

ISUZU DIESEL ENGINE

2KC1, 3KA1, 3KB1
3KC1, 3KB1



ISUZU MOTORS LIMITED

FOREWORD

The ISUZU industrial diesel engines are a product of ISUZU's long years of experience, advanced technology, and up-to date production facilities. ISUZU takes great pride in the superior durability and operating economy of these engines.

In order to get the fullest use and benefit from your industrial engine, it is important that you operate and maintain it correctly. This Manual is designed to help you do this.

Please read this Manual carefully and follow its operating and maintenance recommendations. This will ensure many years of trouble-free and economical engine operation.

Should your engine require servicing, please contact your nearest ISUZU engine outlet. He knows your engine best and is interested in your complete satisfaction.

All information, illustrations, and specifications contained in this Manual are based on the latest product information available at the time of publication.

ISUZU reserves the right to make changes in this Manual at any time without prior notice.

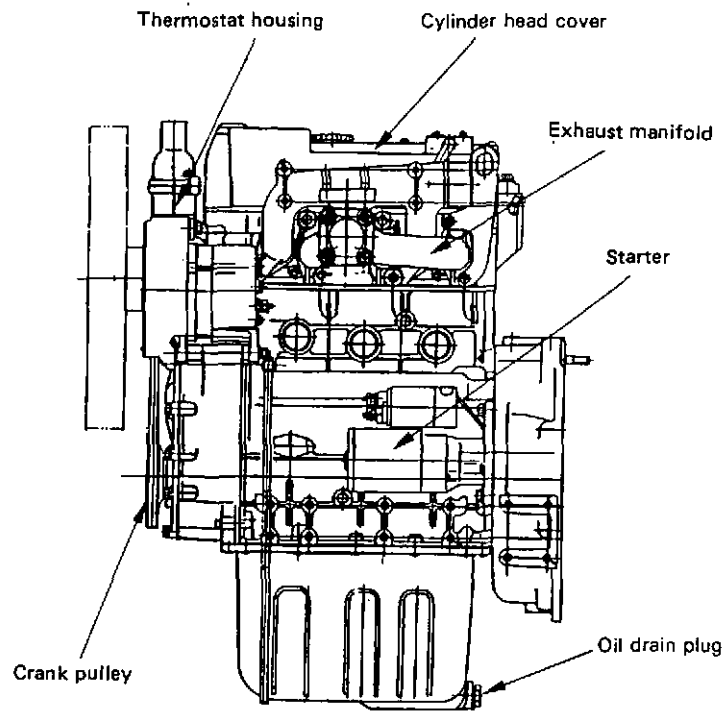
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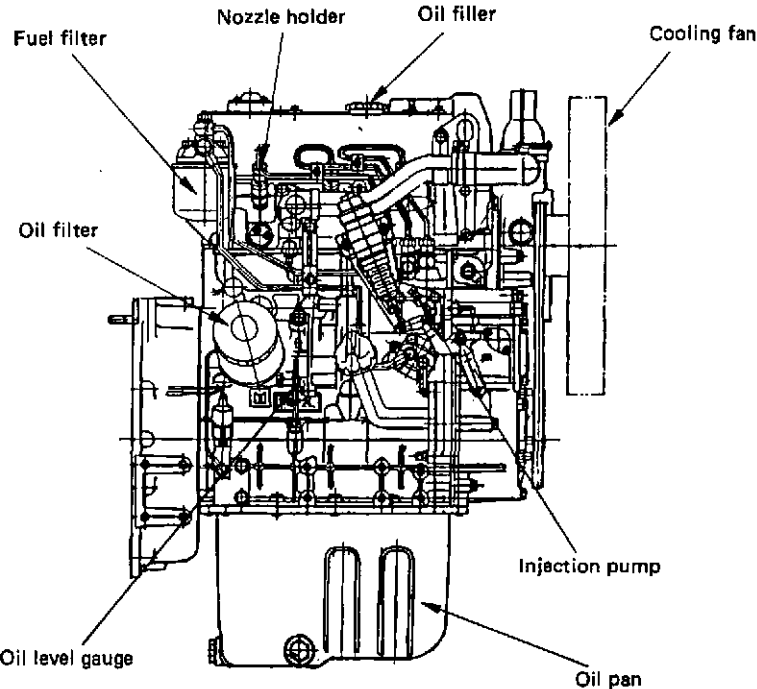
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I. ENGINE EXTERNAL VIEWS

EXTERNAL VIEW (LH)



EXTERNAL VIEW (RH)



II. GENERAL INFORMATION

MAIN DATA AND SPECIFICATIONS

(1) For 2KC1

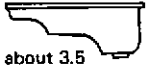
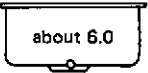
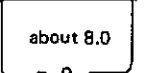
	2KC1
Engine type	Water cooled, four cycle, in-line overhead camshaft
Combustion type	Swirl chamber
No. of cylinders - bore x stroke (mm)	2 - 74 x 76
Piston displacement (cm ³)	653
Compression ratio	23 to 1
Firing order	1 - 2
Injection pump	Diesel Kiki PFR
Governor	Mechanical type
Injection nozzles	Throttle type
Specified fuel	Diesel fuel (ASTM D975 No.2-D)
*Starter (V-kW)	12 - 0.8
*Generator (V-A)	12 - 20

		2KC1
Battery recommended	(V-AH)	(12 - 65)
Specified engine oil		API, CC grade or CD grade
*Oil capacity	(liters)	3.5
Coolant capacity (Engine only)	(liters)	1.5
*Engine dry weight (★)	(kg)	82
*Engine dimension	Overall length	(mm) 450
	Overall width	(mm) 466
	Overall height	(mm) 600
Valve clearance (cold)	(mm)	0.25
Nozzle injection pressure	(kg/cm ²)	120
*Injection timing BTDC		60Hz Generator: 14° (only for USA; 18°) Except 60Hz Generator: 12° (only for USA; 16°)

- NOTE:**
1. These specification are based on the standard engine.
 2. Specification for items marked with an asterisk (*) will vary according to the type of equipment on which the engine installed. Oil capacity will vary depending on engine application. Please check the maker's specifications to determine the oil capacity of your engine.
If you are unable to locate these data applicable to your engine, please contract your machine supplier.
 3. ★: without Starter and Generator.

(2) For 3KA1, 3KB1, 3KC1

	3KA1	3KB1	3KC1
Engine type	Water cooled, four cycle, in-line overhead camshaft		
Combustion type	Swirl chamber		
No. of cylinders - bore x stroke (mm)	3 - 70 x 70	3 - 70 x 76	3 - 74 x 76
Piston displacement (cm ³)	808	877	980
Compression ratio	23 to 1		
Firing order	1 - 3 - 2		
Injection pump	Diesel Kiki PFR		
Governor	Mechanical type		
Injection nozzles	Throttle type		
Specified fuel	Diesel fuel (ASTM D975 No.2-D)		
* Starter (V-kW)	12 - 1.4		
* Generator (V-A)	12 - 20		

		3KA1	3KB1	3KC1
Battery recommended	(V-AH)	(12 - 65)		
Specified engine oil		API, CC grade or CD grade		
Oil capacity *(Varies depending on oil pan configuration)	(liters)	 about 3.5	 about 6.0	 about 8.0
Coolant capacity (Engine only)	(liters)	1.7		
*Engine dry weight (☆)	(kg)	101	103	103
*Engine dimension	Overall length	(mm) 535		
	Overall width	(mm) 453		
	Overall height	(mm) 595		
Valve clearance (cold)	(mm)	0.25		
Nozzle injection pressure	(kg/cm ²)	120		
*Injection timing BTDC		60Hz Generator: 14° (only for USA; 18°) Except 60Hz Generator: 12° (only for USA; 16°)		

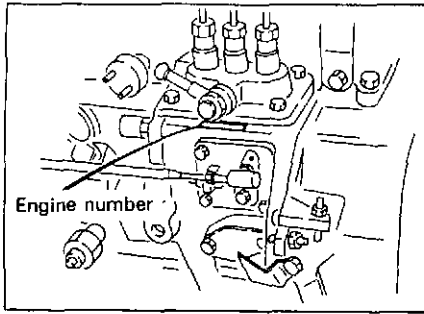
- NOTE:**
1. These specification are based on the standard engine.
 2. Specification for items marked with an asterisk (*) will vary according to the type of equipment on which the engine installed. Oil capacity will vary depending on engine application. Please check the maker's specifications to determine the oil capacity of your engine. If you are unable to locate these data applicable to your engine, please contract your machine supplier.
 3. ☆; without Starter and Generator.

(3) For 3KR1

		3KR1
Engine type		Water cooled, four cycle, in-line overhead camshaft
Combustion type		Swirl camber
No. of cylinders - bore x stroke	(mm)	3 - 81 x 92
Piston displacement	(cm ³)	1422
Compression ratio		21 to 1
Firing order		1 - 2 - 3
Injection pump		Diesel Kiki PFR
Governor		Mechanical type
Injection nozzles		Throttle type
Specified fuel		Diesel fuel (ASTM D975 No.2-D)
* Starter	(V-kW)	12 - 1.4
* Generator	(V-A)	12 - 20

		3KR1
Battery recommended	(V-AH)	(12 - 65)
Specified engine oil		API, CC grade or CD grade
*Oil capacity	(liters)	5.4
Coolant capacity (Engine only)	(liters)	3.1
*Engine dry weight	(kg)	132
*Engine dimension	Overall length	(mm) 592
	Overall width	(mm) 469
	Overall height	(mm) 668
Valve clearance (cold)	(mm)	0.25
Nozzle injection pressure	(kg/cm ²)	120
*Injection timing BTDC		Rated revolution 3600 rpm: 18° Except Rated revolution 3600 rpm: 16°

- NOTE:**
1. These specification are based on the standard engine.
 2. Specification for items marked with an asterisk (*) will vary according to the type of equipment on which the engine installed. Oil capacity will vary depending on engine application. Please check the maker's specifications to determine the oil capacity of your engine.
If you are unable to locate these data applicable to your engine, please contract your machine supplier.

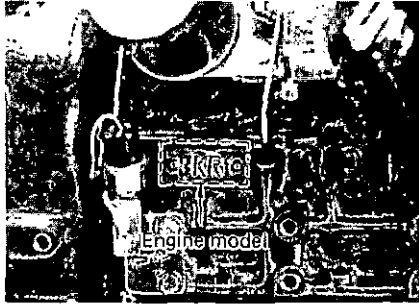


ENGINE IDENTIFICATION

The engine serial number is indelibly stamped on the engine right hand side front upper position as illustrated.

It is advisable to keep note of the engine serial number, engine model name and type of machine together with the machine manufacturer's name, as it is required when you contact with the distributor for repair service or parts ordering.

Engine model	Serial number
2KC1	000000
3KA1	000000
3KB1	000000
3KC1	000000
3KR1	000000



ISUZU ENGINE AFTER SERVICE


1. ISUZU ENGINE AFTER SERVICE

All ISUZU engines are covered with ISUZU engine outlets to support customers in engine after service and normal repair, the people will perform the supporting with aggressive interesting.



2. ISUZU GENUINE PARTS

The ISUZU genuine parts are identical with those of used in the engine production, accordingly, they are warranted by ISUZU MOTORS LIMITED.

The ISUZU genuine parts are boxed in a  marked boxes and supplied by the ISUZU distributors or the authorized parts supply outlets. Please designate "ISUZU Genuine Parts" when you need engine parts.

FUEL, LUBRICANT, AND COOLANT

1. FUEL

(1) Fuel Selection

The following specific natures are required for the diesel fuel.

- 1) Must be free from minute dust particles.
- 2) Must have adequate viscosity.
- 3) Must have high cetane value.
- 4) Must be less sulfur content.

It is strongly advisable to use ASTM D975 No. 2D (the general automotive diesel engine purpose fuel oil) or equivalent which fully meets the above requirement.

NOTE: *If fuel other than the specified on is used, the engine function will be lowered.
The engine failure or malfunction resulted by use of such improper fuel will not be warranted by ISUZU MOTORS LIMITED.*

(2) Handling of the Fuel

The fuel containing dust particles or water will cause an engine failure. Therefore, the following notice must be observed.

- 1) Take care to prevent the fuel from entry of dust particles or water when fuel is supplied to the fuel tank.
When fueling is done from an oil drum directly, keep the drum stationary in a long while, in order to use the clean fuel after the dust particles or water is completely sedimented.
- 2) Always fully fill the fuel tank. Drain the sedimented particles in the fuel tank frequently with opening the tank draining hole.

2. LUBRICANT

The quality of engine oil largely affects on the engine performance, startability and engine life.

Use of unsuitable engine oil will result a piston ring, piston and cylinder seizure and accelerates the sliding surface wear leading increased oil consumption, lowered output and, finally leads engine failure. To avoid this, use the specified engine oil.

(1) Engine Oil Selection

API, CC or CD grade

(2) Oil viscosity

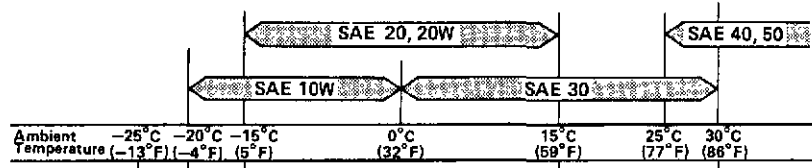
The engine oil viscosity largely affects on the engine startability, performance, oil consumption, speed of wearing and occurrence of seizure etc.

The use of lubricant with viscosity selected according to the atmospheric temperature is important as well as the use of a recommended type. (Refer to page 14)

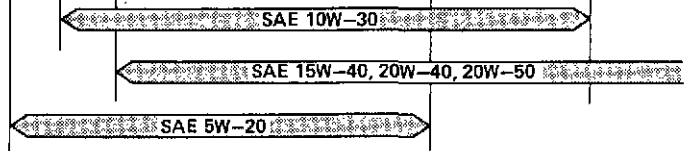
<p>NOTE: 1) <i>Use of an engine oil mixed with a different brand or different quality oil will adversely affect the original oil quality, therefore, never mixed-up the different brand oil or different type oil.</i></p> <p>2) <i>Don't use API, CA, CB grade and refined engine oil.</i></p>
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ENGINE OIL VISCOSITY GRADE-AMBIENT TEMPERATURE

[Single grade]



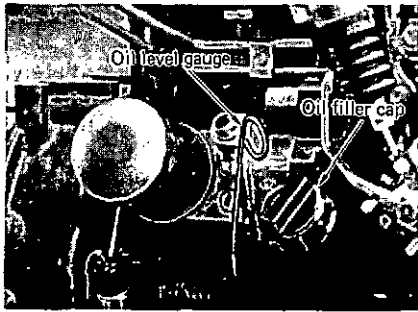
[Multi-grade]



3. COOLANT

Use a city water for coolant and replace it periodically.

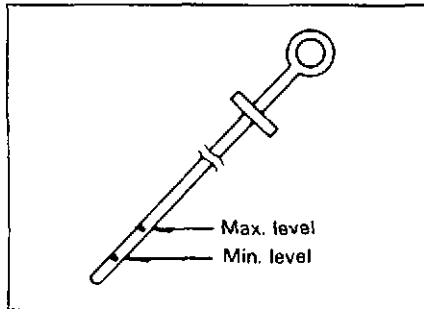
III. ENGINE OPERATION



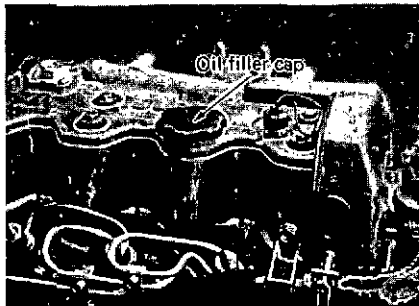
1. CHECK BEFORE OPERATION

(1) Engine Oil Level

- 1) Place the engine or the machine on a leveled ground.
- 2) Remove the dipstick out from the crankcase and wipe it with a rag. Insert it full way in once and again remove it gently. Check the oil level by the level marks on the dipstick. The oil level must be at mid position between the upper mark and the lower mark as illustrated. Also check the sample oil on the dipstick for fouling and the viscosity. Be careful not to fill the oil too much; excessive oil may cause damage to the engine.



NOTE: The oil level check must be made ten or twenty minutes later after the engine has been stopped. When the oil level check is necessary while the engine is running, stop the engine and keep it stationary ten or twenty minutes to allow the oil thoroughly flow down to the crankcase.



- 3) Oiling is done from a oil filler at the front of the cylinder head cover. Use the specified engine oil. (Refer to page 13 ~ 14). A certain period of time is required to allow the engine oil completely flow down from the oil filler to the crankcase. Check the oil level ten or twenty minutes after the oil replenishment.

NOTE: *If the engine oil is splashed onto the fan drive belt, it causes a belt slippage or elongation, therefore, take care to avoid it.*

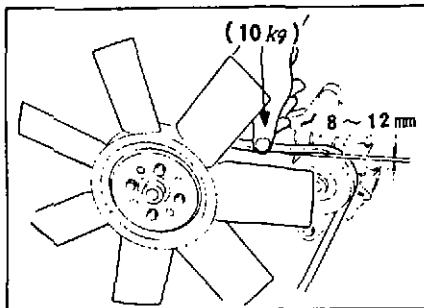
(2) Fan Belt

Check the fan belt for the tension and any abnormalities.

- 1) When the belt is depressed 8 to 12 mm with the thumb (about 10 kg pressure) at midway between the fan pulley and generator pulley, the belt tension is correct.

When the belt tension is too tight, it will result a generator failure.

Contrary, loosely tensioned belt will cause a belt slippage leading belt damage also lead to make noise.



- 2) Check the belt condition. Replace them if any damage is discovered.

NOTE: Replace all belts in a set when one is not usable. Single belt of similar size must not be used as a substitute for a matched belt set, or premature belt wear will result because of varied belt length.

(3) Coolant Level Check

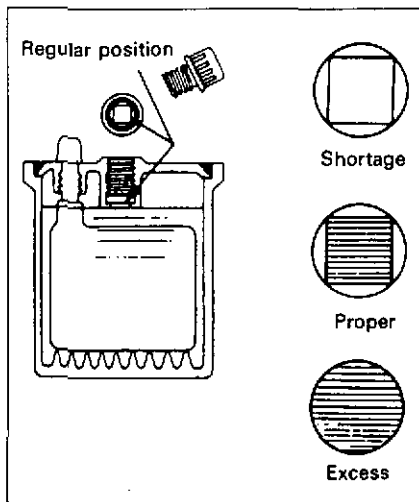
- 1) Remove the radiator filler cap, and check the coolant level as well as the degree of fouling.
Proper coolant level is about 10 mm upper from the radiator core top.

CAUTION: When removing the radiator filler cap while the engine is still hot, cover the cap with a rag, then turn it slowly to release the internal steam pressure. This will prevent a person from scalding with hot steam spouted out from the filler port.

- 2) Use a clean city supply water for coolant. When an anti-freeze solution is required, use the solution with the specified mixing ratio.

(4) Radiator Cap Condition

After the replenishment of the coolant, firmly install the radiator cap, and make sure the cap is securely installed.



(5) Battery Electrolyte Level

The amount of electrolyte in the batteries will be reduced after repeated discharge and charge.

Check the electrolyte for the level position in the batteries, replenish with a commercially available electrolyte such as distilled water if necessary.

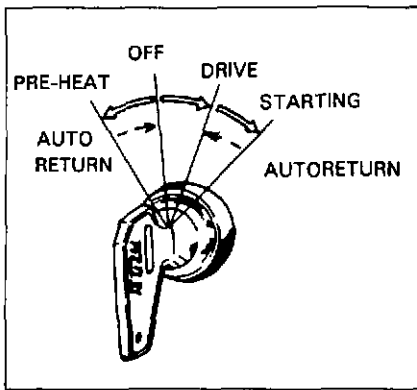
The battery electrolyte level checking procedure or necessity of the electrolyte level check depends on the battery type, therefore, pay attention on the matters.

NOTE: Do not replenish electrolyte with dilute sulfuric acid in the daily service.

(6) Battery Cable Connection

Check the battery cables for looseness of connections or corrosion.

The loosened cable connection will result hard engine starting or insufficient battery charge.



2. ENGINE STARTING

(1) Pre-starting Preparation

- 1) Make sure that all hydraulic control lever etc. on the machine are in neutral position.
- 2) Set the engine stop knob to the start position.
- 3) Switch on the battery switch (if so equipped).
- 4) Insert the starter switch key into the switch key hole.

(2) Pre-heating Procedures

As an engine starting aid, the pre-heating is required in a cold engine starting. (Not required in a warmed-up engine starting)

- 1) Turn the starter switch key counterclockwise to PRE-HEAT position in order to heat the glow plugs on the engine.
The pre-heating time vary depending on the type of pre-heating systems as follows:
 - a. The type with an indication lamp
20 seconds are required until the indication lamp at the instrument board goes off.
 - b. The type with a control resistance 25 to 30 seconds are required until the control resistance coil red heats.
- 2) Turn the starter switch key clockwise to START position as soon as the indication lamp goes off or the control resistance coil red heats.
- 3) When equipped with the quick pre-heating system (QOS-II), turn the starter switch to DRIVE position.
The pre-heating indication lamp will comes on for about 3.5 sec. and the pre-heating will be carried out automatically. (However, the pre-heating will not be performed when the engine has been warmed up.)

(3) Engine Starting

In this paragraph, engine starting procedure is described with reference made to the Isuzu standard starter switch.

- 1) Turn the starter switch key clockwise to DRIVE position and, make sure that the meters and warning lamps are operating.
- 2) Depress the engine throttle lever or throttle pedal and turn the starter switch key fully clockwise to starting position.

The cranking period must be limited to within ten seconds.

Continuous starter run more than ten seconds will lead an over discharge of the batteries as well as starter seizure.

If it is unable to start the engine in one time attempt, keep the batteries and the starter stationary at least 30 seconds to recover their power, then reattempt the preheating and starting operation.

NOTE: *Continuous re-engagement of the starter to the flywheel ring gear without giving them an interval will result the starter pinion gear and the flywheel ring gear damage.*

- 3) When, despite of repeated attempting the starting operations, still the engine does not start, the engine might has an abnormalities on some part. Check the related system to detect the cause.
- 4) When the engine started, release the starter switch key. The key will return to DRIVE position automatically.

CAUTION: *Do not turn the starter switch key to OFF position during engine running, or the electrical circuits will be deenergized causing a generator failure.*

3. CHECK AND OPERATION AFTER THE ENGINE START-UP

(1) Warming-up Operation

Do the warming-up operation about ten minutes at 1000 rpm after the engine has started.

As the lubrication for the entire engine systems will be done in this warming-up, do not operate and load it abruptly. Particularly, observe this in a cold season operation.

(2) Check after the Engine Start-up

Check on the following items in the engine warming-up operation.

1) Engine oil pressure

Although the engine oil pressure gauge reading vary depending on an atmospheric temperature or a type of oil, the gauge registers around 4 to 5 kg/cm² in the warming up.

In the oil pressure warning lamp type, make sure that the lamp is being off.

2) Charge condition

The charge condition is normal when once the ammeter registers plus side greatly in the engine starting, then gradually the meter registering will be minimized.

In the warning lamp type, make sure that the lamp is completely being off during the warming-up.

3) Engine noise and exhaust smoke colour

Pay attention on the engine noise and, if any abnormal noise is heard, check the engine to detect the cause.

Check the fuel combustion condition by the exhaust smoke colour.

The exhaust smoke colour after the warming-up achievement and at no load operation:

No colour or light blue Normal (Perfect combustion)

Black colour Abnormal (Imperfect combustion)

White colour Abnormal (Imperfect combustion)

NOTE: *Engine noise after start-up might be noisy than that of warmed-up engine and, the exhaust smoke colour also more blackish than the normal condition, however, it will be normalized after the warming-up achievement.*

4) Leakage in the systems

Check the following items:

a. Lube oil leakage

Check both sides and bottom face of the engine assembly for lube oil leaks, paying particular attention to the lube oil pressure gauge pipe joint, lube oil filter and lube oil pipe joints.

b. Fuel leakage

Check the fuel injection pump, feed pump, fuel lines and fuel filter for leakage.

c. Coolant leakage

Check the radiator and water pump hose connections also the water drain cocks on the radiator and cylinder body for leakage.

d. Exhaust smoke or gas leakage

5) Checking of the engine coolant

Start the engine and keep it running for about five minutes. The internal air is let out of the mounted machine, and this may cause the coolant level to be lowered.

In such a case, stop the engine and add the coolant as necessary.

NOTE: *When removing the radiator cap while the engine is overheated, high temperature steam blows off and you may get scalded. Apply the cloth to the cap and loosen it by turning it counterclockwise gradually to reduce the steam pressure, and then remove the cap.*

4. CARE IN THE ENGINE OPERATION

In the engine operation, always pay attention to the following items if the engine indicates any sign of abnormalities.

(1) Engine Oil Pressure

- 1) The engine oil pressure is normal when the oil pressure gauge registers 3 to 4 kg/cm² in the engine warmed-up condition.
In the continuous engine operation, the engine oil pressure is slightly lower than the pressure in start-up time.
When, in the continuous engine operation, the engine oil pressure warning lamp is being turned off, the engine oil pressure is normal.
- 2) When the engine oil pressure gauge registers following abnormal states, stop the engine immediately to check the engine oil amount in the oil sump and the oil leakage.
 - a. The engine oil pressure gauge registers below 2 kg/cm² though the engine speed is raised.
 - b. The oil pressure gauge indicator oscillates greatly in a engine low speed range.
 - c. When the engine oil pressure warning lamp goes on and off repeatedly.
When no lack engine oil amount or oil leakage is discovered consequently, a lubricating system failure might be in presence on the engine. In such a case contact your machine supply source.

(2) Coolant Temperature

The Engine performance will be adversely affected if the engine runs in a too hot or too cool condition.

The normal coolant temperature is 75 to 85°C.

- 1) When the coolant temperature gauge is registered over 100°C, or when the coolant temperature warning lamp light on, the engine is overheating.

In such a case, stop the machine and lower the engine speed below 1000 rpm and, allow the engine to cool-down about five minutes.

NOTE: *Do not stop the overheated engine instantaneously.*

- 2) The engine operation under low coolant temperature will not only increase the oil and fuel consumption but also leads the parts premature wear resulting engine failure finally.

**(3) Engine Hourmeter (Engine Operation Hour Integrating Meter)
(If so equipped)**

This meter integrates the engine operation hours. Make sure that the meter is working always in the engine operation. The periodical engine maintenance is scheduled on the operation hours indicated on the hourmeter.

(4) Liquid and Exhaust Smoke Leakage

Pay attention on the lubricant, fuel, coolant and exhaust smoke leakage.

(5) Abnormal Engine Noise

Pay attention on the noise sound from the engine or the related parts diagnosing if the noise is normal.

(6) State of the Exhaust Smoke

Pay attention on the exhaust smoke colour if it is whity or blackish.

5. ENGINE STOPPING

- (1) Make sure that all of the control levers etc. on the machine are in neutral position.
- (2) Before the engine stop, cool down the engine with operating it in low idle speed about three minutes.
In this operation, check the engine noise and the engine oil pressure etc. for abnormalities.
- (3) To stop the engine, pull the engine stop knob full way out. This operation cut the fuel feed permitting the engine to stop.
However, in the case of the engine with stopping device (optional device), the engine can be stopped by turning the starter switch to the OFF position.
- (4) Turn the starter switch key to OFF position. Switch off the battery switch (if so equipped).

NOTE: *Keeping the starter switch key at the DRIVE position a long while after the engine has been stopped, will discharge the batteries wastefully.*

6. ENGINE STOPPING DEVICE (OPTIONAL DEVICE)

- (1) This stopping device can stop the engine only by turning the starter switch to the OFF position.
- (2) Moreover, if the engine oil pressure should go down abnormally, or the coolant temperature should rise abnormally, it will stop the engine automatically by operating the solenoid connected to the fuel cut lever of the fuel injection pump.
- (3) If the engine should stop automatically owing to the engine abnormality, please inspect the following items and take countermeasure against them.
 - 1) Inspect engine oil level by dipstick, if the engine oil pressure gauge should register less than 1.0 kg/cm^2 or the oil pressure warning lamp should be on.
If it should be lower than the specified level, replenish the engine oil.
If the oil leakage should be the cause of abnormality, please contact to ISUZU engine service outlets.
 - 2) Remove the radiator cap and inspect the coolant level, if the coolant temperature should register more than 100°C .
If it should be lower than the specified level, replenish the coolant.
If the coolant leakage should be the cause of abnormality, please contact to the ISUZU service outlets.

CAUTION: *When removing the radiator filler cap while the engine is still hot, cover the cap with a rag, then turn it slowly to release the internal steam pressure. This will prevent a person from scalding with hot steam spouted out from the filler port.*

7. OPERATION AND CARE FOR NEW ENGINE

Your ISUZU engine is carefully tested and adjusted in the factory, however, further, thorough run-in (i.e. break-in) operation is necessary.

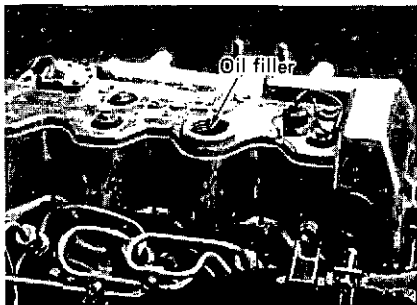
If the new engine is harshly operated, lubricating oil film will be cut leading abnormal wear or seizure. Particularly, avoid a harsh engine operation within the initial 100 operation hours observing the following notice.

- (1) Do the warming-up operation continuously until the engine is warmed-up. In this operation, do not race the engine.
- (2) Also do not operate the engine with rapid acceleration and rapid machine starting.

8. ENGINE CARE FOR OVER-COOLING

Engine over-cooling results premature wear and increased fuel consumption. When the coolant temperature does not be raised to the proper one (75 to 90°C) indefinitely, take an action to recover this with means of radiator curtain or such like.

IV. PERIODICAL INSPECTION AND MAINTENANCE



1. LUBRICATING SYSTEM

Servicing of the engine oil or the oil filter element will largely affects on the engine performance as well as the engine life.

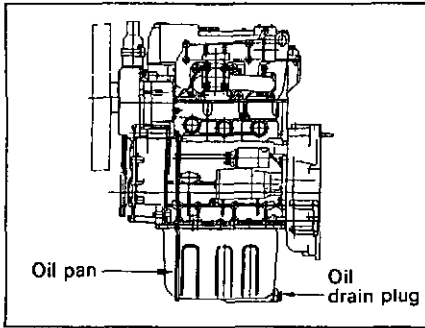
Change the engine oil and the oil filter element periodically with the specified one. (Refer to LUBRICANT at page 13 ~ 14.)

(1) The Engine Oil and the Oil Filter Element Change

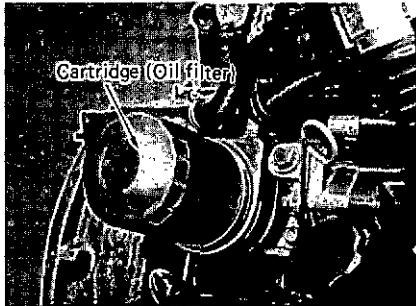
The engine oil change and the main oil filter element change must be made simultaneously according to the following change schedule.

In the engine operation, when the oil filter warning lamp light on, the filter element is clogging. In such a case change the filter element regardless the specified change schedule.

- 1) Change interval
 - a. Engine oil : Every 100 operation hours (50 hours initially)
 - b. Oil filter element : Every 300 operation hours (50 hours initially)
- 2) Engine oil draining
 - a. Wipe clean around the oil filler cap taking care so that no foreign particles entry.
Remove the filler cap.



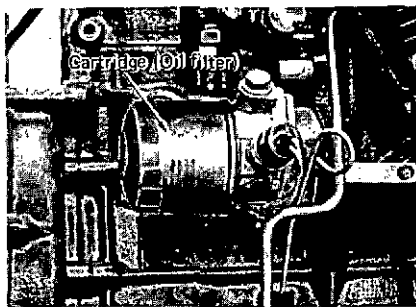
- b. Drain plug at the oil pan to drain the engine oil.
To shorten the oil draining time required, it is recommendable to do this procedures while the engine is warm.



- 3) Oil filter element removal
Use a filter wrench to remove the cartridge type oil filter.

NOTE: Use a container to catch the drained oil so that the engine and the machine does not be fouled by the drained oil.

- 4) Oil filter element installation
Apply a coat of engine oil to the O-ring.
Turn in the new cartridge until the seating face is fitted against the O-ring.
Use the filter wrench to turn in the cartridge an additional one and 1/4 turn.

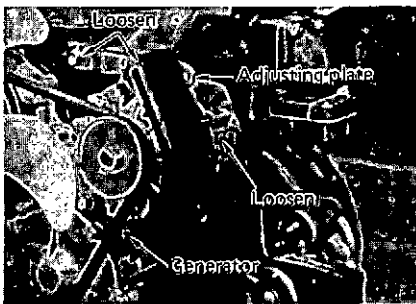
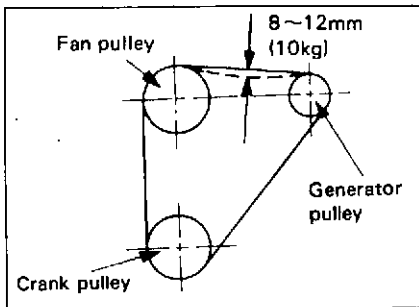


-
- 5) Engine oil refilling
 - a. Reinstall the drain plugs.
 - b. Fill the new engine oil from the oil filler port.
Check the oil level with the dipstick after the oil has been gone down completely. (about 15 minutes)
 - 6) Check after the oil change

Operate the engine with the low idle speed and allow the engine oil to be circulated in the lubricating system.

 - a. Oil leak check
After the oil pressure gauge begins to register the oil pressure normally, check the lubricating system for oil leak, and make sure that no oil leak is observed at all.
 - b. Oil level check
Stop the engine and keep it stationary ten to twenty minutes.
Use the dipstick to recheck the oil level.
Replenish with the engine if necessary until the specified oil level.

NOTE: *When the engine started after the oil has been changed, the oil level will be slightly lowered than the initial level due to the oil is fully filled up into the entire oil circuits.*



2. COOLING SYSTEM

(1) Fan Belt Tension Adjustment

Adjust the fan belt tension when the belt deflection is enlarged than the specified amount and when the belts are replaced.

1) The belt tension

The belt tension is normal when it is depressed 8 to 12 mm with the thumb at the midway between fan pulley and the generator pulley. (about 10 kg depressing force.)

Fan belt deflection amount : 8~12 mm

2) Adjusting procedure

The belt tension adjustment is done by pivoting the generator at the generator mounting bolt.

- a. Loosen the generator adjusting plate bolt and the generator mounting bolt.
- b. Pivot the generator at the mounting bolt toward the engine left or right hand side as required.
Tighten the mounting bolt and the adjusting bolt.

NOTE: The belt tension might be slightly vary after the generator is fixed, therefore, recheck the belt tension after the bolts have been tightened.

- c. After the adjustment, operate the engine about five minutes in low idle speed and recheck the belt tension. Particularly, pay attention on the matter where the new belts are installed. The belt tension might be varied due to the initial belt conforming.

(2) Use of ISUZU Genuine Fan Belt

ISUZU genuine fan belts are provided with a high driving ability and a long operating hours of durability, therefore, use of the ISUZU genuine fan belts are highly recommended. Use of not genuine fan belt will result premature belt wear or a belt length elongation leading an engine overheat or an abnormal belt noise.

(3) Coolant Change

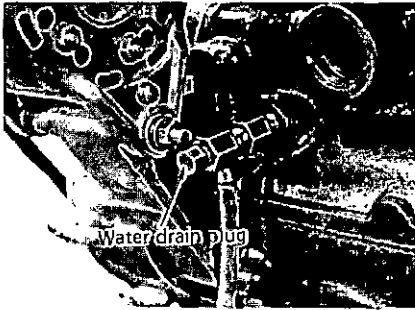
The coolant must be changed at intervals of six months.

If the coolant is being fouled greatly, it will lead an engine overheat or coolant blow off from the radiator.

1) Coolant draining

- a. Remove the radiator cap

Open the drain valve at the radiator lower part to drain the coolant in the radiator.



CAUTION: When removing the radiator filler cap while the engine is still hot, cover the cap with a rag, then turn it slowly to release the internal steam pressure. This will prevent a person from scalding with hot steam spouted out from the filler port.

- b. Loosen the coolant drain plug at the cylinder block left hand side to drain the coolant in the engine.

2) Coolant filling

- a. Close or tighten the coolant drain valve or plug.
- b. Use a clean water such as the city supply water as the coolant. Fill up the radiator with the coolant until the level comes up to the filler port neck.

Fill the coolant gradually to avoid air entry.

Coolant capacity (Engine only) :

Engine model	Coolant capacity (liters)
2KC1	about 1.5
3KA1, 3KB1, 3KC1	about 1.7
3KR1	about 3.1

After the coolant have filled up, operate the engine about five minutes in low idle speed, then the air contained in the coolant circuit is bled resulting lowered coolant level.

Stop the engine to replenish it with the coolant.

(4) Radiator Exterior Cleaning

When the radiator core clogged, the cooling air flow is interrupted lowering the cooling efficiency.

Clean the radiator with a steam or a pressurized water at 600 hours interval. However the radiator core is clogged except the above mentioned interval, clean it.

(5) Cooling System Circuit Cleaning

When the cooling system circuit are fouled with water scales or sludge particles, the cooling efficiency will be lowered.

Periodically clean the circuit interior with a cleaner.

Cooling system cleaning interval : Every 1200 operation hours.

3. FUEL SYSTEM

The fuel injection pump and the fuel injection nozzles are precisely manufactured, therefore, the fuel which contains water or dust particles will result the injection pump plunger seizure or the injection nozzle seizure and the fouled fuel filter element with a sludge or a dust particles lead to decrease the engine output.

Do the periodical servicing in accordance with the following descriptions.

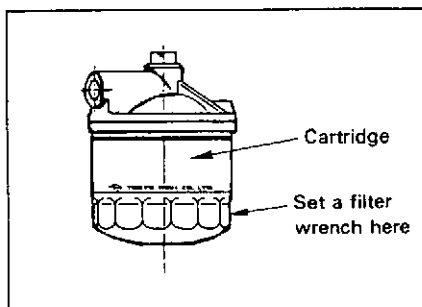
(1) Removal of Water from the Fuel Filter

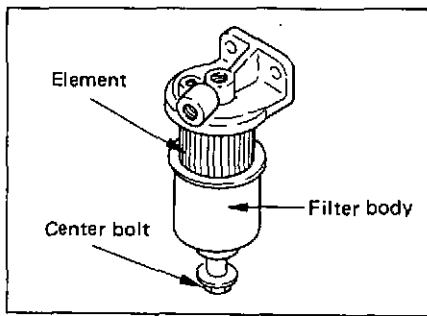
Remove the fuel mixed up with water by removing fuel filter element.

- 1) Removal interval; every 200 operation hours
- 2) Fuel element removal and installation procedure

Cartridge fuel filter

- a. Use a filter wrench to remove the cartridge (element).
- b. Before installation of the fuel filter, apply a coat of fuel on the gasket.
 - Turn in the fuel filter until the filter gasket is fitted against the sealing face.
 - Use the filter wrench to turn in the fuel filter an additional 2/3 of a turn.

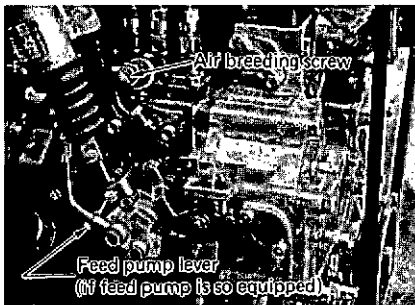




Center bolt type fuel filter

- a. Loosen the center bolt to remove the fuel filter body and the element. The filter body will be removed together with the element.
- b. Clean the filter body. Use the new element and the new gaskets.
- c. Install the filter body together with the element with tightening the center bolt securely.

NOTE: 1. Pay attention to not spill out the fuel remaining in the fuel filter when the filter is removed.
2. Do the air bleeding after removal of air mixed fuel has finished.



(2) Fuel System Air Bleeding

The entry of air into the fuel system will cause hard engine starting or an engine malfunction.

When once the servicing such as to empty the fuel tank, air bleeding for the water sedimentor, or the fuel filter element change etc. are done, be sure to make the air bleeding.

Bleeding procedure

- 1) Loosen the bleeding screws on the fuel injection pump, activate the fuel injection pump with the starter switch at "ON" position, and remove the air mixed fuel.
(When feed pump is equipped, remove the air mixed fuel by operating the feed pump lever.)
- 2) No bubble presence in the air mixed fuel from the loosened bleeding screw indicates that the bleeding is achieved.
Screw in the "air bleeding screws," and turn the starter switch "OFF" to stop the fuel injection pump.
- 3) Start the engine and check the fuel system for fuel leak.

(3) Fuel Filter Element Change

1) Change interval

Fuel filter element change interval : Every 600 operation hours

2) Change procedures

Refer to "Fuel element removal and installation procedure" at page 38 ~ 39.

Center bolt type fuel filter required the new gaskets with the new filter element.

3) Do the air bleeding after the fuel element change has finished referring the description Fuel System Air Bleeding at page 40.

(4) Fuel Injection Pump Control Seals

As the fuel injection pump is precisely adjusted, most of the controls are sealed, please do not break them. When the adjustment is necessary, contact with your machine supply source.

NOTE: *The manufacturer does not warrant the claim on the engine with the broken injection pump seals.*

4. AIR INTAKE SYSTEM

(1) Air cleaner

The engine life and the performance depends on the intake air condition greatly.

A fouled air cleaner element result a decreased intake air amount leading the engine output decrease and finally cause an engine malfunction.

Further, a damaged air cleaner element result wear on the cylinder component or the valve mechanism etc. leading increased engine oil consumption and decreased engine output, finally leads to shorten the engine life.

As the servicing of the air cleaner is specified by the respective machine manufacturer, do the periodical inspection and maintenance in accordance with their instructions or caution plate attached to the air cleaner.

The air cleaner type depends on the machine in which it is used. See the following general instructions for cleaning and element replacing:

CAUTION: *The element service and replacement intervals will be shortened accordingly if the engine has been operated under very dusty conditions.*

1) Air cleaner with cyclone separation vanes

There are 2 types; one is called integrated type of which cyclone separation vanes are attached to the air cleaner body, another is called cyclo-pack type of which vanes are attached to the air cleaner element.

The following descriptions are common to both types.

As outside air is taken into the air cleaner, cyclone separation vanes at the intake side of the air cleaner cause swirling of the air. Dust particles separated by centrifugal force are automatically discharged through the evacuator valve (if so equipped) while the engine runs.

Service of air cleaner

Every 600 hour — clean the air cleaner element

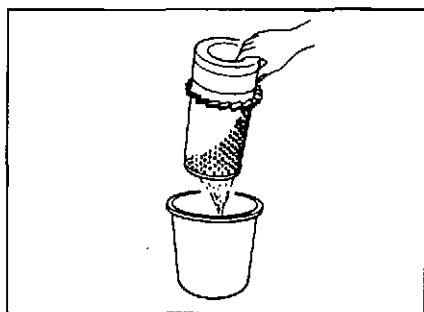
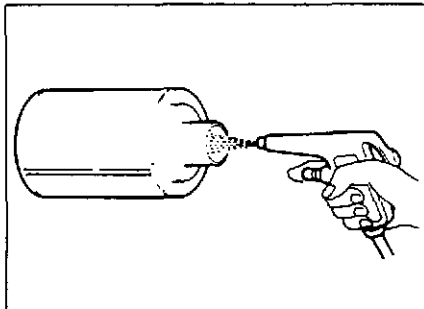
Every 1800 hour — replace the air cleaner element

Every 600 hour, clean the air cleaner by applying compressed air into the body from engine side. Air pressure should not exceed 7 kg/cm². (Illustration shows integrated type as an example)

If the element has been fouled sooty, submerge the assembly in a solution prepared by dissolving element cleaner (ND 1500 element cleaner or equivalent) in water for at least 30 minutes. Rinse well with plain water and dry naturally at room temperature for 24 hours.

Avoid use of compressed air or heat for quick drying.

(Illustration shows cyclo-pack type as an example)



2) Air cleaner without cyclone separation vanes (only paper element)

Viscous type

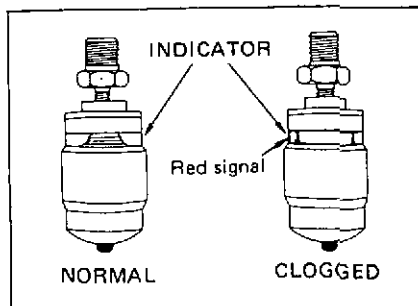
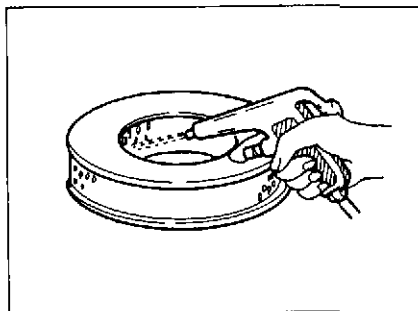
The wet paper air cleaner (viscous type), using filter paper coated with special viscous liquid, has a special filtering function. Do not clean but replace it every 600 operation hours.

Dry type

- Every 100 hour — clean the air cleaner element
- Every 600 hour — replace the air cleaner element

The dry paper air cleaner should be cleaned by blowing air from inside the element.

Excessive air pressure (Air pressure should exceed 7 kg/cm²) may damage the element. Replace the element if it is excessively clogged with dust.



(2) Dust indicator (If so equipped)

When the air cleaner element is clogged, the resistance to air suction increases and the dust indicator for indicating the time for element replacement will turn red.

When the indicator turns red, replace the air cleaner element, regardless of the maintenance interval.

After replacement, press the push button on the dust indicator to reset it.

5. ENGINE ELECTRICALS

The ISUZU engines uses a 12 or 24 volt system and a negative grounding type for the electrical system.

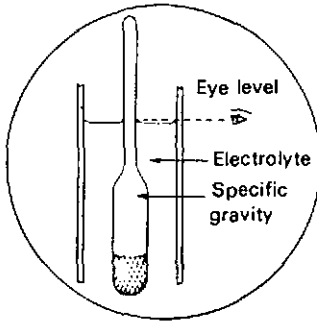
(1) Battery Servicing

- 1) The battery charge condition is judged by the electrolyte gravity measurement.

Periodically measure the electrolyte gravity of the batteries.

Battery electrolyte gravity measurement interval : Every 300 operation hours

The relationship between the electrolyte gravity and the battery conditions are as follows:



Electrolyte Specific Gravity	Battery Conditions
Over 1.280	Over charged (To be rectified.)
1.280 ~ 1.250	Normal
1.250 ~ 1.240	Nearly normal
Below 1.240	Insufficiently charged (To be rectified.)

Gravity conversion

The specified electrolyte temperature for the gravity measurement is 20°C.

Measure the electrolyte temperature and do the conversion in accordance with the following formula when the temperature does not fall to the specified temperature.

$$S_{20} = S_t + 0.0007 (t - 20)$$

S_{20} ; The gravity at 20°C

S_t ; The gravity measured

t ; The electrolyte temperature when measured

NOTE: *The battery electrolyte is dilute sulfuric acid. So, be careful not to stain your body and clothes with it. If stained, rinse the stained portion with clean water.*

- 2) Battery terminal connections
Check the battery terminal connections every 600 operation hours for loosened connections and terminal corrosion.
A faulty contact resulted by an insufficient terminal bolt tightening cause lack battery charge and will result hard engine starting.
- 3) When the batteries are fouled clean it with a clean water or a tepid water and wipe them with a dry cloths to remove the water.
Apply a coat of vaseline or a grease lightly.

(2) Generator Servicing

- 1) The polarity of the generator is negative grounding type. When an inverted circuit connection take place, the circuit will be in short circuit instantaneously resulting the generator failure.
- 2) Do not put water directly on the generator. Entry of water into the generator leads an electrolyte corrosion causing an generator failure. Pay attention particularly when the engine cleaning is done.
- 3) When the battery is charged with a external electric source, be sure to disconnect the battery cables.

(3) Wiring Connections

Check all of the electric wiring connections every 600 operation hours for looseness and damage.

6. ENGINE ASSEMBLY AND OTHERS

To continue a trouble free engine operation during a long time of period, the servicing items need a skilled maintenance technician, therefore, consult your machine supply source on the following items when necessary.

(1) Fuel Injection Nozzle

Use an injection nozzle tester to check the static injection starting pressure and the fuel spray conditions.

Injection nozzle pressure test interval : Every 300 operation hours

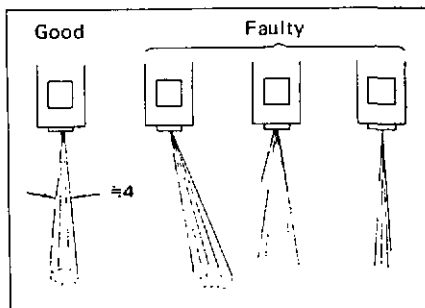
When the injection starting pressure is too high or too low or the fuel spray pattern is improper, an abnormal fuel combustion takes place in the engine leading to a lowered output and blackish exhaust smoke. Further, it causes a piston seizure or piston damage etc. In such cases, the injection nozzle test or the nozzle replacement is required.

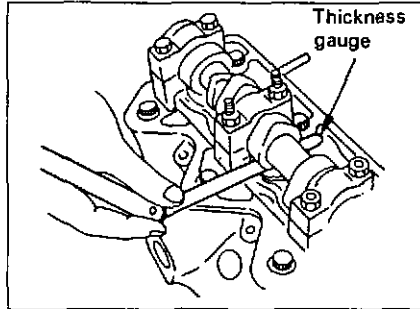
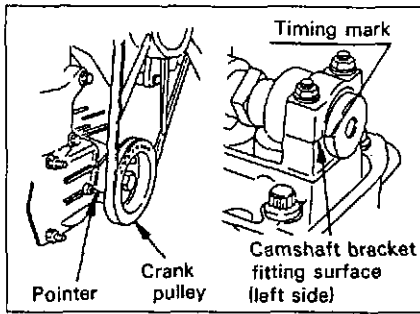
Injection starting pressure ... Refer to the main data and specifications.

(2) Radiator Pressurization Valve Check

A pressurization valve is incorporated within the radiator cap assembly. Check the valve actuating pressure every 300 operation hours with a radiator compression tester.

The valve actuating pressure is to be referred to the machine manufacturer's specified value.





(3) Valve Clearance Adjustment

The valve clearance must be adjusted every 1200 operation hours, or whenever the valve rocker noisy abnormally, or in an engine malfunction though the fuel system is properly working.

Valve clearance : 0.25 mm (When the engine is cold.)

Adjustment Procedures

In order to bring the No. 1 piston to the top dead center in the compression stroke, align the TC mark on the crankpulley with the pointer on the timing gear case cover.

Then, remove the cylinder head cover and check to see if the timing mark on the rear end of the cam shaft is aligned with the camshaft bracket fitting surface (left side).

When the timing mark is aligned with it, the No. 1 cylinder is at the top dead center of the compression stroke. If not aligned, turn the crankshaft 360° clockwise to set the timing mark to the camshaft bracket fitting surface.

In this condition, measure the clearance for the valves marked with a circle in the table below.

And then, give the crankshaft one full turn (clockwise), and measure the clearance for the remaining valves marked with a double circle.

For 2 cylinders engine

Cylinder No.	1		2	
	I	E	I	E
When No. 1 piston is at TDC	○	○		○
When No. 2 piston is at TDC			⊙	

For 3 cylinders engine

Cylinder No.	1		2		3	
	I	E	I	E	I	E
When No. 1 piston is at TDC	○	○	○			○
When No. 3 piston is at TDC				⊙	⊙	

(5) Injection Timing Check and Adjustment

Improper injection timing causes serious engine failures such as blackish exhaust smoke, poor engine output and engine breakage etc. In normal servicing, this check and adjustment is unnecessary. However, if the injection pump should be removed, reinstall it at the attached surface surely with the same thickness shim as the one which was inserted before removed.

(6) Starter and generator servicing

Do the starter and the generator servicing every 600 operation hours on the following items.

- Starter commutator cleaning.
- Generator slip ring cleaning.
- Carbon brushes and the brush contact check.

V. ENGINE CARE IN COLD SEASON

1. FUEL

(1) Fuel Replenishment and Moisture Removal

- 1) Fill the fuel tank fully after the engine operation.
Low fuel level in the fuel tank increases the space to reserve the air leading to increase the vapor amount.
The moisture produced from the vapor in the fuel tank will be reserved causing to produce a rust and sludge in the tank interior, finally this will result a hard engine starting or an engine malfunction.
- 2) Before to start the engine, loosen the fuel tank drain plug to drain the sedimented water.

(2) Fuel Selection

In the cold zone, the fuel might be frozen resulting hard engine starting, therefore, select a suitable fuel for such engine operation.
Use ASTM 975 No. 2-D fuel if you expect temperatures above 20°F (-7°C).
Use Number 1-D if you expect temperatures below 20°F (-7°C).
If Number 1-D is not available, a "winterized" blend of 1-D and 2-D is available in some areas during the winter months.
Check with the service station operator to be sure you get the properly blended fuel.

2. COOLANT

Where the atmospheric temperature falls below freezing point, the cooling system should be drained after engine operation, but to eliminate the need for repeated draining and refilling, the use of anti-freeze solution is highly recommended.

A 50/50 Ethylene glycol base antifreeze/water mix. (which provides protection to -37°C (-34°F) is recommended for use in these ISUZU diesel engines.)

Concentrations over about 65% adversely affect freeze protection, heat transfer rates, and silicate stability which may cause waterpump leakage.

Never exceed a 60/40 antifreeze/water mix.

(which provides protection to about -50°C (-58°F .)

- | |
|--|
| <p>NOTE: 1. <i>Methyl alcohol base antifreeze is not recommended because of its effect on the non-metallic components of the cooling system and because of its low boiling point.</i></p> <p>2. <i>High silicate antifreeze is not recommended because of causing serious silica gelation problems.</i></p> <p>3. <i>Usage and mixing ratio etc. should be followed to the anti-freeze manufacture's recommendations.</i></p> |
|--|

3. ENGINE OIL

The engine oil viscosity largely affects the engine startability, so the use of lubricant with viscosity selected according to the atmospheric temperature is important. (Refer to page 13-14)

In a low atmospheric temperature, the engine oil viscosity will be raised leading hard engine starting.

Therefore, avoid to cool the engine by cold wind placing the machine on the appropriate place.

4. BATTERY

- (1) Always pay attention to charge the batteries completely in cold season. As the discharge current from the battery is large in the cold engine starting, it takes a comparatively long while to recharge the batteries than the recharge after the normal engine starting. Particularly, as the gravity of the insufficiently charged battery's electrolyte is low, it will easily be frozen. Pay attention to keep the batteries warmth in the cold season.
- (2) To replenish the battery with a distilled water, do it immediately before the engine operation. If the work is done after the engine has already been in an operation, the distilled water replenished does not be mixed up with the original electrolyte, this will be danger allow to freeze the not mixed distilled water staying in the battery cell upper part.

5. ENGINE STARTING

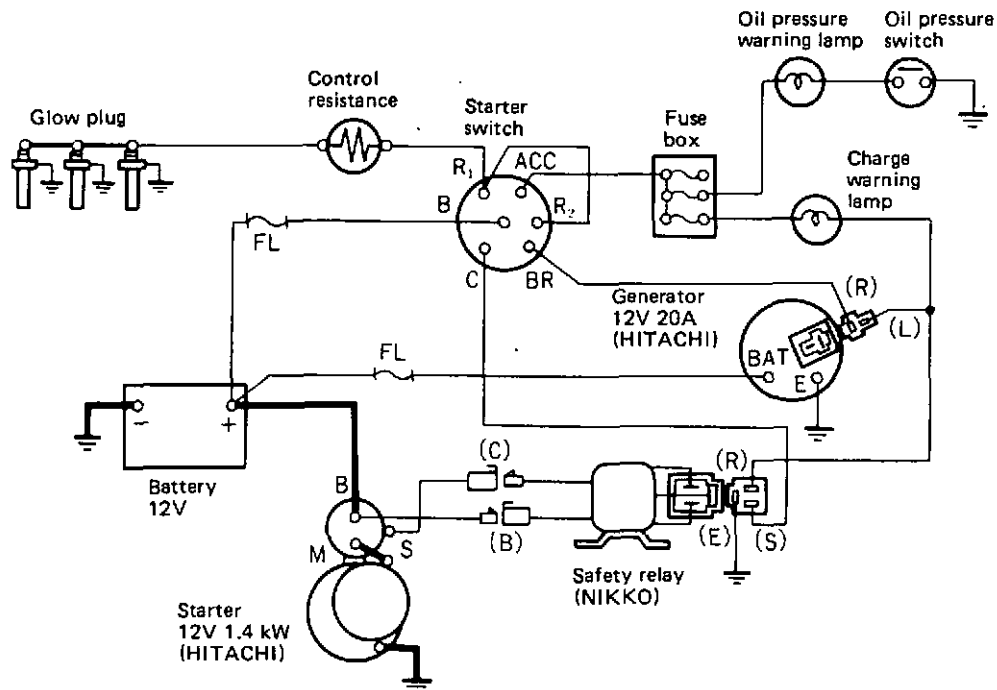
In a cold engine starting done in below 0°C atmospheric temperature, pay attention to the following items.

- (1) Do the preheating operation before the engine cranking with the starter.
- (2) Set the engine throttle lever or pedal to the 1/3 position of the full lever or pedal stroke.
- (3) If the engine does not start with the initial cranking, keep the batteries stationary a while to recover their power and, reattempt the preheating and the cranking operation.
- (4) In order to secure the starter, one time cranking must be limited to within 10 seconds.
- (5) In a cranking operation, when a phenomenon, that the starter pinion and the flywheel ring gear engagement to repeated disengage and engage take place, as this is a sign of weakened battery power, charge the batteries with an external electrical source.
- (6) In an extreme cold temperature engine starting, do the engine cranking a while with setting the throttle lever at no fuel position to allow the engine rotating or travelling parts come to an unrestricted condition from the adhesive cold lubricant, after then do preheating and cranking to start the engine.

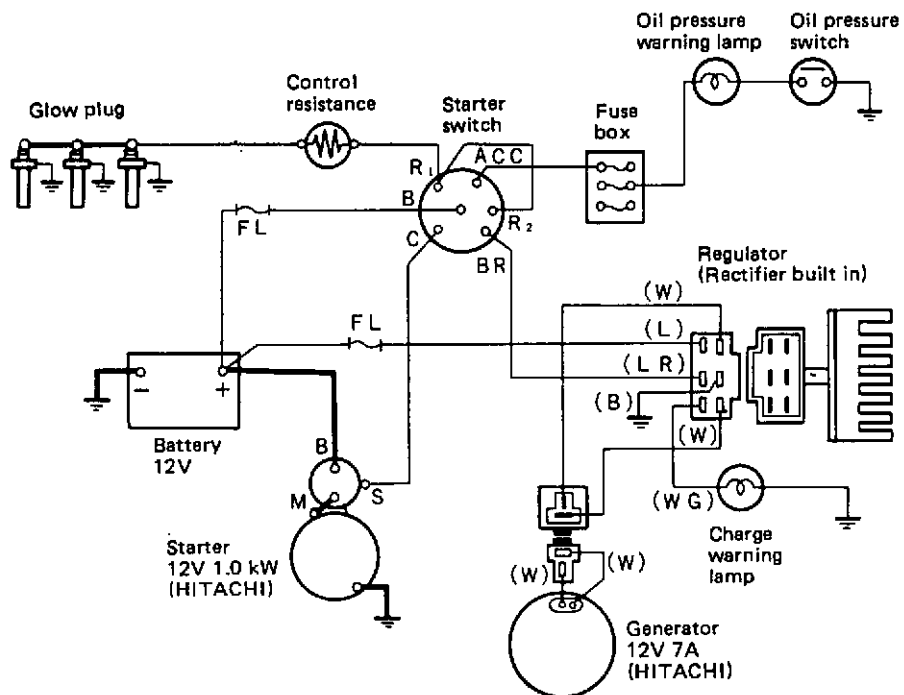
VI. ENGINE ELECTRICAL WIRING DIAGRAMS

As the electrical wiring depending on the respective machine, merely standard wirings are shown in the diagrams.

1. In case of regulator built-in generator



2. In case of generator separated from regulator



VII. ENGINE MAINTENANCE SCHEDULE

When performing the following items, the daily inspection items should also be carried-out.

Description of check and maintenance	Daily	50	Every 100	Every 200	Every 300	Every 600	Every 1200	Remark
		(operation hours)						
LUBRICATING SYSTEM								
Oil level and oil fouling	○							
Oil leakage	○							
Oil pressure gauge registration	○							About 3~4kg/cm ² 1400rpm
Oil pressure warning lamp	○							Light off (operating)
Engine oil and engine oil filter element replacement		○	○					Initially 50 hours
Oil filter element replacement		○			○			Initially 50 hours
FUEL SYSTEM								
Fuel leakage	○							
Water removal from fuel filter				○				
Fuel filter element replacement						○		
Fuel tank and strainer cleaner				○			○	
Injection nozzle check					○			

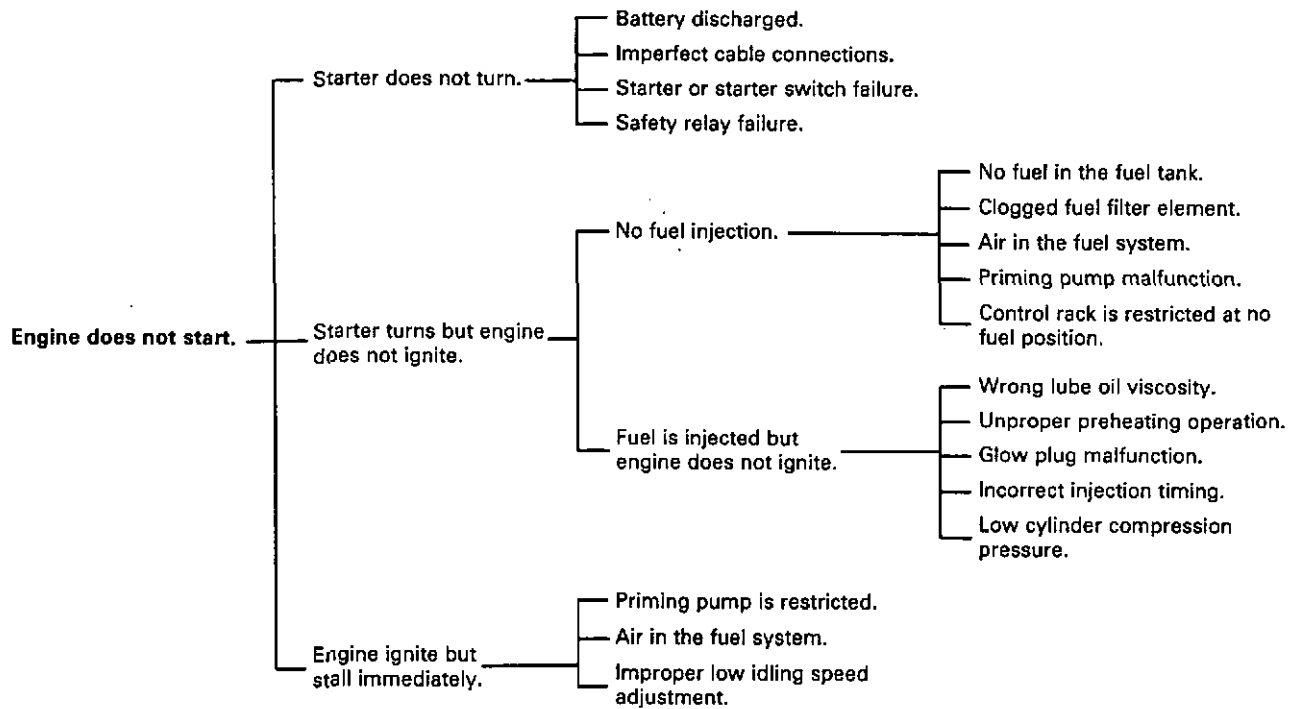
Description of check and maintenance	Daily	50	Every 100	Every 200	Every 300	Every 600	Every 1200	Remark
		(operation hours)						
COOLING SYSTEM								
Coolant level and coolant fouling check	<input type="radio"/>							10mm upper position from the radiator core.
Coolant leakage check	<input type="radio"/>							
Radiator filler cap fitting condition	<input type="radio"/>							To be securely tightened.
Fan belt tension check (Replace if necessary.)	<input type="radio"/>							Deflection amount 8~12mm (about 10kg force)
Coolant temperature registration	<input type="radio"/>							75~85°C
Coolant replacement								Every 6 months.
Radiator external face cleaning						<input type="radio"/>		
Cooling system circuit cleaning							<input type="radio"/>	
Radiator filler cap function check								According to the machine manufacturer's specifications.

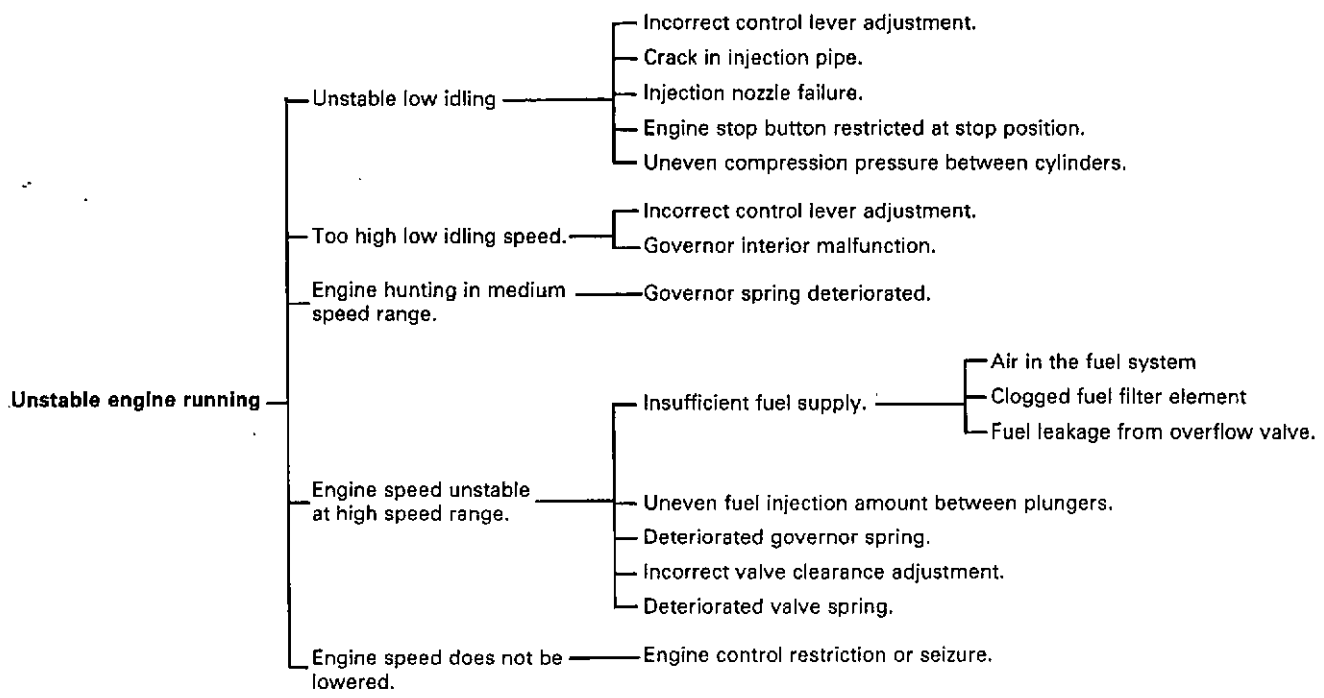
Description of check and maintenance	Daily	50	Every 100	Every 200	Every 300	Every 600	Every 1200	Remark
	(operation hours)							
AIR INTAKE SYSTEM								
Air cleaner element replace								According to the machine manufacturer's specifications or caution plate.
ELECTRICAL SYSTEM								
Electrolyte level check	○							Replenish with a distilled water.
Battery cleaning.	○							
Battery charge condition								
Ammeter registration	○							Immediately after engine starting goes to + side (From great to small)
Charge warning lamp	○							Light off (on operation)
Electrolyte gravity check					○			
Starter and generator * check and cleaning						○		

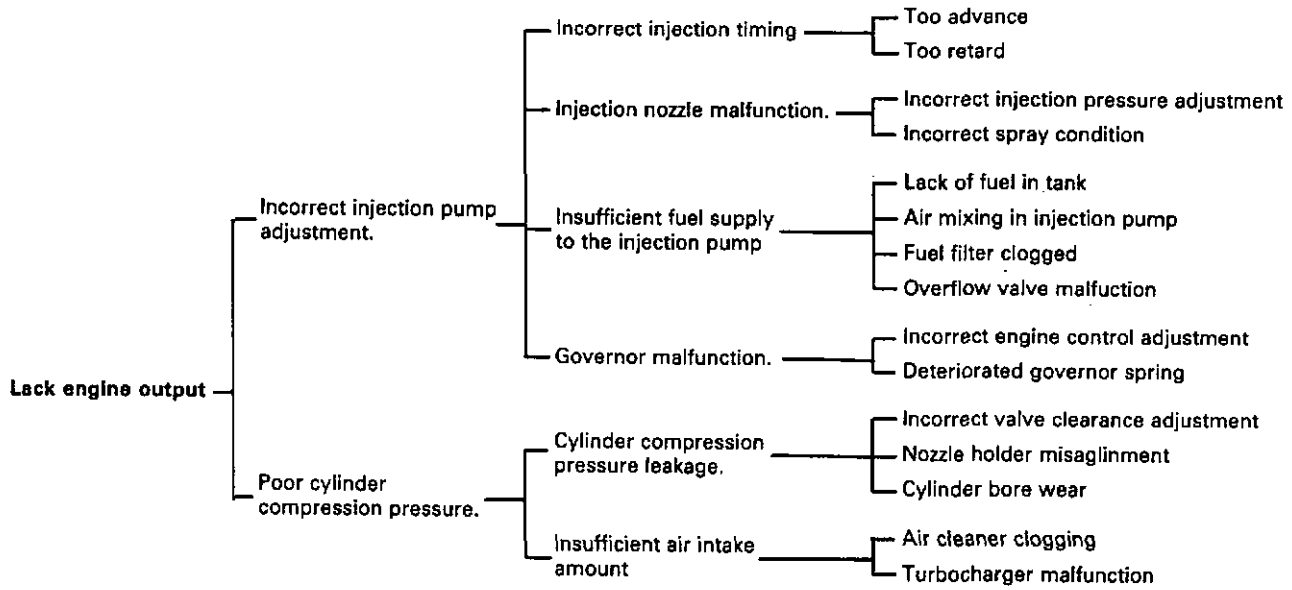
Description of check and maintenance	Daily	50	Every 100	Every 200	Every 300	Every 600	Every 1200	Remark
Wiring and connection check						○		
Preheating condition check	○							About 25 seconds
OTHERS								
Engine starting conditions and noise conditions	○							
Exhaust smoke condition	○							Exhaust smoke color
Valve clearance check *							○	0.25mm for exhaust and inlet valves (cold)

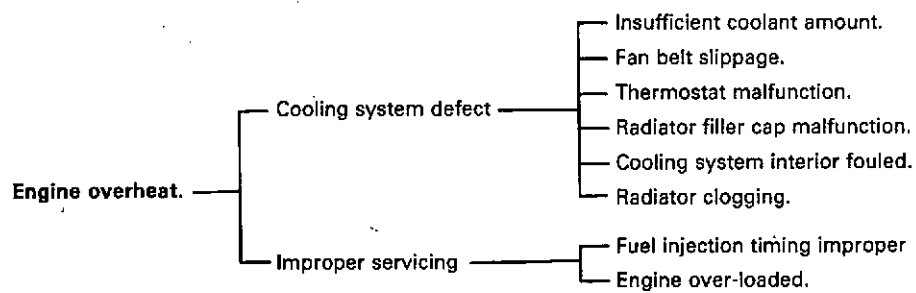
- NOTE:** 1. The service intervals after 1200 operation hours should also be made every 100 operation hours in accordance with this check and maintenance schedule.
2. When the servicing on the asterisked (*) items are necessary, consult the machine supply source.

VIII. SIMPLE ENGINE TROUBLESHOOTING









All information, illustrations and specifications contained in this manual are based on the latest product information available at the time of publication.

The right is reserved to make changes at any time without notice.

INSTRUCTION MANUAL (INDUSTRIAL)

2KC1, 3KA1, 3KB1, 3KC1, 3KR1

(IDE-1186)

Issued by

ISUZU MOTORS LIMITED

ENGINE SALES ENGINEERING DEPT.

22-10 Minami-oi 6-chome, Shinagawa-ku, Tokyo, Japan

Cable Address: "ISUZU TOKYO"

Tel: Tokyo 762-1111

First edition Sept., 1987

011-06-1800K