

ISUZU DIESEL ENGINE

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

INSTRUCTION MANUAL

INDUSTRIAL VERSION

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. They know your engine best and are ready to meet your 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.

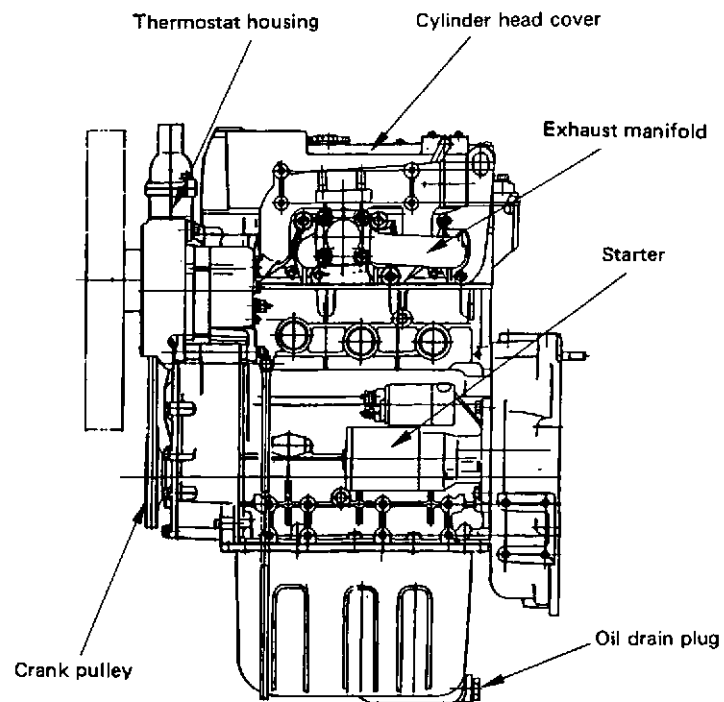
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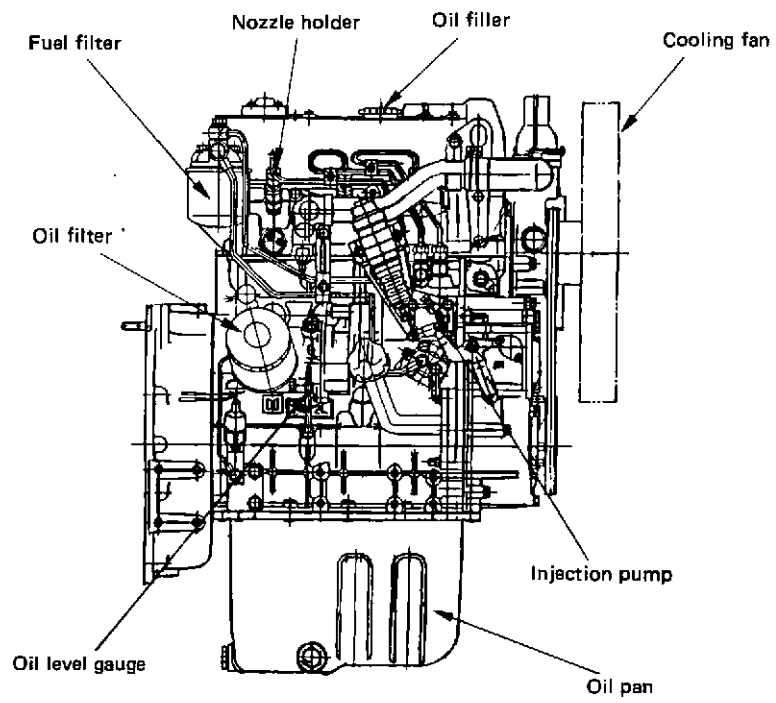
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I. ENGINE EXTERNAL VIEWS

EXTERNAL VIEW (LH)



EXTERNAL VIEW (RH)



II. GENERAL INFORMATION

MAIN DATA AND SPECIFICATIONS

(1) For 2KC1

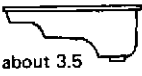
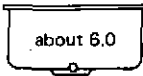
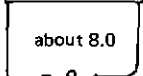
		2KC1
Engine type		Water cooled, four cycle, in-line overhead camshaft
Combustion type		Swirl chamber
No. of cylinders - bore x stroke	(mm)	2 - 74 x 76
Piston displacement	(cm ³)	653
Compression ratio		23 to 1
Firing order		1 - 2
Injection pump		Diesel Kiki PFR
Governor		Mechanical type
Injection nozzles		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 volume	(liters)	3.5
Coolant volume (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 in 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 contact 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 volume *(Varies depending on oil pan configuration)	(liters)	 about 3.5	 about 6.0	 about 8.0
Coolant volume (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°)		

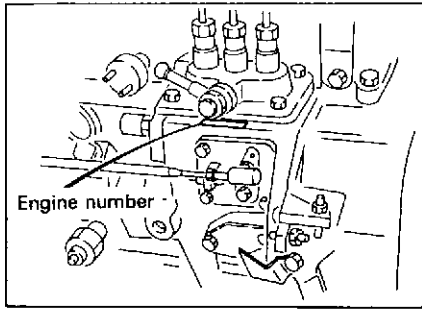
- NOTE:**
1. These specification are based on the standard engine.
 2. Specification for items marked with an asterisk (*) will vary according to the type of equipment in which the engine installed.
Oil capacity will vary depending on engine application. Please check the maker's specifications to determine the oil capacity of your engine.
If you are unable to locate these data applicable to your engine, please contact 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 volume	(liters)	5.4
Coolant volume (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 in 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 contact your machine supplier.

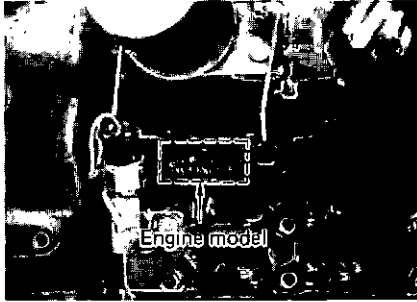


ENGINE IDENTIFICATION

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

Please feel free to contact your ISUZU dealer for periodical inspection and maintenance.

2. ISUZU GENUINE PARTS

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 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 requirements.

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

(2) Handling of Fuel

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

- 1) Take care to prevent the entry of dust particles or water when filling 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 by opening the tank draining hole.

2. LUBRICANT

The quality of engine oil has close relationship to engine performance, startability and engine life.

Use of unsuitable engine oil will result in a piston ring, piston and cylinder seizures and accelerate the sliding surface wear leading to increased oil consumption, lowered output and, finally causing engine failure. To avoid this, use the specified engine oil.

(1) Engine Oil Selection

API, CC or CD grade

(2) Oil viscosity

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

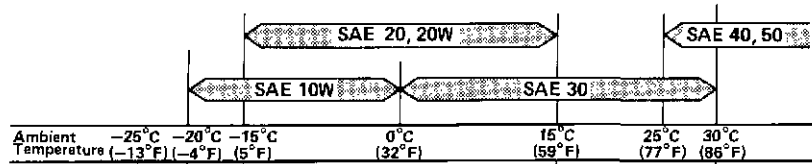
The use of lubricant with viscosity selected according to the atmospheric temperature is important as well as the use of a recommended type. (Refer to page 14)

NOTE: 1) *Use of an engine oil mixed with a different brand or different quality oil will adversely affect the original oil quality, therefore, never mix different brand or different type oils.*

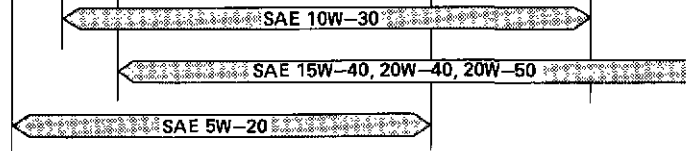
2) *Don't use API, CA, CB grade and refined engine oil.*

ENGINE OIL VISCOSITY GRADE-AMBIENT TEMPERATURE

[Single grade]



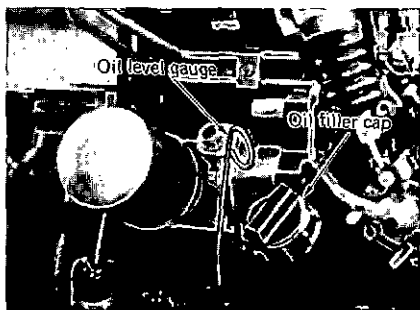
[Multi-grade]



3. COOLANT

Use city water as coolant and change periodically.

III. ENGINE OPERATION



1. CHECK BEFORE OPERATION

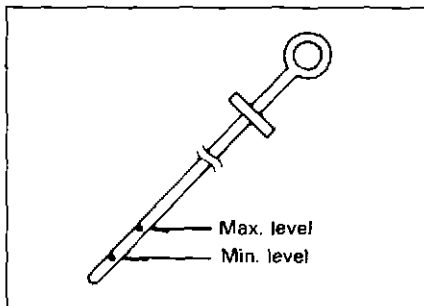
(1) Engine Oil Level

- 1) Place the engine or the machine on a leveled ground.
- 2) Remove the dipstick out of the crankcase and wipe it with cloth. Insert it to the full and remove it gently.

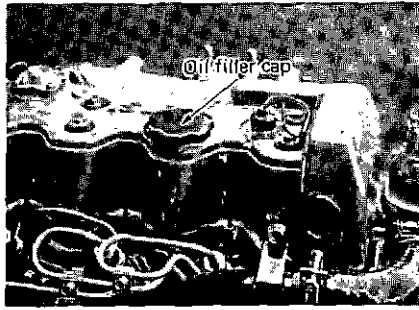
Check the oil level by the level marks on the dipstick. The oil level must be midway between the upper mark and the lower mark as illustrated.

Also check the sample oil on the dipstick for fouling and viscosity.

Be careful not to fill with the oil to excess; excessive oil may cause damage to the engine.



NOTE: The oil level check must be made ten to twenty minutes after the engine has been stopped. When the oil level check is necessary while the engine is running, stop the engine and wait for ten to twenty minutes until the oil thoroughly flows down to the crankcase.

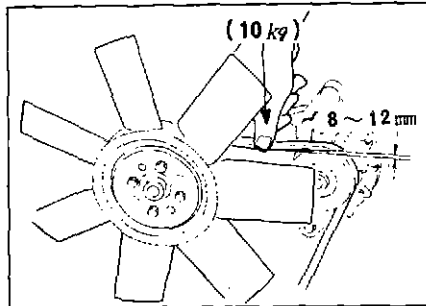


- 3) Oil is poured through the oil filler provided at the front of the cylinder head cover.
Use the specified engine oil. (Refer to page 13 ~ 14).
A certain period of time is required to allow the engine oil to completely flow down from the oil filler to the crankcase.
Check the oil level ten or twenty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

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

(2) Fan Belt

Check the fan belt for tension and any abnormalities.



- 1) When the belt is depressed 8 to 12 mm with the thumb (about 10 kg pressure) midway between the fan pulley and generator pulley, the belt tension is correct.
When the belt tension is too high, it will result in generator failure.
Contrary, loosely tensioned belt will cause belt slippage leading to belt damage and/or 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

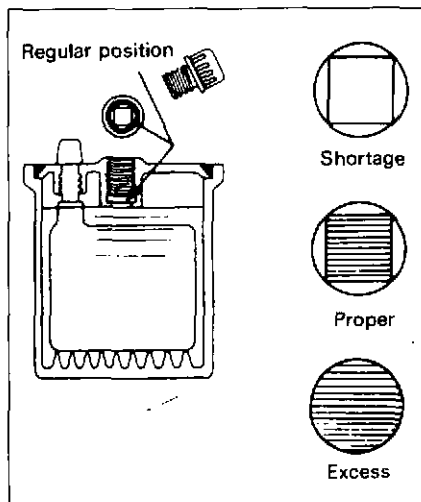
- 1) Remove the radiator filler cap, and check the coolant level as well as the degrees of fouling.
Proper coolant level is about 10 mm higher from the radiator core top.

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

- 2) Use clean city water as coolant. When an anti-freeze solution is required, pay attention to the specified mixing ratio.

(4) Radiator Cap Condition

After the replenishment with 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.

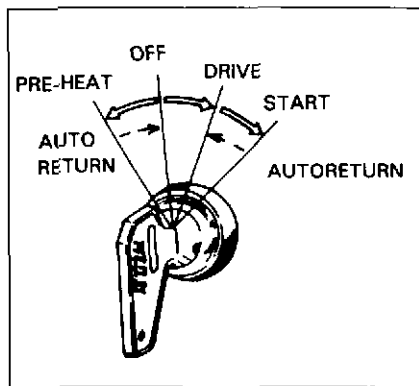
The battery electrolyte level checking procedure or necessity of the electrolyte level check depends on the battery type, therefore, pay attention to the battery type.

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

(6) Battery Cable Connection

Check the battery cable connections for looseness or corrosion.

The loosened cable connection will result in 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 the 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 for cold engine starting. (Not required for warmed-up engine starting)

- 1) Turn the starter switch key counterclockwise to the PRE-HEAT position in order to heat the glow plugs on the engine.
The pre-heating time varies 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 on the instrument board goes off.
 - b. The type with a control resistance
25 to 30 seconds are required until the control resistance coil gets red-hot.
- 2) Turn the starter switch key clockwise to START position as soon as the indication lamp goes off or the control resistance coil gets red-hot.
- 3) When equipped with the quick pre-heating system (QOS-II), turn the starter switch to DRIVE position.
The pre-heating indication lamp will come 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 to the Isuzu standard starter switch.

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

The cranking period must be limited to ten seconds.

Continuous starter running for more than ten seconds will lead to overdischarge of the batteries as well as starter seizure.

If it is impossible to start the engine at one attempt, wait for at least 30 seconds until the batteries and starter 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 in the starter pinion gear and the flywheel ring gear damage.*

- 3) If, despite of repeated attempt of starting operation, the engine does not start yet, the engine might have abnormalities somewhere. Check the related system to locate the cause.
- 4) When the engine has started, release the starter switch key. The key will return to DRIVE position automatically.

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

3. CHECK AND OPERATION AFTER ENGINE START-UP

(1) Warming-up Operation

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

As the lubrication for the entire engine system is done during this warming-up, do not operate and load the engine abruptly. Particularly, make sure of this in cold season operation.

(2) Check after 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 varies depending on atmospheric temperature or type of oil, the gauge indicates around 4 to 5 kg/cm² during warming-up.

With oil pressure warning lamp provided, make sure that the lamp is off.

2) Charge condition

The charge condition is normal if once the ammeter indicates the plus side simultaneously with engine start, then gradually getting smaller.

With the warning lamp provided, make sure that the lamp is completely off during warming-up.

-
- 3) Engine noise and exhaust smoke color
Pay attention to engine noise and, if any abnormal noise is heard, check the engine to locate the cause.
Check the fuel combustion condition by the exhaust smoke color.
Exhaust smoke color (after the warming-up and no-load operation):
No color or light blue Normal (Perfect combustion)
Black color Abnormal (Imperfect combustion)
White color Abnormal (Oil up or down)

NOTE: *Engine after start-up may be noisier than warmed-up engine and, the exhaust smoke is more blackish than usual. However, it is normalized on completion of the warming-up.*

- 4) Leakage in the systems
Check the following items:
- a. Lubricant and fuel leakage
 - b. Coolant leakage
 - c. Exhaust gas leakage

5) Coolant level check

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

On such occasion, stop the engine and add more coolant as required.

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

4. ENGINE OPERATION CARE

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

(1) Engine Oil Pressure

1) Engine oil pressure is normal when the oil pressure gauge indicates 3 to 4 kg/cm² with the engine warmed up.

As engine operation continues, engine oil pressure becomes slightly lower than in the start-up period.

Engine oil pressure is normal if the engine oil pressure warning lamp remains OFF with the engine running continuously.

2) If the engine oil pressure gauge indicates following abnormal conditions, stop the engine immediately and check the engine oil amount in the oil sump and oil leakage:

a. The engine oil pressure gauge indicates 2 kg/cm² or less although engine speed is raised.

b. The oil pressure gauge indicator fluctuates widely in the engine low-speed range.

c. The engine oil pressure warning lamp goes on and off repeatedly.

If there is no lack of engine oil or oil leakage found, the possibility of hydraulic system trouble may be considered. It is recommended that you make contact with your machine supplier.

(2) Coolant Temperature

Engine performance will be adversely affected if the engine runs too hot or too cool.

The normal coolant temperature is 75 to 85°C.

- 1) When the coolant temperature gauge indicates 100°C or more, or when the coolant temperature warning lamp lights on, the engine is overheated.

In such a case, stop the machine and lower engine speed to 1000 rpm, thereby cooling down the engine for five minutes.

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

- 2) Long-hour engine operation at low coolant temperature will not only increase oil and fuel consumptions but also will cause parts premature wear resulting in engine failure finally.

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

This meter integrates the engine operating hours. Make sure that the meter is at work during engine operation.

The periodical engine maintenance is scheduled on the basis of hourmeter reading.

(4) Liquid and Exhaust Smoke Leakage

Pay attention to lubricant, fuel, coolant and exhaust smoke leakages.

(5) Abnormal Engine Noise

Pay attention to the noise from the engine or other related parts, checking if the noise is normal.

(6) State of the Exhaust Smoke

Pay attention to exhaust smoke color, checking if it is whitish or blackish.

5. ENGINE STOPPING

- (1) Make sure that all the control levers on the machine are in the "NEUTRAL" positions.
- (2) Before stopping the engine, cool down at a low idle speed for three minutes.
During this operation, make sure engine noise and engine oil pressure are normal.
- (3) To stop the engine, pull the engine stop knob to the full. This operation cuts fuel feed causing the engine to stop.
If the engine is provided with a stopping device (as option), however, the engine can be stopped by turning the starter switch key to the "OFF" position.
- (4) Turn the starter switch key to the OFF position. Switch off the battery switch (if so equipped).

NOTE: *Leaving the starter switch key in the DRIVE position for a long while after the engine stops, will discharge the batteries wastefully.*

6. ENGINE STOPPING DEVICE (OPTIONAL DEVICE)

- (1) This stopping device can stop the engine by only turning the starter switch to the OFF position.
- (2) Moreover, if engine oil pressure should drop abnormally, or if coolant temperature should rise abnormally, the solenoid connected to the fuel cut lever of the fuel injection pump will be actuated to automatically stop the engine.
- (3) If the engine should stop automatically owing to engine abnormality, please inspect the following items and take following corrective actions:
 - 1) Inspect engine oil level by dipstick. If the engine oil pressure gauge should read 1.0 kg/cm² or less, or if the oil pressure warning lamp should be on, replenish with engine oil.
If oil leakage is considered as the cause of abnormality, contact ISUZU engine service plant.
 - 2) Remove the radiator cap and inspect the coolant level to see if the coolant temperature is more than 100°C.
If it should be lower than the specified level, replenish with coolant.
If coolant leakage is considered as the cause of abnormality, contact the ISUZU service plant.

CAUTION: When removing the radiator filler cap while the engine is still hot, cover the cap with cloth, then turn it slowly to release the internal steam pressure. It will protect yourself from getting scalded with hot steam spouted out from the filler port.

7. NEW-ENGINE OPERATION AND CARE

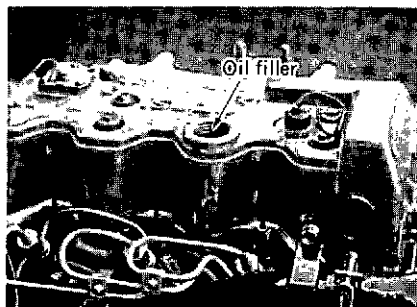
Your ISUZU engine is carefully tested and adjusted in the factory, however, further, thorough run-in (i.e. break-in) operation is necessary. If the new engine is harshly operated, lubricating oil film will be cut leading abnormal wear or seizure. Particularly, avoid a harsh engine operation within the initial 100 operation hours observing the following notice.

- (1) Continue warming-up operation until the engine is warmed up. Do not race the engine.
- (2) Do not accelerate the engine nor start the machine abruptly.

8. ENGINE CARE FOR OVER-COOLING

Engine over-cooling will result in premature wear and increased fuel consumption. Coolant temperature should rise to 75 to 85°C. If coolant temperature does not reach this range, check the cooling system. If there is no trouble, cover the radiator with a radiator curtain to raise engine coolant temperature.

IV. PERIODICAL INSPECTION AND MAINTENANCE



1. LUBRICATING SYSTEM

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

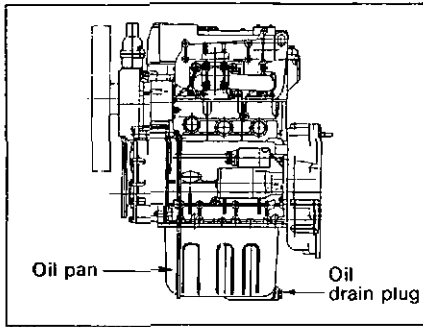
Change the engine oil and the oil filter element periodically with the specified one. (Refer to LUBRICANT at page 13 ~ 14.)

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

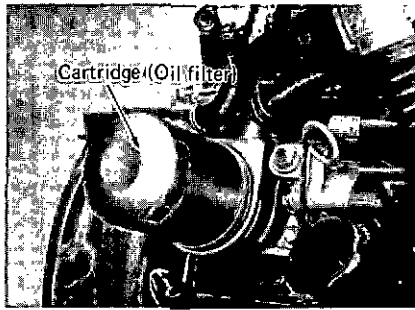
The engine oil change and the main oil filter element change must be made simultaneously according to the following change schedule.

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.



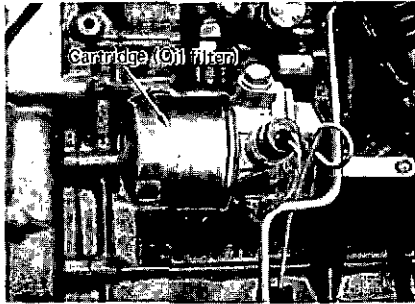
- b. Drain plug at the oil pan to drain the engine oil.
To shorten the oil draining time required, it is recommendable to do this procedures while the engine is warm.



- 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 sealing face is fitted against the O-ring.
Use the filter wrench to turn in the cartridge an additional one and 1/4 turn.

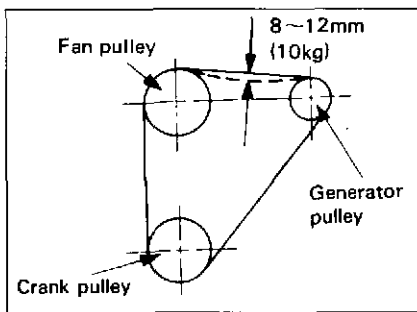


-
- 5) Engine oil refilling
 - a. Reinstall the drain plugs.
 - b. Fill the new engine oil from the oil filler port.
Check the oil level with the dipstick after the oil has been gone down completely. (about 15 minutes)
 - 6) Check after the oil change

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 fan belt tension when the belt slackness is bigger than the specified amount and when the belts are replaced.

1) Belt tension

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

Fan belt slackness amount : 8~12 mm

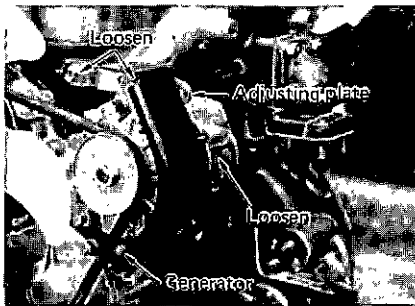
2) Adjusting procedure

Belt tension adjustment can be made 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 left or right hand side of the engine as required.
Tighten the mounting bolt and the adjusting bolt.

NOTE: *Belt tension may slightly vary after the generator is fixed, therefore, recheck belt tension after the bolts have been tightened.*

- c. After the adjustment, operate the engine about five minutes at low idle speed and recheck belt tension. Particularly, pay attention to the matter where the new belts are installed. Belt tension may vary 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 on the left hand side of the cylinder block to drain the coolant in the engine.
- 2) Coolant filling
- a. Close or tighten the coolant drain valve or plug.
 - b. Use clean water such as city water as the coolant.
- Fill up the radiator with the coolant until the level comes up to the filler port neck.
Fill with the coolant gradually to prevent air entry.
Coolant volume (Engine only) :

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

After the coolant have been filled with operate the engine about five minutes at low idle speed, then the air contained in the coolant circuit is bled to lower the 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.

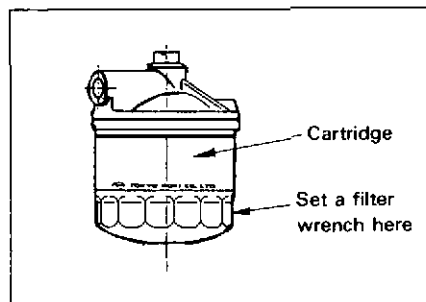
(1) Removal of Water from the Fuel Filter

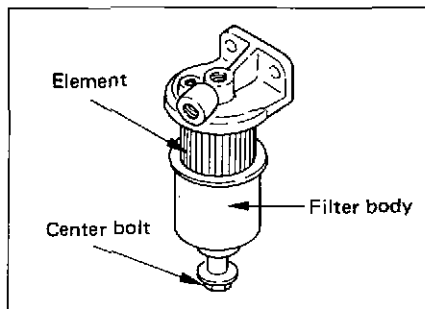
Remove the fuel mixed up with water by removing fuel filter element.

- 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.

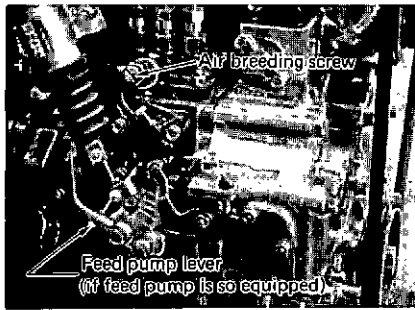




Center bolt type fuel filter

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

NOTE: 1. Be careful not to spill out the fuel remaining in the fuel filter when the filter is removed.
2. Do air bleeding after removal of air-mixed fuel is over.



(2) Fuel System Air Bleeding

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

When servicing such as emptying the fuel tank, air bleeding for the water sedimentor, or the fuel filter element change etc. has been done, be sure to conduct air bleeding.

Bleeding procedure

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

Engine life and the performance depends greatly on the intake air condition.

A fouled air cleaner element result in decreased intake air amount leading to engine output decrease and finally causing an engine malfunction.

Further, a damaged air cleaner element result in the wear of the cylinder component or the valve mechanism etc. leading to increased engine oil consumption and decreased engine output, finally leading to shortened 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

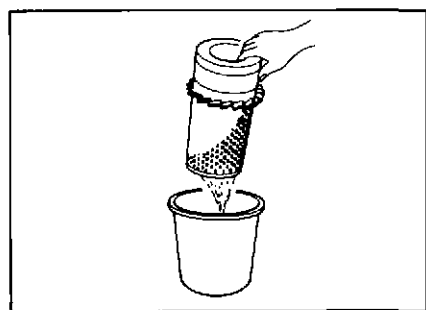
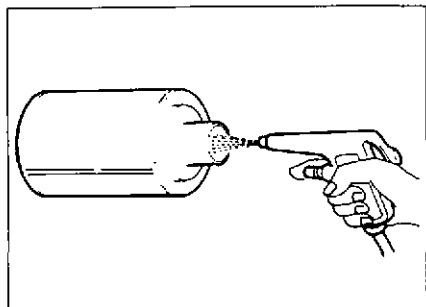
Every 1800 hour — replace the air cleaner element

Every 600 hour, clean the air cleaner by applying compressed air into the body from engine side. Air pressure should not exceed 7 kg/cm^2 . (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 cyclopack type as an example)



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

Viscous type

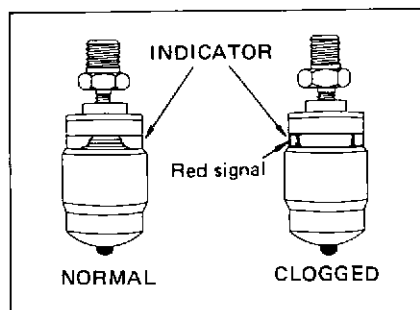
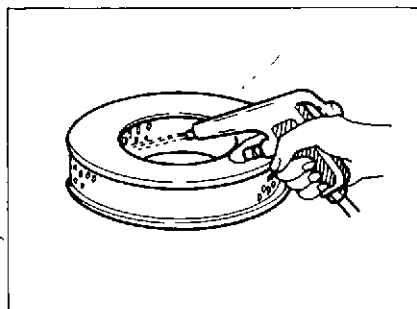
The wet paper air cleaner (viscous type), using filter paper coated with special viscous liquid, has a special filtering function. Do not clean but replace it every 600 operation hours.

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/cm^2) 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.

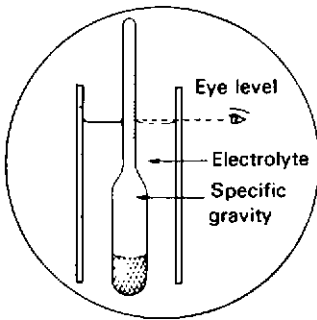
(1) Battery Servicing

- 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

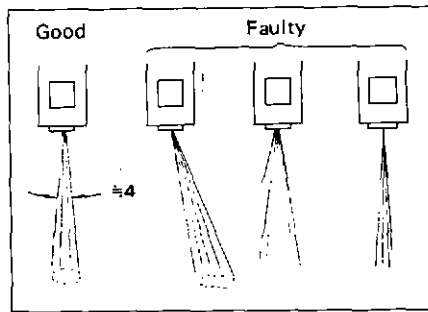
- 1) The polarity of the generator is negative grounding type.
When an inverted circuit connection take place, the circuit will be in short circuit instantaneously resulting the generator failure.
- 2) Do not put water directly on the generator. Entry of water into the generator leads an electrolyte 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

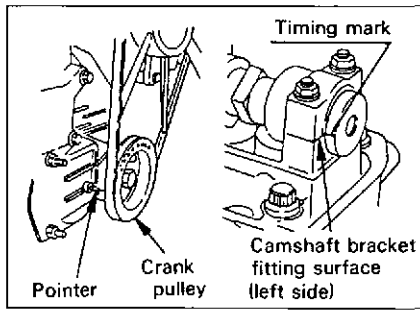
When the injection starting pressure is too high or too low or the fuel spray pattern is improper, an abnormal fuel combustion take place in the engine leading a lowered output and blackish exhaust smoke. Further, it causes a piston seizure or piston damage etc. In such cases, the injection nozzle test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

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

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

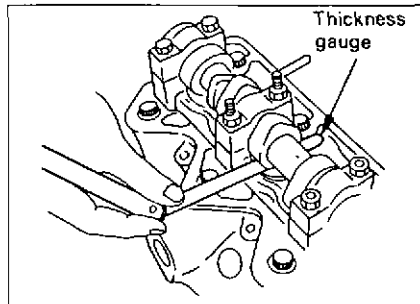
Adjustment Procedures

In order to bring 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, 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	
	valve	I	E	I	E
①	When No. 1 piston is at TDC in the compression stroke	○	○		○
②	Turn crankshaft 360° clockwise from the status ① above			⊙	

For 3 cylinders engine

	Cylinder No.	1		2		3	
	valve	I	E	I	E	I	E
①	When No. 1 piston is at TDC in the compression stroke	○	○	○			○
②	Turn crankshaft 360° clockwise from the status ① above				⊙	⊙	

(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 antifreeze manufacture's recommendations.</i></p> |
|---|

3. ENGINE OIL

As atmospheric temperature drops, engine oil viscosity will increase to cause hard engine starting. It is recommended that the machine is not exposed to cold wind.

4. BATTERY

- (1) Always pay attention to charging the batteries completely in cold season.

As the discharge current from the battery is large in the cold engine starting, it takes a longer while to recharge the batteries than the recharge after the normal engine starting.

Particularly, as the specific gravity of the insufficiently charged battery's electrolyte is low, it will be easily frozen.

Take care to keep the batteries warm in the cold season.

- (2) To replenish the battery with distilled water, do it immediately before the engine operation.

If the work is done after the engine has run into operation, the distilled water replenished will not be mixed up with the original electrolyte. It may cause to freeze the distilled water remaining in the upper part of the battery cell.

5. ENGINE STARTING

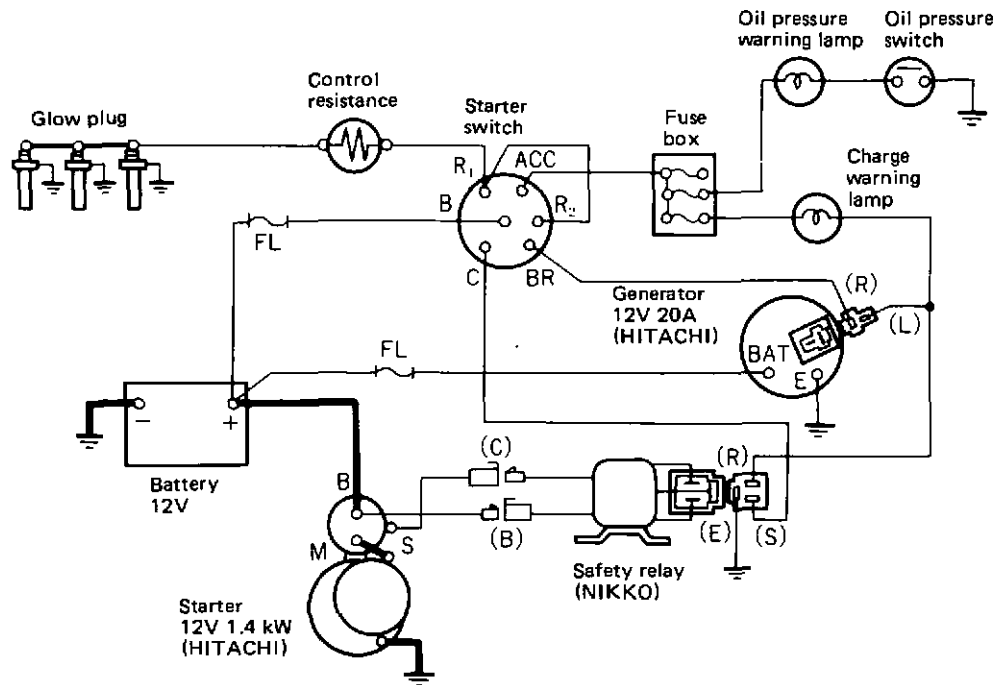
In a cold engine starting done in below 0°C atmospheric temperature, pay attention to the following items.

- (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.

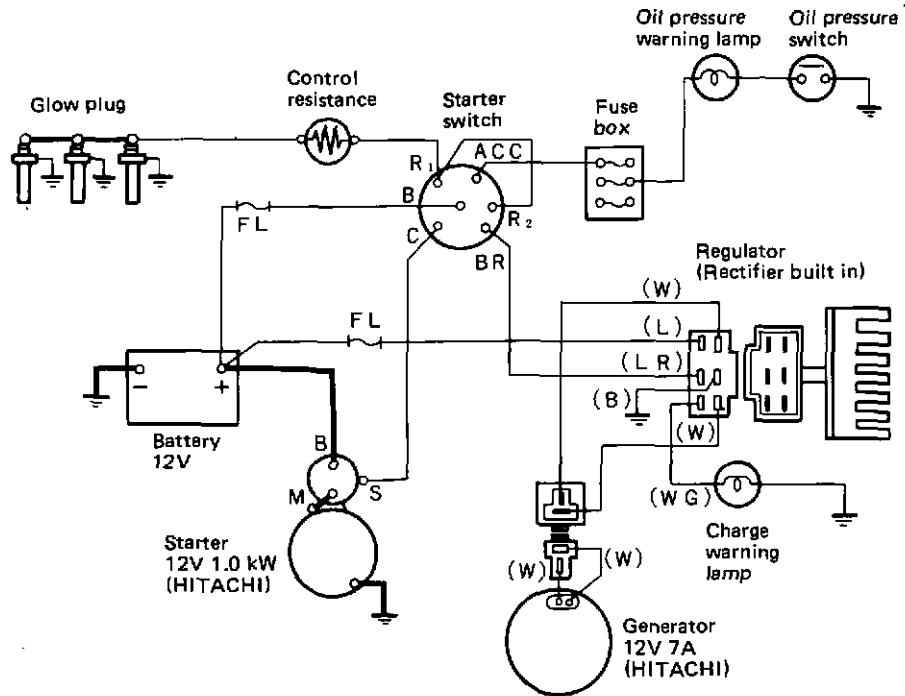
VI. ENGINE ELECTRICAL WIRING DIAGRAMS

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					○			

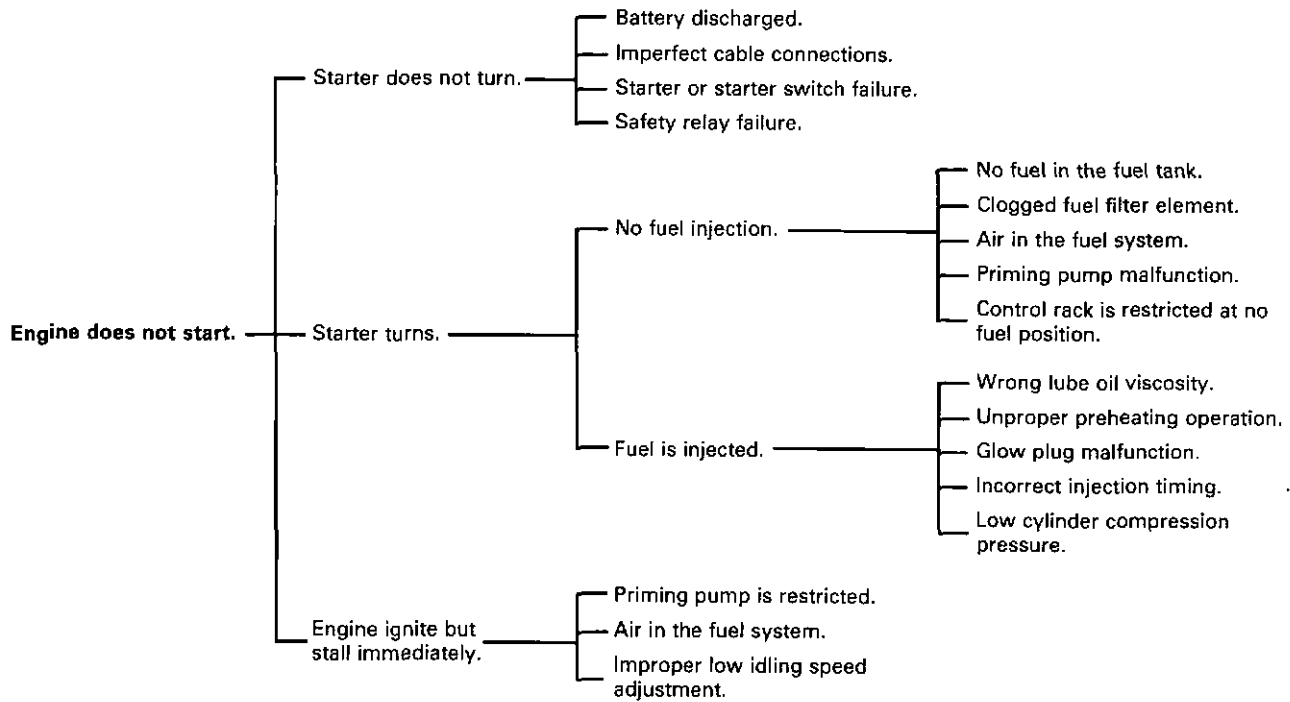
Description of check and maintenance	Daily	50	Every 100	Every 200	Every 300	Every 600	Every 1200	Remark
	(operation hours)							
COOLING SYSTEM								
Coolant level and coolant fouling check	<input type="radio"/>							10mm upper position from the radiator core.
Coolant leakage check	<input type="radio"/>							
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.

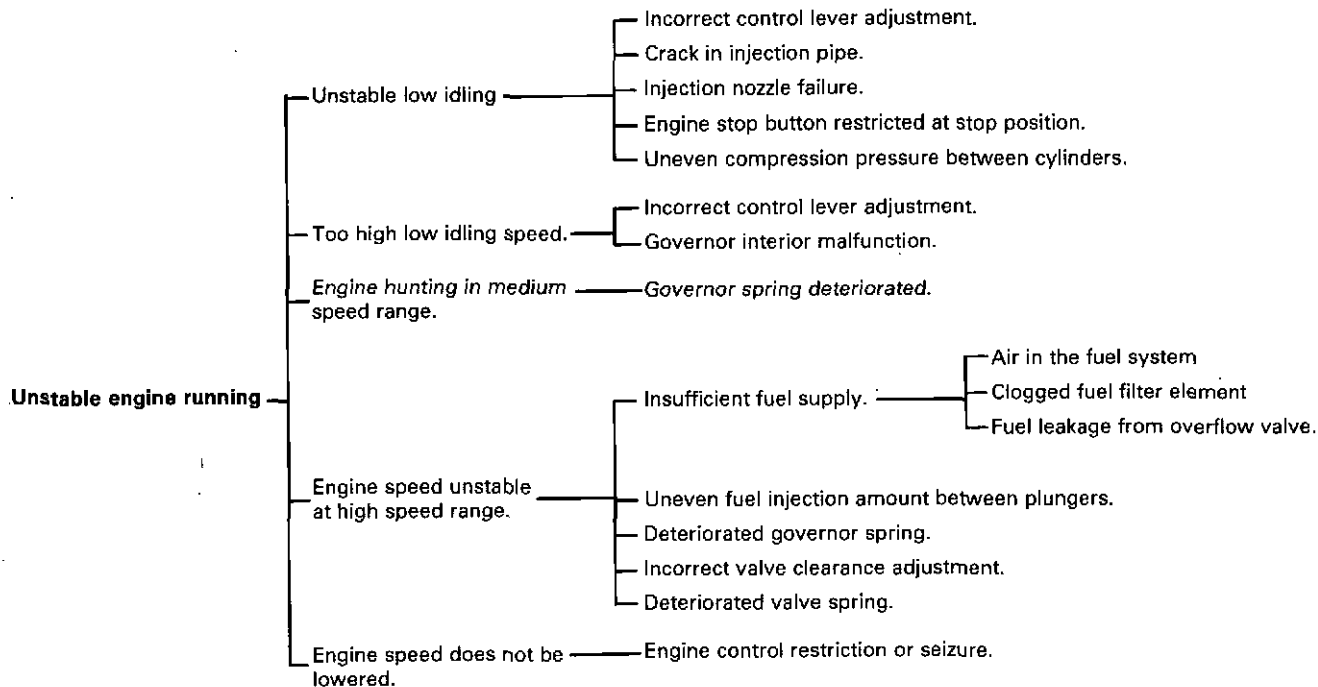
Description of check and maintenance	Daily	50	Every 100	Every 200	Every 300	Every 600	Every 1200	Remark
AIR INTAKE SYSTEM								
Air cleaner element replace								According to the machine manufacturer's specifications or caution plate.
ELECTRICAL SYSTEM								
Electrolyte level check	○							Replenish 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						○		

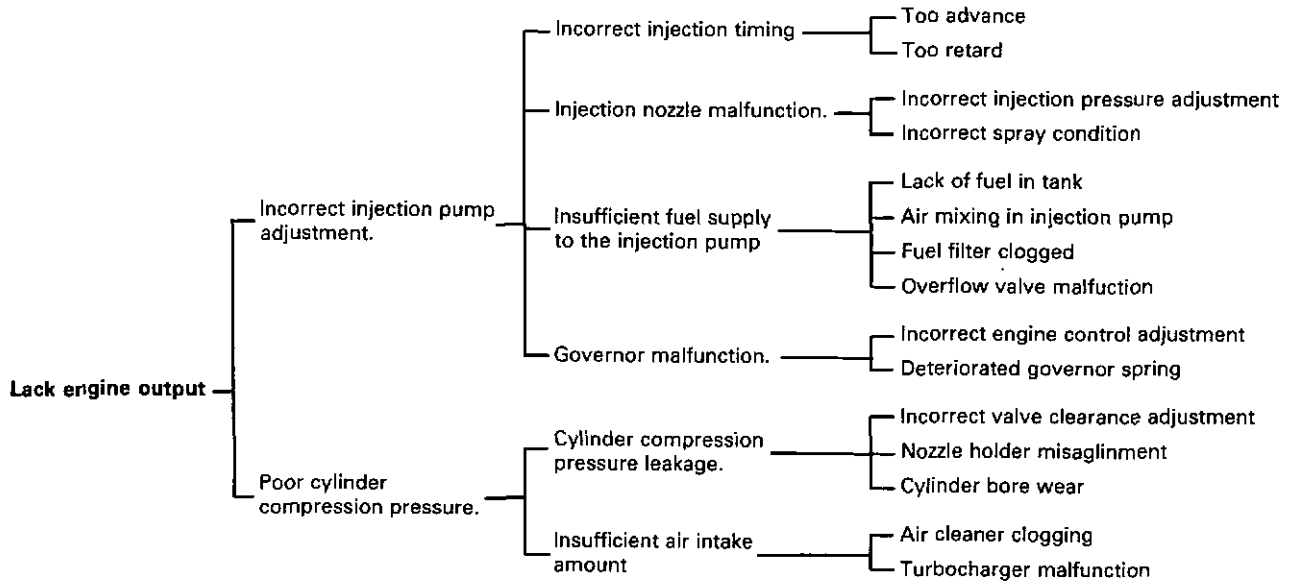
Description of check and maintenance	Daily	50	Every 100	Every 200	Every 300	Every 600	Every 1200	Remark
	(operation hours)							
Wiring and connection check						○		
Preheating condition check	○							About 25 seconds
OTHERS								
Engine starting conditions and noise conditions	○							
Exhaust smoke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

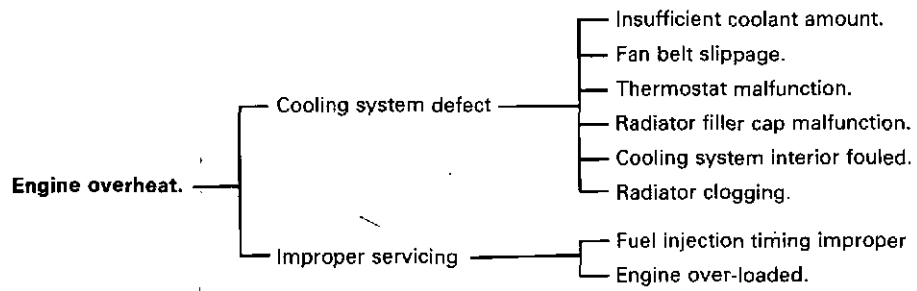
- NOTE:** 1. The service intervals after 1200 operation hours should also be made every 100 operation hours in accordance with this check and maintenance schedule.
2. When the servicing on the asterisked (*) items are necessary, consult the machine supply source.

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

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