

Symbols Used in This Manual

DANGER

Failure to follow these instructions identified by this symbol could result in death or serious injury to you and/or other people.

WARNING

Failure to follow these instructions identified by this symbol could result in death or severe injury/engine fire.

CAUTION

Failure to follow these instructions identified by this symbol could result in injuries or an accident.

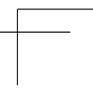
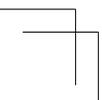
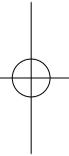
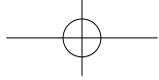
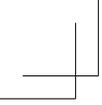
ADVICE

Failure to follow these instructions identified by this symbol could result in engine failure/damage.

NOTE

This symbol identifies information that you need to know.

This symbol also identifies information that would be useful for operating the engine.



HOW TO USE THIS MANUAL AND HOW TO FIND A SPECIFIC TOPIC

0

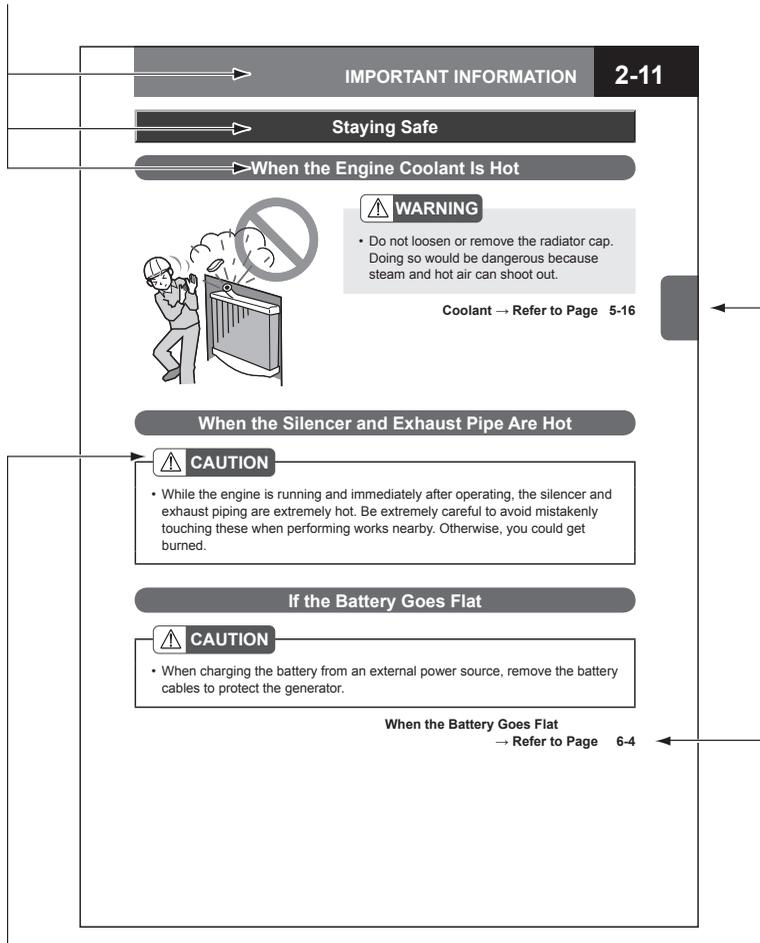
• HOW TO USE THIS MANUAL	0-2
• HOW TO FIND A SPECIFIC TOPIC	0-3
• CHAPTER DESCRIPTION	0-5
• PICTORIAL INDEX	0-6

Chapter/section titles

These titles are useful for getting the gist of the content at a glance.

Chapter index tab

Use this for quick access to your desired chapter.



DANGER

WARNING

CAUTION

ADVICE

NOTE

Symbols

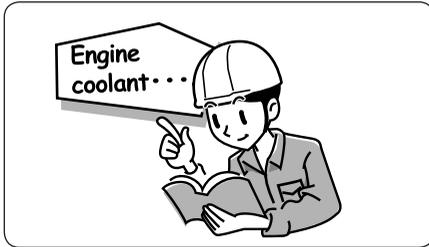
See the preceding page for the meanings of these symbols.

Reference page

Refers you to a page (or pages) of this manual that concerns the present topic and that you should also read.

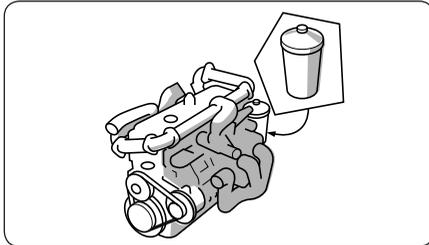
All values in this manual are indicated primarily according to the International System of Units (or in SI units) with the conventional metric values and American units indicated in parentheses.

Note: This page is shown only as an example. It is not intended to give you information on your particular engine.



Use chapter/section titles as keys
 ➔ Page 0-5

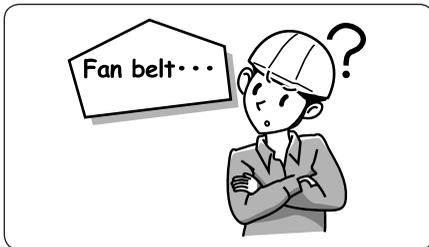
Search for the page describing the specific topic by using the general table of contents under CHAPTER DESCRIPTION, the CHAPTER INDEX, and/or the TABLE OF CONTENTS on the first page of each chapter.



Use the pictorial indexes
 ➔ Pages 0-6 to 0-9

PICTORIAL INDEX

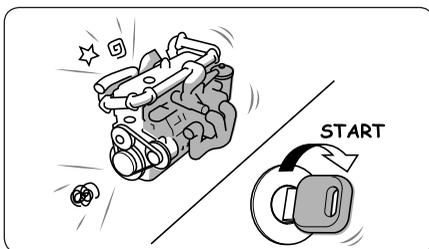
If you don't know the name of the parts or other device for which you need information, locate the page describing it by using the pictorial indexes.



Use device names as keys
 ➔ Pages 8-1 to 8-2

INDEX

If you know the name of the switch or other device for which you need information, locate the page describing it by using the Index at the end of this manual.



If you have a problem with your engine
 ➔ Pages 6-2 to 6-6

IN CASE OF EMERGENCY

0-4



PICTORIAL INDEX..... 0-6**INFORMATION 1****IMPORTANT INFORMATION 2**

Describes what you should know before you operate the engine safely and smoothly.

HANDLING OF ENGINE 3

Explains how to start and stop the engine and describes various switches.

HANDLING IN COLD SEASON 4

Describes the points you should be aware of to operate the engine safely and smoothly under various conditions and in different seasons.

INSPECTION AND MAINTENANCE 5

Describes daily and periodic inspections and other engine or machine care and maintenance information necessary to keep your engine in good condition.

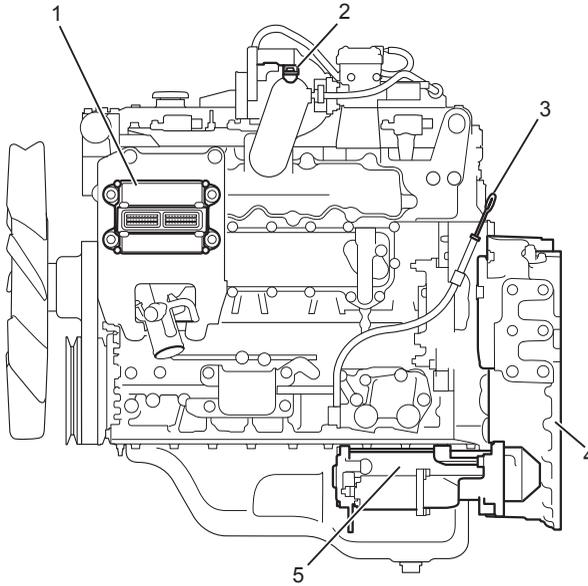
IN CASE OF EMERGENCY 6

Enumerates possible emergency situations and describes the actions you should take to deal with any one of them.

MAIN DATA..... 7**INDEX 8**

Exterior

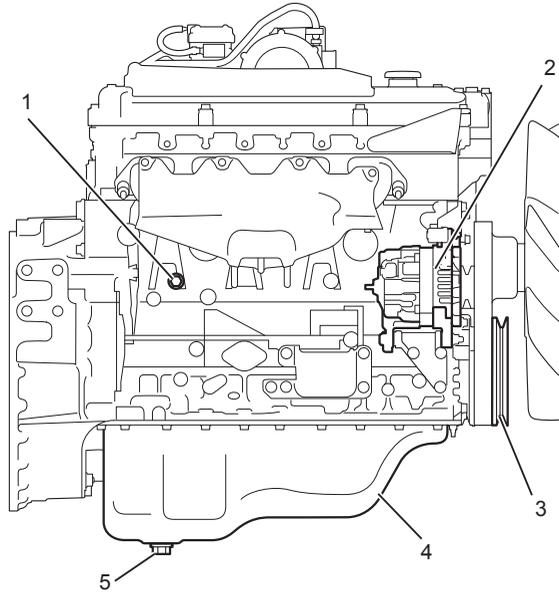
NG engine model (Left side)



No.	Equipment	Reference Page
1	Engine controller (ECM)	—
2	Intake throttle	—
3	Oil dipstick	5-7

No.	Equipment	Reference Page
4	Flywheel housing	—
5	Starter motor	5-27

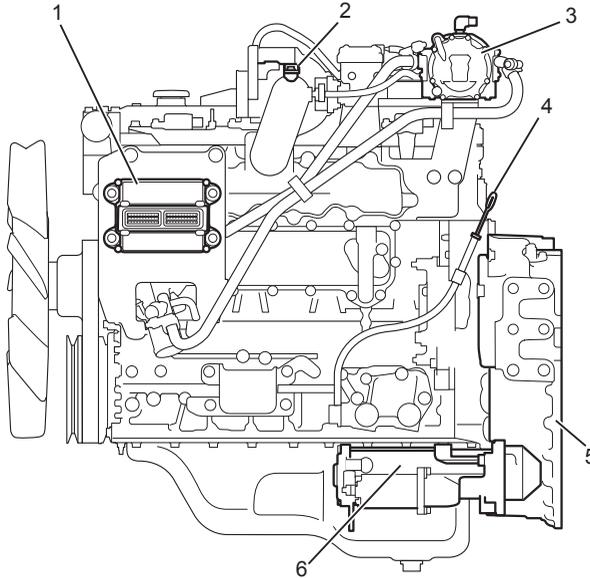
NG engine model (Right side)



No.	Equipment	Reference Page
1	Water drain plug	5-19
2	Generator	5-27
3	Crank pulley (Crankshaft damper)	—

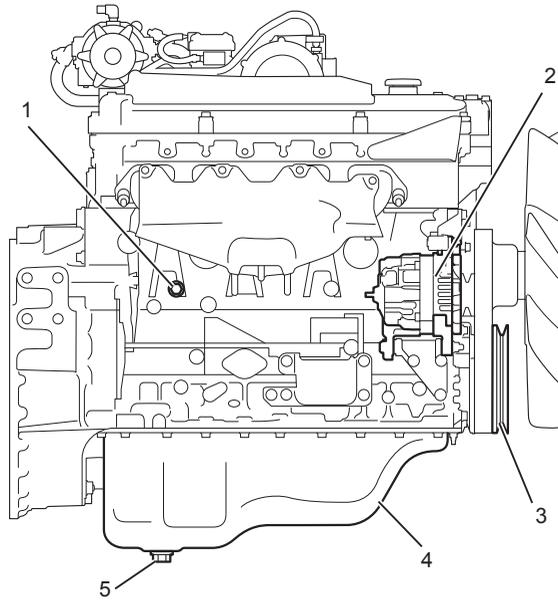
No.	Equipment	Reference Page
4	Oil pan	—
5	Oil drain plug	5-10

LPG engine model (Left side)



No.	Equipment	Reference Page	No.	Equipment	Reference Page
1	Engine controller (ECM)	—	4	Oil dipstick	5-7
2	Intake throttle	—	5	Flywheel housing	—
3	Vaporizer	5-23	6	Starter motor	5-27

LPG engine model (Right side)



No.	Equipment	Reference Page
1	Water drain plug	5-19
2	Generator	5-27
3	Crank pulley (Crankshaft damper)	—

No.	Equipment	Reference Page
4	Oil pan	—
5	Oil drain plug	5-10

0-10

PICTORIAL INDEX



INFORMATION

1

• Isuzu Genuine Parts	1-2
• Warranty	1-2
• Engine Number/Emission Label/Special Vehicle Labels	1-3
• Exhaust Emission Regulation Related Parts	1-4

Isuzu Genuine Parts**ISUZU
GENUINE PARTS**

"Isuzu genuine parts" are manufactured with the same specifications as those of the parts that are installed at the time of engine assembly, and the quality and performance of them are guaranteed by Isuzu. For parts and oils required for maintenance and service, it is recommended to use genuine Isuzu parts or equivalent.

"Isuzu genuine parts" are packed in the box with the mark above and sold at Isuzu Distributor or the machine manufacturer.

Warranty

If a failure occurs, repair shall be provided for free to the extent described in the separate "warranty certificate" (service handbook).

Please bring the "warranty certificate" (service handbook), and ask the nearest Isuzu Distributor or the machine manufacturer.

Engine Number/Emission Label/Special Vehicle Labels

- If any of these labels is smudged, damaged, or peeled, contact an Isuzu Distributor or the machine manufacturer.
- For the labels on the actual machine side, refer to the instruction manual from the relevant manufacturer.
- Some examples of these labels are indicated below, but there are many others not shown. The contents of these labels may vary depending on the specifications.

Engine Number/ID (Identification) Labels

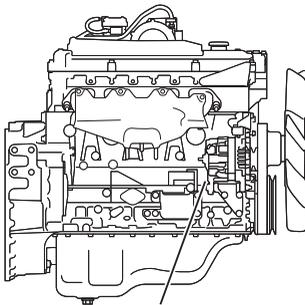
The engine number is required for engine registration/inspection. Provide your Isuzu Distributor or the machine manufacturer with names of the machine manufacturer, type, etc. in addition to the engine number when you are having the machine repaired or are ordering replacement parts, so that the Isuzu Distributor or the machine manufacturer can provide service more effectively and efficiently.



WARNING

- When checking the engine number, make sure to stop the engine to prevent your body from being caught in the rotating unit and confirm that the engine is cooled down. Be careful not to get burned with the heat from the exhaust system, the high temperature coolant or the heat from the engine itself when checking it.

Engine Number



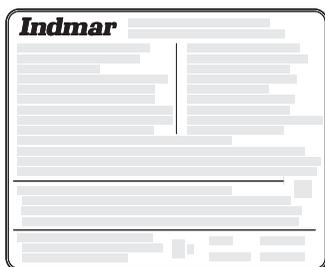
Engine number

It is stamped on the right side bottom part of the cylinder block.

ID Label

It is attached to the cylinder head cover.

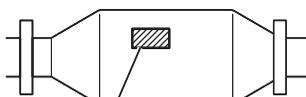
Emission Labels



It is attached to the cylinder head cover. The emission labels on the engine indicate very important instructions and information that you should respect to ensure safe and proper use of the engine. Be sure to read them before using the engine.

The descriptions in the emission labels are only about the engine unit.

Three-way Catalyst Serial Number



Three-way catalyst
serial number

It is stamped on the top surface of the three-way catalyst.

Exhaust Emission Regulation Related Parts

This engine has been certified under EPA regulations. Do not remove or modify the equipped parts related to the exhaust gas control system.

IMPORTANT INFORMATION

2

• About Natural Gas (NG) Engines and Liquefied Petroleum Gas (LPG) Engines	2-2
• Before Driving	2-2
• Fuel, Lubricant and Coolant	2-5
• Driving	2-7
• Staying Safe	2-11
• Preventing Engine Failure	2-12
• When to Visit an Isuzu Distributor	2-14

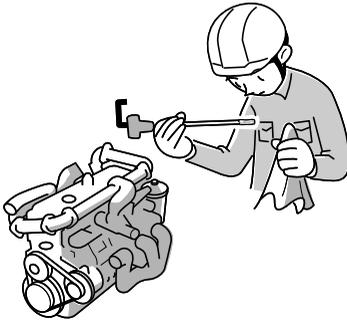
This chapter contains information and cautions that you should observe for safe and comfortable engine operation, so be sure to read it before using the engine.

About Natural Gas (NG) Engines and Liquefied Petroleum Gas (LPG) Engines

An NG engine is an engine that uses natural gas (NG) as fuel. An LPG engine is an engine that uses liquefied petroleum gas (LPG) as fuel. Follow the handling method specified for the respective engines.

Before Driving

Perform Daily (Pre-Driving) Inspections



For safe and comfortable driving, grasp the engine operation hours and the conditions of the engine during operation, and perform inspections at appropriate intervals, and provide maintenance works in accordance with the findings of the inspections.

When an inspection reveals an abnormality or there was an abnormality found while driving in the previous day or time, have the machine repaired at an Isuzu Distributor or the machine manufacturer before it is driven again.

Be Careful with Exhaust Emissions



WARNING

- The exhaust gas contains carbon monoxide (CO) which is colorless, odorless and harmful. It is dangerous to inhale the exhaust gas, which may cause carbon monoxide poisoning.
- Do not leave the engine running in a place where ventilation is poor. It is particularly dangerous to run the engine in an indoor place where it can be easily filled with the exhaust gas.
- Inspect the exhaust pipe from time to time. When an abnormality such as a hole or crack due to corrosion and a damaged joint is found on the exhaust pipe, have the machine inspected/serviced at the nearest Isuzu Distributor or the machine manufacturer. Continuous use of the machine without having the defect repaired is dangerous because the exhaust gas may intrude into the actual machine, causing carbon monoxide poisoning.

Inspection Point	Inspection Item	Reference Page
Engine	Coolant level*	—
	Oil level and contamination*	5-7
	Leakage of gas, engine oil and coolant	—
	Engine starting condition and abnormal noise*	5-5
	Color of exhaust smoke	3-6
	Conditions at low speeds and during acceleration*	5-5
	Fan belt looseness and damage*	5-14
Battery	Fluid level*	5-31
	Looseness and corrosion in terminal section	5-32
Indicator lights and liquid crystal display (LCD) on the actual machine	Engine failure indication	—
Location where an abnormality is found while driving	No abnormality is found in the relevant location	5-5

* : Inspection items that should be performed at an appropriate period determined based on the operation hours, driving conditions, etc. are indicated.

Use the Specified Fuel

Natural gas or liquefied petroleum gas for engines must be used as the fuel.



CAUTION

- When filling NG/LPG, never smoke or place any ignition source nearby. An engine must be stopped.

Check the NG/LPG Level

Fuel gauge



When the needle of the fuel gauge is near 0 or "E", refill NG/LPG as soon as possible. Refer to the instruction manual from the machine manufacturer for the fuel gauge.



ADVICE

- Running out of fuel on the road is dangerous and can cause an accident.

After Filling with NG/LPG, the Pressure May Drop



NOTE

- After filling with NG/LPG, the pressure can drop due to a temperature drop inside the NG/LPG containers (NG/LPG cylinders).
- Variations in temperature can cause slight fluctuations in the position of the fuel gauge.

Check for Odors Before Driving

In addition to the normal daily inspection items, an odor inspection must also be conducted for NG/LPG engines.

Inspect for odors or anything else unusual around the engine to make sure that there are no gas leaks.

Daily (Pre-Driving) Inspection

→ Refer to Page 5-4



ADVICE

- If a gas leak is found, have the engine inspected at the Isuzu Distributor or the machine manufacturer as soon as possible.

Fuel, Lubricant and Coolant

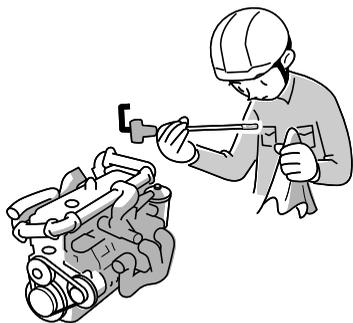
Handling the Fuel



WARNING

- Be sure to place the starter switch in the "OFF" position to shut down the engine before refueling the machine because refueling while the engine is running may cause a fire.
- When refueling, putting any flame nearby is strictly prohibited. Do not place a lighted cigarette or something similar nearby which may result in a fire.
- Securely close the filling unit cap.

Lubricant (Engine Oil)



ADVICE

- The engine oil has a significant impact on the performance and service life of the engine and fuel economy. It is recommended to use genuine Isuzu oil or equivalent.

The engine oil has the following important functions.

- Prevents some parts of the engine from wearing.
- Cools down each part of the engine.
- Cleans each part of the engine.
- Maintains airtightness of the combustion chambers and prevents rust generation. Replace the engine oil periodically.

Daily (Pre-Driving) Inspection

→ Refer to Page 5-4

Engine Oil

→ Refer to Page 5-6

Periodic Inspection and Maintenance List

→ Refer to Page 5-33

Coolant



Replace the engine coolant periodically. In the cold season, to prevent the engine damage or accident due to freezing of the coolant, the Isuzu genuine long-life coolant (LLC) is available at Isuzu Distributor or the machine manufacturer. Take advantage of this product.

Replacing the Coolant

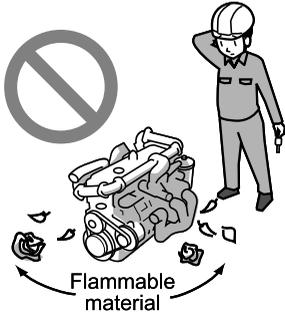
→ Refer to Page 5-18

Handling the Long-Life Coolant

→ Refer to Page 5-17

Driving

Keep Flammable Material Away from the Engine



CAUTION

- While the engine is running and immediately after operating, the exhaust piping is extremely hot. Make sure that there are no flammable items such as plants, dry grass, paper waste, oil, or old tires nearby. Take extra caution when operating the machine indoors.
- Be careful of the exhaust gas heat generated while the engine is idling.

Handling in Initial Use Phase

The engine has gone through the severe inspection before shipping, but furthermore sufficient initial settlement and breaking-in are required for the engine.



ADVICE

- When extreme driving is performed during initial use phase, the oil film may be broken causing abnormal wear or seizure. Especially for the first 100 hours or around, drive as pre-conditioning period without forcing too far, and observe the following cautions.
 - Revving the engine while the gear in the neutral position should not be performed.
 - Sudden acceleration, abrupt starting, or sudden application of load should be avoided.

If the Engine Has not Been Used for a Long Period



ADVICE

- When using the engine that has not been used for a long period of time (one month or longer), perform an inspection thoroughly before starting the engine. Also, confirm that there is no oil leakage and the oil has been sufficiently added to the specified level. If the oil level is insufficient, the oil is not supplied adequately, and a breakdown may result.
- Start the engine and idle it at least for 10 minutes. Also, make sure that the engine produces no abnormal noise.
- For warming up operation, refer to "Starting the Engine" in page 3-2.

Be Careful with Exhaust Emissions



WARNING

- The exhaust gas contains carbon monoxide (CO) which is colorless, odorless and harmful. It is dangerous to inhale the exhaust gas, which may cause carbon monoxide poisoning.
- Do not leave the engine running in a place where ventilation is poor. It is particularly dangerous to run the engine in an indoor place where it can be easily filled with the exhaust gas.
- Inspect the exhaust pipe from time to time. When an abnormality such as a hole or crack due to corrosion and a damaged joint is found on the exhaust pipe, have the machine inspected/serviced at the nearest Isuzu Distributor or the machine manufacturer. Continuous use of the machine without having the defect repaired is dangerous because the exhaust gas may intrude into the actual machine, causing carbon monoxide poisoning.

When Leaving the Engine Running

 CAUTION

- In order to prevent a fire, make sure that there are no flammable materials near the exhaust system while the engine is running. Also, there is a risk of burn injury due to the high temperature exhaust gas.

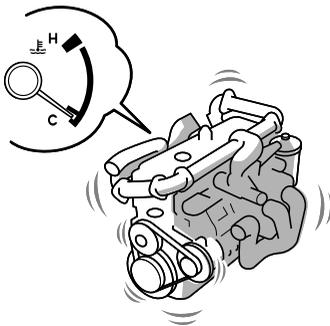
Do not Turn Off the Engine While the Machine Is Running



 WARNING

- Do not place the starter switch to any position other than the "DRIVE" position while driving.
If the engine is stopped while driving, the engine may be damaged.
- It is very dangerous because all the electric circuits for various warning/indicator lights stop working.

Recommendations for Warming Up the Engine



Perform warming-up for approx. 10 minutes.

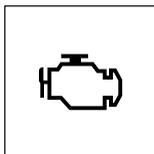
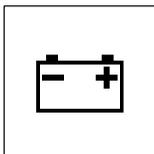
 ADVICE

- Do not rev the engine or quickly accelerate before the engine has sufficiently warmed up (in other words, when the engine is cold).
The oil is not supplied to the engine sufficiently, and it may cause a failure.
- The exhaust pipe becomes extremely hot while the engine is idling, so make sure there is no flammable material such as a plant, dried grass, paper waste, oil and old tire nearby before starting warm-up operation.

Be Careful with the Too Cold Engine

When the engine is too cold, in addition to accelerating engine wear, it cause deterioration in fuel economy. While driving, when the coolant temperature does not reach the appropriate temperature (approx. 75 - 90°C (167 - 194°F)) indefinitely, take an appropriate action such as inspecting or replacing the thermostat.

When the Warning Light Comes On



ADVICE

- It is dangerous to ignore the turned on warning light and continue driving. Perform an inspection and take appropriate actions. When the meter shows an abnormality, take necessary actions.

Staying Safe

When the Engine Coolant Is Hot



WARNING

- Do not loosen or remove the radiator cap. Doing so would be dangerous because steam and hot air can shoot out.

Coolant → Refer to Page 5-16

When the Silencer and Exhaust Pipe Are Hot

CAUTION

- While the engine is running and immediately after operating, the silencer and exhaust piping are extremely hot. Be extremely careful to avoid mistakenly touching these when performing works nearby. Otherwise, you could get burned.

If the Battery Goes Flat

CAUTION

- When charging the battery from an external power source, remove the battery cables to protect the generator.

When the Battery Goes Flat

→ Refer to Page 6-4

Preventing Engine Failure

Do not Climb onto the Engine



ADVICE

- The engine is the heart of the machine. Do not step on the engine or climb onto it. The head cover and the various connectors may be damaged, leading to an engine failure.

Make Sure the Engine is Inspected at Regular Intervals



ADVICE

- Inspections and maintenance enable you to use the engine with peace of mind. They also extend the engine's service life.

Daily (Pre-Driving) Inspection

→ Refer to Page 5-4

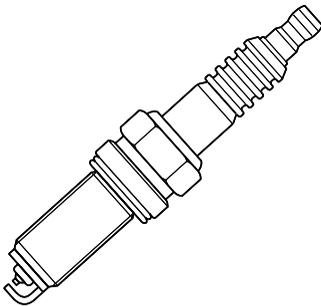
Engine Oil

→ Refer to Page 5-6

Periodic Inspection and Maintenance List

→ Refer to Page 5-33

Replacement of Spark Plug



In contrast to diesel engines, NG/LPG engines have spark plugs installed. Replace the spark plugs according to the Maintenance Schedule.

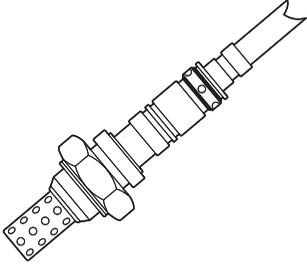
Spark Plug

→ Refer to Page 5-22

Periodic Inspection and Maintenance List

→ Refer to Page 5-33

Replacement of O₂ Sensor



In contrast to diesel engines, NG/LPG engines have O₂ sensors installed. Replace the O₂ sensors according to the Maintenance Schedule.

O₂ Sensor → Refer to Page 5-23

Periodic Inspection and Maintenance List → Refer to Page 5-33

Inspecting and Maintaining the Valve Clearance

Inspection and maintenance of the valve clearance is a periodic inspection item. Have the valve clearance check and maintenance performed at the Isuzu Distributor or the machine manufacturer in accordance with the Maintenance Schedule.

Periodic Inspection and Maintenance List → Refer to Page 5-33

When to Visit an Isuzu Distributor

Do not Modify the Engine



CAUTION

- Attaching a part that is not suitable for the performance or function of the machine may lead to an unexpected breakdown or accident. Please consult the Isuzu Distributor or the machine manufacturer for adjustment of the engine or installation of the equipments.

Ask an Isuzu Distributor for Engine Adjustment



CAUTION

- Do not perform engine adjustment by yourself.
Be sure to consult your nearest Isuzu Distributor or the machine manufacturer.

Handling Electric Accessories

This engine is an electronically controlled engine, and has many electronic control equipment and electrical components installed. Take special care when performing a high-pressure washing or welding operation.



CAUTION

- When performing a high-pressure washing for the engine, prevent the wiring connectors and the electronic control equipment from contacting directly with water. Failure to observe this precaution may cause a malfunction or failure.
- When electric welding is performed carelessly onto the engine, the welding current may counterflow in the ground circuits of various parts and may damage the various electric accessories and components, which may result in malfunction of those accessories and components. When electric welding is necessary, be sure to consult the nearest Isuzu Distributor or the machine manufacturer.
- When performing a welding operation on the actual machine out of necessity, remove the battery connectors, and then remove the connectors of electronic control equipment (especially, engine controller (ECM)) before starting the work. Due to the excess current load, the electronic control equipment may be broken.

Inspection and Maintenance

Dependably performing inspections and maintenance prevents faults. Make sure to perform periodic inspections and maintenance. Also, quickly rectify any small fault observed to prevent it from becoming more serious.

When any of the failures listed below occurs, perform inspection and take action following the table.

If a repair cannot be performed by yourself, the corrective action shown in the table does not eliminate the problem or a failure location cannot be identified, contact the nearest Isuzu Distributor or the machine manufacturer.



ADVICE

- © in the "Corrective Action" column indicates that the failure requires a repair or adjustment, so contact the nearest Isuzu Distributor or the machine manufacturer.

Symptom	Cause	Corrective Action	Reference Page
The exhaust smoke is white	Insufficient warming-up	Perform warming-up	3-2
	Too much engine oil	Adjust to the appropriate oil amount	5-7



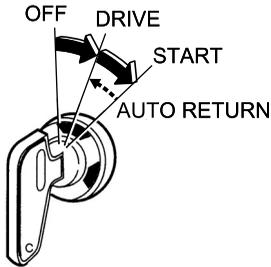
HANDLING OF ENGINE

3

• Starting the Engine	3-2
• Inspection Method After the Engine Started	3-4
• Stopping the Engine	3-8

Starting the Engine

Starting Preparation

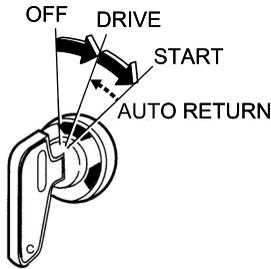


1. Before starting the engine, confirm that the machine is not set to the operation/driving mode and each switch such as for the windshield wiper, lighting, and air conditioner on the actual machine side is turned to "OFF".
2. Check manually that the manual cylinder valves of the NG/LPG containers (NG/LPG cylinders) have been turned so that they are fully open.
3. When the battery switch is equipped, turn it to the "ON" position.
4. Turn the starter switch to the "DRIVE" position and check the lighting of each warning/indicator light and the gas pressure (fuel remaining level).
5. The engine emergency stop function may be set depending on the machine. Confirm that the engine emergency stop function is turned "OFF" before starting the engine. For the engine emergency stop switch, etc., refer to the instruction manual of the machine manufacturer as well.

Starting the Engine

WARNING

- Do not keep the starter switch turned for 20 seconds or longer. Operating the starter for too long might cause battery failure or might result in overheating and even a fire.
- When starting the engine, make sure that no flammable material is present in the direction of exhaust outlet. If a flammable material is present, it is very dangerous because such material may be deformed, discolored or ignited, leading to a fire.



1. Place the accelerator, throttle and operation levers to the idling position.
2. Turn the starter switch to the "START" position to start the engine.
3. When the engine is not started with one operation, turn the battery and starter switches to "OFF". Have a break of 60 seconds or longer for starter functionality recovery and engine controller (ECM) communication process, and then perform the starting operation again.

**CAUTION**

- When an abnormal sound is heard from the starter, if the starting operation is continued, the starter can be burned out. After disconnecting the battery cables, charge the battery from an external power source.
- When the starting operation is performed repeatedly, starting the next motion without waiting for the starter to stop completely may damage or break the starter pinion and the engine ring gear.
- Starter failure may occur if the engine is started when the battery has not been sufficiently charged.

**ADVICE**

- If the engine still does not start after the starter is held in the turned position for about 10 seconds, return the starter switch to the "OFF" position, wait at least one minute, and then try starting again.
- After starting the engine, check that the warning lights are off.

4. When the engine is not started after the starting operating is performed repeatedly, an abnormality in the starting system can be suspected, so inspect the related parts.

**CAUTION**

- Do not turn the starter switch to the "OFF" position while the engine is running. Depending on the machine on which the engine is installed, this may cause a failure such as a malfunction of meters and battery charging failure.
- Do not apply a starting aid to the intake system. This may damage the engine.

**ADVICE**

- In the cold season, when the engine is cold, the exhaust smoke (white smoke) may generate, but this is not a failure.

Inspection Method After the Engine Started**CAUTION**

- In the cold season, immediately after the engine is started, the operating sound of the engine may be slightly louder than when it is warmed up and the smoke of the exhaust gas may slightly increase, but this is not abnormal.
- When the engine is not sufficiently warmed up, the engine oil is not supplied adequately, and a breakdown may result. Be practically careful in the cold season.
- Warning display and buzzers may vary depending on the machine manufacturer. For details regarding warning displays and buzzers, refer to the Owner's manual from the machine manufacturer.

Avoid a quick increase of engine speed or load immediately after the engine is started. First, idle the engine for about 10 minutes, and then check the operating status of instruments and warning lights. Also, check for abnormal vibration from the engine, noise, and the conditions of smell and color in the exhaust gas.

Engine Oil Pressure

When the engine oil pressure gauge is equipped, after the engine is warmed up, confirm that the gauge reads the appropriate values during the idle speed operation and the rated speed operation.

**ADVICE**

- Since the oil pressure is low immediately after the engine is started, take measurements after the engine is warmed up.

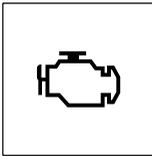
Engine oil pressure

Proper value

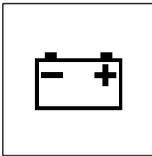
340 kPa (3.5 kgf/cm²/49.3 psi) or more at 3,200 r/min

**CAUTION**

- For the following cases, immediately stop the engine, check the oil level and inspect for an oil leakage.
 - The oil pressure gauge reads **200 kPa** (2 kgf/cm²/**29 psi**) or below even when the engine speed is raised
 - The needle of the oil pressure gauge swings widely at low rotation speeds
 - The oil pressure warning light flashes or comes on
- When the oil level is normal and no oil leak is found, a failure in the hydraulic system can be suspected. Promptly consult an Isuzu Distributor or the machine manufacturer.

Engine Warning Light/Engine Failure Code**CAUTION**

- When the failure indicator light comes on, or the engine failure code is indicated in the liquid crystal display (LCD) on the actual machine, promptly contact an Isuzu Distributor or the machine manufacturer.

Generator Warning Light

When a current meter is equipped and the charging status is normal, the needle of the current meter swings to the plus direction immediately after the engine is started, and then the amplitude gradually becomes smaller. For the machine with the generator warning light equipped, make sure to confirm that the generator warning light turns off.

Abnormal Noise of Engine and Color of Exhaust Smoke



CAUTION

- Immediately after the engine is started, the engine sound is louder compared to the sound after the engine is warmed up. The engine sound turns to normal after the engine is warmed up.
- If an abnormality is found in the engine sound or the color of the exhaust, immediately contact an Isuzu Distributor or the machine manufacturer.

Abnormal Noise of Engine

- Listen to the engine sound carefully, and if an abnormal noise is heard, check the engine and identify the possible cause.

Color of Exhaust Smoke

- Check the combustion state of the fuel by observing the color of the exhaust smoke.

After the engine is warmed up, the color of the exhaust smoke becomes as follows without any load applied.

Color of exhaust smoke	Combustion state of engine
Colorless	Normal
Light blue	Abnormal
Black	Abnormal
White	Abnormal

Also, inspect the exhaust pipe for leakage.



ADVICE

- When the engine is started in a low temperature, moisture vapor may be generated temporarily, but this is not a failure.

Coolant Temperature

Both too high and too low temperatures of the coolant can cause an engine malfunction. The temperature in the range of approx. 75 - 90°C (167 - 194°F) is suitable.

When the engine coolant temperature gauge reads a value exceeding the appropriate temperature, or when the coolant temperature warning light comes on, an dangerous condition of substantially heated engine can be suspected. For details of the coolant temperature warning light, refer to the instruction manual from the machine manufacturer.

When the temperature of the coolant exceeds the appropriate temperature, the fuel flow is restricted. After stopping the machine operation, decrease the engine speed to the level equal to the idling speed, and then confirm that the coolant temperature has dropped to the appropriate temperature before stopping the engine.



CAUTION

- Stopping the engine with its overheated condition should be avoided.
- Driving for a long period of time with a low coolant temperature not only increases the oil and fuel consumptions but also accelerates the engine wear, resulting in an engine failure.

Hour Meter (Cumulative Operating Hour Counter)

The cumulative time during engine operation is counted. Confirm that it is always operating while driving.

Perform inspection and maintenance on each part in accordance with the time count displayed in this hour meter. For details of the hour meter, refer to the instruction manual from the machine manufacturer.



ADVICE

- The hour meter cannot be reset.

Stopping the Engine



1. Confirm that the machine is not set to the operation/driving mode.
2. Before stopping the engine, decrease the engine speed to the idling speed to cool down for approx. 3 minutes.
During this cooling down period, check for an abnormality in the engine sound, oil pressure, etc.
3. After confirming that the engine temperature has dropped to the specified level, turn the starter switch to "OFF".
4. If a battery switch is equipped, turn the battery switch "OFF" after first turning the starter switch to the "OFF" position and then waiting for 1 minute or more.
Systems such as the engine controller (ECM) continue to operate for approximately 1 minute after the engine is stopped, and may malfunction if the battery power is turned off while these systems are still operating.



ADVICE

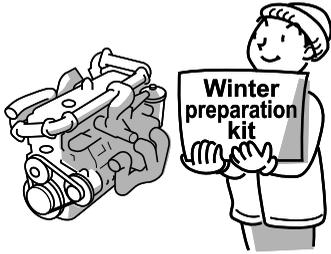
- Stopping the engine immediately after driving may cause a failure such as a seizure. Stop the engine after the engine temperature has dropped.
- Make sure to place the starter switch in the "OFF" position after the engine is stopped or when the engine is left unused for a long time. Otherwise the battery may run out.

HANDLING IN COLD SEASON

4

- **Cautions for Driving in Cold Regions and Season**

4-2

Cautions for Driving in Cold Regions and Season

These cautions apply to the sectional intense cold and heavy-snow regions such as a snow-covered area, mountain region, and ski resort, but they can be also referenced for handling in winter time for other regions.

Visit the nearest Isuzu Distributor or the machine manufacturer to arrange the following winter preparations for the engine. Also, arrange the following winter preparations before going to a cold region.

Coolant	→ Refer to Page 5-16
Battery	→ Refer to Page 5-28
Engine Oil	→ Refer to Page 5-6

**CAUTION**

- Do not cover the front of the radiator with newspapers, cardboard or any other flammable material to raise the coolant temperature.
- When the coolant temperature does not rise after the engine is warmed up, have the thermostat inspected at the nearest Isuzu Distributor or the machine manufacturer.
- In an area with heavy snow, the snow accumulated around the machine may cause bad ventilation. When the engine is left running under such a condition, the exhaust gas may be accumulated, causing carbon monoxide poisoning. Remove the snow around the machine to take a precaution.

Handling the Coolant



To prevent the engine damage due to freezing of the coolant, mix the long-life coolant (LLC) and tap water to be an appropriate concentration.



CAUTION

- When water is used for cooling purpose instead of the long-life coolant, to prevent the engine damage due to freezing, discharge the water from the radiator and the engine after the engine is stopped.

Replacing the Coolant

→ Refer to Page 5-18

Handling the Long-Life Coolant

→ Refer to Page 5-17

Replacing the Engine Oil

SAE10W-40									

-30 -20 -10 0 10 20 30 40 (°C)
-22 -4 14 32 50 68 86 104 (°F)

AMBIENT TEMPERATURE

For the engine oil, use Isuzu genuine oil or an equivalent NG/LPG engine oil throughout all seasons.

Replacing the Engine Oil

→ Refer to Page 5-9

Recommended Lubricants

→ Refer to Page 5-38

Battery

In the winter time, in addition to that the amount of discharge current at the time of engine starting increases, the battery becomes difficult to be charged, so try to maintain the battery always fully charged. Also, the battery fluid of the battery that is close to the discharge state has a low specific gravity and freezes easily, so take good care of heat-retention for the battery.



CAUTION

- When adding distilled water in the cold season, it should be performed immediately before driving. For the adding method, refer to "Inspecting the Battery Fluid Level and Adding the Battery Fluid".
- When the distilled water is added after the engine operation is stopped, the added water does not mix with the battery fluid sufficiently and freezes at the top, which may damage the battery case.

**Inspecting the Battery Fluid Level and
Adding the Battery Fluid**

→ Refer to Page 5-31

INSPECTION AND MAINTENANCE

5

• Precautions for Inspections and Adjustments	5-2
• Discarded Parts, Oils and Other Liquids	5-3
• Isuzu Genuine Oils and Grease	5-3
• Daily (Pre-Driving) Inspection	5-4
• Inspecting Components that Showed Abnormalities During Previous Operation	5-5
• Engine Conditions	5-5
• Engine Oil	5-6
• Engine Oil Filter	5-11
• Fan Belt	5-13
• Coolant	5-16
• Air Cleaner	5-22
• Spark Plug	5-22
• O ₂ Sensor	5-23
• Vaporizer	5-23
• Valve Clearance/Others	5-24
• Battery	5-28
• Periodic Inspection and Maintenance List	5-33
• Recommended Lubricants	5-38

Precautions for Inspections and Adjustments

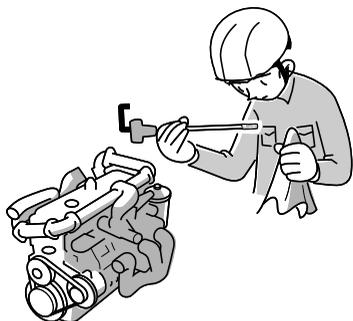
WARNING

- Select a place with flat and firm ground for performing maintenance. It would be very dangerous if the engine started to move.
- Make sure to stop the engine and pull out the starter key.
- When performing works with the electrical system, make sure to disconnect the negative (-) battery terminal.
- Do not perform work near an open flame or other heat sources.
- Each part on the engine is hot immediately after driving. Be careful not to get burned. Perform inspection when the engine has cooled down.
- Replacement of each oil and oil filter should be performed when each oil has cooled down sufficiently. Performing work when they are still hot can cause a burn injury.
- Do not leave the engine running in a poorly ventilated indoor place. This could cause carbon monoxide poisoning.

ADVICE

- Use only appropriate tools.
- Do not leave the removed parts or tools on the engine. They may damage the equipment if they are caught in the belts or other moving components.
- When replacing, take sufficient care so that filth or foreign matter does not attach to the removed component.
- Dirty water, dirt and other impurities seriously impair the effectiveness of the oil, and damage the parts, so take sufficient care not to let filth or foreign matter mix into the oil while adding or replacing.
- Confirm that all systems and components are normal after performing the work.

Maintenance Or Repairs



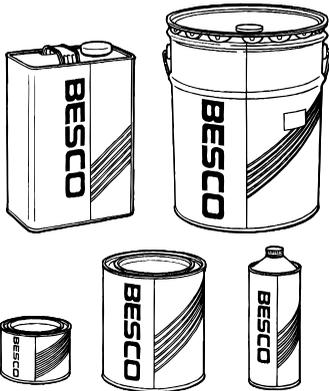
A repair shop or person of the owner's choosing may maintain, replace, or repair emission-control devices and systems.

Discarded Parts, Oils and Other Liquids **CAUTION**

- Discarded parts, oil, grease and fluids could have an adverse effect on the environment. It is difficult to dispose of these properly, so have an Isuzu Distributor or the machine manufacturer handle all inspections and replacements.

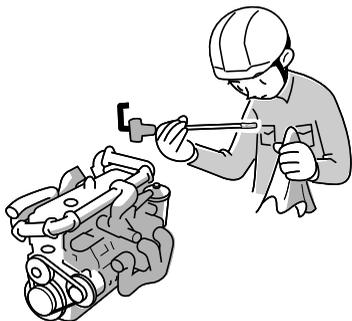
When replacing each oil, filter, or coolant, prepare a pan and discharge it into the pan.

Disposal and treatment of replaced each component, oil, filter or coolant must be conducted in accordance with the specified procedure.

Isuzu Genuine Oils and Grease

Periodic adding and replacement of oils and greases are very essential works to maintain the engine performance and to prevent failures. For Isuzu genuine greases and oils, their quality and performance are guaranteed by Isuzu. For maintenance and service, use of Isuzu genuine greases and oils is recommended.

Daily (Pre-Driving) Inspection



Perform the daily inspection once per day before starting the engine to confirm that there is no abnormality. For safe and comfortable driving, grasp the engine conditions during operation, and perform inspections at appropriate intervals, and provide maintenance works in accordance with the findings of the inspections.

When an inspection reveals an abnormality or there was an abnormality found while driving in the previous day or time, have the machine repaired at an Isuzu Distributor or the machine manufacturer before driving the next time.

Daily (Pre-Driving) Inspection List

[1. Inspecting components that showed abnormalities during the previous operation]

Inspection Item	Reference Page
Inspecting components that showed abnormalities during previous operation	5-5

[2. Inspecting each part of the engine]

Inspection Item	Reference Page
Battery fluid level*	5-31
Looseness and corrosion in terminal section of battery	5-32
Engine oil level and contamination*	5-7
Coolant level*	—
Leakage of fuel, engine oil and coolant	—
Presence or nonpresence of engine failure indication	—
Fan belt tension and damage*	5-14
Gas leak inspection Inspect for odors or anything else unusual around the vehicle to make sure that there are no gas leaks. (Inspect both before and after operation.)	—

* : Inspection items that should be performed at an appropriate period determined based on the operation hours, driving conditions, etc. are indicated.

[3. Starting the engine]

Inspection Item	Reference Page
Engine startability and presence or nonpresence of abnormal noise*	5-5
Color of exhaust smoke	3-6
Conditions at low speeds and during acceleration*	5-5
Gas leak inspection Check that there is nothing wrong with the fuel gauge during operating the engine (such as a sudden drop in pressure).	—

* : Inspection items that should be performed at an appropriate period determined based on the operation hours, driving conditions, etc. are indicated.

Inspecting Components that Showed Abnormalities During Previous Operation

Check the components that showed abnormalities during the previous operation. Have the location with the abnormality repaired at the nearest Isuzu Distributor or the machine manufacturer before driving the next time.

Engine Conditions

Periodic Inspection and Maintenance
List → Refer to Page 5-33

Inspecting Engine Startability and Abnormal Noise

Operate the starter switch to start the engine.
At this time, confirm that the engine is started quickly and also there is no abnormal noise.

Starting the Engine
→ Refer to Page 3-2

Inspecting Condition of the Engine at Low Speeds and During Acceleration



1. Operate the starter switch to start the engine, and warm up the engine.

Starting the Engine

→ Refer to Page 3-2

2. Confirm that the engine is running smoothly at the idling speed within the range of normal idling speeds.
However, the following condition should be excluded.
 - When the coolant temperature is low
3. Confirm that the engine speed increases smoothly and there is no knocking when accelerating gradually by operating the accelerator.

Engine Oil

The engine oil has functions of cooling inside the engine and flushing out the filth inside the engine. The engine oil has a significant impact on the performance and service life of the engine, and fuel economy, so use of the recommended oil is encouraged.

Periodic Inspection and Maintenance List

→ Refer to Page 5-33

Selecting the Engine Oil

→ Refer to Page 5-38



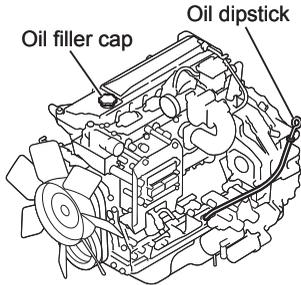
ADVICE

- Engine oil lubricates and cools the engine interior components. The quality of the oil is degraded and the quantity of oil is reduced by evaporation, exhaust, and combustion during the engine's operation. Continually using the same oil without checking the level, or without replenishing and changing it could cause seizure or damage to the engine. Add or change the oil when the quality of the oil has degraded or the quantity is reduced, even if that occurs before expiration of the specified intervals in the Maintenance Schedule, which will differ depending on the conditions of use.
- Failure to use the NG/LPG engine oil may result in an engine malfunction or poor fuel economy. Be sure to use the NG/LPG engine oil.

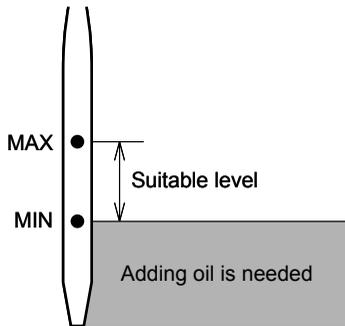
Inspecting the Engine Oil

**ADVICE**

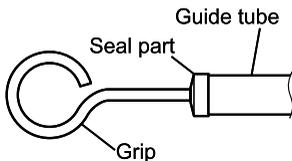
- When the engine oil level is above the "MAX" position on the oil dipstick, it may cause an engine failure.

**NOTE**

- Perform inspection on a level surface before starting the engine.
- Accurate oil level cannot be measured when the engine is running.
- When the engine has been running, wait for 10 - 20 minutes after stopping the engine and then measure the oil level.



1. Pull out the oil dipstick and wipe off the attached oil.
2. Reinsert the oil dipstick fully and then gently pull it out. When the oil surface is between the "MAX" and "MIN", the oil level is appropriate. At this time, also check for the degree of oil contamination and stickiness.
3. When the oil level is insufficient, add the oil up to the "MAX" position.
4. Reinstall the oil dipstick into position after checking the oil level.

**ADVICE**

- When inserting the oil dipstick, be careful not to bend it. Otherwise, the oil dipstick may be deformed.
- Take care not to use excessive force when inserting the oil dipstick. If the oil dipstick is long, do not hold the grip and try to forcefully insert, but instead hold an area around the guide tube to insert.

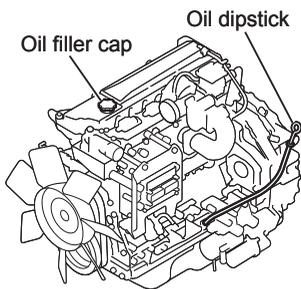
Adding the Engine Oil

 **WARNING**

- When adding oil, be careful not to spill any, but keep a workshop rag handy just in case there are any spills.
If any oil should spill onto the engine, carefully wipe it away. Otherwise, the spilled oil could ignite and a fire could spread.
- Do not leave a flammable item such as a cloth or cotton work glove on the engine. Such items may trigger a fire.

 **ADVICE**

- Prevent dirt from entering the filler port when adding the oil. If foreign matter mixes with the oil, it could damage the engine.
- When the oil is added rapidly through a funnel attached to the filler port, the oil inside the head cover may overflow from the breather. Add the oil gently.
- When the oil is added as much as exceeding the "MAX" position, this may cause an engine malfunction. Wait for 10 - 20 minutes after the oil is added, and make sure to check the oil level using the oil level gauge.



When the engine oil level is less than "MAX", remove the supply inlet oil filler cap, pull out the oil level gauge, and add engine oil up to "MAX". After adding the oil, securely install the oil filler cap and the oil level gauge.

Replacing the Engine Oil



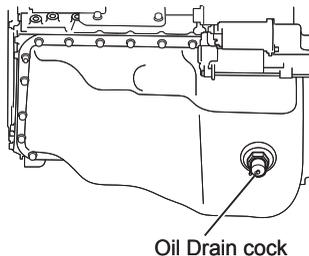
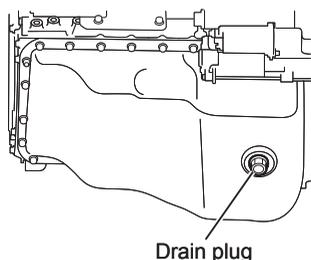
WARNING

- When adding oil, be careful not to spill any, but keep a workshop rag handy just in case there are any spills.
If any oil should spill onto the engine, carefully wipe it away. Otherwise, the spilled oil could ignite and a fire could spread.
- Do not leave flammable items such as a cloth or cotton work gloves in the engine room. Such items may trigger a fire. Also, do not leave any of the tools.
- When replacing the engine oil after driving, the oil temperature is high. Be careful not to get burned while replacing it.



ADVICE

- When replacing the engine oil, also replace the engine oil filter at the same time.
- Do not perform abrupt engine idling, which may cause an engine failure.
- Make sure to check the oil level using the oil level gauge, because adding the oil in excess of the "MAX" position on the oil level gauge may cause an engine malfunction.
- Make sure to check the oil level on the oil level gauge, as the engine may be damaged if the oil level falls below "MIN" on the oil level gauge.
- Disposal and treatment of the drained oil must be conducted in accordance with the specified procedure.

One-touch type**Drain plug type**

1. Clean around the oil filler cap so that foreign matter does not enter. Remove the oil filler cap.
2. Place a container for receiving the oil beneath the oil pan and the oil filter.
3. For the one-touch type, loosen the cap of the oil drain cock to remove it. Tightly attach the oil drain hose to the oil drain cock all the way to the end to drain the oil.
For the drain plug type, loosen the drain plug to remove it, and then drain the oil.
4. When the oil is completely drained out, for the one-touch type, disconnect the oil drain hose, and wipe off the oil attached to the drain cock.
For the drain plug type, replace the packing of the drain plug with a new one, and then install the drain plug.
5. For the one-touch type, securely tighten the cap of the oil drain cock. (Tighten the cap lightly until it is seated, and then tighten it further for approx. 60 - 90°.)
For the drain plug type, tighten the drain plug.

Drain plug tightening torque

73.5 - 93.1 N·m (7.5 - 9.5 kgf·m/54 - 69 lb·ft)

**ADVICE**

- Make sure to wipe off any dirt on the drain cock or plug before installing it.
6. Remove the oil level gauge and carefully fill the specified engine oil into the oil filler.
 7. Install the oil level gauge and the filler cap, and start the engine 5 minutes after refueling, and then let it idle. At this time, check whether any oil leak is found around the oil filter and drain cock or plug.

**ADVICE**

- Do not perform abrupt engine idling, which may cause an engine failure.

8. Stop the engine, wait for 20 - 30 minutes, and then check the oil level with the oil level gauge.

Engine Oil Filter

The engine oil filter has the function of removing the dirt, dust and other impurities mixed into the engine oil. The engine filter has a significant impact on the performance and service life of the engine, so use of the "Isuzu genuine parts" is recommended.

Periodic Inspection and Maintenance List → Refer to Page 5-33

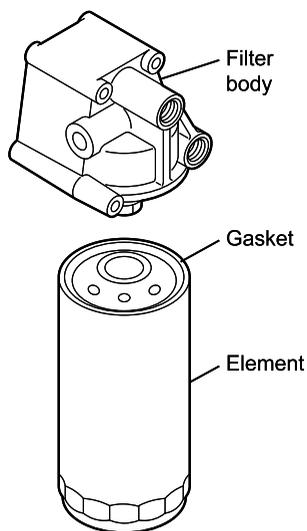
**ADVICE**

- When replacing the engine oil filter, it is recommended to use an Isuzu genuine oil filter. When another type of oil filter is used, it may cause a failure.
- Replace the oil filter at the same time as replacing the engine oil.
- Disposal and treatment of the drained oil and the element must be conducted in accordance with the specified procedure.

Changing the Oil Filter

**ADVICE**

- When installing the oil filter, make sure that the gasket does not get caught at the rim. This could cause oil leakage.
- Any dirt on the cock should be wiped off before installing it.
- Do not perform abrupt engine idling, which may cause an engine failure.
- After replacement is completed, test run the engine and confirm that there is no oil leakage from the area around the filter.



1. Clean around the oil filler cap so that foreign matter does not enter. Remove the oil filler cap.
2. Place a container for receiving the oil beneath the oil pan and the oil filter.
3. Remove the oil pan drain cock to discharge the oil.
4. Use the special oil filter wrench to remove the element.
5. Apply a thin layer of clean engine oil to the gasket of a new element.
6. Install the new element. Screw in the element until the gasket comes in contact with the seal surface, and then tighten it by one turn using the special oil filter wrench.
7. Confirm that the oil pan drain cock is securely tightened.
8. Remove the oil level gauge and carefully fill the specified engine oil into the oil filler.
9. Install the oil level gauge and the filler cap, and start the engine 5 minutes after refueling, and then let it idle. At this time, check whether any oil leak is found around the oil filter and drain cock.
10. Stop the engine, wait for 10 - 20 minutes, and then check the oil level with the oil level gauge.

Fan Belt

The fan belt has the function of conveying the driving force of the engine to the electricity related/auxiliary equipment to operate each mechanism.

When a bad quality belt is used as a replacement, a trouble such as abnormal noise generation, engine stop and insufficient battery charging may be caused due to belt rapid wear or belt breakage. When replacing the fan belt, it is recommended to use the "Isuzu genuine parts".

Periodic Inspection and Maintenance List → Refer to Page 5-33



CAUTION

- The V ribbed fan belt adopted in the engine requires more accurate belt tension adjustment than that of a conventional V belt. When the tension is improper, in addition to belt squeak or belt breakage, the bearing of water pump or generator may be damaged. When the fan belt is cut, electricity is not properly generated, and it becomes a cause of overheating, so check the tension of the fan belt extremely carefully.
- To accurately check fan belt tension, use a sonic wave tension gauge and inspect to see if the frequency is within the specified range. Ask about sonic wave tension gauges at your Isuzu Distributor or the machine manufacturer.

[Cautions for belt adjustment]

- Initial stretching takes place in any new belt after installation. Also, to fit the belt well in the pulley groove, adjust the belt following the adjustment procedure below regardless of new installation or tension adjustment.
 - Adjust the belt alignment and belt tension in accordance with the specified procedure.
 - Start the engine and allow it to idle for at least 5 minutes in order to run-in the belt.
 - Stop the engine, and again adjust the belt tension to the standard value.

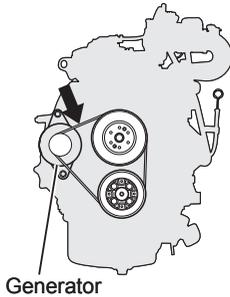
Inspecting the Fan Belt

Press the center of the belt with a hand, and check whether the belt deflects only slightly. Also, check the belt for a damage.

Measurement of Deflection Amount and Vibration Frequency

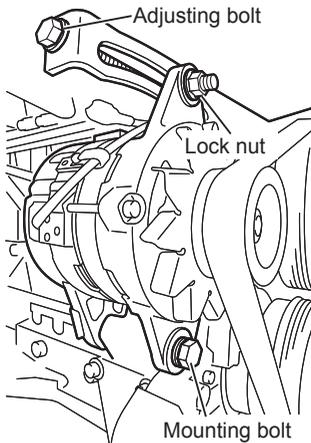
Press the middle of the belt with a force of **98 N** (approx. 10 kgf/**22 lb**), and check whether the amount of deflection is within the range of standard values.

Measure the frequency to confirm it falls within the specified range by following the sonic wave tension gauge handling procedure. Adjust if the frequency is outside the specified range. Also, check the belt for damage such as scratches or cracking, and replace if such damage is found.



Fan belt	Standard value [Amount of deflection]	Standard value [Vibration frequency]
New	5 - 7 mm (0.20 - 0.28 in)	184 – 206 Hz
Reused	8 - 9 mm (0.31 - 0.35 in)	158 – 170 Hz

Adjusting the Fan Belt



1. Loosen the lock nuts and bolts at the top and bottom of the generator, and lightly tighten to the point where the lock nut and bolt bearing surfaces are seated.
2. Turn the adjusting bolt until the belt tension falls within the standard value range.
3. After the adjustment, firmly tighten the loosened lock nuts and bolts to the specified torque.

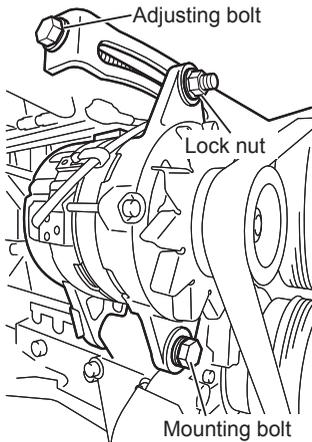
Lock nut tightening torque

18.6 - 28.4 N·m (1.9 - 2.9 kgf·m/14 - 21 lb·ft)

Mounting bolt tightening torque

34.3 - 46.1 N·m (3.5 - 4.7 kgf·m/25 - 34 lb·ft)

Replacing the Fan Belt



1. Loosen the lock nuts and bolts at the top and bottom of the generator, and remove the belt from the pulleys.
2. Pull out the belt through the opening in the fan guide.
3. Insert the new belt through the opening in the fan guide and install the belt while aligning it with the grooves of the generator pulley and crankshaft pulley.
4. Lightly tighten the point where the bearing surfaces of the lock nuts and bolts at the top and bottom of the generator are seated.
5. Turn the adjusting bolt until the belt tension falls within the standard value range.
6. After the adjustment, firmly tighten the loosened lock nuts and bolts to the specified torque.

Lock nut tightening torque

18.6 - 28.4 N·m (1.9 - 2.9 kgf·m/14 - 21 lb·ft)

Mounting bolt tightening torque

34.3 - 46.1 N·m (3.5 - 4.7 kgf·m/25 - 34 lb·ft)

7. After the adjustment, run the engine at the idling speed for approx. 5 minutes, and then stop the engine to recheck the belt tension.

Inspecting the Fan Belt

→ Refer to Page 5-14

**CAUTION**

- When the generator is fixed, the belt tension slightly changes, so check the belt tension again after the generator is fixed.
- If the lock nuts and bolts that are fixing the generator are not tightened securely, they may be loosened by the vibrations generated during engine operation, which may cause damage to the components or an accident.

Coolant

The coolant is a type of fluid which is made by mixing tap water and the long-life coolant with an appropriate ratio. It has the function of cooling off the heat generated by combustion or friction inside the engine.

Periodic Inspection and Maintenance List → Refer to Page 5-33



WARNING

- Inspection, adding or replacement of the coolant should be performed when the engine has cooled down sufficiently.
- Do not loosen or remove the cap of the radiator or reserve tank when the temperature of coolant is still high. Hot vapor or boiling water may burst out and cause a burn. Cover the cap with a cloth, etc. and remove it gradually when the engine has cooled down sufficiently and the temperature of the coolant has dropped.
- When removing the cap of the radiator or reserve tank, use a thick cloth to cover the cap and loosen it gradually.
- The coolant is toxic and must not be ingested. If the coolant is mistakenly ingested, immediately vomit it and seek prompt medical attention.
- When the coolant gets in your eyes, rinse it off immediately with a large amount of water for 15 minutes or longer. Also, if still an abnormality such as irritation is felt, seek medical attention.
- When the coolant gets on your skin, rinse it off using a soap with a large amount of water. Also, if an abnormality is observed, seek medical attention.
- The coolant is flammable. Keep flames away from it. Also, the coolant could ignite if it comes in contact with a hot surface, such as the exhaust manifold. Exercise caution to prevent this from happening.



ADVICE

- Replace the coolant periodically.
Failure to periodically replace the engine coolant may cause rust due to engine coolant deterioration, possibly resulting in water leakage, clogging of the radiator or heater core.

**NOTE**

[Coolant]

- A type of fluid which is made by mixing tap water and the long-life coolant with an appropriate ratio.

Handling the Long-Life Coolant

To prevent the engine damage due to freezing of the coolant and to protect the cooling system from corrosion, mix the Isuzu specified long-life coolant (LLC) and tap water with an appropriate ratio.

Usage region	Outside temperature	Long-life coolant concentration
Warm region (other than the cold region specifications)	Up to -12°C (10°F)	30%
Cold region (Cold region specifications)	Up to -30°C (-22°F)	50%

**WARNING**

- The long-life coolant (LLC) is toxic and must not be ingested. If the coolant is mistakenly ingested, immediately vomit it and seek prompt medical attention.
- When the long-life coolant gets in your eyes, rinse it off immediately with a large amount of water for 15 minutes or longer. Also, if still an abnormality such as irritation is felt, seek medical attention.
- When it gets on your skin, rinse it off using a soap with a large amount of water. Also, if an abnormality is observed, seek medical attention.
- For storage, close the cap securely and keep it in a place inaccessible to children.
- The long-life coolant is flammable. Keep flames away from it. Also, it could ignite if it comes in contact with a hot surface, such as the exhaust manifold. Exercise caution to prevent this from happening.

**CAUTION**

- As for the long-life coolant (LLC), make sure to use either BESCO LLC SUPER TYPE E or BESCO LLC SUPER TYPE AS or equivalent.
- Failure to use a long life coolant (LLC) recommended by Isuzu may result in damage to the engine, radiator or heater core.

**ADVICE**

- The water which is mixed with the long-life coolant (LLC) has to be tap water (soft water), not well water or river water.
- Do not use the long-life coolant at any concentration other than the one specified.
When the long-life coolant concentration is 60% or higher, overheating is likely to occur, while when it is 30% or lower, the anti-corrosion function is not provided sufficiently.
- Using the long-life coolant at any concentration other than the one specified may reduce the anti-freezing performance, and the coolant may freeze. Adjust the concentration of the coolant depending on the situation.
- If the coolant decreases rapidly, go immediately to the nearest Isuzu Distributor or the machine manufacturer for a check or repair.

Inspecting the Coolant

Inspect the radiator and radiator hose for a crack, damage and water leakage. Also, check whether a stain of water leakage is left on the ground surface where the machine is set. When a crack, damage or water leakage is found, contact an Isuzu Distributor or the machine manufacturer.

**CAUTION**

- Use without fixing the water leakage can cause engine seizure.

Replacing the Coolant

Clean also the coolant passages using a cleaning agent. Also, clean the radiator, radiator cap, and intercooler.

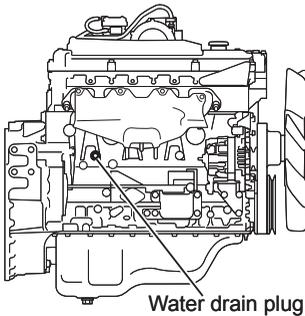
It is recommended to use the Isuzu genuine radiator cleaner for cleaning of coolant passages.

Cleaning the Radiator Exterior

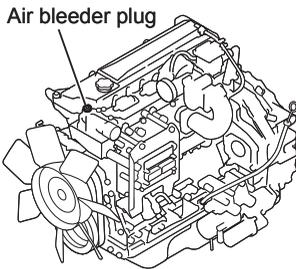
→ Refer to Page 5-21

**ADVICE**

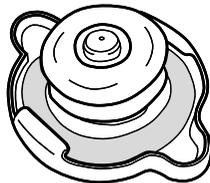
- After the coolant is discharged, do not start the engine when there is no water in the radiator. This could cause the engine to seize up.
- Hand tighten the drain cock of the radiator. Tightening with pliers or some other tool could damage it.
- Disposal and treatment of the discharged coolant must be conducted in accordance with the specified procedure.



Water drain plug



Air bleeder plug

**Draining the Cooling System**

1. Remove the radiator cap.
2. Open the coolant drain cock on the radiator to discharge the coolant.
3. Loosen the air bleeder plug (do not remove completely).
4. Loosen the water drain plug located on the right side of the cylinder block, and discharge the coolant inside the engine.
5. Close the drain cock and the water drain plug.
6. Close the air bleeder plug.

Cleaning the Coolant Passages

1. Fill the radiator with tap water up to the top of the opening.
2. Check and clean the radiator cap. Replace the cap if it is damaged.
3. Firmly close the radiator cap.

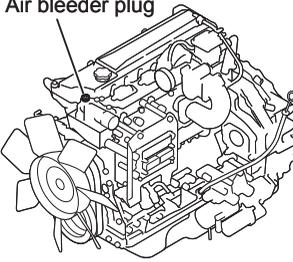
4. Fill the reserve tank with tap water up to the "MAX" line.
5. Close the cap of the reserve tank.
6. Start the engine to idle it for 20 minutes, and then stop the engine, wait until it cools down sufficiently, and drain out the water.

Filling the Cooling System

WARNING

- Exercise caution to prevent this overflowed coolant from splashing onto the exhaust system components. The coolant may induce a fire, so make sure to wipe it off.

Air bleeder plug



1. When the radiator is located at the same level as or below the air bleeder plug, loosen the air bleeder plug, and supply the coolant slowly from the water inlet on the radiator. To avoid air intrusion, the coolant should be supplied slowly.
2. Before installing the air bleeder plug, apply sealant (THREEBOND[®]1241, LOCTITE[®]962T or equivalent) to the air bleeder plug. And tighten the air bleeder plug when the coolant overflows from the air bleeder plug.



NOTE

- When the radiator is located above the air bleeder plug, steps 1 and 2 can be omitted.

Engine	Air bleeder plug tightening torque
4HV1	39 - 49 N·m (4.0 - 5.0 kgf·m/28 - 36 lb·ft)

3. Fill the radiator with engine coolant to the top of the filler opening.

4. While manually pressing the radiator upper hose several times to bleed any air from within the hose, add an amount of engine coolant equivalent to the amount in which the coolant level has dropped so that the coolant level is up to the brim of the radiator filler neck.
5. Repeat Step 4. until the coolant level no longer decreases.
6. Firmly close the radiator cap.
7. Fill the reserve tank with the coolant up to the "MAX" line and close the cap of the reserve tank.
8. Idle the engine for 5 minutes and then stop the engine.
9. After making sure that the coolant has cooled down, remove the radiator cap, and if the coolant level has lowered, add the coolant up to the radiator filler opening. If the coolant level is abnormally low, check for coolant leaks.
10. Firmly close the radiator cap.
11. Start and warm up the engine. For models equipped with a heater, bleed any air from inside the heater circuit. Set the temperature and blower speed to their maximum. Also, warm the engine by accelerating to around 1,500 - 2,000 rpm.
12. Touch the upper hose with the engine running and check whether it has become warm. If it has not become warm, return to Step 11.
13. Idle the engine for 5 minutes and then stop the engine.
14. Remove the radiator cap after confirming that the engine coolant has cooled and add coolant up to the brim of the radiator filler neck if the coolant level has decreased. If it has decreased significantly, inspect for engine coolant leakage. When leakage is found, contact an Isuzu Distributor or the machine manufacturer.
15. Firmly close the radiator cap.
16. Fill the reserve tank with the coolant up to the "MAX" line, and close the cap of the reserve tank.

**CAUTION**

- If the coolant of the reserve tank has decreased the next morning, add engine coolant up to the "MAX" line.

Cleaning the Radiator Exterior

When the radiator fin is clogged with filth such as dirt and dry grass, it may interrupt the air flow and cause overheat.

Periodically check for the clogging condition, and when clogging is observed, clean the radiator fin with steam or pressured water.

Air Cleaner

The air cleaner cleans the air that is sent to the engine by removing the dust and other impurities contained in the air.

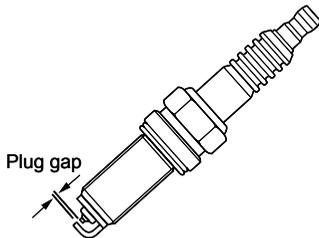
When the element of the air cleaner is dirty, the intake air volume decreases, which cause drop in engine output or engine malfunction. Also, when the element is damaged, the cylinder portion or valve may wear due to the dust sucked in, which may lead to increase in oil consumption or drop in engine output, and not only shorten the engine service life but also cause a engine failure or an accident. For handling the air cleaner, perform periodic inspections and maintenance as specified by the machine manufacturer. Also, for use in a dusty environment, consult the machine manufacture for application of a pre-filter.



CAUTION

- When using in a dusty environment, shorten the interval of cleaning or replacement.
- When a damage is found on the air cleaner during cleaning, replace the element.
- When disassembling the air cleaner, be careful not to cause an air leak.

Spark Plug



Replace according to the Maintenance Schedule.

Spark plug type	Plug gap
DENSO GX8-1	0.7 - 0.8 mm (0.028 - 0.031 in)

Periodic Inspection and Maintenance List → Refer to Page 5-33

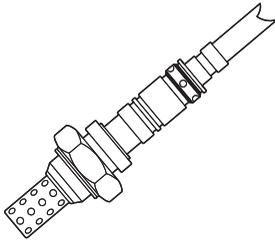


CAUTION

- Use only the specified spark plug.
- Do not use a wire brush to clean the spark plug.
- Do not adjust the plug gap.

**ADVICE**

- Have the spark plugs replaced at the Isuzu Distributor or the machine manufacturer.

O₂ Sensor

Replace according to the Maintenance Schedule.

Periodic Inspection and Maintenance**List**

→ Refer to Page 5-33

**CAUTION**

- Use only the specified O₂ sensor.

**ADVICE**

- Have the O₂ sensors replaced at the Isuzu Distributor or the machine manufacturer.

Vaporizer

Only the LPG engine model is equipped with the vaporizer. Inspect according to the Maintenance Schedule. Refer to the instruction manual from the machine manufacturer for the maintenance.

Periodic Inspection and Maintenance**List**

→ Refer to Page 5-33

Valve Clearance/Others

The following items are the inspection and maintenance items that enable smooth and long-term use of the engine and require specialized maintenance techniques. In accordance with the inspection and maintenance list, consult the nearest Isuzu Distributor or the machine manufacturer periodically for inspection and adjustment.



ADVICE

- Inspection and maintenance should be performed by personnel who are qualified or experienced in maintenance. A general user or inexperienced person should not perform the works.

Adjusting the Valve Clearance

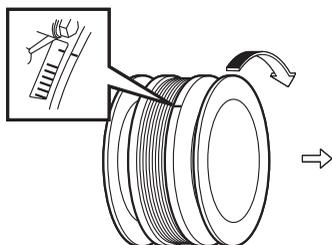
Perform periodic inspections and cleanings in accordance with the periodic inspection and maintenance list. Also, perform an inspection and maintenance when the sound of rocker arm is loud or when the engine is not working well without a failure in the fuel system.

**Periodic Inspection and Maintenance
List** → **Refer to Page 5-33**



CAUTION

- Adjustment of the valve clearance should be performed when the engine is cold.



1. Rotate the crankshaft in the forward direction until the TDC mark in the crank pulley rulings aligns with the timing mark of the timing gear case cover. Move the piston of the No. 1 cylinder or No. 4 cylinder to the compression top dead center.

**CAUTION**

- Before adjusting the valve clearance, confirm that the rocker arm shaft bracket nuts are not loosened, and tighten them as necessary.
2. Check for free play of the rocker arms of the No. 1 cylinder's intake and exhaust valves. If free play is present, it indicates that the piston of the No. 1 cylinder is at top dead center.
When the exhaust valve of the No. 1 cylinder has been pushed down, it indicates that the piston of the No. 4 cylinder is at top dead center.
 3. Adjust the valve clearance with the piston of the No. 1 cylinder or No. 4 cylinder set at top dead center.
The "●" mark in the table indicates the cylinder and valve to be adjusted when the piston of the No. 1 cylinder or No. 4 cylinder is at top dead center.

No. 1 cylinder top dead center of the compression stroke

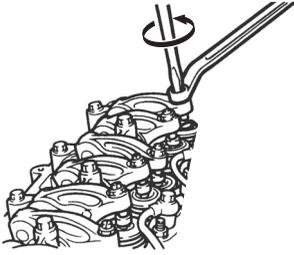
1		2		3		4	
Exhaust	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust	Intake
●	●		●	●			

No. 4 cylinder top dead center of the compression stroke

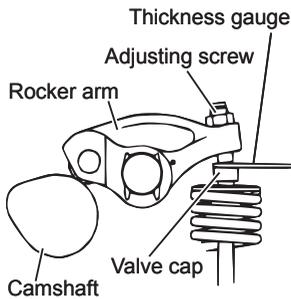
1		2		3		4	
Exhaust	Intake	Exhaust	Intake	Exhaust	Intake	Exhaust	Intake
		●			●	●	●

Valve clearance (when cold)

Exhaust	0.4 mm (0.016 in)
Intake	0.4 mm (0.016 in)



4. Loosen the adjusting screws of the rocker arm.



5. Insert a 0.4 mm (0.016 in) thickness gauge between the rocker arm and the valve cap, and then tighten the adjusting screw of the rocker arm until it slightly touches the thickness gauge. Tighten the lock nut.

Adjusting screw lock nut tightening torque

Rocker arm	22 N·m (2.2 kgf·m/16 lb·ft)
------------	------------------------------------

6. Rotate the crankshaft 360° in the forward direction, align the TDC mark in the crank pulley rulings with the timing mark, and adjust the clearance of the remaining valves.

Measuring the Engine Compression Pressure

This should be performed at periodic inspections or when the engine output has dropped.

Periodic Inspection and Maintenance List → Refer to Page 5-33

Compression pressure*	
12V specification	2,000.0 kPa (20.39 kgf/cm²/290 psi)

* Measurement should be taken under the conditions of cranking speed 200 rpm and coolant temperature 20°C (68°F).



ADVICE

- When the compression pressure is below **1,600.0 kPa (16.32 kgf/cm²/232 psi)**, repair or replace the defective parts on the engine or auxiliary equipment.

Starter, Generator

In accordance with the periodic inspection and maintenance list, clean the commutator of the starter, and check the wear and contact surface conditions of the carbon brush.

Periodic Inspection and Maintenance List → Refer to Page 5-33

Inspecting the Radiator Cap

Check the operating pressure of the radiator cap pressure valve using the radiator compression tester. As for the operating pressure of the pressure valve and the inspection period, follow the provisions specified by the machine manufacturer.

Battery

The battery has the function to operate the various lights and many electric accessories including the engine startup. For inspection and replacement, consult an Isuzu Distributor or the machine manufacturer.

Periodic Inspection and Maintenance List → Refer to Page 5-33

Battery Handling Precautions

Keep the battery always clean. When it is left unclean, impurities enter in the battery fluid and damage the battery plates or a short circuit occurs at the top of the battery, which may shorten the battery life.



DANGER

- Using or charging the battery with the battery fluid level being below the lower limit may accelerate battery deterioration or induce heat generation or even explosion.
- If the battery fluid gets in your eyes, immediately wash them with large volume of water for more than 5 minutes and seek medical treatment.
- For ground of electrical components, "negative (-) ground method" has been adopted.
When handling a metallic object such as a tool in the vicinity of the battery, take care to prevent it from coming into contact with the positive (+) terminal. As the machine itself is negative (-), any such contact can cause a short-circuit and is very dangerous.
- The battery generates extremely flammable hydrogen gas. Do not throw sparks or use a fire near the battery. Failure to observe this precaution can result in explosion should the hydrogen gas be ignited. Also, when wiping off the spilled battery fluid, use a wet cloth to remove it.

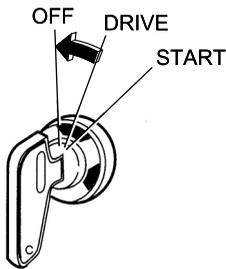
WARNING

- Make sure to stop the engine when inspecting the battery.
- The battery fluid is diluted sulfuric acid. Be extremely careful not to let the fluid get on your hands, clothes, or metals. If it happens, wash the fluid away with water immediately.
- When disconnecting the cables from the terminals, start with the negative (-) terminal. Also, when connecting them, the negative (-) terminal should be connected the last.
- When connecting the battery cables, take care to avoid mixing up the positive (+) terminal and the negative (-) terminal. Excess current flows, and the generator or actual machine wiring may be burned out.
- When performing inspection or refill, be careful not to splash the battery fluid on nylon tubes, harnesses, etc., and if it is attached, wash it away with water immediately. Particularly, the nylon tube does not readily withstand acids, so it is likely to become damaged.
- When using a battery charger, be sure to remove the cables from the battery terminals.
- Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Wash hands after handling.

When Performing Inspection and Maintenance

When performing inspection and maintenance on the electrical system including the battery, place the starter switch in the "OFF" position, turn each switch on the actual machine "OFF", and then disconnect the negative (-) terminal of the battery before starting the work.

If inspection or maintenance is performed with the battery connected, the electric components may be damaged.



When Removing Battery



CAUTION

- Systems such as the engine controller (ECM) continue to operate for approximately 1 minute after the starter switch is turned to the "OFF" position. Removing the battery cable before the engine controller (ECM) has stopped may cause a malfunction.

When removing the battery, disconnect the battery cable negative (-) terminal side first. If a tool contacts the battery positive (+) terminal and the engine with the cable on the negative (-) terminal side connected to the battery, it is dangerous because a short-circuit can be created. Also, this may cause a failure in the electrical system. Also, wait 1 minute or more after turning the starter switch to the "OFF" position before removing the battery cable negative (-) terminal.

When Charging Battery

- When charging the battery, remove the battery from the machine. Remove the battery cap, and charge the battery in a location with good ventilation. When charging the battery as installed in the machine, remove the battery cables before charging is started.
- When the charger is connected to or disconnected from the battery, ensure that the switch of the charger is turned off.
- Battery cables must always be disconnected when performing quick charging. If the quick charge is performed with the battery cables connected, the generator may be burned out.

When Connecting Battery Cable

When connecting the battery cables, first connect the battery positive (+) terminal side, and then connect the negative (-) terminal at the end.

When Taking Out Power Supply Directly from Battery

Do not take out power supply directly from the battery.

If it is necessary to take out power supply from the battery, consult an Isuzu Distributor or the machine manufacturer.

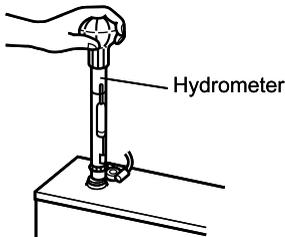
Inspecting the Battery Fluid Level and Adding the Battery Fluid



ADVICE

- Depending on the battery type, there is a case that the fluid level check method is different or that fluid level check or fluid adding is not required, so carefully read the instruction attached to the battery before starting any work.
- The battery fluid should never be added beyond the specified level. The battery fluid can spill over, and the battery terminals may be corroded. When the battery fluid is spilled, immediately wash it away with water completely.
- When the battery fluid has been added, make sure to charge the battery (through driving). Especially in winter, the battery fluid may freeze causing a damage to the battery case.
- If reduction in the battery fluid is drastic, immediately have it inspected at an Isuzu Distributor or the machine manufacturer.

Inspecting the Specific Gravity of Battery Fluid



Check the specific gravity of the battery fluid using a hydrometer. When the specific gravity is low, then charge the battery.

Specific gravity of fluid
(When the fluid temperature is 20°C (68°F))

1.27 - 1.29

Conversion of Specific Gravity

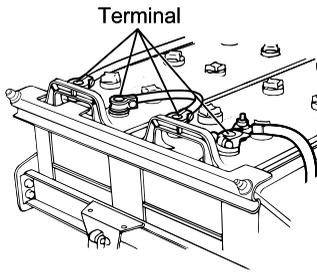
Measurement of specific gravity should be taken based on the fluid temperature of 20°C (68°F). Measure the fluid temperature, and when the temperature is other than 20°C (68°F), the specific gravity should be converted using the following conversion formula.

Conversion formula

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

*: S_{20} = Specific gravity at 20°C (68°F) (Standard temperature), S_t = Measured specific gravity, t = Fluid temperature at measurement

Inspecting the Battery Terminals



1. Check the terminal section for looseness and corrosion.
2. When the terminal section is corroded and coated with white powder, wash it off with warm water and then wipe fully dry. If corrosion is significant, polish it with a wire brush or sand paper.
3. After cleaning is finished, apply a thin layer of Besco grease to the terminal section, and securely connect the battery cable so that it will not be loosened.

Periodic Inspection and Maintenance List

To manage safe and economical driving, it is recommended to perform inspection and maintenance periodically.



ADVICE

- After 1,500 hours, perform inspection and maintenance for every 250 hours or 500 hours in accordance with this table.

Lubrication System

Inspection/Maintenance Item	Daily	250 hours	500 hours	750 hours	1,000 hours	1,250 hours	1,500 hours	Remarks
Oil level and contamination	●							
Oil leak	●							
Oil pressure gauge indication or lighting of warning light	●							Approx. 290 - 490 kPa (3 - 5 kgf/cm ² / 42 - 71 psi) 1,800 min ⁻¹
Oil pressure warning light	●							Off (in operation)
Replacing the engine oil			●		●		●	Every 500 hours
Replacing the oil filter element			●		●		●	Every 500 hours

Fuel System

Inspection/Maintenance Item	Daily	250 hours	500 hours	750 hours	1,000 hours	1,250 hours	1,500 hours	Remarks
Gas leak	●							
Drain oil from the gas filter (low pressure side)								As specified by the machine manufacturer
Replacing the gas filter (low pressure side)								As specified by the machine manufacturer
Drain oil from the gas filter (high pressure side)								As specified by the machine manufacturer
Replacing the gas filter (high pressure side)								As specified by the machine manufacturer
Inspecting the spark plug								Every 2,500 hours
Replacing the spark plug								Every 5,000 hours
Inspecting the O ₂ sensor								Every 2,500 hours
Inspecting the vaporizer***					●			As specified by the machine manufacturer

*** : For liquefied petroleum gas (LPG) engine model only

Cooling System

Inspection/Maintenance Item	Daily	250 hours	500 hours	750 hours	1,000 hours	1,250 hours	1,500 hours	Remarks
Coolant quantity	●							Inspecting the reserve tank
Abnormal discoloration and contamination of coolant	●							
Coolant leak	●							
Radiator cap installation condition	●							As specified by the machine manufacturer
Inspecting (replacing) the fan belt	●		●		●		●	
Inspection using the coolant temperature gauge or monitor	●							75 - 90°C (167 - 194°F)
Replacing the coolant								Every 12 months**
Cleaning the coolant passage								Every 12 months
Cleaning the radiator exterior	●							As specified by the machine manufacturer
Inspection and maintenance the cooling system	●							As specified by the machine manufacturer
Inspecting the functionality of radiator cap*	●							As specified by the machine manufacturer

* : When performing inspection or maintenance, consult an Isuzu Distributor or the machine manufacturer.

** : When using long life coolant

Intake/Exhaust System

Inspection/Maintenance Item	Daily	250 hours	500 hours	750 hours	1,000 hours	1,250 hours	1,500 hours	Remarks
Replacing the air cleaner element								As specified by the machine manufacturer
Inspecting the air filter case for cracking and replacing it as necessary							●	Every 1,500 hours

Electrical System

Inspection/Maintenance Item		Daily	250 hours	500 hours	750 hours	1,000 hours	1,250 hours	1,500 hours	Remarks
Inspecting the engine failure indication and liquid crystal display (LCD)		●							
Inspecting the battery fluid level		●							Adding distilled water (As specified by the machine manufacturer)
Cleaning the battery		●							
Charging status	Current meter	●							Immediately after start, + side (large) → (small) Normal operation, + side (small)
	Charge light	●							Off (in operation)
Measuring the specific gravity of battery fluid		●							As specified by the machine manufacturer
Inspecting and cleaning the starter and generator*						●			Every 1,000 hours
Inspecting the wiring and connections									As specified by the machine manufacturer

* : When performing inspection or maintenance, consult an Isuzu Distributor or the machine manufacturer.

Engine/Others

Inspection/Maintenance Item	Daily	250 hours	500 hours	750 hours	1,000 hours	1,250 hours	1,500 hours	Remarks
Inspecting and replacing the gas pipe and coolant pipe								Every 24 months
Engine startability and abnormal noises	●							
Exhaust conditions	●							Exhaust color
Measuring the compression pressure*					●			Every 1,000 hours
Inspecting and adjusting the valve clearance*					●			Every 1,000 hours 0.4 mm (0.016 in) for both intake and exhaust (in cold engine)

* : When performing inspection or maintenance, consult an Isuzu Distributor or the machine manufacturer.

Recommended Lubricants

It is extremely important to select correct lubricants so that your engine demonstrates its full performance over the years.

Top up the lubricants in accordance with the Periodic Inspection and Maintenance List specified for your engine. It is recommended to use the Isuzu genuine lubricants or an equivalent. The lubricant change intervals specified in the Periodic Inspection and Maintenance List and the terms and conditions of the new engine warranty assume the use of recommended lubricants listed below.

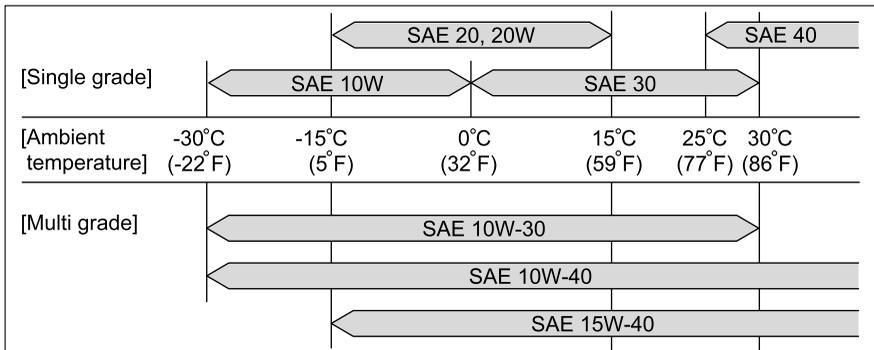
Selecting the Engine Oil

As for the engine oil, use the Isuzu genuine engine oil or those equivalent to the oils specified below. When planning to use any other engine oil, contact an Isuzu Distributor or the machine manufacturer.

LUBRICATION	BRAND
NG/LPG engine crankcase	BESCO CNG ENGINE OIL (10W-30), Delo 400 NG (15W-40), Rimula R3 NG (15W-40), or equivalent

Engine Oil Viscosity

The viscosity of the engine oil (SAE) is an important factor determining the engine startability, performance, oil consumption, etc. When an inappropriate oil viscosity is selected, it may lead to a rapid wear, a failure such as a seizure or an accident, so depending on the air temperature, use different types properly in accordance with the table below.



IN CASE OF EMERGENCY

6

• Cause of Failure and Corrective Action	6-2
• When the Battery Goes Flat	6-4
• When the Fuel Runs Out	6-6
• When the Fuel (Gas) Leaks	6-6

Cause of Failure and Corrective Action

Dependably performing inspections and maintenance prevents faults. Make sure to perform periodic inspections and maintenance. Also, if a small problem is found, take an immediate action for it before it leads to a bigger problem.

If any of the failures listed below occurs, perform inspection and take action following the table.

If a repair cannot be performed by yourself, the corrective action shown in the table does not eliminate the problem or a failure location cannot be identified, contact the nearest Isuzu Distributor or the machine manufacturer.



ADVICE

- ◎ in the "Corrective Action" column indicates that the failure requires a repair or adjustment, so contact the nearest Isuzu Distributor or the machine manufacturer.

Symptom		Cause	Corrective Action	Reference Page
Engine does not start	Starter does not turn over, or is weak	Flat batteries	Recharge or replace	6-4
		Battery terminals detached, loose or corroded	After repairing corroded section, connect the terminals firmly	5-32
		Starter ground wire terminal detached, loose, or corroded	After repairing corroded section, connect the terminals firmly	—
		Starter or electrical system is faulty	◎	—
	Starter turns over	No fuel	Make sure there are no fuel (gas) leaks, and then refuel (fill gas).	—
		Fuel shut-off valve is faulty	◎	—
		Pressure reducing valve is faulty	◎	—
		Ignition system is faulty	◎	—
		Engine control (electrical system) is faulty	◎	—
		Engine starts, but immediately stops Unsteady engine speed	Idling speed too low	◎
Air cleaner is clogged	Clean or replace element	5-22		
Fuel system is faulty	◎	—		
Engine control (electrical system) is faulty	◎	—		

Symptom	Cause	Corrective Action	Reference Page
Engine revolution is unstable	Failure of the fuel system	⊙	—
	Failure of the engine control system	⊙	—
Engine is overheating	No engine coolant	Add engine coolant	5-20
	Front of radiator is clogged with dirt	Clean with a soft bristle brush	—
	Radiator cap not fully tightened	Make sure it is firmly tightened	—
	Fan belt loose	Adjust the tension or replace the belt	5-14 5-15
	Engine coolant dirty	Clean the radiator interior or change engine coolant	5-18
	Fan clutch is faulty	⊙	—
	Radiator cap dirty or faulty	Clean or replace	—
Oil pressure is low	Inappropriate engine oil viscosity	Replace it with oil with appropriate viscosity	4-3
	Engine oil level too low	Add engine oil	5-8
	Engine inner components are faulty	⊙	—
	Meter, warning and indicator lights or switches faulty	⊙	—
Not enough engine power	Air cleaner clogged	Clean or replace element	5-22
	Poor engine control system adjustment	⊙	—
	Engine faulty	⊙	—

When the Battery Goes Flat

Using the jumper cables (sold separately) and the battery of another machine, start the engine in the following sequence.



CAUTION

- Use a machine which is equipped with the same voltage battery as the one in the disabled machine as a rescue machine.
- The positive (+) terminal and the negative (-) terminal should not be put in contact with one another.
- When connecting the jumper cables, the clips should not be put in contact with one another.
- Ask an Isuzu Distributor or the machine manufacturer to recharge the battery.
- Do not disconnect a battery terminal with the engine running. Doing so could cause a failure in the electrical system.

1. Check the battery fluid level in the disabled machine.

Inspecting the Battery Fluid Level and Adding the Battery Fluid

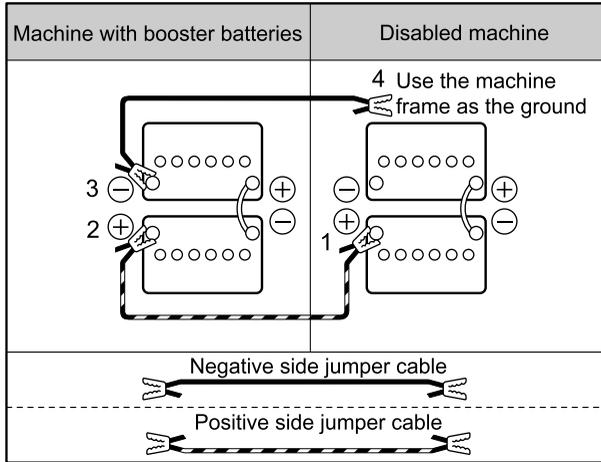
→ Refer to Page 5-31

2. Use a machine that has the same battery voltage (24V) as a rescue machine.
3. Remove the battery cover and connect the jumper cables in the numbered sequence in the illustration.
4. After connecting the jumper cables, start the engine of the rescue machine.
5. Slightly raise the engine speed of the rescue machine, and start the engine of the disabled machine.
6. When the engine can be started, disconnect the jumper cables in the reverse sequence of the cable connection.



NOTE

- When it is difficult to start the engine in a cold area, first start the engine of the normal machine (rescue machine), wait for a few minutes, and then start the engine of the disabled machine.



WARNING

- Check the battery fluid level before connecting the jumper cables. Using or charging the battery with the battery fluid level being below the lower limit may accelerate battery deterioration or induce heat generation or even explosion. Perform the work after adding the battery fluid.
- When connecting the jumper cable to the frame 4 of the disabled machine, it may create sparks. For this reason, if the cable is connected too close to the battery, the flammable gas which is generated from the battery may catch the sparks and explode, so choose a position as far away as possible.
- Do not let the positive (+) side of the jumper cable come in contact with the negative (-) side of jumper cable or the machine body.
- Keep flames away from it.
- Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm. Wash hands after handling.

When the Fuel Runs Out

If the engine runs out of fuel while operating, refill with natural gas (NG) or liquefied petroleum gas (LPG) using a method selected by the customer.

When the Fuel (Gas) Leaks

A gas leak may have occurred if the fuel gauge drops suddenly or you can smell the odor of natural gas (NG) or liquefied petroleum gas (LPG).

If there is a gas leak, immediately stop the engine, and close the manual cylinder valves of the NG/LPG containers (NG/LPG cylinders). Contact the nearest Isuzu Distributor or the machine manufacturer when you discover gas leaks.

MAIN DATA

7

• Main Data and Specifications

7-2

Main Data and Specifications

Engine

4HV1-NG/4HV1-LPG

Specifications	
Water-cooled, overhead camshaft, natural gas (NG) multi point injection/ Water-cooled, overhead camshaft, liquefied petroleum gas (LPG) multi point injection	
Number of cylinders - Inner diameter x Travel mm (in)	4 - 115 × 110 (4.53 × 4.33)
Compression ratio* (to 1)	12.5
Displacement cc (cu. in)	4,570 (278.9)
Firing order	1-3-4-2
Ignition timing (static) degree	Electronic controled
Spark plug gap mm (in)	0.7 - 0.8 (0.028 - 0.031)
Rated output (without fan)* kW (hp)/min ⁻¹	NG: 60.0 (80) / 1,800 LPG: 63.0 (84) / 1,800
Maximum torque (without fan)* N·m (lb·ft)/min ⁻¹	NG: 275 (203) / 2,200 LPG: 208 (153) / 2,200
Valve clearance (intake and exhaust) mm (in)	Both intake and exhaust valves: 0.4 (0.016) in cold engine
Fuel type	NG: Natural gas LPG: Liquefied petroleum gas
Idle speed r/min	800
Fan belt tension mm (in)/Hz	New belt: 5 - 7 (0.20 - 0.28)/184 - 206 When reused: 8 - 9 (0.31 - 0.35)/158 - 170
Oil filter	Cartridge type
Engine oil capacity [Reference value]* liters (US gal./Imp gal.)	When changing oil only: 8.5 (2.25 / 1.87) When changing oil and filter: 9.5 (2.51 / 2.09)
Engine coolant capacity [Reference value] liters (US gal./Imp gal.)	12.0 (3.17 / 2.64)
Generator* volt/amp.	12 / 140
Starter motor* volt-kw	12 / 2.5

This specification is subject to change in part without notice.

*: Specification may vary depending on the machine, so refer to the specifications of the machine manufacturer.

A

About Natural Gas (NG) Engines and Liquefied Petroleum Gas (LPG) Engines	2-2
Air Cleaner	5-22

B

Battery	5-28
Before Driving	2-2

C

Cause of Failure and Corrective Action	6-2
Cautions for Driving in Cold Regions and Season	4-2
Coolant	5-16

D

Daily (Pre-Driving) Inspection	5-4
Discarded Parts, Oils and Other Liquids	5-3
Driving	2-7

E

Engine Conditions	5-5
Engine Number/Emission Label/Special Vehicle Labels	1-3
Engine Oil	5-6
Engine Oil Filter	5-11
Exhaust Emission Regulation Related Parts	1-4
Exterior	0-6

F

Fan Belt	5-13
Fuel, Lubricant and Coolant	2-5

I

Inspecting Components that Showed Abnormalities During Previous Operation	5-5
Inspection Method After the Engine Started	3-4
Isuzu Genuine Oils and Grease	5-3
Isuzu Genuine Parts	1-2

M

Main Data and Specifications	7-2
------------------------------	-----

O

O ₂ Sensor	5-23
-----------------------	------

P

Periodic Inspection and Maintenance List	5-33
Precautions for Inspections and Adjustments	5-2
Preventing Engine Failure	2-12

R

Recommended Lubricants	5-38
------------------------	------

S

Spark Plug	5-22
Starting the Engine	3-2
Staying Safe	2-11
Stopping the Engine	3-8

V

Valve Clearance/Others	5-24
Vaporizer	5-23

W

Warranty	1-2
When the Battery Goes Flat	6-4
When the Fuel (Gas) Leaks	6-6
When the Fuel Runs Out	6-6
When to Visit an Isuzu Distributor	2-14

MEMO

MEMO

MEMO

MEMO