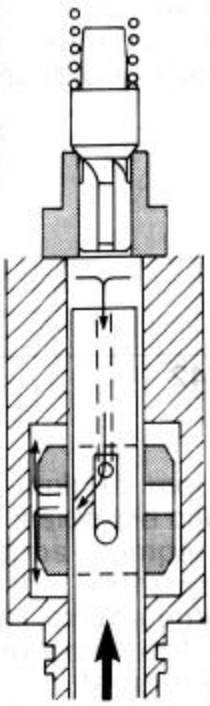
Beginning of Injection
As the plunger rises, it blocks the spill port hole in the timing sleeve. The plunger blocks the inlet port preventing additional fuel from entering the high-pressure chamber. It is during this transition that pressure inside the chamber begins to develop.

Pump Injection Sequence (continued)



Pressure feed

Pressure Feeding
Since the intake port and helix are kept closed by the timing sleeve, fuel pressure continues to rise, the delivery valve opens, and fuel flows to the injector.

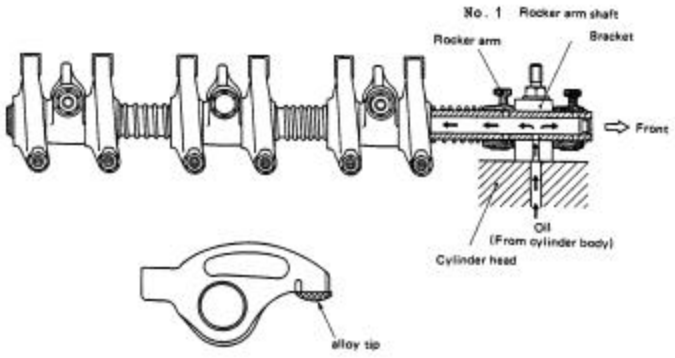


End-of-injection

End of Injection
On the return stroke, when the plunger helix reaches the timing sleeve's spill port, the pressurized fuel flows through the spill port and into the oil reservoir. At this moment pressure in the chamber drops which ends the injection cycle.

II. Engine Component Description

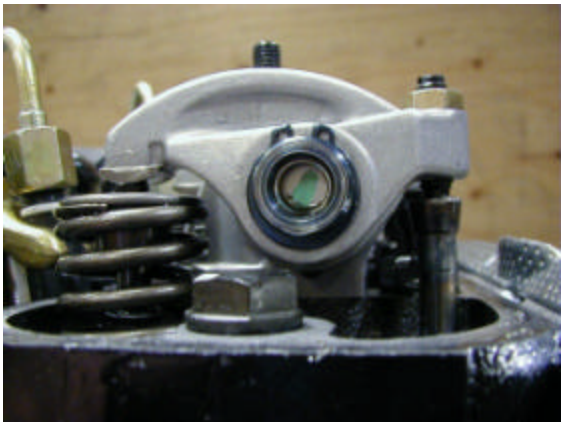
Valve Train



J-series engines use individual rocker arms mounted on a common shaft. Both components can be removed for servicing by simply removing the shaft bracket fixing bolts.

The rocker shaft is oil pressure fed through a galley machined in the cylinder head. This galley intersects with the main oil galley in the block to provide full pressure oiling to the rocker arms.

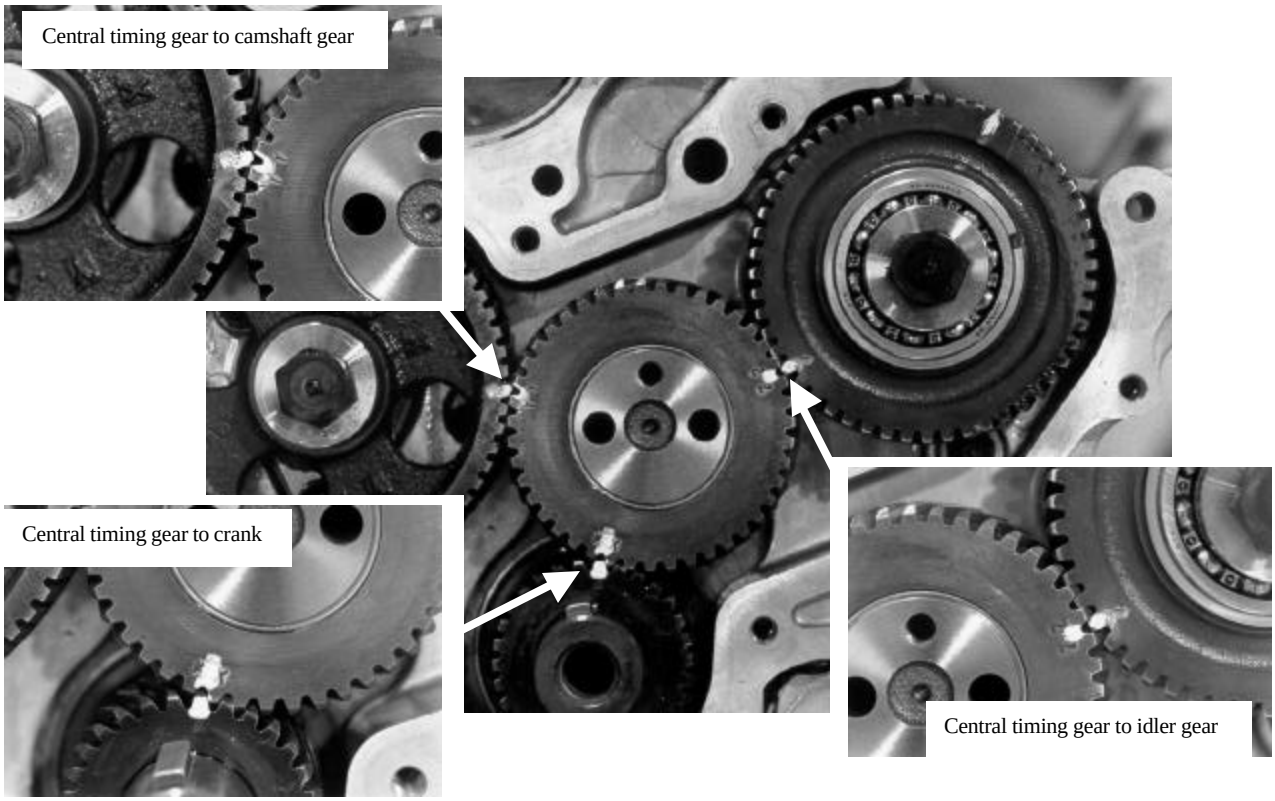
(View from front to rear of engine)



(View from rear to front of engine)

(Overhead view from exhaust side)

Drive Gear Timing



Correct camshaft timing is shown above. The crankshaft is positioned with the key way at the top (#1 BTDC). The crankshaft gear timing mark will be at approximately 12 o'clock. The central timing gear has three marks:

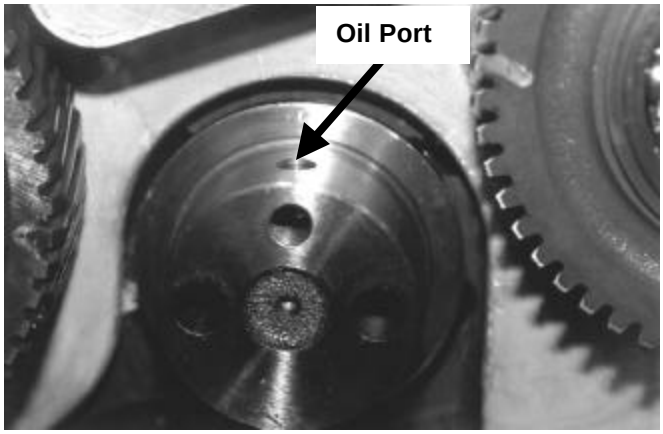
7 o'clock - lines up with crank's mark (X – XX)
10 o'clock - lines up with camshaft gear (Y – YY)
2 o'clock – lines up with idler gear (Z – ZZ)

The camshaft and injection pump gears each have an addition mark ("0") for fuel injection timing.

IMPORTANT: The initial timing of these gears is absolutely essential. Due to the combination of different gear ratios, the timing marks will not line-up with their respective gears after the engine has been rotated a few times.

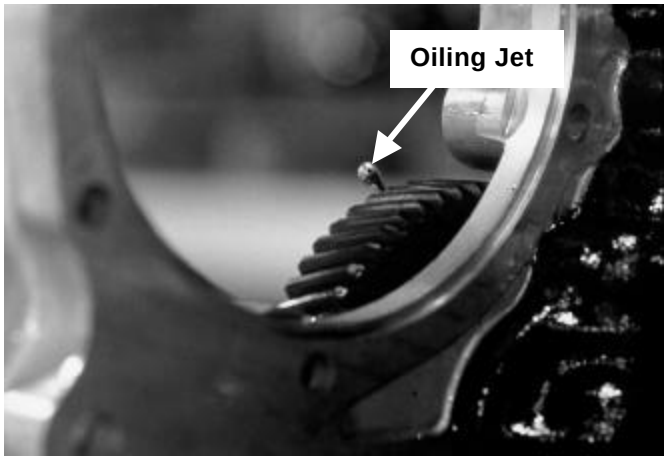
Drive Gear Timing (continued)

In addition to ensuring proper gear timing, proper gear lubrication is achieved only if the oiling bushing and oiling jet are installed properly and functioning:



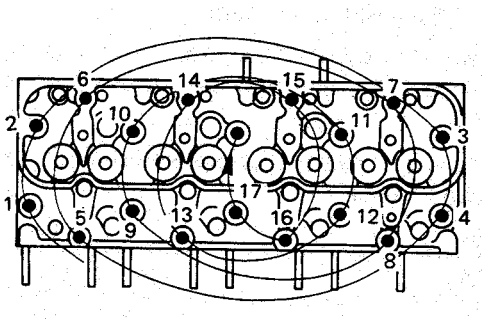
The central timing gear shaft bushing placement is critical. The oiling hole must be placed in the 12 o'clock position for proper lubrication.

With the central timing gear installed, an oiling jet provides additional lubrication to the idler and injection pump gears' mesh areas.



The idler gear (that meshes with the injection pump gear) has an oil passage drilled through the teeth to allow the oil from the center of the gear to flow outwards and properly lubricate the mesh area.

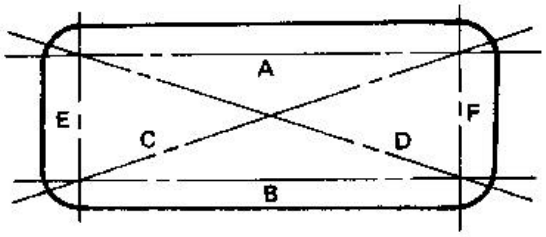
Cylinder Head



The J-series cylinder heads are cast iron with replaceable valve guides and valve seats.

Compression tests are conducted using a compression gauge adapter used as a glow plug insert, special tool number 5-88402-656-0. Refer to workshop manual for procedure.

The compression service limit for this engine is 370 psi (26.0 kg/cm^2). Standard pressure is 441 psi (31.0 kg/cm^2). Isuzu allows an 8% variance between neighboring cylinders on compression tests, but there can be no more than a 15% difference between any two cylinders.

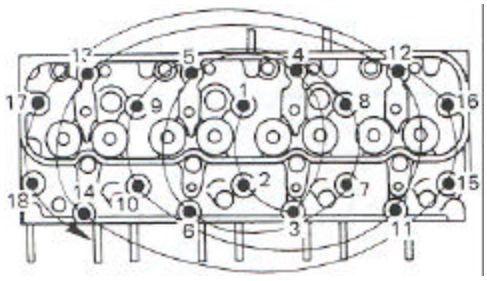


Letters A-F represent the different measurements that need to be taken to determine head warpage.

Lower face warpage specifications:
Standard: 0.05 mm. (0.002 in.)
Limit: 0.2 mm. (0.008 in.)
Max Grinding Allowance: 0.3 mm. (0.0118 in.)

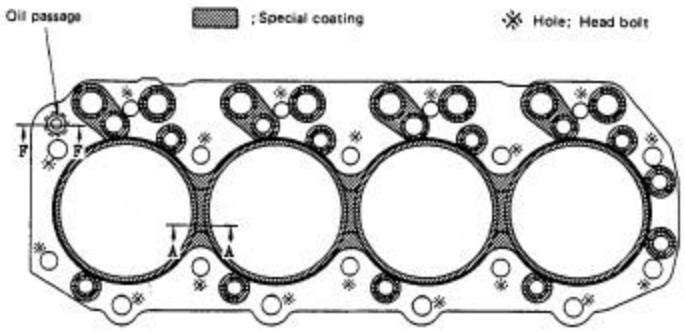
Head Height:
Standard: 91.95 – 92.05mm. (3.620 – 3.624 in.)
Limit: 91.65 mm. (3.61 in.)

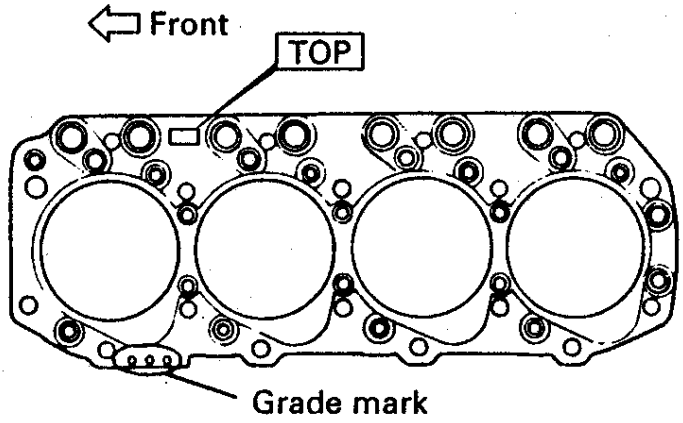
IMPORTANT: Valve depression must be checked to ensure that it is still within specification.



NOTE: The head gasket and torque angle head bolts cannot be reused.

Cylinder Head Gasket





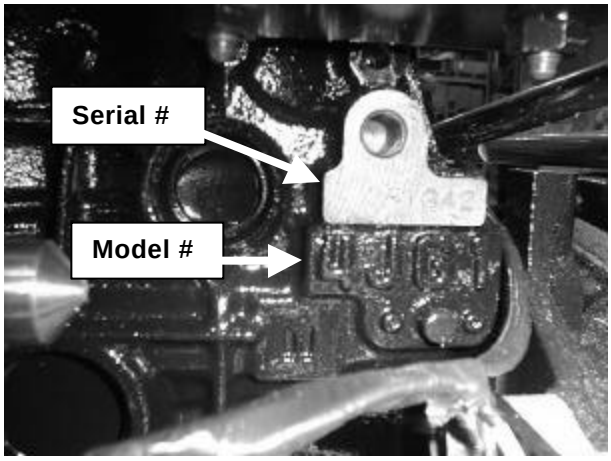
The J-series engines use a three layer ultra thin laminated steel head gasket that comes pre-coated with a silicon material.

Holes for coolant are drilled between the valve seats for effective cooling of the combustion area. The sealing bead surrounding the cylinders of the gasket is stainless steel. It protects the head gasket from the high cylinder pressures.

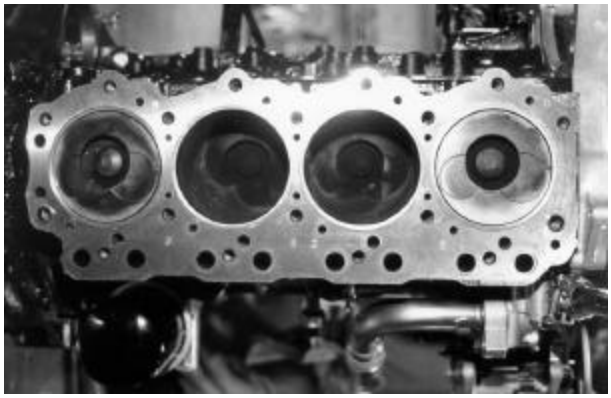
The cylinder head gasket is available in three grades (thickness), identifiable by the punched Grade Mark. The appropriate head gasket grade is selected according to the average measured piston projection. A good rule of thumb is that unless you are machining the deck, replace with the same grade (thickness) of gasket that came out.

During installation, the "TOP" mark of the gasket must be facing up and no additional application of sealers or gasket adhesives is necessary. In addition, no re-torqueing of the head bolts is required after the engine break-in period if the prescribed angular tightening method is used.

Cylinder Block

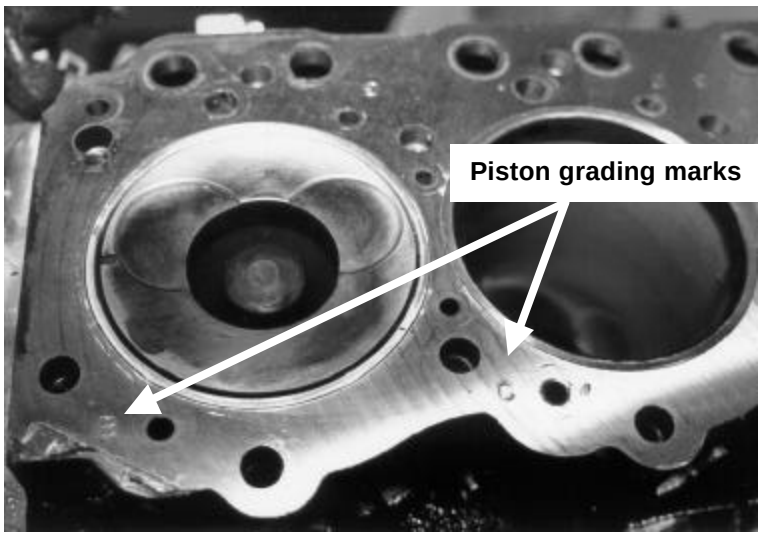


The engine’s serial number is stamped on the front of the engine block. This number is used by parts technical personnel to track an engine's application or verify a specification.

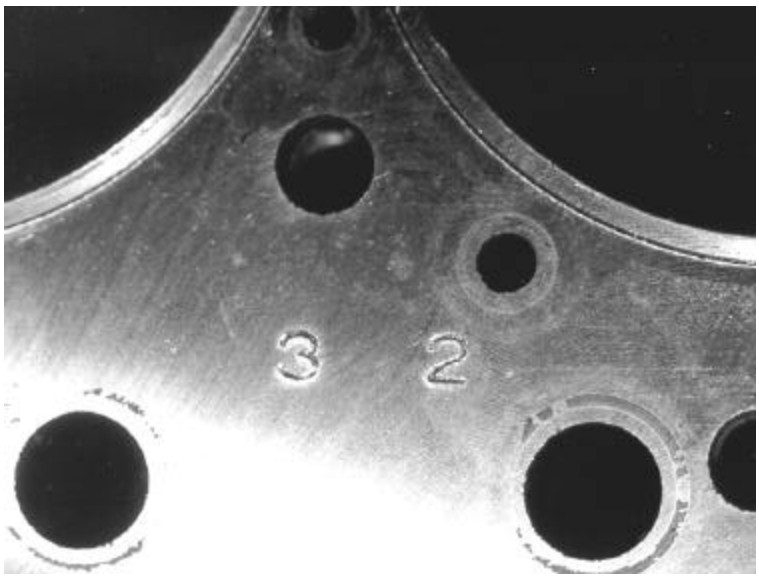


The engine block uses chromard cylinder liners that are removable for servicing.

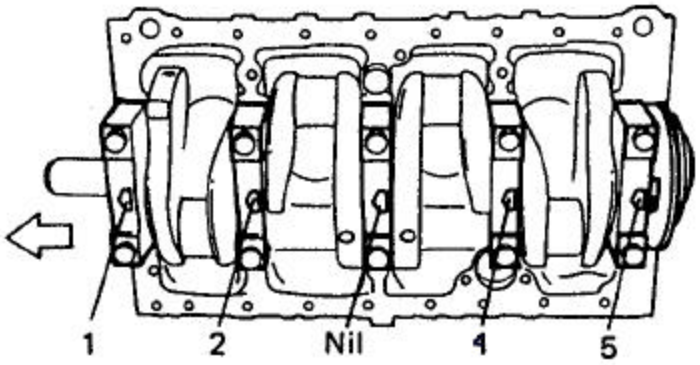
Cylinder Block (continued)



The letters stamped on the block deck surface represent the grade of the piston. If these letter(s) do not match the letters on the piston(s), the pistons have been replaced.



The number stamped on the block deck is the liner grading (referencing the outside diameter of the liner to fit the block).



The 4J block contains 5 main bearings. The caps are identified as detailed below:

#1 "1"
#2 "2"
#3 "3" (Cast in cap)
#4 "4"
#5 "5" (Cast in cap)

When installing the bearing caps, ensure that the arrows face forward.

Piston Sizing

Pistons are matched during assembly to the liner sleeve bore internal diameter dimensions. The number stamped on top of the piston represents the last four digits of that piston's part number.

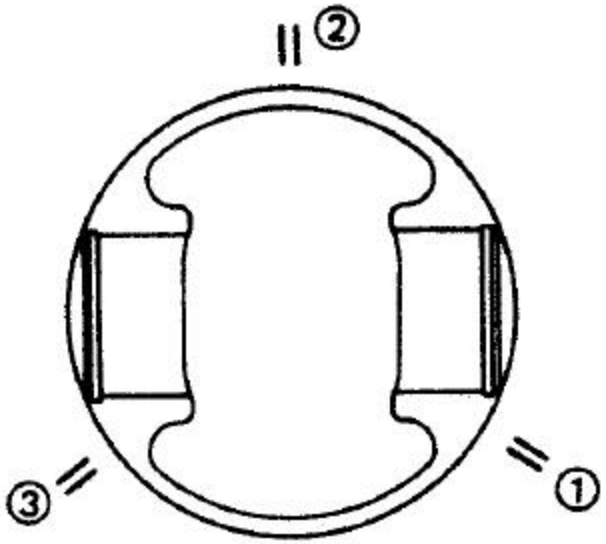
The letter stamped in the piston should match the letter stamped on the block deck surface. (If it doesn't, the piston has been replaced.)

J-Series engines use replaceable cylinder liners. A kit containing a new piston and liner is used when servicing engines under warranty. This liner and piston kit needs to be sized according to the number stamped on the block.

Please refer to bulletin #AIPDN-PTS-ED02-98 for ordering replacement pistons.

Piston Ring Installation

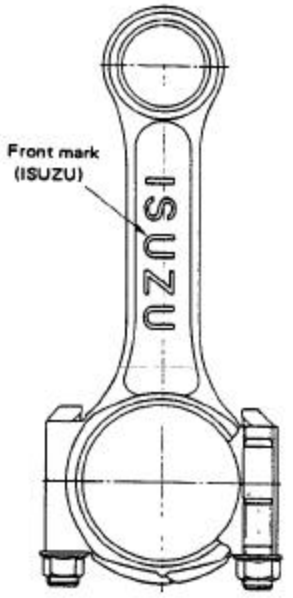
Piston rings are installed on the piston with the "N" mark facing up.



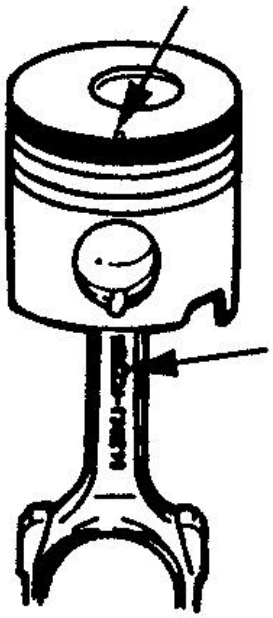
The piston ring gaps are placed 120° apart.

① 1st (top) compression ring
② 2nd compression ring
③ Oil control ring

Connecting Rod

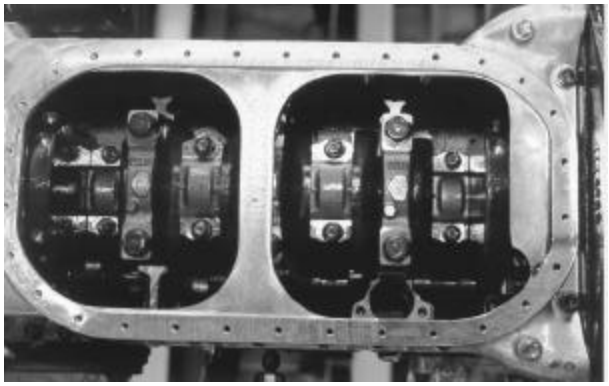


A forged steel I-beam connecting rod is used for all J-series engines.



NOTE: When removing and replacing the connecting rod assemblies, be sure to install the connecting rod with the Isuzu Logo facing the same direction as the piston's notch. Both of these should face the front of the engine.

Crankshaft

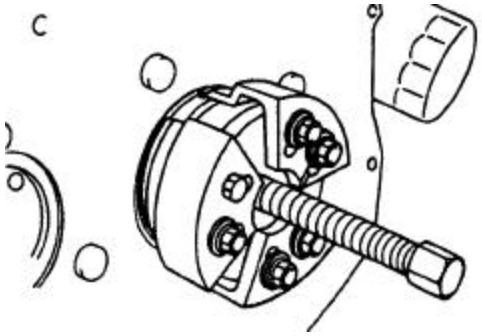


The crankshaft is forged steel with tufftrided main and connecting rod journal surfaces. Tufftriding is applied to the friction surfaces of the journals, crank pins and oil seal surfaces to improve wear resistance.

Each rod journal has its own set of counter weights to simplify balancing and help reduce crankshaft vibrations. Certain J-Series engines are externally balanced with the use of weights on the crankshaft damper. **NOTE: The dampers should NEVER be interchanged. Excessive engine vibration and damage will occur.**

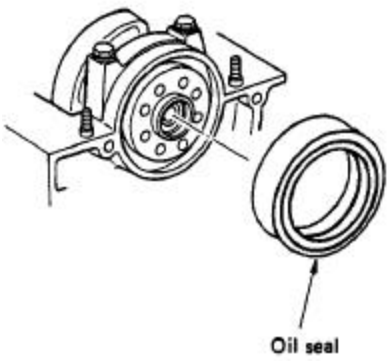
IMPORTANT: The crank is hardened using Tufftriding. Isuzu does not recommend grinding or polishing the crankshaft undersize.

Rear Axial Oil Seal

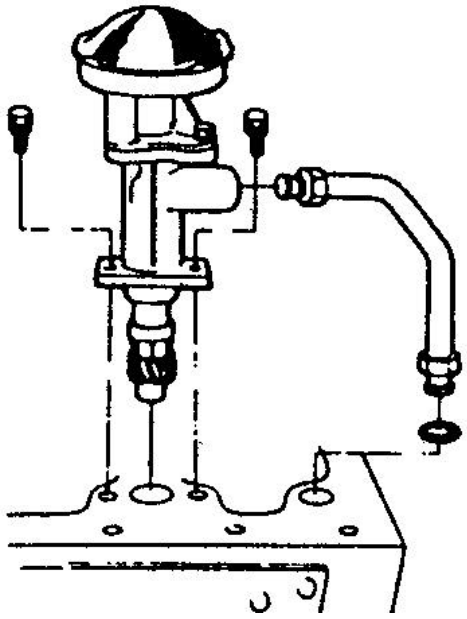


Removal of the rear oil seal is achieved with the use of special tool 5-8840-2360-0.

The oil seal is a 360° style with an integral oil slinger and presses onto the block.



Lubrication



Lubrication is achieved with a conventional wet sump oiling system. Internally, the oil pump uses a single rotor instead of spur gears or a set of rotors.

The pump is mounted under the engine block and driven by the camshaft.

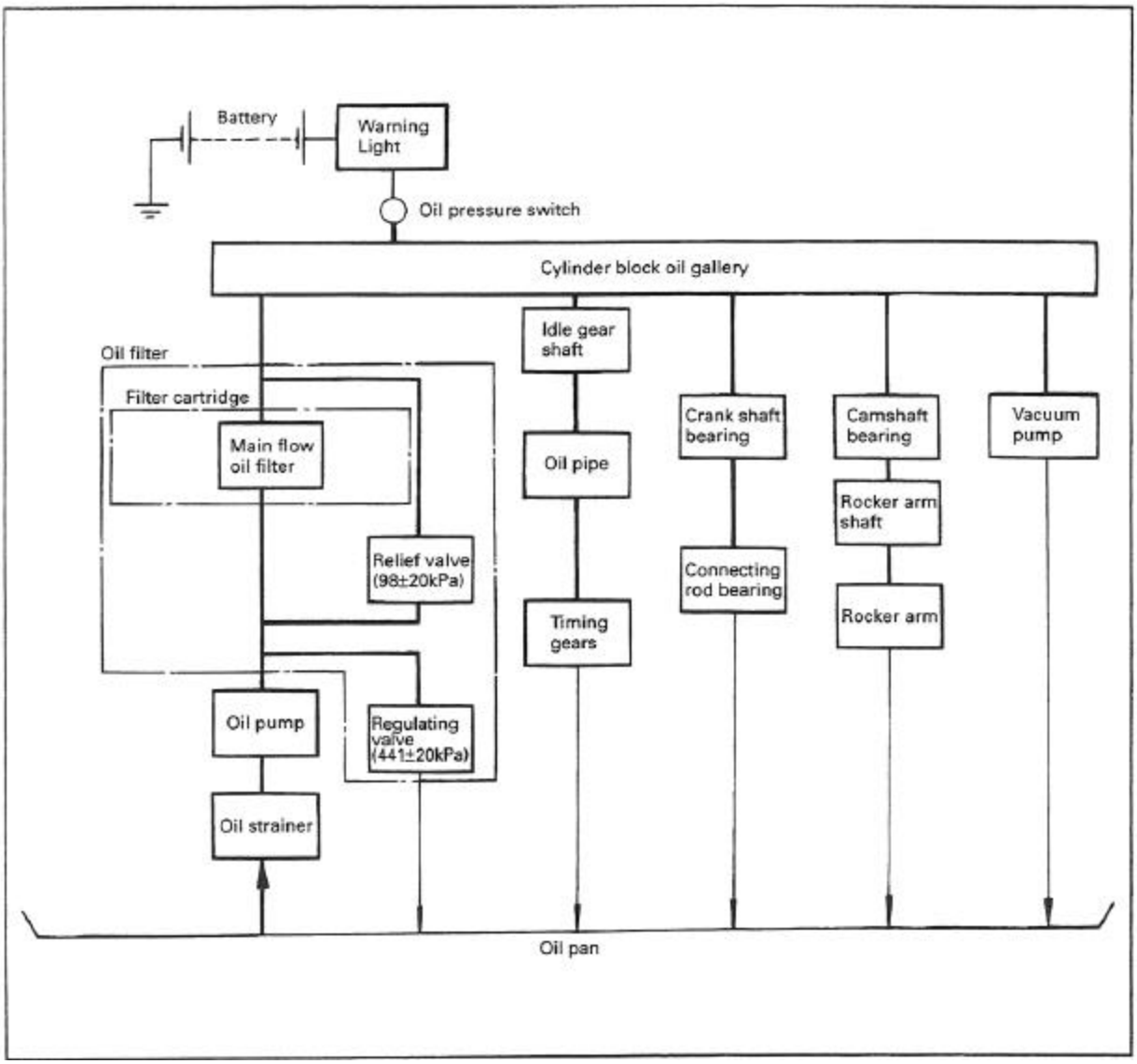
The journal oil feed routing is as follows:

Main		Rod
#1	→	#1
#2	→	#2
#3	→	Sump/Screen ASM
#4	→	#3
#5	→	#4

Lubrication (continued)

Below is the oil full flow diagram. Note the following valve opening pressures:

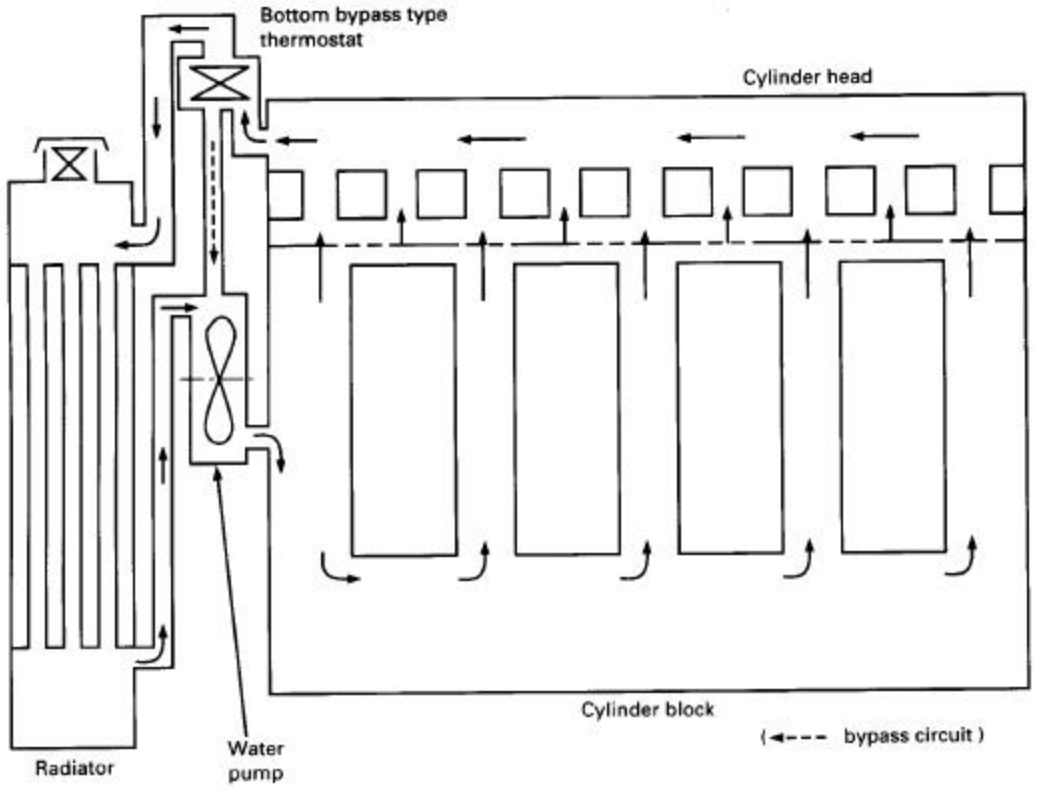
- For the oil filter bypass valve(**Relief Valve**), 14 PSI is where the valve *begins* to open.
- For the oil pump relief valve (**Regulating Valve**), 64 PSI is where the valve *begins* to open.



NOTE: Conversions to above pressure specifications.
20 kPa = 2.9 PSI
98 kPa = 14.21 PSI
441 kPa = 63.96 PSI

Cooling System

Below is the coolant flow diagram. Good coolant circulation is ensured by utilizing water jackets formed with a one-piece casting core, which eliminates burrs in the water passage.



Maintain a coolant/water solution concentration ratio of $^{50}/_{50}$. Use only de-mineralized (soft) water, since hard water tends to neutralize the corrosion inhibitors in the antifreeze and add scale (particularly in hot spots) to the cooling system. It is absolutely ***required*** that you use a ***low-silicate*** formula anti-freeze. Do not add any additional water pump lubricants to the cooling system. Refer to the Workshop Manual for radiator cap and cooling system testing and specifications.

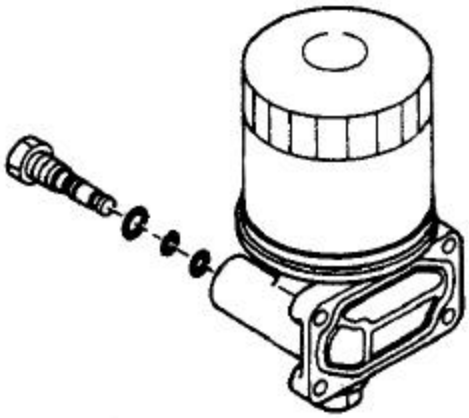
Use a commercially available antifreeze tester when testing for coolant/water mixture. Testing for pH is recommended, as too high an acidity or alkalinity can cause severe damage to the engine and cooling systems. The pH readings should be 7.5-8.5 (SAE J1034 allows for 7.5-11.0). Litmus test paper is available from most commercial tool suppliers and product distributors.

Oil Filter Change

The oil filter in the J-Series engine is mounted in an upright position. Therefore, a special draining procedure needs to be performed to avoid an oil spill when changing the filter.

1. Warm the engine to or near normal operating temperature.

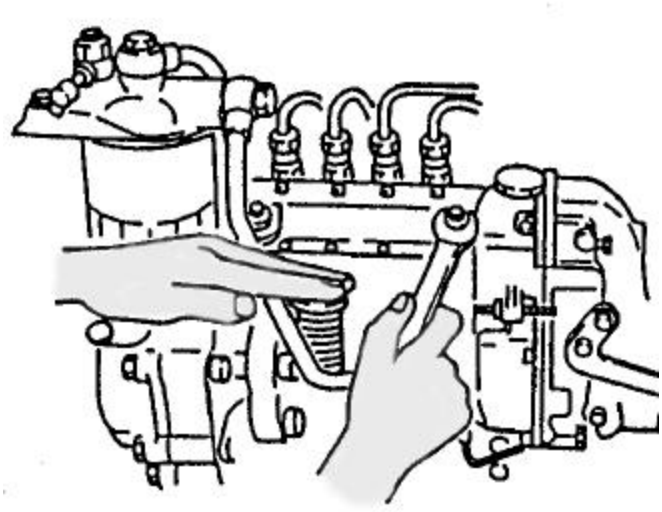
2. Loosen the oil drain bolt (*see arrow*) one full turn to allow the oil to drain out of the filter and down to the crankcase. (The time it takes to drain the oil from the oil pan is sufficient to thoroughly drain the filter.)



3. Once drained, remove the drain bolt entirely and replace the O-ring on the bolt (which is supplied with each Genuine Isuzu oil filter).

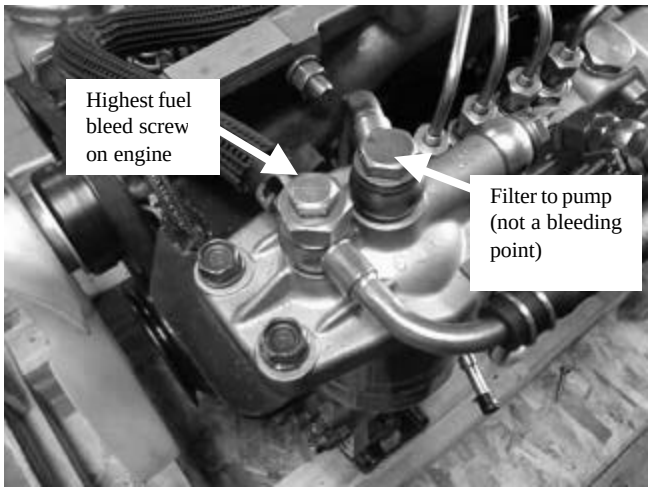
4. Install the oil drain bolt. Tighten to 14-22 lb. ft. (20-30 Nm).

Injection System Air Bleeding



Unscrew the feed pump priming knob and prime up the system.

Loosen the air bleeding screws on the injection pump.



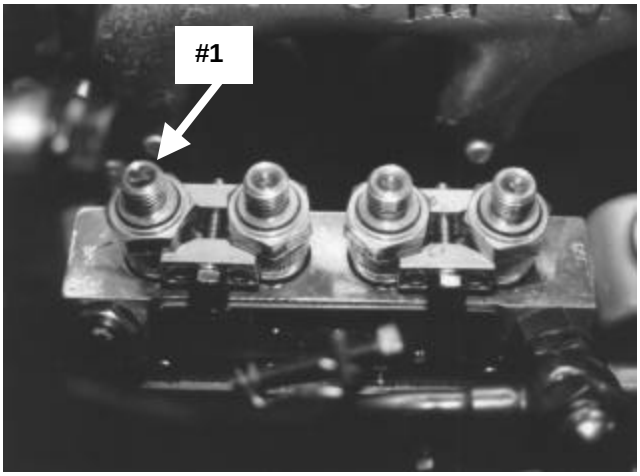
Pump the feed pump priming knob to force the air out of the system. Once the air is bled, tighten the bleeding screws. Clean up any excessive spills.

Start engine and check for leaks.

Spill Port Timing

Spill-port timing is a precise method of measuring the initial injection of fuel by the pump and the duration of injection. It is a standard procedure used by Isuzu when timing Zexel pumps. This procedure is a very precise method of timing fuel because it shuts off fuel to the high-pressure chambers relative to the position of the piston.

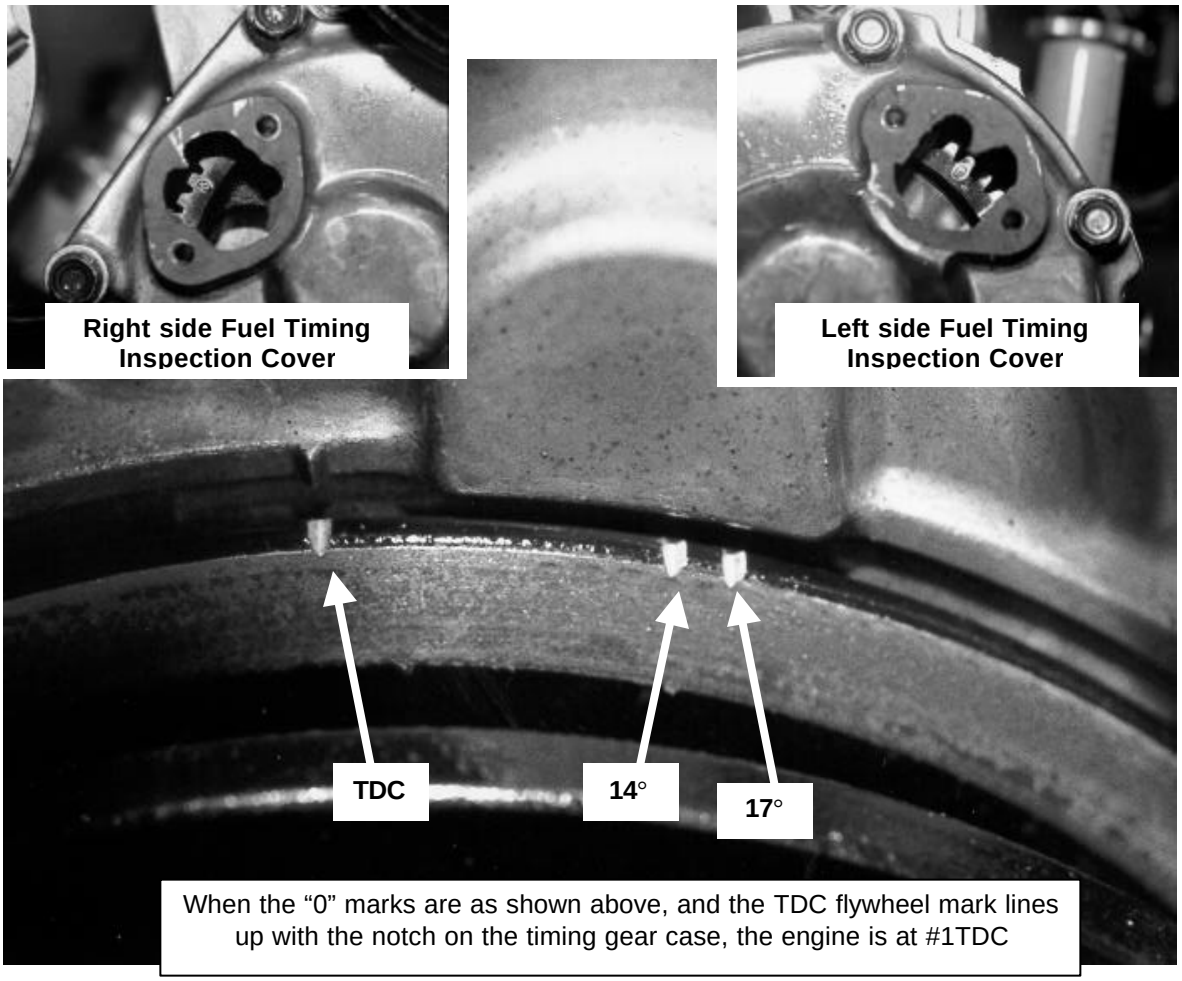
Disconnect and remove the #1 injection pipes from the nozzle and fuel pump.



First clean the fuel pump to prevent any foreign materials to enter the pump. Then remove the delivery valve holder from the injection pump. Then disassemble the delivery valve holder to remove the valve and valve spring. Replace the delivery valve holder. Tighten to 29-33 Ft. lbs.

Place the stop solenoid in the “on” or up position to allow full fuel flow. Bring the TDC mark to 90° BTDC. Cover the valve assembly with a rag and prime the pump. Uncap the fuel return to bleed any air in the system. Then rotate the engine clockwise until fuel quits flowing out of the holder. This is the beginning of the injection.

Spill Port Timing (continued)



When the "0" marks are as shown above, and the TDC flywheel mark lines up with the notch on the timing gear case, the engine is at #1TDC

Observe the reading on the crank pulley in relation to the timing marks on the gear case cover. Note crankshaft's position and adjust as necessary. Loosen the injection pump cradle bolts and all fuel lines from pump to injectors (at both ends). Pull the pump away from the block to advance the timing, push towards the block to retard. **NOTE: Refer to the proper specification sheet for timing adjustment information.**

After spill port is performed, be sure to reassemble all components and install correctly for proper operation. Refer to appropriate Workshop Manual for procedures and torque specifications.

Valve Adjustment

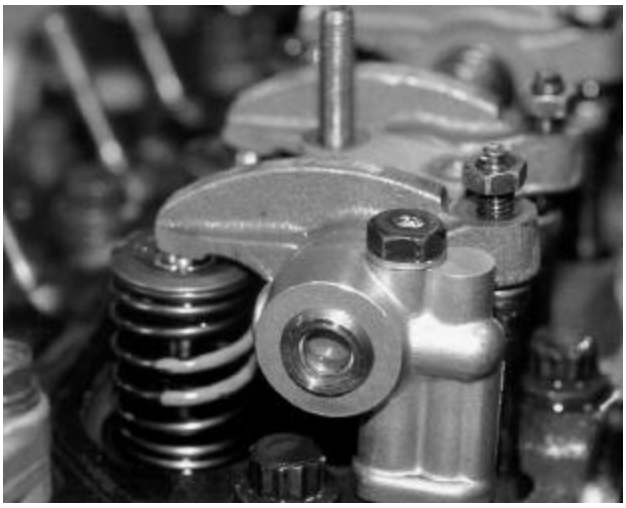
Bring the engine up on number one compression stroke. Verify the position by checking for clearance in-between the valve stem tip and the rocker arm. **NOTE: Valves can be adjusted beginning with #1 or #4. This adjustment should not be made with the engine running.**

Cylinder Number	1		2		3		4	
Valve Arrangement	I	E	I	E	I	E	I	E
Valve Numbers	✓	✓	✓	---------	---------	✓	---------	---------

Loosen the adjuster jam nut; insert a 0.40 mm (0.016”) feeler gauge in-between the rocker tips and the valve stems to adjust the valves. **NOTE: Proper adjustment is obtained when there is a slight drag against the feeler gauge. Jam nut torque is 5.8-8.7 lbs. ft (0.8-1.2 kg m)**

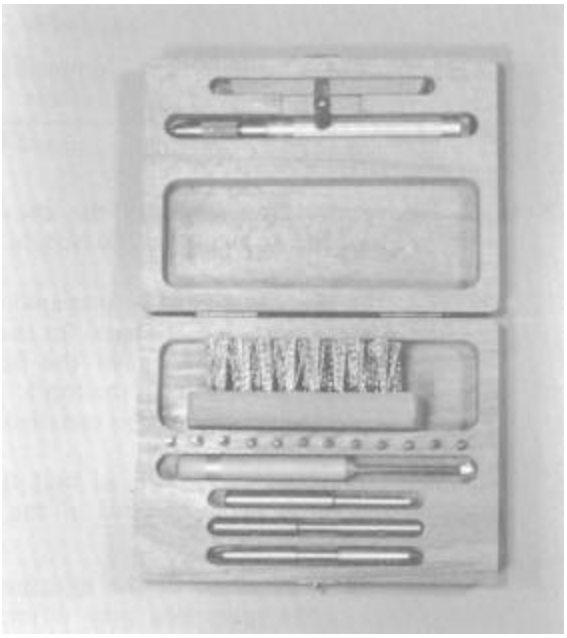
Rotate the crankshaft 360° (so that the opposing piston is now on its exhaust stroke) and adjust the remaining valves.

Cylinder Number	1		2		3		4	
Valve Arrangement	I	E	I	E	I	E	I	E
Valve Numbers	---------	---------	---------	✓	✓	---------	✓	✓



Injector Service

The following procedures are service recommendations from Zexel:



Thoroughly clean all carbon residue and carbon build–up on the surface of the nozzle using Zexel cleaning kit #1057790010.

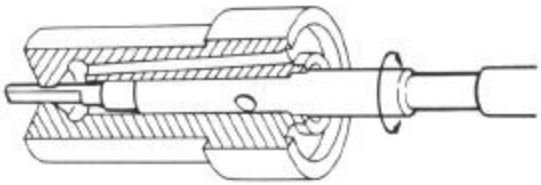
Soak all parts other than the nozzle in cleaning oil.

Use a soft wire brush to clean excessively dirty parts.

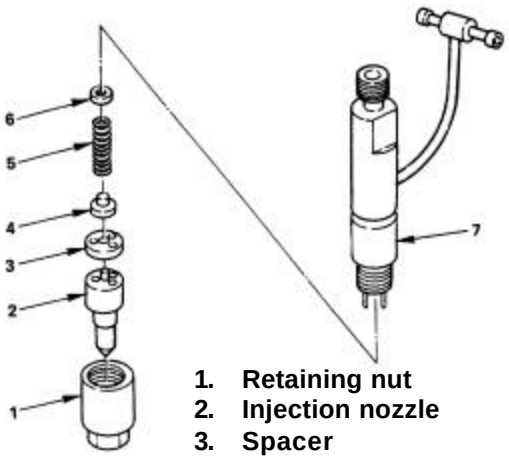
IMPORTANT! Do not use metal or abrasive cleaning media to clean the nozzle holder. Their abrasive nature will leave scars on the ground surface and may cause fuel leaks.

Injector Service (continued)

Remove the needle valve from the nozzle. Clean the seat's surface and shaft section using the piece of hardwood from the cleaning kit or a clean soft cloth dipped in oil.



Likewise, clean the spray hole with the special needle also supplied with the cleaning kit.



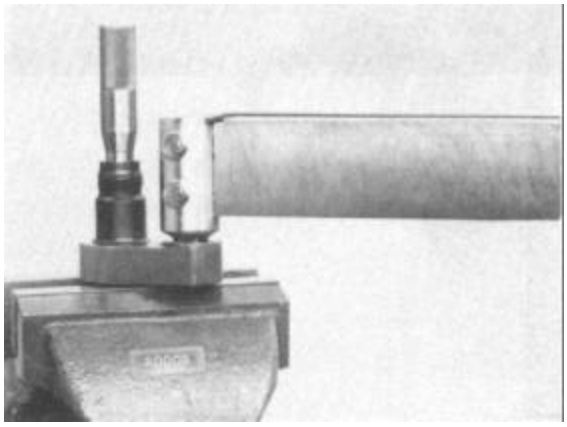
1. **Retaining nut**
2. **Injection nozzle**
3. **Spacer**
4. **Spring seat**
5. **Spring**
6. **Adjusting shim**
7. **Nozzle holder**

Re-wash the injector components to remove any final debris.

Reassemble the injector.

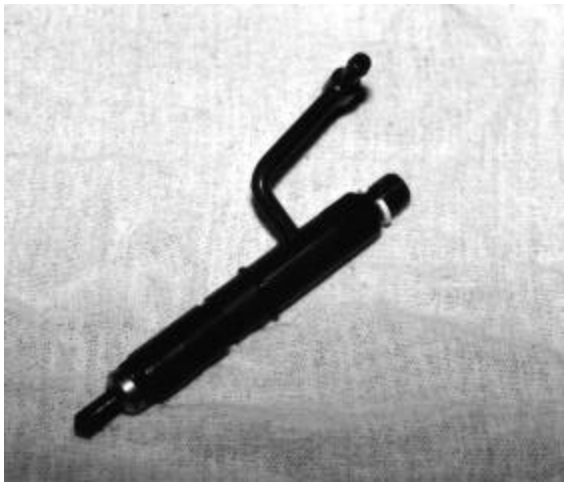
Injector Service (continued)

Note: Before assembling the injector, perform a needle slide test to ensure that there is no obstruction that could cause a fuel leak.



Insert the body nozzle holder to center the nozzle in the retaining nut. For reassembly torque specifications, see Appendix "Nozzle Holder Tightening Standards."

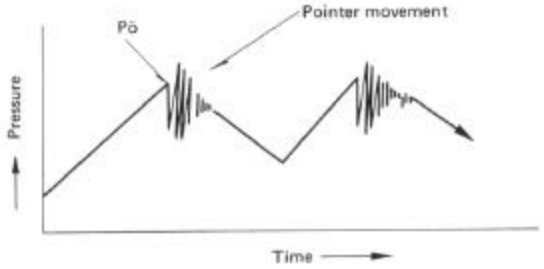
NOTE: Use a flare nut/crowfoot socket on the torque wrench.

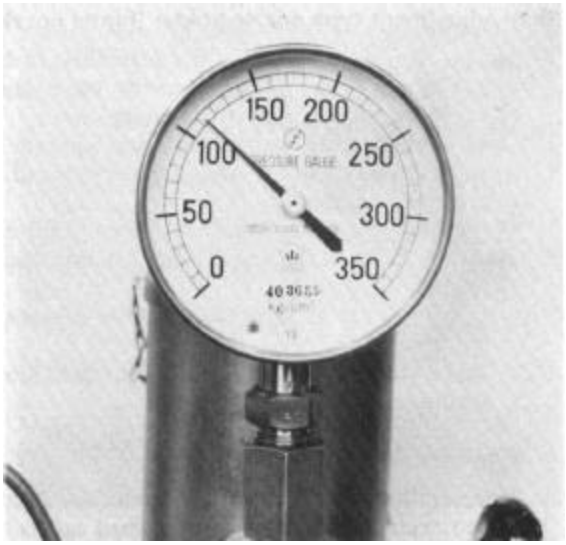


Install the nozzle assembly back into the head. Tighten the retaining nut with a torque wrench to 29-36 lb. ft. (39-49 Nm).

Injector Pop-off Test

WARNING: FLUID FROM THE NOZZLE TESTER WILL SPRAY OUT UNDER GREAT PRESSURE. IT CAN EASILY PUNCTURE A PERSON'S SKIN. KEEP YOUR HANDS AWAY FROM THE NOZZLE TESTER AT ALL TIMES.





Use the following procedure to check nozzle opening pressure, spray pattern, chatter and leakage:

Mount the nozzle and holder assembly to the gauge (J28829) and bleed the system of air.

Open the pressure gauge valve and pump the lever at a rate of one stroke per second.

Then check the opening pressure. When the pressure gauge pointer decreases rapidly, read pop-off value. (Refer to engine's specification sheet for values. An Indirect Injection will have lower readings than a Direct Injection engine.)

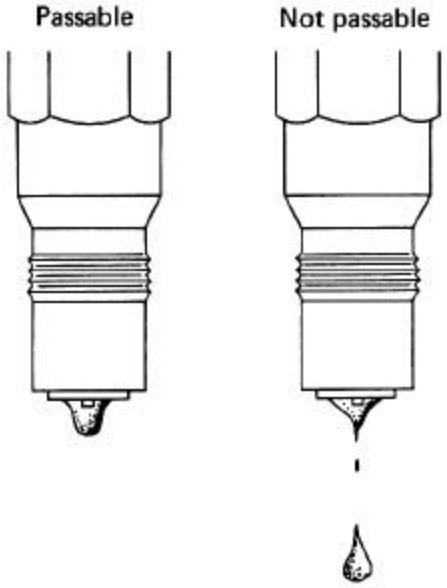
IMPORTANT! If the nozzle opening pressure is not steady or cannot be checked the trouble is with the nozzle assembling procedure.

If the nozzle "pop-off" pressure does not meet factory pressures, disassemble the nozzle and make a shim adjustment. If the pop-off pressure is low, increase the shim thickness.

The following size shims are available through AIPDN.

4JG1	4JA/B/C1
Shim Sizes mm	Shim Sizes mm
0.1-0.5mm (.1mm increments)	0.50-1.50mm (0.025mm increments)
0.51-0.59mm (.01mm increments)	

Injector Leak Test



The leak test should be conducted immediately following the nozzle opening pressure adjustment check.

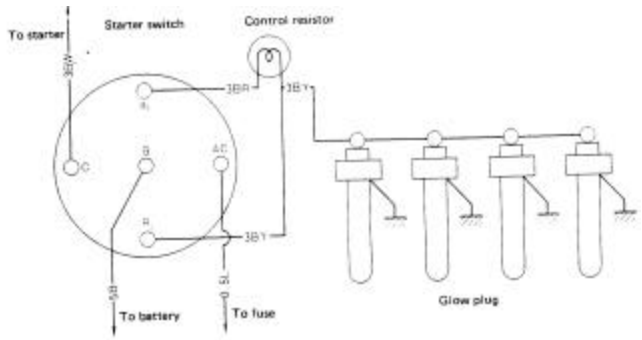
⇒ Wipe the nozzle with a clean shop towel.

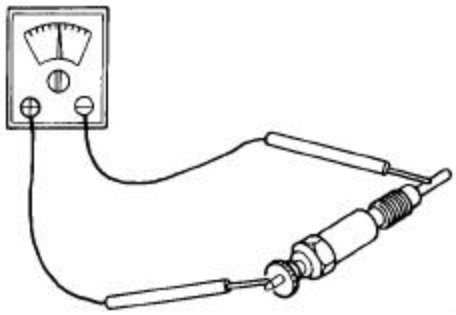
⇒ Decrease the tester pressure about 20 kg/cm^2 less than the pop-off pressure and maintain the position.

⇒ There should be no fuel discharge from the nozzle for at least 10 seconds.

⇒ Re-clean or replace any nozzle that doesn't meet the criteria.

Glow Plug Inspection





The following procedure tests the resistance value of the glow plug. **NOTE: The test can be performed on or off the engine.**

Total glow plug resistance value should be £ 0.9 ohms.

On engine service:

- Remove the buss bar from the glow plug.
- Attach the DVOM red lead to the to the tip of the glow plug.
- Attach the DVOM black lead to a good ground source. Verify the ground integrity by testing it with the DVOM.

Off engine service:

- Disconnect and remove glow plug.
- Place DVOM leads across glow plug (one lead at each end) to obtain resistance reading.

IV. Engine Repair Specifications – 4J

Maintenance Specifications

Item	Metric Measure	US Measure
Engine Oil Capacity ① *4JA/B/C1* *4JG1*	5.5 L 7.6 L	5.8 Qts. 9.6 Qts.
Engine Oil Pressure ⑤		
Compression Pressure ②	3.04 Mpa	441psi
Valve Adjustment	0.40mm	0.016in.
Engine Coolant Capacity ③	5.0 L	5.3 Qts
Injection Starting Pressure	18.1 Mpa	2630 psi
Injection Timing ④ *4JA/B/C1* *4JG1*	17° BTDC 16° BTDC	
Glow Plug Resistance	.7-.9 Ohms	

① These specifications vary depending upon the type of equipment in which the engine is being installed. Only use API class CD or better.

② First warm up engine until coolant temperature reaches 167° F (75° C)
Measured at 250 rpm
Service Limit is 26 Kg/cm^2 (370 psi)

③ Use only an Ethylene glycol based anti-freeze/ water mixture. A $^{50}/_{50}$ concentration ratio provides maximum protection to –37°C or –34°F. Never exceed a $^{60}/_{40}$ concentration ratio, which provides protection to ≈ -50°C or –58°F.

④ Timing may vary depending on engine specification.

⑤ Pressure may be lower at engine idle.

Mechanical Specifications

Cylinder Head/ Valve Train	Standard	Service Limit
Valve Clearance①	0.40mm. (0.016in.)	N/A
Cylinder Head Lower Face Warpage②	0.05mm. (0.002in) or less	0.2mm. (0.008in.)
Cylinder Head Height ③	91.95-92.05mm . (3.620-3.624in.)	91.65mm. 3.60 in.
Valve Depression ④	.65mm. (.026 in.) 1.10mm (.043in.)	1.28mm. (.050in.) 1.60mm (.063in.)
Valve Thickness ⑤ Intake Exhaust	1.79mm. (.070in.) 1.39mm (.0547in.)	1.1mm. (.043in.) 1.1mm. (.043in.)
Valve Stem Diameter Intake Exhaust	7.946-7.961mm. (.3128-.3134in.) 7.921-7.936mm. (.3118-.3124in.)	7.88mm. (0.3102in.) 7.88mm. (0.3102in.)
Valve Spring Free Height	49.7mm. (1.96in.)	48.2mm. (1.9in.)
Valve Seat Angle	45°	

① Valve adjustment clearances are establis hed cold.

② Maximum grinding allowance is 0.3 mm/ 0.0118 in

③ Measurement is established by measuring from the head's sealing surface to the rocker bracket surface area.

④ Dimension taken from the cylinder head surface to the top of the valves

⑤ Specification is for both intake and exhaust valves.

Lubrication and Sealant Specifications

Application	Thread Lockers	Lubricants	Sealant
Flywheel Bolts	----------	Engine Oil	----------
Oil Pan	----------	----------	TB1207C
Rocker Bracket①	----------	----------	TB1207C
Air Inlet Pipe	----------	----------	TB1207C
Front Plate (PTO only)	----------	----------	TB1207C
Timing Case $^{w}/_{wo}$ PTO	----------	----------	TB1207C
Water Pump	----------	----------	TB1207B
Core Plugs	----------	----------	TB1207B
Injection Pump Housing Cover	----------	----------	TB1207C
Fuel Cut Solenoid	----------	----------	TB1207C
Oil Seal Retainer	----------	----------	TB1207C
Connecting Rod Bolts	----------	Engine Oil	----------
Cylinder Head Bolts	----------	Engine Oil	----------
Main Cap Bolts	----------	Engine Oil	----------
Head Gasket	----------	----------	----------
Exhaust Gasket	----------	----------	----------
Oil Pump O-ring	----------	Engine Oil	----------
Oil Strainer O-ring	----------	Engine Oil	----------
Drain Plug O-ring	----------	Engine Oil	----------
Head Cover Gasket	----------	----------	----------
Oil Pump Back Cover	----------	----------	----------
Camshaft	----------	Extreme Pressure Lubricant	----------
Lifters	----------	Extreme Pressure Lubricant	----------
Engine Bearings	----------	Engine Oil	----------
Piston Pin	----------	Engine Oil	----------
Pistons	----------	Engine Oil	----------
Piston Rings	----------	Engine Oil	----------
Valve Guides	----------	Engine Oil	----------
Valves	----------	Engine Oil	----------

① During Installation of the rocker arm bracket, be sure not to cover the rocker shaft oil passage.

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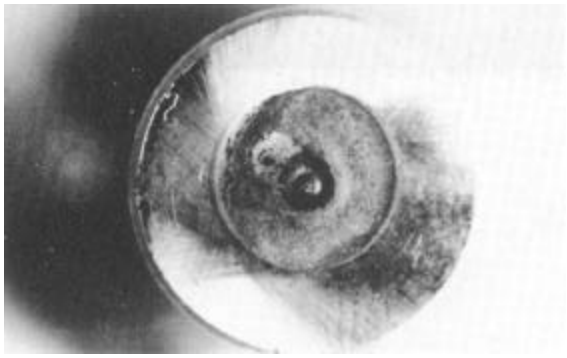
Fuel System

Nozzle Holder component failure

Description:
Broken coil on the holder spring directly related to large amounts of carbon build – up on the nozzle spring. Carbon build-up can also be seen on the push rod. This condition is directly related to combustion gases passing through the nozzle holder spring chamber. Problem can be avoided be routine inspection of the nozzles.

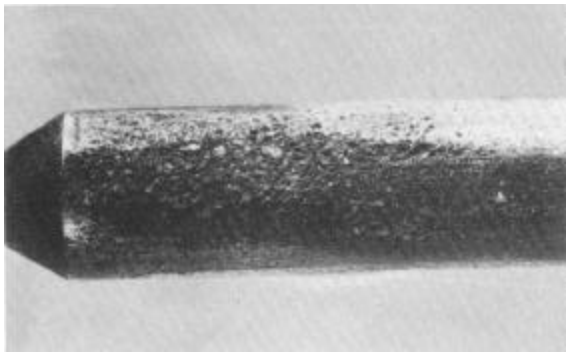
Description:
Broken coil due to oxidation caused by moisture or high sulfur content in the fuel. Condition can be prevented through routine inspection of the fuel and filter.



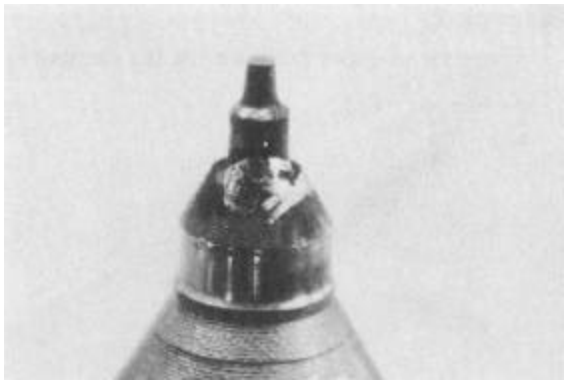
Description:
Sulfuric acid corrosion at the pintal caused by high sulfur content in the fuel. This is a result of water reacting with the sulfur to form sulfuric acid.

Fuel System

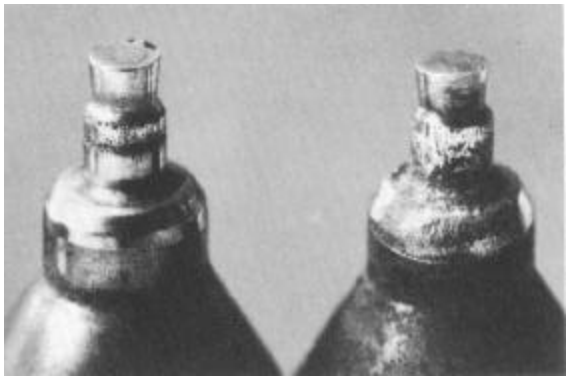
Nozzle component failure (continued)



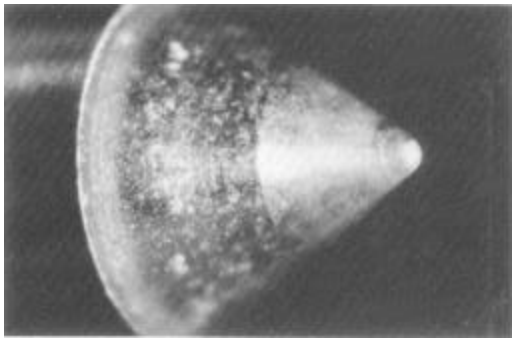
Description:
Corrosive abrasion of the pintal nozzle edge caused by direct contact with blow-by of the combustion gases in the combustion chamber.



Description:
Nozzle seat damage caused by metal contaminants in the fuel that pressed onto the seat area. The condition can cause leaks or distorted spray patterns from improper nozzle seating.



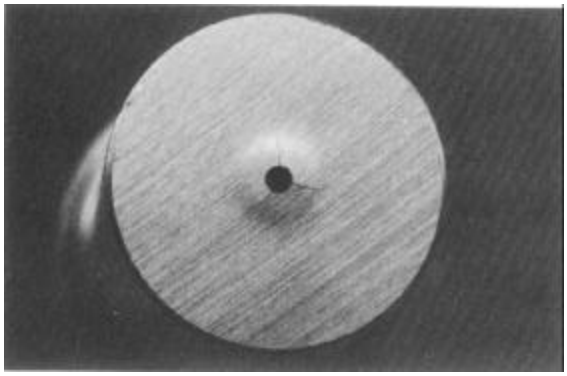
Description:
Pintal valve abrasion caused by sulfuric acid. This condition will cause the nozzle to stop functioning.



Description:
Foreign material build-up on the nozzle seat surface. This condition will cause an injector leak.

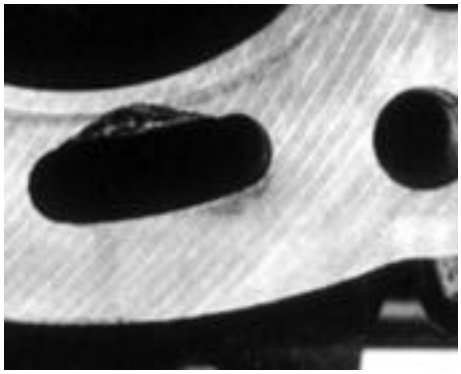
Fuel System

Nozzle component failure (continued)



Description:
Damage to the nozzle seat and spray hole sections when the nozzle holder is over tightened.

Cylinder Block



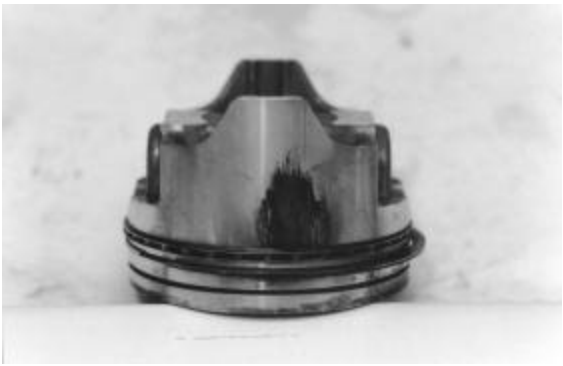
Description:
Damaged head gasket, cylinder head, pistons, connecting rods and crankshaft caused by poor cylinder block casting, cooling system cavitation, or cooling system electrolysis.

Description:
Low oil pressure readings or premature engine bearing wear due to missing internal oil galley plugs.

Piston

Description:
Piston Failure due to reusing a previously cracked piston skirt.

Description:
Broken piston skirt tang due to excessive piston to wall clearance. (Creates piston slap sound).



Description:
Seized piston skirt due to insufficient piston to wall clearance. (a.k.a. piston galling).

Description:
Failed piston due to lack of oil in the engine at the time of failure.

(Heat failure can be identified by "4 point" scoring resulting in vertical scoring on the sides of the pin boss on both sides of the piston.)

Piston Failure

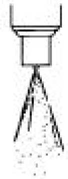
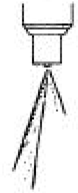
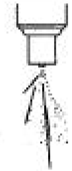
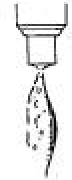
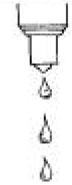
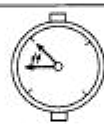
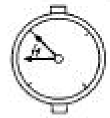
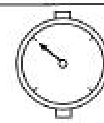
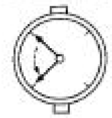
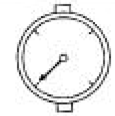
Description:
A wrist pin seized in this bore due to a previously used bent wrist pin or damaged piston pin bore.

Description:
(Normal piston skirt wear)

NOZZLE
TROUBLESHOOTING GUIDE

Condition: Nozzle opening pressure too low	Nozzle opening pressure too high	Unsatisfactory chatter	Oil leak from nozzle seat	Improper spray pattern	Excessive pressure drop	External oil leak	Cause
●	●						Improper adjustment of nozzle opening pressure
	●	●		●			Clogged pintle nozzle hole and spray hole (carbon residue, foreign matter)
	●	●	●	●	●		Needle valve sticking
●		●	●	●	●		Abrasion, damage or accumulation of foreign matter at seat section
		●		●			Damage to pintle section of needle valve (pintle type nozzle)
●		●		●			Broken needle valve holding shaft
		●			●		Corrosion of sliding section
●		●					Damage to nozzle spring
●		●					Damage to push rod
					●	●	Scars or wear to nozzle's high pressure surface
					●	●	Scars or wear to spacer's high pressure surface
					●	●	Scars or wear to holder's high pressure surface
					●	●	Foreign matter accumulation in each mating surface of nozzle, spacer and holder
					●	●	Insufficient tightening of inlet connector
					●	●	Defective gasket of each seal section
			●				Damage or excessive wear to nozzle hole area
		●		●		●	Defective retaining nut (deformation caused by corrosion or insufficient cleaning)

PERFORMANCE EXAMPLES OF USED NOZZLES

Judgement Rank	A	B	C	D	E
Spray pattern example					
Pressure gauge pointer movement	 Continuously moves in the neighborhood of nozzle opening pressure.	 The sames as "A"	 Stabilizes and does not move in the neighborhood of nozzle opening pressure.	 Rises to nozzle opening pressure, but the pressure markedly drops.	 Pressure does not rise even when the tester handle is operated.
Spray pattern	Almost uniform	Extremely non-uniform	Atomizes, but no pulsation of needle.	Incorrect atomization with extreme after-drip.	Dripping
Possible cause of malfunction	(Normal)	1) Common cause is carbon residue sticking to the nozzle edge. 2) Occasionally the needle edge is damaged or broken.	1) A large quantity of carbon residue is sticking to the nozzle edge. 2) Occasionally caused by foreign materials caught in the spray hole.	1) Damage to the seat section. 2) Fine foreign matter caught in the seat section. 3) The seat section has worn excessively.	1) Needle stick 2) The seat section has been damaged or worn excessively. 3) Foreign matter caught in the seat section. 4) Damage to nozzle holder internal parts.
Judgement after nozzle cleaning (removal of carbon residue and foreign matter, etc.)	Usable as is.	Replace with a new nozzle if the "A" performance is not restored after cleaning.	The same as "B" ←	The same as "B" ←	The same as "B" Note: Replace with a new nozzle holder or parts (in the case of Item 4 above).

NOZZLE HOLDER TIGHTENING STANDARDS

Unit: kg-m

Parts / Type	Retaining nut	Nozzle holder plug	Adjusting screw lock nut	Cap nut	Leak off pipe joint bolt	Eye lock nut	Inlet connector
KB-S	M20x1.5 ZMC2 6–8 " Br 8–10 3/4-16UNF ZMC2 6–8 " ZMC2 8–10 M22x15 ZMC2 6–8 " Br 8–10 M24x1.5 Br 9–11	M22x1.5 Br 5–6	M8x0.75 Br 2.5	M22x1.5 ZMC2 4–5 " Br 5–6	M8x1 ZMC2 1–1.5 " Br 1–1.5 M8x1.25 ZMC2 1–1.5 " Br 1–1.5 M10x1 ZMC2 1.5–2 " Br 1.5–2		M12x1.5 ZMC2 5–6 " Br 6–7 M14x1.5 ZMC2 6–7 " Br 7–8 M16x1.5 Br 8–10 M18x1.5 Br 10–12
KBA . . S	M22x1.5 Br 10–12				M8x1 Br 1–1.5		M14x1.5 Br 7–8
KBL . . S	M20x1.5 ZMC2 6–8 " Br 8–10 3/4-16UNF ZMC2 6–8 " Br 8–10 M22x1.5 ZMC2 6–8 " Br 8–10 M24x1.5 Br 9–11			M14x1 ZMC2 3–4 " Br 4–5 M20x1 ZMC2 4–5 " Br 5–6 M22x1 ZMC2 4–5 M22x1.5 ZMC2 4–5 " Br 5–6	M8x1 Br 1–1.5 M8x1.25 ZMC2 1–1.5 " Br 1–1.5 M10x1 ZMC2 1.5–2 " Br 1.5–2		M12x1.5 ZMC2 5–6 " Br 6–7 M14x1.5 ZMC2 6–7 " Br 7–8 M16x1.5 Br 8–10 M18x1.5 Br 10–12
KB . . . T	M24x1.5 Br 18–20	M22x1.5 Br 5–6	M8x0.75 Br 2.5–3.5	M22x1.5 Br 4–5	M10x1 Br 1.5–2.0		029301-0090 M18x1.5 Br 10–12 029300-4030 M18x1.5 Br 1.5–17 150604-1420 M18x1.5 Br 150604-3820 M20x1.5 1.5–17
KB . . . U	M36x3 Br 24–27	M36x3 Br 12–14	M12x1.5 Br 2.5–3.5	M36x3 Br 10–12	M14x15 Br 5–6		M22x1.5 B4 20–23

Note: ZMC2 . . . . . Galvanizing and chrome treatment
Br . . . . . Black oxide coating

Parts / Type	Retaining nut	Nozzle holder plug	Adjusting screw lock nut	Cap nut	Leak off pipe joint bolt	Eye lock nut	Inlet connector
KBF . . .T	M24x1.5 Br 18–20	M22x1.5 Br 5–6	M8x0.75 Br 2.5–3.5	M22x1.5 Br 4–5	M10x1 Br 1.5–2.0		029301-0090 M18x1.5 Br 10–12 029300-4030 M18x1.5 Br 15–17 150604-1420 M18x1.5 Br 150604-3820 M20x1.5 15–17
KBF . . .U	M36x3 Br 24–27	M36x3 Br 12–14	M12x1.5 Br 2.5–3.5	M36x3 Br 10–12	M14x1.5 Br 5–6		M22x15 Br 20–23
KCA . . .S	M22x1.5 ZMC2 8–10 " Br 10–12					M12x1.5 ZMC2 4–5 " Br 4–5 M14x1.5 ZMC2 5–6 " Br 5–6	
KCA . . SD	M22x1.5 ZMC2 8–10 " Br 10–12					M12x1.5 ZMC2 4–5 " Br 4–5 M14x1.5 ZMC2 5–6 " Br 5–6	
KD . . . .S	M20x1.5 ZMC2 6–8 " Br 8–10 3/4-16UNF ZMC2 6–8 " Br 8–10 M22x1.5 ZMC2 6–8 " Br 8–10 M24x1.5 Br 9–11		M22x1 ZMC2 5–6 M22x1 Br 6–7	M22x1 ZMC2 5–6 " Br 5–6	M8x1 ZMC2 1–1.5 M8x1.25 " Br 1–1.5 M10x1 ZMC2 1.5–2 " Br 1.5–2		M12x1.5 ZMC2 5–6 " Br 6–7 M14x1.5 ZMC2 6–7 " Br 7–8 M16x1.5 Br 8–10 M18x1.5 Br 10–12
KDL . . .S	M20x1.5 ZMC2 6–8 " Br 8–10 3/4-16UNF ZMC2 6–8 " Br 8–10 M22x1.5 ZMC2 6–8 " Br 8–10 M24x1.5 Br 9–11		M22x1 ZMC2 5–6 M22x1 Br 6–7	M22x1 ZMC2 5–6 " Br 5–6	M8x1 ZMC2 1–1.5 M8x1.25 " Br 1–1.5 M10x1 ZMC2 1.5–2 " Br 1.5–2		M12x1.5 ZMC2 5–6 " Br 6–7 M14x1.5 ZMC2 6–7 " Br 7–8 M16x1.5 Br 8–10 M18x1.5 Br 10–12

Note: ZMC2 . . . . . Galvanizing and chrome treatment.
Br . . . . . Black oxide coating

VII. Appendix – Miscellaneous Service Information

Turbocharger Boost Pressure Diagnosis

Listen below are suggested checks for determining the cause of lowered turbo boost pressure (in the sequence they should be performed). To obtain maximum boost pressure, the engine must be operated at rated RPM under a full load condition. Boost pressure is measured with a mercury manometer. A pressure gauge may be substituted.

One of the following checks will uncover the reason for low boost pressure.
(Normal pressure is 11-16 psi.)

1. Check the throttle linkage for travel to full fuel position.

2. Measure the maximum no load engine RPM. Adjust if necessary.

3. Inspect the manifolds and turbo for cracks, loosened mounting bolts or leaking gaskets.

4. Check the intake and exhaust systems for restriction, i.e., dirty air cleaner, collapsed hose or crushed exhaust pipe.

5. Check the fuel system, i.e., air in the fuel, dirty fuel inlet screen (rock stopper), dirty fuel filter, contaminated fuel or reduce fuel delivery to the injection pump.

6. Check the valve clearance adjustment.

7. Check the injection nozzles, i.e., popping pressure, spray pattern or leakage.

8. While the injection nozzles are removed, check the compression pressure.

9. With the turbo mounted to the manifold inspect the following:
   It is necessary to remove the intake and exhaust piping from the turbo.
   a) The wastegate (if used) does not close completely.
   b) Check the compressor wheel for damage.
   c) Check the turbine side for heavy carbon deposits or damage.
   d) Measure the wheel shaft end play and bearing clearance.

10. Have the injection pump tested by an authorized Zexel dealer for proper calibration.

VII. Appendix – Miscellaneous Service Information

Exhaust Temperature Test

Exhaust temperature is measured with a pyrometer, thermo coupler, or infrared meter.

The temperature probe is installed in a straight section of the exhaust pipe approximately 6 inches from the turbo flange or manifold flange for naturally aspirated engines.

The reading is taken with the engine operating at rated output.

When the exhaust temperature is high, check the following: 1. Retarded timing. 2. Air intake system restriction. 3. Excessive exhaust system back pressure.

When exhaust temperature is low, check the following: 1. Low compression. 2. Inadequate fuel delivery from injection pump.

Crankcase Pressure Test (a.k.a. Blow-By Test)

Crankcase pressure is measured with a water manometer.
NOTE: 2 in. of water (or less) is normal. Pressure should never measure more than 2 in.

The manometer pickup tube is inserted into the oil level gauge tube, from which the level gauge has been removed. **Do not insert the tube into the oil.** Do not attempt to seal engine openings.

The reading is taken with the engine operating at rated output.

Inlet Manifold Pressure (Boost Pressure) Test

Boost pressure is to be measured with a mercury manometer. A pressure gauge may be used when a manometer is not available. 1 inch of mercury =.49 PSI

The measuring device is to be installed in or straight run of the inlet air pipe. The most desirable location is 6 inches from the inlet manifold flange.

The reading is taken with the engine operating at its peak rated output.

Specifications for these tests:

The results of all three of these tests will vary between engine models and between specifications of the same model. To find the specifications applicable to your particular engine, reference American Isuzu Motors Inc. Engine & Components Operations Publication #SV-5013-00 (“Engine Service Specifications Manual”).

Used Oil Sample Data (Limits)

Item	Unit of Measurement	Limit
Kinematic Viscosity	(@ 98.9°C (CST)/210° F	-20 to 50% of new oil
Total Base No.	KOH mG/G	1 (min.)
Total Acid No.	KOH mG/G	3 (max.)
B-Heptane Insoluble	Wt %	3 (max.)
Resin Insoluble	Wt %	Reference [1 (max.)]
Ash Sulfate	Wt %	Reference [0.5 (max.)]
Diesel Fuel Content	Wt %	5 (max.)
Water Content	Wt %	.5 (max.)
Worn Metal particle: Fe	PPM	150
Worn Metal particle: Cu	PPM	50
Worn Metal particle: PB	PPM	50
Worn Metal particle: Cr	PPM	20 (or 80..Cr-plated liner)
Worn Metal particle: Al	PPM	20-40
Worn Metal particle: Si	PPM	20

Based on testing a new oil sample of exact same kind as used oil.

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J-Series Diesel Engine

Technician Guide

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