

MACTM

A Generac Company

MAC 400FHC

MANUAL



Pictures and Dimensions

MAC 400FHC Air Heater

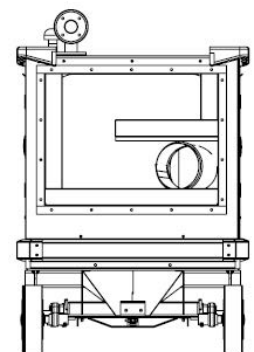
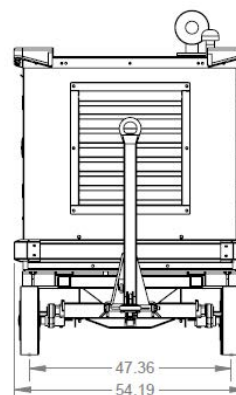
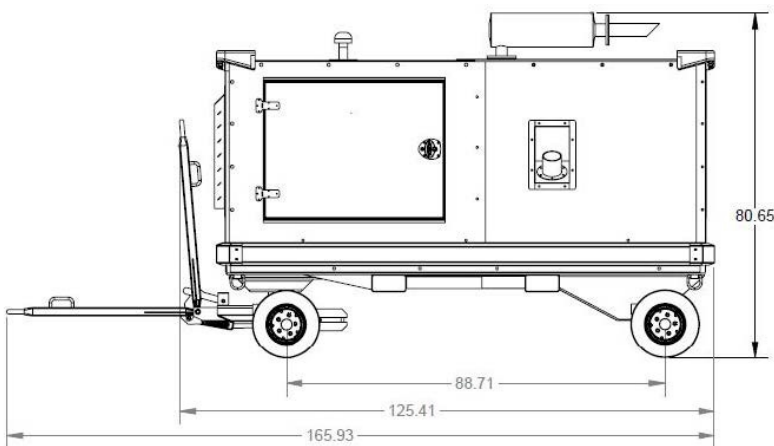


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MAC 400FHC – STANDARD FEATURES

WASP 6,000lb Axle Kit
Airline Tug Hitch with Wheel Locking Position
Isuzu 2.2 diesel engine, 62 HP (46 kW) Engine
950 CCA Wet Cell Battery
Secondary fluid containment (110%)
One 12" Airline Outlet Duct
Positive Air Shutdown
Lockable access doors
Powder coat finish
Duct Storage Wall
Fork Lift Pockets
Operating Beacon (Orange)
Low Fuel Beacon (blue)

MAC 400FHC - OPTIONAL FEATURES

Additional ducting/duct splitters

Custom paint colors

Global Positioning System (GPS)

Service/work light packages

- Interior LED service lights
- Exterior LED work lights (flood or spot)

Cold weather package

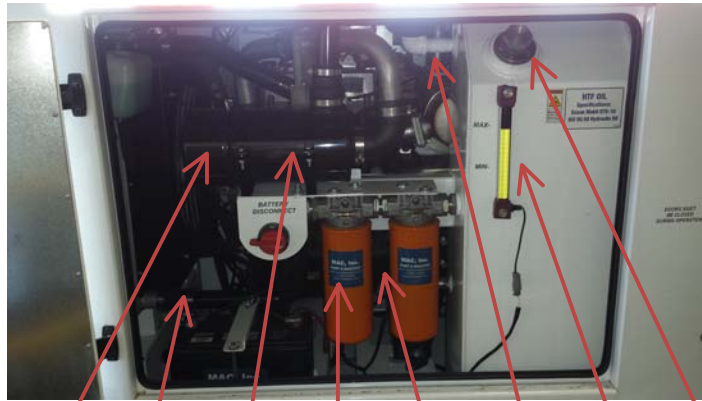
- EON dry cell battery 1090 CCA - 4 year full warranty
- Battery blanket
- Fuel pre-heater
- Insulated duct sections (25' lengths)

Hazardous environment options

- Lower Explosive Level (LEL) monitor – 75 harmful/explosive gas detection
- Carbon Monoxide (CO) monitor
- Spark arrestor/silencer
- Brushless starter
- Brushless alternator

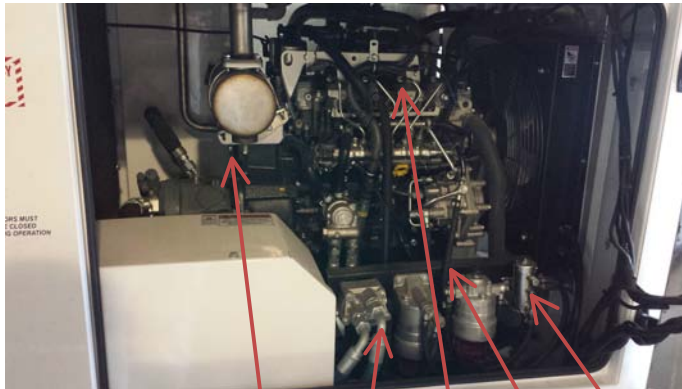
General Information

MAC 400FHC Air Heater



1 2 3 4 5 6 7 8

- 1 Engine radiator
- 2 Fluid Drain (Oil, Fuel, Coolant)
- 3 Air Filter
- 4 Hydraulic fluid filter
- 5 Hydraulic fluid filter
- 6 Hydraulic fluid breather/separator
- 7 Hydraulic fluid reservoir tank gauge
- 8 Hydraulic fluid fill



1 2 3 4 5

- 1 Diesel Oxidation Catalyst
- 2 Diesel engine oil filter
- 3 Diesel injection system
- 4 Diesel fuel filters Diesel
- 5 fuel prime

Warranty

MAC 400FHC Air Heater

ONE (1) YEAR LIMITED WARRANTY

MAC, a Generac Company, warrants to the original purchaser of the equipment, that all workmanship and materials utilized in the construction of the equipment by MAC, a Generac Company, will be free from substantial defects in material and workmanship for a period of one (1) year from the date of purchase.

In addition to the above warranty, these components have an extended warranty period beyond one (1) year.

Engine

12 months, unlimited hours

* Whichever occurs first. In the absence of a functional hour meter, the engine will be deemed to be in use for eight (8) hours per calendar day commencing from the start of the warranty period.

12-36 months or 3,000 hours

** Coverage for all electrical and/or electronic (including factory-installed wiring harnesses), fuel system, and turbocharger components are limited to two (2) years or 2,000 hours, whichever occurs first.

36-60 months or 5,000 hours

Major Component Limited Warranty (MCW) covers the following components only: cylinder block, cylinder head, crankshaft (excluding bearings), camshaft, connecting rods (excluding bushings), flywheel and flywheel housing.

Axles

Two (2) years

Notwithstanding anything set forth herein, MAC, a Generac Company, makes no warranties whatsoever, whether implied or express, including any implied warranties of the merchantability or fitness for a particular purpose as to said equipment. In addition thereto, the following items are specifically excluded from coverage by the terms of the limited warranty, damage or defects which result from accident, collision, abuse, normal wear and tear, neglect, improper maintenance, improper installation, improper placement or any damage caused by alteration.

This warranty extends only to the original purchaser of MAC, a Generac Company, equipment and is not transferable to any other parties. MAC, a Generac Company, does not assume responsibility for any promises, warranties, or representations beyond those expressed in the written document.

MAC, a Generac Company, obligations and understandings in this warranty are limited to the repair or replacement, at its option, of any defective products manufactured by MAC, a Generac Company, and in no event shall MAC, a Generac Company, be liable for any consequential, indirect, or incidental costs or damages, including loss of use or any other damages of any type arising out of such defective parts or products.

Some States in the U.S.A. do not allow exclusion or limitation of incidental or consequential damages or implied warranties. In addition you may have other rights which vary from state to state. Any items of this warranty which conflict with the laws of our state are deemed amended by the law of your state.

Warranty (cont.)

MAC 400FHC Air Heater

In the event that you believe any product manufactured by MAC, a Generac Company, has a defect or malfunction or failure to conform to this written warranty, you should contact MAC, a Generac Company, at its Bismarck, ND address:

**MAC, a Generac Company,
2106 East Indiana Ave.
Bismarck, ND U.S.A. 58504
+1.800.272.4604
www.macflameless.com**

Follow this procedure for warranty:

1. Contact MAC, a Generac Company, at +1.800.272.4604
2. Ask to speak to a service representative
3. Have the following information ready when you call
 - a. Original purchaser's company name
 - b. Model number of your equipment
 - c. Serial number of your equipment
 - d. Purchase date of your equipment
4. Defective product may need to be returned to MAC, a Generac Company, with the freight prepaid. Take appropriate precautions against damage during shipping.
5. Supply the following information with the returned product
 - a. Name, address, contact person and telephone number of the original purchaser of the equipment and indicate the date of purchase.
 - b. Serial number and model number defective part is attached

MAC, a Generac Company, will replace or repair any defective products within a reasonable period of time and return them to you. If MAC, a Generac Company, determines there is no failure to this limited warranty, you will be notified to retrieve your product from the service facility. MAC, a Generac Company, assumes no responsibility for merchandise not retrieved within thirty (30) days of notification to the original purchaser or owner of the product.

This warranty has been drafted to comply with Federal legislation and rules promulgated by the Federal Trade Commission.

You have additional legal rights in addition to those set forth in this written limited warranty.

Warnings and Cautions

MAC 400FHC Air Heater

The MAC 400FHC flameless air heater is designed and built for sustained reliable heat production in industrial, severe operating conditions, and environments. The MAC 400FHC is built to withstand rough and frequent handling.

The skid sub-frame has forklift access at either side with cable lift points on each end (spreader bar required) for loading, transport, tie down, and chain attach points for skid positioning of the unit. The total enclosure design protects the operating components allowing all-weather storage or operations. All options incorporate integrated control and safety systems to ensure reliable operations.

MAC, Inc. offers training services to learn how to properly operate and maintain your unit. Contact MAC, Inc. at +1.800.272.4604

WARNINGS AND CAUTIONS LISTED IN THIS MANUAL MUST BE FOLLOWED!

REMEMBER

SAFETY FIRST!! OPERATOR MUST READ AND UNDERSTAND ALL OPERATING INSTRUCTIONS, WARNINGS, AND CAUTIONS BEFORE OPERATING HEATER.

WARNING!

- IMPROPER OPERATION OF THIS EQUIPMENT CAN CAUSE SERIOUS INJURY OR DEATH.
- READ OPERATION MANUAL SUPPLIED WITH THIS EQUIPMENT BEFORE OPERATING OR SERVICING.
- DO NOT OPERATE WHILE TRANSPORTING.
- MAKE SURE UNIT IS PROPERLY SECURED WITH WHEEL CHOCKS AND ON LEVEL GROUND TO PREVENT SHIFTING OR ROLLING.
- HEARING PROTECTION REQUIRED WHEN OPERATING THIS MACHINE.
- ADEQUATE AIRFLOW TO THE HEATER IS MANDATORY FOR SAFE RELIABLE OPERATION. DO NOT COVER UNIT OR RESTRICT PROPER AIR FLOW.
- KEEP AIR INTAKE FREE AND CLEAR OF DEBRIS.
- HEATER SHOULD NOT BE LEFT UNATTENDED DURING OPERATION.
- SHUT ENGINE OFF BEFORE CHECKING OIL LEVELS.
- ALL SAFETY GUARDS MUST BE IN PLACE DURING OPERATION.
- FOLLOW LOCKOUT PROCEDURE BEFORE SERVICING.
- MOVING PARTS CAN CRUSH AND CUT.
- HOT PRESSURIZED FLUID. DO NOT OPEN DOORS WHILE MACHINE IS RUNNING.
- DOORS MUST REMAIN CLOSED DURING OPERATION.
- JACKS ARE INTENDED FOR LEVELING AND STABILIZING ONLY.
- FAILURE IN THE EXHAUST OR HEAT EXCHANGER CAN INTRODUCE DANGEROUS LEVELS OF CARBON MONOXIDE INTO OUTLET AIR FLOW.
- DURING OPERATION, INTERNAL COMPONENTS CAN BECOME BURN HAZARDS. DO NOT TOUCH. ALLOW TIME TO COOL BEFORE SERVICING.
- FIRE FROM FLAMABLE FUEL CAN CAUSE SERIOUS INJURY OR DEATH.
- NO SMOKING, SPARKS OR OPEN FLAME DURING FUELING OR WASHDOWN.
- DO NOT ATTEMPT TO SERVICE ANY PART OF THIS MACHINE WHILE IN OPERATION.
- DO NOT ATTEMPT TO DISCONNECT OR REMOVE HOSES OR DUCTING DURING OPERATION.



Pre-Start Checklist

MAC 400FHC Air Heater

WARNING!

- SEVERE INJURY MAY RESULT IF PRECAUTIONS ARE NOT FOLLOWED.
- DO NOT COVER THE MACHINE. MACHINE MUST BE USED IN AN OPEN AREA. DO NOT USE IN ENCLOSED AREAS.
- DO NOT OPERATE MACHINE WITH ACCESS DOORS OPEN.
- MACHINE MUST BE COMPLETELY SHUT DOWN BEFORE OPENING ACCESS DOORS.
- MAKE SURE ENGINE IS SHUT OFF BEFORE CHECKING FLUID LEVELS.
- MACHINE MUST BE RUN ON LEVEL GROUND TO ENSURE PROPER OPERATION AND SAFETY.
- MACHINE MUST BE SECURED ON LEVEL GROUND TO PREVENT ROLLING OR SHIFTING AS SERIOUS INJURY MAY OCCUR.

WARNING!

Do not use any fuel other than diesel #1 or diesel #2

- DO NOT use diesel fuel additives
- DO NOT use gasoline or ANY fuel contaminated with gasoline

PRE-START CHECKLIST

- Check area surrounding heater for flammable materials or fire hazards.
- Check exterior of heater for any fluid leaks. (fuel, engine oil, hydraulic oil, engine antifreeze)
- Check general condition of heater.
- Check fan air intake screen for any obstructions and is in proper working condition.
- Check exhaust stack for any obstruction. (snow, ice, etc..)
- Ensure air duct hose is securely fastened to outlet duct assembly.
- Check to see that unit has been serviced and ready for operation.
- Check fuel tank for proper fuel and fuel level. Only diesel fuel oil #1, #2
- Check that the unit is level and properly secure before starting.

ENGINE COMPARTMENT CHECKLIST

- Check interior compartment for fluid leaks. (fuel, engine oil, hydraulic oil, engine antifreeze)
- Check all filters for leaks and are in proper working condition.
- Check all fluid levels prior to starting machine. (fuel, engine oil, hydraulic oil, engine antifreeze)
- Check battery, battery cables and harnesses are secure and in good working condition.
- Check fuel lines and electrical cables and connections for damage and security.
- Check hydraulic lines and fittings for leaks, cracks and overall condition.
- Check engine belts and hoses for overall condition.
- Check engine control panel for security.

Start/Stop Procedure

MAC 400FHC Air Heater

Start Up Procedure:

Raise tow bar to engage parking brake. Place wheel chocks in front and back of wheels.

Rotate main battery disconnect to “ON” position.

Open control panel access door and rotate engine starter key to 1st position to engage engine glow plug system.

Rotate starter key to 2nd position to start engine after waiting about 5 seconds for fuel pump to build pressure. Release key to run position once engine is running.

Attach air ducting to aircraft avoiding sharp bends or twists in duct.

IMPORTANT!

A TWISTED OR BENT AIR DUCT WILL CAUSE LOSS OF AIR PRESSURE AND TEMPERATURE!

Press “START” button on display to start the heat sequence. The blower will start when the heater reaches a steady state temperature.

Use up and down arrow keys on display to adjust temperature selection to desired outlet temperature. (100°F, 120°F, 140°F, 160°F)

Monitor and adjust as required.



Heater Control Panel

Start/Stop Procedure

MAC 400FHC Air Heater



Shut Down Procedure:

Press “STOP” button on display. The heater will shut down and the blower will keep running for cooling of heat exchanger.

The blower will display a countdown and automatically stop spinning when the unit has safely cooled down.

After the heater has safely cooled down, the display will indicate to shut down the engine.

Rotate engine starter key to “OFF” position.

Disconnect and retract air ducting and place in storage area.

CAUTION!

DO NOT DETACH DUCTING UNTIL ALL AIR PRESSURE HAS BEEN EMPTIED FROM HOSE DUCT!

Rotate main battery disconnect to “OFF” position.

Replacement Parts and Filters

MAC 400FHC Air Heater

MAC 400FHC Parts Supplement

Description	Quantity	MAC Part #
Engine Oil Filter	1	3020852
Engine Fuel Filter	1	3020989
Engine Air Filter	1	3021636
Belt	1	3021028
Glow Plug	1	3021440
Starter	1	MAC 4019
Alternator	1	3021441
Water Pump	1	3021438
T-Stat	1	3021439
Switch, Overheat	1	MAC 4024
Switch, Oil Pressure	1	MAC 4023
Battery	1	MAC 3578
Hydraulic Fluid Filters		
20 Micron	1	MAC 3521
9 Micron	1	MAC 3522
Hydraulic Oil		
Exxon Mobil DTE 10 Excel-68		MAC 3885
Total System Capacity	22 ½ Gallons	
Tank Capacity	18 ½ Gallons	
Breather/Separator	1	MAC 3597

Any deviation from manufacturer's specifications for parts, service or maintenance may void Warranty and could negatively impact the performance or longevity of your machine.

ISUZU DIESEL ENGINE 4LE2X

INSTRUCTION MANUAL

ISUZU MOTORS LIMITED

FOREWORD

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

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

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

Should your engine require servicing, please contact your nearest ISUZU engine outlet. He knows your engine best and is ready to meet your satisfaction.

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

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

WARNING AND CAUTION

SAFETY WARNINGS

WARNING: These mean there is something that could hurt you or other people.

In the warning area, we tell you what the hazard is. Then we tell you what to do to help avoid or reduce the hazard. Please read these warnings. If you don't, you or others could be hurt.

ENGINE OR EQUIPMENT DAMAGE WARNINGS

CAUTION: These mean there is something that could damage your engine or equipment.

In the caution area, we tell you about something that can damage your engine or equipment. Many times, this damage would not be covered by your warranty, and it could be costly. But the caution will tell you what to do to help avoid the damage.

EMPHASIZED WARNINGS

NOTICE: These mean there is something that needs to be emphasized but which does not concern the possibility of personal injury or mechanical damage.

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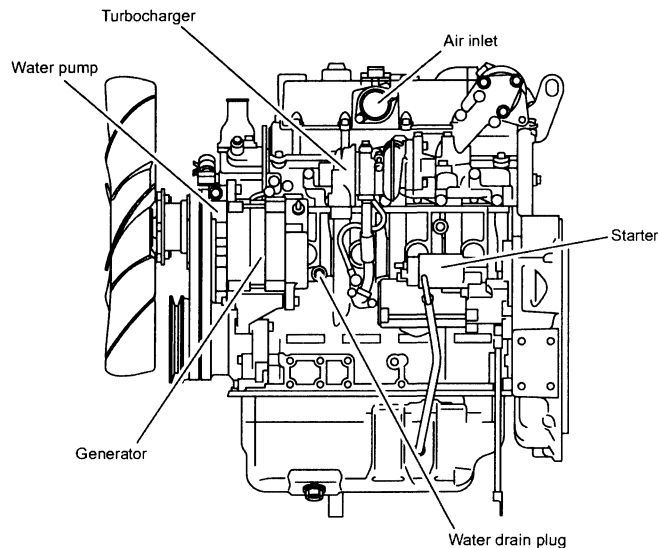
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1. ENGINE EXTERNAL VIEWS

1. MODEL 4LE2X

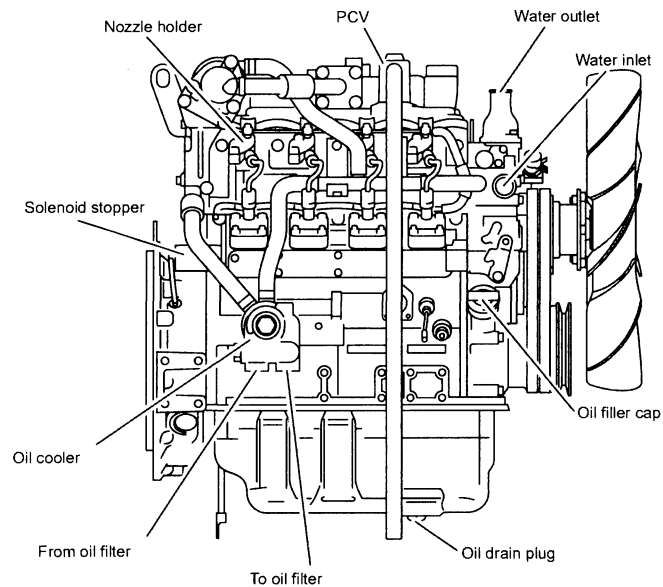
(1) LH



Note:
*Engine details may
vary depending on the
specifications.*

IMLE0034

(2) RH

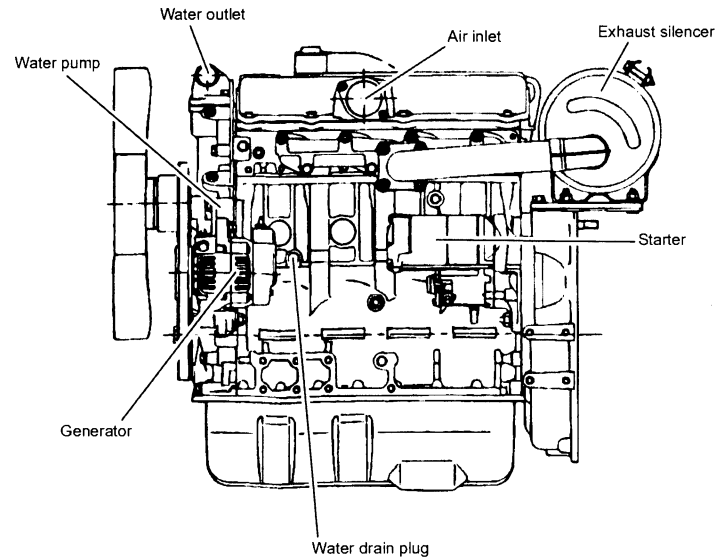


Note:
*Engine details may
vary depending on the
specifications.*

IMLE0035

2. MODEL 4LE2

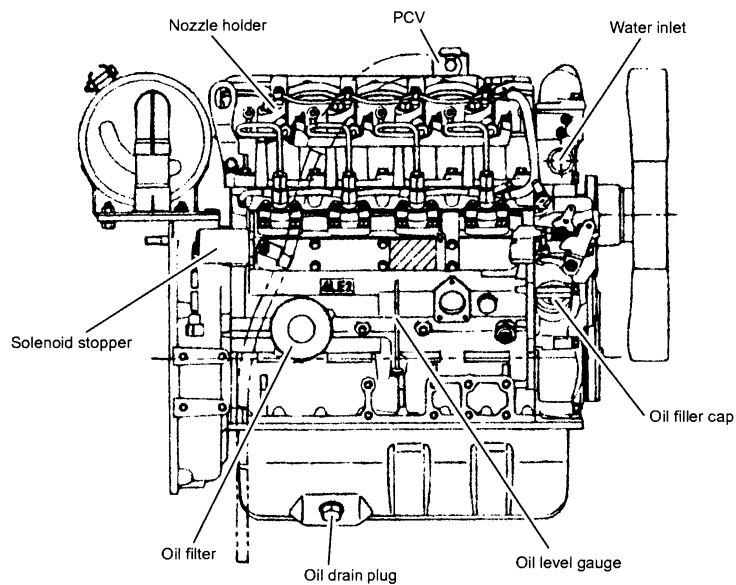
(1) LH



Note:
*Engine details may
vary depending on the
specifications.*

IMLE0064

(2) RH



Note:
Engine details may
vary depending on the
specifications.

IMLE0065

2. GENERAL INFORMATION

1. EPA AND CARB CERTIFIED ENGINE DATA AND SPECIFICATIONS

Se rapporter à la fin de ce document pour les informations EPA en français.

(1) Model AU-4LE2X

ISUZU engine model name		AU-4LE2X
Engine family		*SZXL02.2UXA
Engine code		4LE2XXXXX-XX
Engine type		Water-Cooled, four cycle, in-line overhead valve type
Combustion type		Direct Injection
No. of cylinders – bore × stroke	mm(in)	4 – 85 × 96 (3.35 × 3.78)
Engine displacement	L(cid)	2.179 (133)
Compression ratio		18.3 to 1
Firing order		1 – 3 – 4 – 2
*2 Rated power: SAE NET	kW(hp)/min ⁻¹	40.5 (54.3) / 2000
*2 Fuel flow at max rated power	(mm ³ /stroke)	43.8
Exhaust emission control system		EM, DFI, TC, EGR
Injection pump		Bosch, PFR type
Governor		Variable speed, Mechanical type

* Mark ; Put a letter codes for model year on the top of the letters.

Y : 2000, 1 : 2001, 2 : 2002, 3 : 2003, 4 : 2004, 5 : 2005, 6 : 2006, 7 : 2007, 8 : 2008, Model Year

Engine code varies depending on each engine.

ISUZU engine model name			AU-4LE2X	
Injection nozzles			Multi-hole type	
Specified fuel			Diesel fuel (ASTM D975 No.2-D)	
*2 Starter	(V-kW)		24 – 3.2	
*2 Alternator	(V-A)		24 – 30	24 – 50
Specified engine oil (API grade)			Refer to 3.LUBRICANT, Engine Oil Selection.	
*2 Lub. oil volume	L(qts)		9.3 (9.8) – 12.1 (12.9)	
Coolant volume (Engine only)	L(qts)		4.3 (4.5)	
*2 Engine dry weight	kg(lb)		210 (463)	
*2 Engine dimensions	Overall length	mm(in)	756.3 (29.8)	
	Overall width	mm(in)	577 (21.9)	
	Overall height	mm(in)	747.3 (29.4)	
Valve clearance (cold)			0.4 (0.0157)	
Nozzle injection pressure			16.7 / 25.0 (2420 / 3625)	
*2 Injection timing B.T.D.C.			2°	
Maker and type of turbocharger			IHI, RHF-3	

Specification for items marked with an asterisk (*2) will vary according to the type of equipment in which the engine is installed.

(2) Engine family index

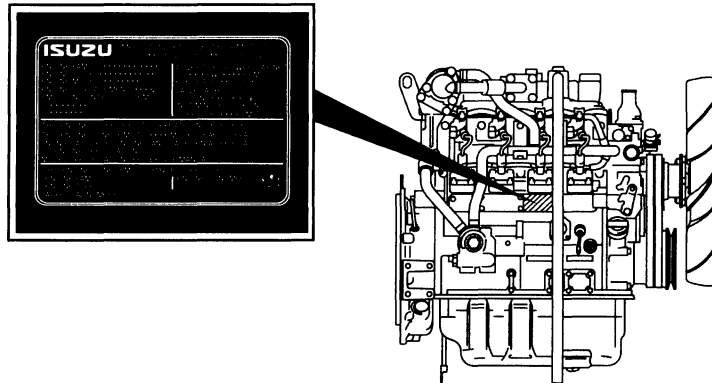
Engine	Engine family	Engine code	Injection nozzle opening pressure MPa(psi)	Injection timing B.T.D.C. (Static)
4LE2X	8SZXL02.2UXA	ALL	—	—
4LE2	8SZXL02.2VNB	ALL	—	—

EMISSION CONTROL LABEL: ENGINE LABEL (EPA, EC COMBIND TYPE)

Emission control label is attached at the center of injection pump cover located at the right side of cylinder body, or on the cylinder head cover.

The location of emission control label attached on the engine may vary depending on the engine specification.

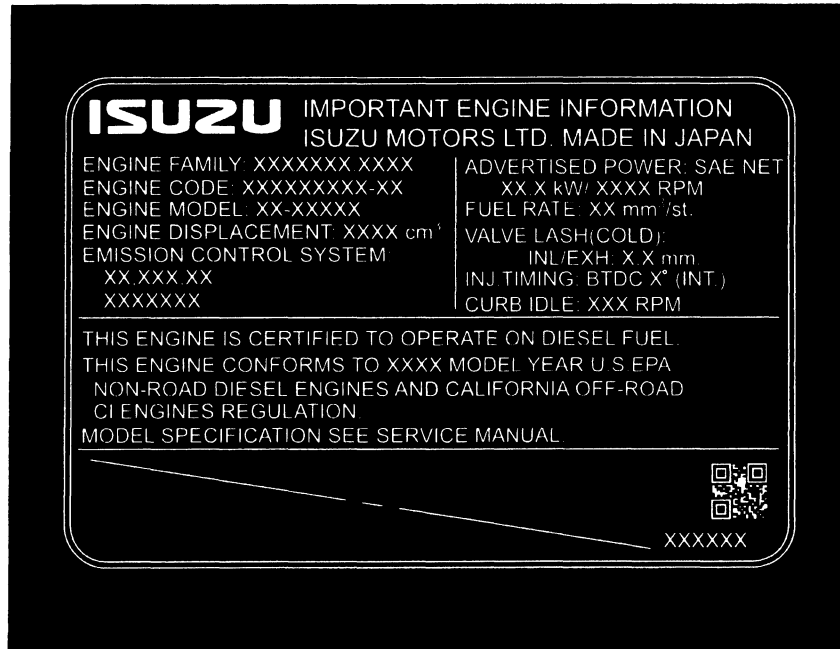
The following is the sample of a label required for engine emission control information, along with location.



IMLE0036

EMISSION CONTROL LABEL: ENGINE LABEL (ONLY EPA TYPE)

Emission control label is attached at a visible point on the equipment.



IMLE0037

FUEL TYPE IN USE LIMITATION LABEL (FOR EPA)

The fuel type in use limitation label is attached on the filler neck of the fuel tank.

Contents of the label:

LOW SULFUR OR ULTRA LOW SULFUR DIESEL FUEL ONLY

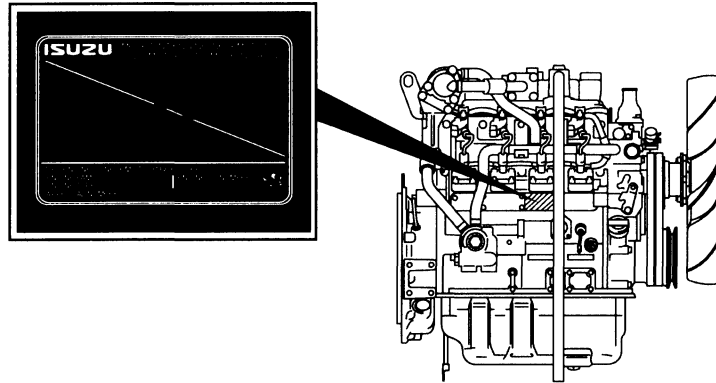


IMLE0066

2. EC EMISSION CONTROL LABEL: ENGINE LABEL (ONLY EC TYPE)

Emission control label is attached at the front of injection pump cover located at the right side of cylinder body or the cylinder head cover.

The following is the detail of a label required for engine emission control information, along with location.



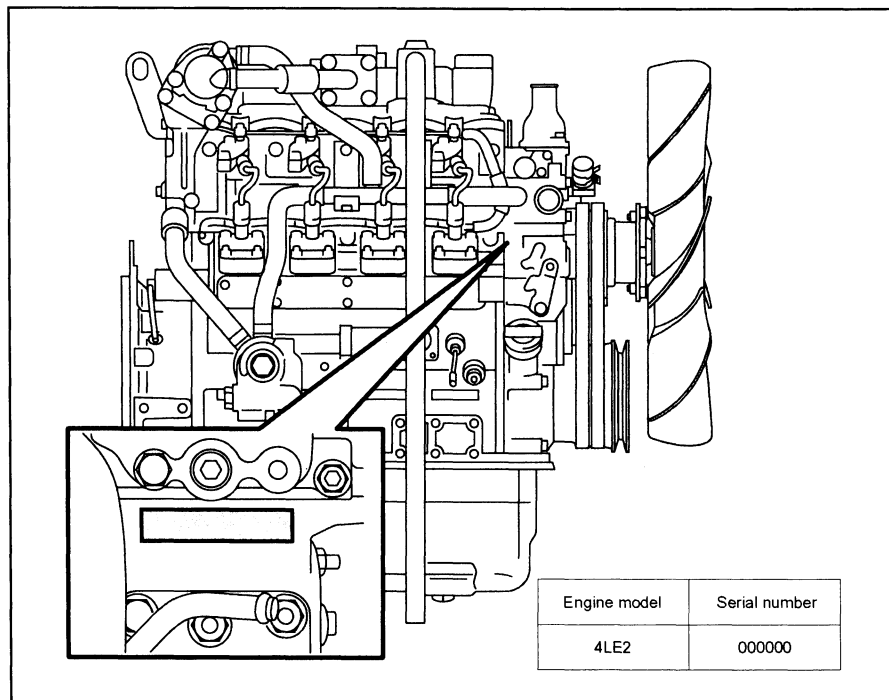
IMLE0038

3. ENGINE IDENTIFICATION

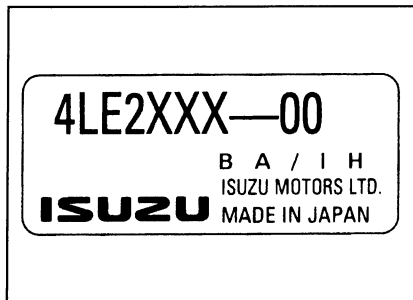
(1) Position of Display

The engine serial number is stamped on the front upper right side of the cylinder body, and the engine model is cast on the rear lower right side of cylinder body just above the oil cooler.

Further, engine model is described also on an ID label on the top of the cylinder head cover.



IMLE0005



IMLE0039

(2) Confirmation of Engine Serial Number

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

WARNING: *Conduct confirmation of engine serial number with the engine stopped.
To avoid being injury, don't check it, while the engine is still hot.*

4. ISUZU ENGINE AFTER SERVICE

(1) Isuzu Engine After Service

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

(2) Isuzu Genuine Parts

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

The ISUZU genuine parts are supplied by the ISUZU distributors or the authorized parts suppliers. Please designate "ISUZU Genuine Parts" when you need engine parts.



IMWG0005

3. **FUEL, LUBRICANT, AND COOLANT**

1. **FUEL**

(1) **Fuel Selection**

The following specific advantages are required for the diesel fuel.

- 1) Must be free from minute dust particles.
- 2) Must have adequate viscosity.
- 3) Must have high cetane value.
- 4) Must have high fluidity at low temperature.
- 5) *Low sulfur or ultra low sulfur diesel fuel only.
- 6) Must have little residual carbon.

* EPA regulations

Diesel fuels

Applicable Standard	Recommendation
JIS (JAPANESE INDUSTRIAL STANDARD)	NO. 2
DIN (DEUTSCHE INDUSTRIE NORMEN)	DIN 51601
SAE (SOCIETY OF AUTOMOTIVE ENGINEERS)	
Based on SAE-J-313C	NO. 2-D
BS (BRITISH STANDARD)	
Based on BS/2869-1970	Class A-1

If fuel other than the specified one is used, engine function will be lowered.

(2) Fuel Requirements

CAUTION: *Use of other types of fuel than ultra low-sulfur fuel may not conform to emission regulations.*

CAUTION: *The fuel injection pump, injection nozzle or other parts of the fuel system and engine can be damaged if you use any fuel or fuel additive other than those specifically recommended by Isuzu.*

Such damage is not Isuzu's responsibility, and is not covered by the Warranty. To help avoid fuel system or engine damage, please heed the following:

- *Some service stations mix used engine oil with diesel fuel. Some manufacturers of large diesel engines allow this; however, for your diesel engine, do not use diesel fuel which has been contaminated with engine oil. Besides causing engine damage, such fuel can also affect emission control. Before using any diesel fuel, check with the service station operator to see if the fuel has been mixed with engine oil.*
- *Do not use any fuel additive (other than as recommended under "Biocide" in this section). At the time this manual was printed, no other fuel additive was recommended. (See your authorized dealer to find out if this has changed.)*
- *Take care not to run out of diesel fuel. If you do run out of fuel, you may need to bleed air out of the fuel injection pump to re-start the engine after fuel has been added.*

Your engine is designed to use either Number 1-D or Number 2-D diesel fuel. However, for better fuel economy, use Number 2-D diesel fuel whenever possible. At temperatures less than -7°C, (20°F), Number 2-D fuel may pose operating problems (see "Cold Weather Operation" which follows). At colder temperatures, use Number 1-D fuel (if available) or use a "winterized" Number 2-D (a blend of Number 1-D and Number 2-D). This blended fuel is usually called Number 2-D also, but can be used in colder temperatures than Number 2-D fuel which has not been "winterized." Check with the service station operator to be sure you get the properly blended fuel. Note that diesel fuel may foam during a fill-up. This can cause the automatic pump nozzle to shut off even though your tank is not full.

CAUTION: *Do not use home heating oil or gasoline in your diesel engine; either may cause engine damage.*

(3) Replacement Fasteners

CAUTION: *Fuel may be under pressure. Remove the fuel cap slowly to prevent fuel from spraying out and causing injury.*

NOTICE: *Always use diesel fuel.
Use of low quality fuel may adversely affect the engine parts, and cause failure.
Use of other than specified fuel may adversely affect the engine or emission control system and cause failure.
If other than specified diesel fuel is used, the machine may not conform to specifications.*

(4) Handling of the Fuel

The fuel containing dust particles or water will cause engine failure.

Therefore, the following notice must be observed.

- 1) Take care to prevent the fuel from entry of dust particles or water when filling the fuel tank.

When fueling is done from an oil drum directly, keep the drum stationary over a long time so that clean fuel can be used after the dust particles or water is completely sedimented.

- 2) Always fully fill the fuel tank. Drain the sedimented particles in the fuel tank frequently by opening the tank draining hole.

(5) Water in Fuel

During refueling, it is possible for water (and other contaminants) to be pumped into your fuel tank along with the diesel fuel. This can happen if a service station does not regularly inspect and clean its fuel tanks, or if a service station receives contaminated fuel from its supplier(s).

To protect your engine from contaminated fuel, there is a fuel filter system on the engine which allows you to drain excess water.

WARNING: *The water/diesel fuel mixture is flammable, and could be hot. To help avoid personal injury and/or property damage, do not touch the fuel coming from the drain valve, and do not expose the fuel to open flames or sparks. Be sure you do not overfill the container. Heat (such as from the engine) can cause the fuel to expand. If the container is too full, fuel could be forced out of the container. This could lead to a fire and the risk of personal injury and/or machine or equipment damage.*

(6) Fuel Filter

- 1) Be sure to use the genuine fuel filter. The fuel injection system is precision structure so that its filter has a finer mesh than conventional one to extend life of the system. Be sure to use "**Genuine fuel filter**".
- 2) Replacement interval may be shortened depending on the characteristic of fuel. Clogged fuel filter may cause to result in stopping the engine. In a place where fuel gets mixed with foreign matter, perform early inspection and periodic replacement.
Depending on the machine, the electromagnetic type fuel pump is equipped in this engine. Periodical cleaning is required for this pump filter. (Refer to FILTER CLEANING)
When the filter exchange of this pump is necessary, please inquire at your machine supply source or contact ISUZU dealer.

(7) Biocides

In warm or humid weather, fungus and/or bacteria may form in diesel fuel if there is water in the fuel.

CAUTION: *Fungus or bacteria can cause fuel system damage by plugging the fuel lines, fuel filters or injector. They can also cause fuel system corrosion.*

If fungus or bacteria has caused fuel system problems, you should have your authorized dealer correct these problems. Then, use a diesel fuel biocide to sterilize the fuel system (follow the biocide manufacturer's instructions). Biocides are available from your dealer, service stations, parts stores and other automotive places. See your authorized dealer for advice on using biocides in your area and for recommendations on which biocides you should use.

(8) Smoke Suppressants

Because of extensive testing of treated fuel versus untreated fuel, the use of a smoke suppressant additive is not recommended because of the greater possibility of stuck rings and valve failure, resulting from excessive ash deposits.

2. LUBRICANT

The quality of engine oil may largely affect engine performance, startability and engine life.

CAUTION: *Use of unsuitable engine oil will result in piston ring, piston and cylinder seizure and accelerate the sliding surface wear causing increased oil consumption, lowered output and, finally engine failure. To avoid this, use the specified engine oil.*

(1) Engine Oil Selection

For engine oil, use API grade: CD,CE,CF,CF-4,CH-4,CI-4,CI-4 plus or ACEA grade: A3/B3,A3/B4,A5/B5,E2,E3,E4,E5,E7 or JASO grade: DH-1.

The brands/types of oil described below can be used regardless of specified API or ACEA grade above. Their qualities are guaranteed by ISUZU.

LUBRICATION	MAKER	BRAND/TYPE	GRADE		
			API	ACEA	JASO
Diesel engine crankcase	ISUZU GENUINE	BESCO MULTI-Z TYPE CE (10W-30)	CE		
	ISUZU GENUINE	*BESCO MULTI-Z (10W-30)	CD/CF/CF-4		
	ISUZU GENUINE	BESCO S-3 (10W, 20W, 30, 40)	CD		
	Caltex/Chevron	Delo CXJ (15W-40/20W-50/40)	CF		DH-1
	Shell	Delo 400 Multigrade (15W-40)	CE/CF/CI-4	E3/E5	DH-1
		Rimula X (15W-40)	CH-4	E3	DH-1
	Elf	Rimula D (15W-40/30/40)	CF		
		Perfo 3F (15W-40)	CF-4/CE	B2/E2	
	Total	Rubia XT (15W-40)	CF-4	E2	
	Castrol	RX Super Plus (15W-40)	CH-4	E3	
		Tecton J Plus (15W-40)	CH-4	E3/B3	DH-1
	BP	BP Vanellus C6 (15W-40)	CH-4	E3	
		APOLLOIL EX (10W-40)	CF		DH-1
	IDEMITSU	APOLLOIL TOUGH RUNNER (10W-30,15W-40)	CF		DH-1
		APOLLOIL MULTI RUNNER (10W-30, 15W-40)	CF-4/CE		DH-1
		*2 APOLLOIL SUPER WIDE DH-1(10W-30, 15W-40)	CF-4		DH-1
		Essolube XTJ (15W-40)	CF-4		DH-1
		Exxon/Essolube XD-3 (15W-40)	CI-4		
		Mobil Delvac 1300 Super (15W-40)	CI-4 Plus	E7/E5	DH-1
		Mobil Delvac 1 (5W-40)	CI-4 Plus	E7/E5/E4/E3	DH-1
	ExxonMobil				

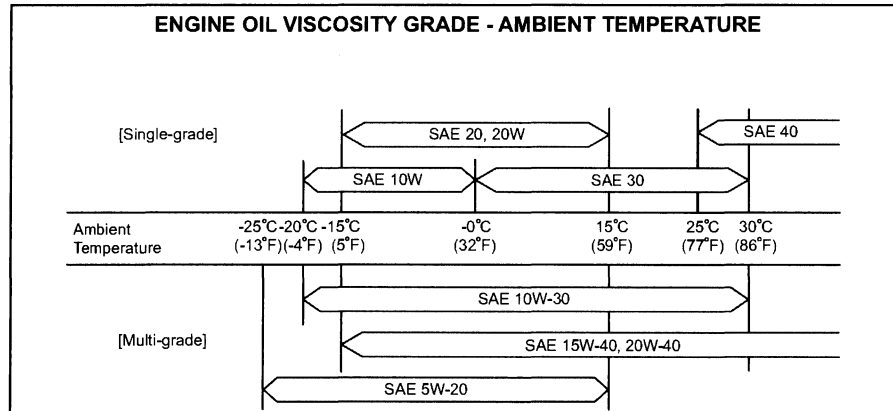
* Initial Engine Oil from Engine plant

*2 Initial Engine Oil from Engine plant (Only a Part of Models)

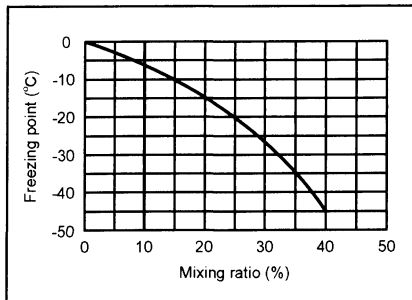
(2) Oil Viscosity

Engine oil viscosity largely affect engine startability, performance, oil consumption, speed of wearing and occurrence of seizure, etc. Using lubricants whose viscosity selected according to the atmospheric temperature is important.

CAUTION: 1. Using a mixture of different brand or quality oils will adversely affect the original oil quality; therefore, never mix up different brand or different type oils.
2. Don't use API, CA, CB grade and reconstituted engine oil.
3. Engine damage due to improper maintenance, or using oil of the improper quality and/or viscosity, is not covered by the warranty.



IMLE0040



1MJJ0025

3. COOLANT

Always refer to the chart to determine the correct cooling water to antifreeze solution mixing ratio.

- CAUTION:**
1. Supplement inhibitors or additives claiming to provide increases cooling capability that have not been specifically approved by Isuzu are not recommended for addition to the cooling system.
 2. When supplying or replacing coolant, do not use water of well or river, but be sure to use tap water.
 3. It is strongly recommended to use Isuzu genuine engine coolant or equivalent for addition or replacement.
 4. Coolants from other brands often do not contain anti-corrosive, and use of such products could result in corrosion of the engine and radiator.
 5. If the density of Isuzu genuine engine coolant exceeds 60%, the reduced specific heat characteristic of the coolant could result in overheating. If the density is below 20%, the anticorrosion characteristic may degrade. Adjust the coolant density in the range from 20% to 60% according to the situation.

4. ENGINE OPERATION

Engine Exhaust Gas Caution (Carbon Monoxide)

WARNING: *Do not breathe exhaust gas because it contains carbon monoxide, which by itself has no color or odor. Carbon monoxide is a dangerous gas. It can cause unconsciousness and can be lethal.*

We recommend that the exhaust system be inspected by competent technician:

- *Each time the machine has an oil change.*
- *Whenever a change is noticed in the sound of the exhaust system.*
- *Whenever the exhaust system is damaged or becomes corroded.*

See "Maintenance Schedule" in Section 8 of this manual for parts requiring inspection.

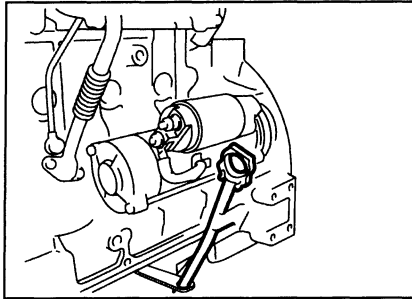
Do not run the engine in confined areas (such as garages or next to a building) any more than needed to move the machine or the equipment.

Keep the exhaust tailpipe area clear of snow and other material to help reduce the buildup of exhaust gases or the equipment. This is particularly important when parked in blizzard conditions.

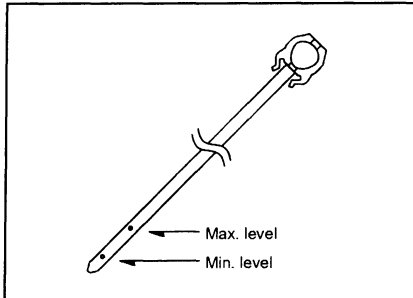
1. CHECK BEFORE OPERATION

WARNING: For Safety's sake, conduct the inspection before start-up with the engine stopped.

CAUTION: As the remote filter is used, the engine oil is filled above the specified level.
Adjust the engine oil level as required.



IMLE0009



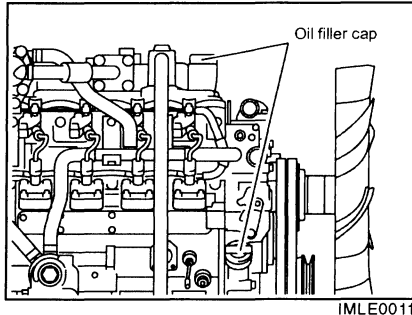
IMJJ0021

(1) Engine Oil Level

- 1) Place the engine on a level surface.
 - 2) Remove the dipstick from the crankcase, wipe it with clothing. Insert it fully and take out it gently again. Check the oil level by the level marks on the dipstick. The oil level must be between the "Max" level mark and the "Min" level mark as illustrated.
Take care not to add too much engine oil.
- Drain oil to the max. oil level if oil level is above the max. level mark.
 - Add oil to the max. oil level if oil level is below the min. level mark.

- 3) Also check the sample oil on the dipstick for fouling and degrees of viscosity.

CAUTION: *Oil level check must be made ten or twenty minutes later after the engine has been stopped. When the oil level check is necessary while the engine is running, stop the engine and keep it stationary ten or twenty minutes until the oil thoroughly flows down to the crankcase.*



- 4) Oil is poured either through the oil filler at the front of the cylinder head cover or through the oil filler on the right side of the timing gear case. A certain period of time is required before the engine oil completely flows down from the oil filler to the crankcase. Check the oil level ten or twenty minutes after oil replenishment.

CAUTION: *If the engine oil is splashed on the fan belt, it causes belt slippage or slackness; therefore, take care to avoid it.*

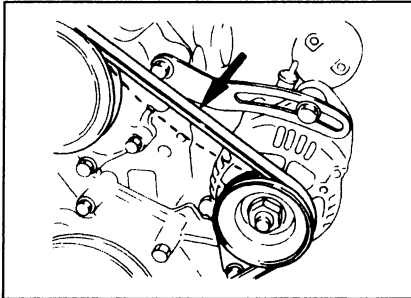
WARNING: 1. *In adding oil, take care not to spill it. If you spill oil on engine or equipment, wipe it properly, or this could lead to a fire and the risk of personal injury and/or equipment damage.*

2. *For model that employs the closed PCV, excessive oil may cause hunting in oil pressure, increase in the oil temperature, oil seepage from the intake system and engine oil intrusion into the combustion chamber, resulting in engine damage.*

(2) Fan Belt Check

Check the fan belt for tension and abnormalities.

WARNING: For the sake of safety, before conducting fan belt check, make sure that the engine is stopped and is not be operated during check.



IMLE0012

- 1) When the belt is depressed with the thumb (about 100 N (22 lb) pressure) at the midway between the alternator pulley and fan pulley, the belt tension is correct as the following:
Fan belt slackness : With one belt : 5.5 – 6.0 mm (0.21 – 0.23 in)
 With two belts : 7.5 – 8.5 mm (0.3 – 0.33 in)
When the belt tension is too high, it will result in alternator failure.
Contrarily, loose belt will cause belt slippage which may result in damaged belt and abnormal noise.
- 2) Check the belts. Replace them if any damage is found.

CAUTION: Replace all belts as a set even when one is not usable. Single belt of similar size must not be used as a substitute for a matched belt set. Otherwise, premature belt wear would result because of uneven belt length.

(3) Coolant Level Check

1) Without the reserve tank

Remove the radiator filler cap, and check the coolant level as well as the degrees of fouling.

Proper coolant level is about 10 mm higher from the radiator core top.

2) With the reserve tank

The coolant level must be between "FULL" and "LOW" marks on the reserve tank.

Check and see that the level is correct.

When the coolant level is lower than the "LOW" mark, replenish the reserve tank by the filler port, but when the reserve tank is empty, replenish by the radiator filler port.

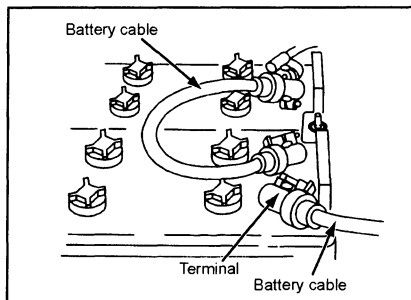
WARNING: *When removing the radiator filler cap while the engine is still hot, cover the cap with clothing, then turn it slowly to gradually release the internal steam pressure. This will prevent you from getting burnt with hot steam spouted out from the filler port.*

CAUTION: *Use Isuzu genuine anti-freeze (ethylene-glycol based) or equivalent with the specified mixing ratio.*

(4) Radiator Cap Condition

After the replenishment of the coolant, install the radiator cap.

Make sure the cap is securely installed.



IMWG0012

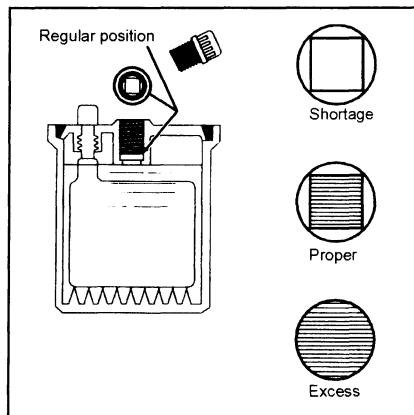
(5) Battery Cable Connection

Check the battery cable connections for looseness or corrosion.

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

The battery cables must be tightened securely.

CAUTION: *Never reverse "+" and "-" terminals when reconnecting cables after disconnection.
Even a short period of reverse connection will damage the electrical parts.*



IMWG0013

(6) Battery Electrolyte Level

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

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

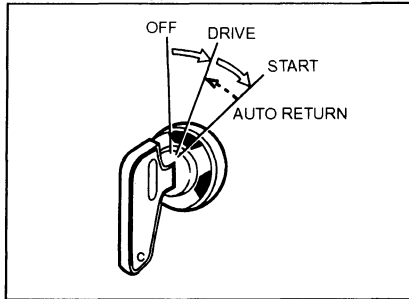
The battery electrolyte level checking procedure will vary with battery type. Follow the equipment manufacturer's instructions.

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

-
- WARNING:**
1. When inspecting the batteries, be sure to stop the engine.
 2. As diluted sulfuric acid is used as electrolyte, be careful not to stain your eyes, hands, clothes, and metals with the electrolyte. If it gets in your eye, wash with a large amount of water at once. Then go and see a doctor.
 3. As highly flammable hydrogen gas is rising from the batteries, do not make a spark or use fire in any other way near the batteries.
 4. When handling such metallic articles as a tool near the batteries, be sure not to contact $\oplus$ terminal. As the machine body is $\ominus$, it may cause a big danger.
 5. When disconnecting the terminals, start with $\ominus$ terminal. When connecting them, connect the $\ominus$ terminal last.

2. ENGINE STARTING

In case of the type with QOS system

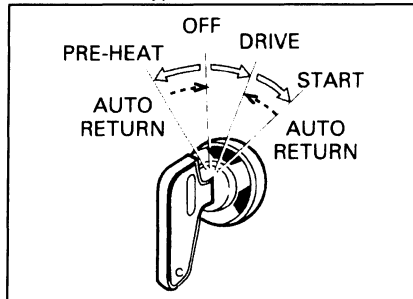


IMWG0014

(1) Pre-starting Preparation

- 1) Make sure that all hydraulic control levers etc. on the equipment are in the NEUTRAL position.
- 2) Set the engine stop knob in the START position. (It is unnecessary for the engine equipped with the engine shutdown switch.)
- 3) Switch ON the battery switch (if so equipped).
- 4) Insert the starter switch key into the switch key hole.
Turn the key clockwise to DRIVE position and, make sure that the meters and warning lamps are actuated.

In case of the type with control resistance



IMLE0041

(2) Pre-heating Procedures

As an engine starting aid, pre-heating is required in a cold engine starting.

The type with QOS system:

This pre-heating uses "QOS," a quick pre-heating system which automatically controls pre-heating time utilizing coolant temperature to conduct the irreducible minimum of pre-heating.

- 1) Turn the key to the DRIVE position, and the glow plugs built in the engine will grow red-hot to pre-heat the engine. At this time the pre-heating indicator lamp on the meterboard is actuated.
- 2) When the pre-heating indicator lamp goes out, try starting the engine at once.

Relationship between water temperature and pre-heating time (For ref.)

20°C (68°F) About 0.5 sec.

5°C (35°F) About 1.5 sec.

0°C (32°F) About 2 sec.

-15°C (5°F) About 6.3 sec.

The type with a control resistance

- 1) Turn the starter switch key counter-clockwise to PRE-HEAT position in order to heat the glow plugs on the engine.
The Pre-heating time of 5 seconds is required until the control resistance coil becomes red.
- 2) Turn the starter switch key clockwise to START position as soon as the control resistance coil red heat.

WARNING: *Make sure that there is no flammable near outlet port of exhaust gas at engine starting. It is very dangerous due to deformation, discoloration or a fire.*

(3) Engine Starting

- 1) Depress the engine throttle lever or throttle pedal and turn the starter switch key clockwise to START position.

The cranking period must not exceed ten seconds.

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

Release the starter switch after the engine starts.

The switch will return to the "DRIVE" position automatically.

For the engine equipped with a safety unit, the starter circuit is automatically turned off when the engine starts. This prevents the starter from overrunning.

If the engine cannot be started in one time attempt, keep the batteries and the starter stationary at least 30 seconds for their functional recovery, then repeat the pre-heating and the starting operations.

CAUTION: *Continuous re-engagement of the starter to the flywheel ring gear without giving them a break will result in the damaged starter pinion gear and flywheel ring gear.*

- 2) If, despite repeated operations, the engine does not start, wait for a minute or more until the functions of the batteries and starter are recovered and then repeat pre-heating and starting operations.

-
- 3) When repeating starting operation, return the key to the OFF position and then pre-heat and start the engine once again.
If the engine still remains unstarted, something may be wrong with the engine. Check the repeated parts to locate the cause.

CAUTION: *Do not use starting "aids" in the air intake system. Such aids can cause immediate engine damage.*

3. CHECK AND OPERATION AFTER THE ENGINE START-UP

(1) Warming-up Operation

Do the warming-up operation at 1000 min^{-1} about ten minutes after the engine has started.

As the lubrication for the entire engine systems will be done in this warming-up, do not speed up and load it abruptly.

Particularly, observe this in cold season operation.

(2) Check after the Engine Start-up

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

Engine oil pressure

Although the engine oil pressure gauge readings vary depending on ambient temperature, a type of oil or engine specification, the gauge registers around 390 to 690 kPa (57 to 100 psi) in the warming-up.

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

Charge condition

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

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

Engine noise and exhaust smoke color

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

Check the fuel combustion condition by exhaust smoke color.

The exhaust smoke color after engine warming-up and at no-load operation.

- { Colorless or light blue.... Normal (Perfect combustion)
- { Black color..... Abnormal (Imperfect combustion)
- { White color Abnormal (Oil coming up and coming down)

CAUTION: *Engine noise after start-up might be noisy than that of warmed-up engine and, the exhaust smoke color also being more whitish than the normal condition.
However, it will be normalized after warming-up engine.*

Leakage in the systems

CAUTION: *When checking, leaking liquid from engine may be splattered during engine operation. It may cause a burn. Approach the engine gradually from a long distance and then check it.*

Check the following items:

- Lube oil leakage

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

- Fuel leakage

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

- Coolant leakage

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

- Exhaust smoke or gas leakage.

Checking coolant level

The coolant level could drop depending on the equipment because the mixed air is expelled in about 5 minutes after the engine started.

Stop the engine, remove radiator cap, and add coolant.

WARNING: *Hot steam will rush out and you could get burnt, if the radiator cap is removed when the engine is hot.*

Cover the radiator cap with a thick cloth and loosen the cap slowly to reduce the pressure, then remove the cap.

4. CARE IN THE ENGINE OPERATION

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

(1) Engine Oil Pressure

Engine oil pressure is normal when the oil pressure gauge shows 290 to 590 kPa (43 to 85 psi) in the engine warmed-up condition.

In the continuous engine operation, engine oil pressure is slightly lower than the pressure at start-up time.

Also, make sure that the oil warning lamp is off.

If, in continuous engine operation, the engine oil pressure warning lamp is off, engine oil pressure is normal.

When the engine oil pressure gauge shows the following abnormal conditions, stop the engine immediately and check the engine oil amount in the oil sump and oil leakage:

- The engine oil pressure gauge shows below 200 kPa (28 psi) though the engine speed is raised.
- The oil pressure gauge indicator oscillates greatly in the engine low speed range.
- When the engine oil pressure warning lamp goes on and off repeatedly.

When not lack of engine oil or no oil leakage is found, contact your equipment supplier to determine the cause of the abnormal reading.

(2) Coolant Temperature

The engine performance will be adversely affected if engine coolant temperature is too hot or too cold.

The normal coolant temperature is 75 to 90°C (167 to 194°F).

Overheating

WARNING: *If the Engine Coolant Temperature Gage shows an overheat condition or you have other reason to suspect the engine may be overheating, continued operation of the engine (other than as spelled out here) even for a short period of time may result in a fire and the risk of personal injury and severe vehicle or equipment damage. Take immediate action as outlined following.*

If you see or hear escaping steam or have other reason to suspect there is a serious overheat condition, stop and park the machine or equipment as soon as it is safe to do so and then turn off the engine immediately and get out of the machine or equipment.

The engine cooling system may overheat if the engine coolant level is too low, if there is a sudden loss of engine coolant (such as hose splitting) or if other problems occur. It may also temporarily overheat during severe operating condition such as:

- Climbing a long hill on a hot day.
- Stopping after high rpm.

If the Engine Coolant Temperature gage shows an overheat condition, or you have reason to suspect the engine may be overheating, take the following step:

- If your air conditioner (if equipped) is on, turn it off. And turn on the heater.
- Don't turn off your engine.
- With the transmission in Neutral, increase the engine speed to about one-half full operating speed or 1200 RPM, maximum. Bring the idle speed back to normal after two or three minutes.

If the engine coolant temperature does not start to drop within a minute or two:

- Let the engine run at normal idle speed for two or three minutes.

If the engine coolant temperature does not start to drop, turn off the engine and get out of the machine or equipment then proceed as follows:

WARNING: *To help avoid being burned-*

- *Do not open the engine access cover if you see or hear steam or engine coolant escaping from the engine compartment. Wait until no steam or engine coolant can be seen or heard before opening the engine cover.*
- *Do not remove the radiator cap or engine coolant reserve tank cap if the engine coolant in the tank is boiling. Also do not remove the radiator cap while the engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if either cap is taken off too soon.*

If no steam or engine coolant can be seen or heard, open the engine access cover. If the engine coolant is boiling, wait until it stops before proceeding. Look at the see-through reserve tank. The engine coolant level should be between the "MAX" and "MIN" marks on the reserve tank. If necessary, pour engine coolant into the reserve tank only, never directly into the radiator. Also, do not check engine coolant level at the radiator.

Make sure the fan belts are not broken, or off the pulleys and that the fan turns when the engine is started.

If the engine coolant level in the reserve tank is low, look for leaks at the radiator hoses and connections, heater hoses and connections, radiator, and water pump. If you find major leaks, or spot other problems that may have caused the engine to overheat, do not run the engine until these problems have been corrected. If you do not find a leak or other problem, carefully add engine coolant to the reserve tank. (Engine coolant is a mixture of ethylene glycol antifreeze and water. See "Engine Care in cold season" in Section 6 for the proper antifreeze and mixture.)

WARNING: *To help avoid being burned, do not spill antifreeze or engine coolant on the exhaust system or hot engine parts. Under some conditions the ethylene glycol in engine coolant is combustible.*

If the engine coolant level in the reserve tank is at the correct level but there is still an indication on the instrument panel of an overheat condition:

- **YOU MUST LET ENGINE COOL FIRST.** You may then add engine coolant directly to the radiator.

Once the Engine Coolant Temperature Gage no longer signals an overheat condition, you can resume operating at a reduced speed. Return to normal operating after about ten minutes if the gage pointer does not again show an overheat condition.

If no cause for the overheat condition was found, see a qualified service technician.

Overcooling

The engine operation at low coolant temperature will not only increase the oil and fuel consumption but also will lead to premature parts wear which may result in engine failure.

(3) Engine Hourmeter (Engine Operation Hour Indicating)
(If so equipped)

This meter indicates the engine operation hours. Make sure that the meter is always working during engine operation.

Periodical engine maintenance is scheduled on the operation hours indicated on the hourmeter.

(4) Liquid and Exhaust Smoke Leakage

Be careful with lubricant, fuel, coolant and exhaust smoke leakage.

(5) Abnormal Engine Noise

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

(6) State of the Exhaust Smoke

Be careful with exhaust smoke color, check if it is whitish or blackish.

5. ENGINE STOPPING

- 1) Make sure that all of the control levers on the equipment are in NEUTRAL position.
- 2) Before stopping the engine, cool down the engine by operating it at low idle speed about three minutes.
In this operation, check the engine noise and the engine oil pressure for abnormalities.

CAUTION: *In the turbocharged engine, if the engine is stopped instantaneously, a dry condition produced by high temperature will take place in the turbocharger rotating parts which may cause lack of lubrication. This will result in turbocharger failure.*

- 3) To stop the engine, turn the starter switch key to OFF position. The engine stop solenoid automatically shut off the fuel to stop the engine. Switch off the battery (if so equipped).

CAUTION: *Leaving the starter switch key in the DRIVE position for a long while after the engine has been stopped, will discharge the batteries wastefully.*

6. OPERATION AND CARE FOR NEW ENGINE

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

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

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

7. ENGINE CARE FOR OVER-COOLING

Engine over-cooling cause premature wear and increased fuel consumption. When the coolant temperature is not raised to 75 to 90°C (167 to 194°F) indefinitely, take an action to recover this with means of radiator curtain or such like.

8. OPERATION AND CARE FOR TURBOCHARGED ENGINE

(1) Engine Starting

The warming-up operation of the engine should be done in the way separately described. In addition, ensure the bearings supporting the rotating parts of the turbocharger are sufficiently lubricated.

- 1) Do not race cold engine.
- 2) When starting the engine after a long period (more than one month) of standing, proceed as follows:

Pour engine oil into the turbocharger through the oil inlet port with the air intake duct and oil inlet side pipe removed. Then turn the impeller by hand to thoroughly lubricate the bearings.

- 3) When pouring oil in, do not allow dust particles and other foreign materials to enter through the opening.

On completion of this operation, securely install the oil pipe and air intake duct.

(2) Engine Stopping

Whenever stopping the engine, the last about 3 minutes of operation should be at idle. After hard operation, at least 5 minutes of operation should be at idle until the turbocharger cools down. This allows the turbocharger to return to idle speed while engine oil pressure is available for lubrication.

CAUTION: <i>Failure to cool down turbocharger at idle could result in insufficient lubrication of its bearings and their shortened life.</i>
--

9. STARTING THE ENGINE AFTER BEING LEFT UNUSED FOR A LONG PERIOD OF TIME

When the machine or equipment is left unused for "more than three months" without running the engine (warming up), conduct a thorough inspection of the machine before starting the engine.

Crank the engine for 10 seconds and then stop it for 30 seconds with the fuel cut. Repeat this procedure for three times. This sends the oil to each part.

After starting the engine, be sure to warm it up for more than ten minutes at 1000 min^{-1} .

5. PERIODICAL INSPECTION AND MAINTENANCE

1. LUBRICATING SYSTEM

WARNING: 1. *During inspection and service, a burn injury may occur due to hot engine body, coolant or engine oil. For the sake of safety, conduct service work after the engine is stopped and cools down sufficiently.*

2. *It is very dangerous to inspect and service the rotating parts. For the sake of safety, conduct service work after the engine is stopped. Also, make sure that it is not started during work.*

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

Change the engine oil and the oil filter element periodically with the specified ones. (Refer to 3.2. LUBRICANT.)

(1) Engine Oil and Oil Filter Element Change

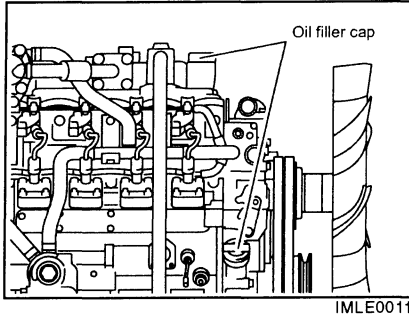
Engine oil change and oil filter element change must be made according to the following change schedule. For the engine equipped with the oil filter warning lamp, if the lamp comes on while driving, the filter element is clogged. Replace the element regardless of the change interval.

Change interval

Engine Oil Every 500 operating hours

Oil Filter Element Every 500 operating hours

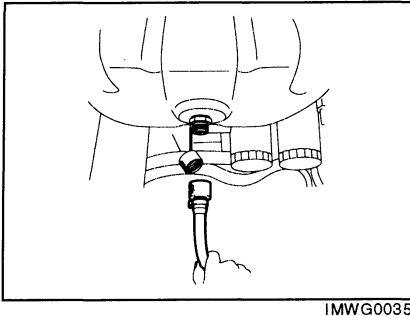
Engine oil draining

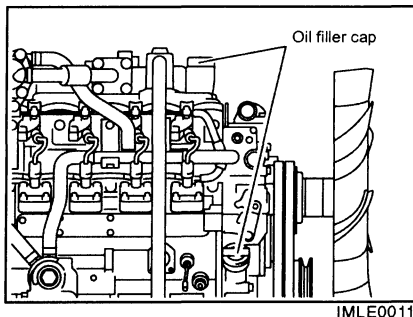


WARNING: To help avoid the damage of being burned, do not drain oil while the engine is still hot.

One-touch type

- 1) Wipe clean around the oil filler cap taking care so that no foreign particles entry. Remove the filler cap.
- 2) Loosen the cap of oil drain cock and remove it. Connect the oil drain hose to the oil drain cock and drain the oil.
- 3) After the completion of draining, disconnect the hose and wipe off the oil on the drain cock.
- 4) Turn the cap of oil drain cock slightly and settle it. From that position, turn more about 60 to 90 degrees.

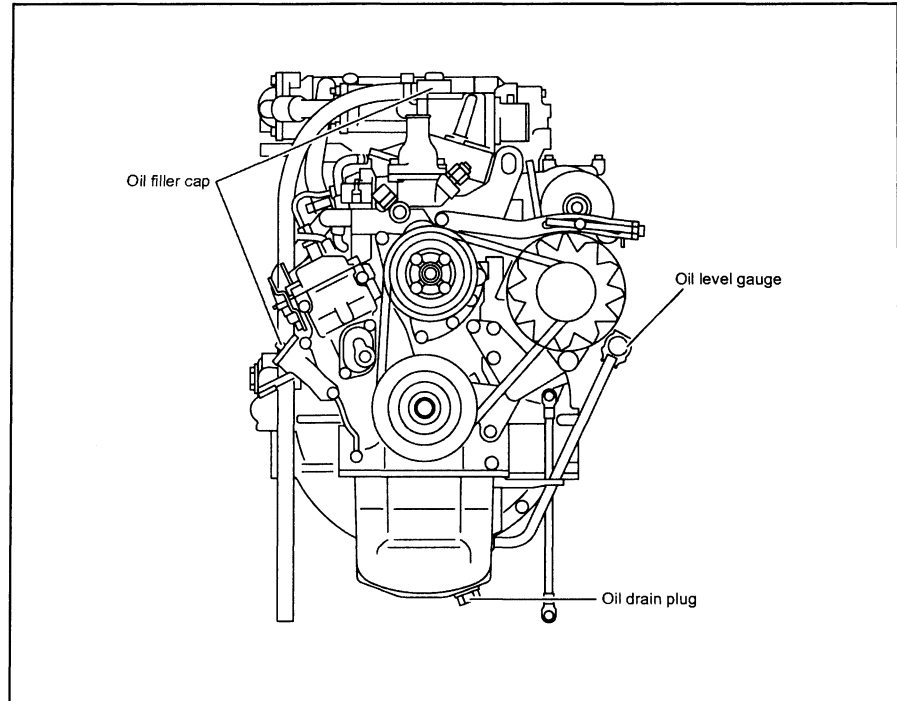




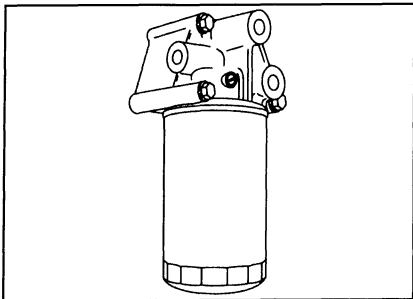
Drain plug type

- 1) Wipe clean around the oil filler cap taking care so that no foreign particles entry. Remove the filler cap.
- 2) Remove the drain plug by loosening it, and then drain oil.
- 3) After oil has been drained completely, replace the packing of the drain plug with a new one, and then install the plug.
- 4) Tighten the drain plug.
Torque (drain plug) : 78.4 Nm (8.0 kgm)

CAUTION: Use a receptacle to receive the drained oil so that the engine and equipment may not be stained with the drained oil.



IMLE0017



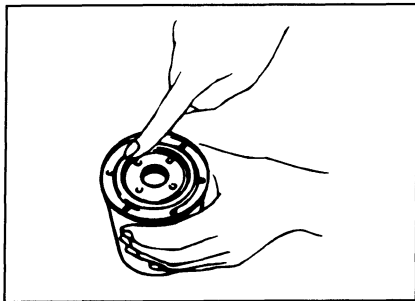
1MJJ0018

Oil filter element removal

Use a filter wrench to remove the cartridge type oil filter element.

There may remain the used engine oil in the cartridge, and care should be taken not to spill it when removing the filter.

Discard the used filter.



1MWG0034

Oil filter element installation

- 1) Apply lightly engine oil to the O-ring.
 - 2) Turn in new cartridge until its sealed face comes in contact with the O-ring.
 - 3) Use a filter wrench to further turn in the cartridge.
- Oil filter element tightening torque : 14.7 – 20.6 Nm (1.5 – 2.1 kgm)

Engine oil refilling

- 1) Disconnect the oil drain hose and reinstall the cap of drain cock. (One - touch type)
Install the drain plug. (Drain plug type)
- 2) Fill with new engine oil by the oil filler port.
Wait about fifteen minutes until the oil gets down to the oil pan.
Then check the oil level with a dipstick.
Do not insert the dipstick by force. The dipstick may be broken.

WARNING: 1. *In adding oil, take care not to spill it. If you spill oil, wipe it properly, or this could lead to a fire.*
2. *Do not leave any flammables such as cloth or gloves in the engine compartment. It may result in a fire.*

CAUTION: 1. *Prevent dust particles from entering through filler port at replenishment. Be careful, entry of dust particles may cause engine damage or accident.*
2. *Replenishment of oil above "Max" level or below "Min" level may cause engine damage or accident. Drain oil to the "Max" level if the oil level is above "Max" level. Also, replenish oil to the "Max" level if the oil level is below "Min" level.*

(2) Check after Oil and Filter Changes

The remote-type oil filter is used so that it takes time to pressure-feed oil to each part of engine after oil filter is changed. Idle approx. 30 seconds at the first start-up after oil filter is changed. Do not perform sudden loading or rapid acceleration. In addition, the time to pressure-feed oil can be shortened by filling engine oil into oil filter.

Oil leakage check

Idle the engine to raise the oil pressure, then check for oil leakage.

Oil level recheck

Stop the engine and keep it stationary about twenty minutes.

Use the dipstick to recheck the oil level.

Replenish with engine oil, if necessary, to the specified level.

CAUTION: *When the engine is started, the oil level will slightly drop from the initial level as the oil fully comes into the entire oil circuit.*

(3) Engine Oil Additives

Engine oils contain a variety of additives. Your engine should not need any extra additives if you use the recommended oil quality and change intervals.

(4) Used Oil Disposal

Do not dispose of used engine oil (or any other oil) in a careless manner such as pouring it on the ground, into sewers, or into streams or bodies of water. Instead, recycle it by taking it to a used oil collection facility which may be found in your community. If you have a problem disposing of your used oil, it is suggested that you contact your dealer or service station.

(This also applies to diesel fuel which is contaminated with water. See "Diesel Fuel" in Section 3.)

(5) Used Engine Oil

WARNING: *Used engine oil contains harmful contaminants that have caused skin cancer in laboratory animals. Avoid prolonged skin contact. Clean skin and nails thoroughly using soap and water - not mineral oil, fuels, or solvents. Launder or discard clothing, shoes or rags containing used engine oil.*

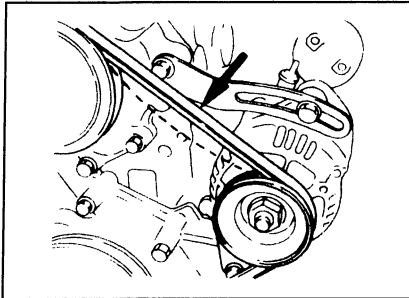
Discard used engine oil and other oils properly.

2. COOLING SYSTEM

(1) Fan Belt Tension Adjustment

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

WARNING: To help avoid being injury, check and adjust fan belt tension with engine stopped.



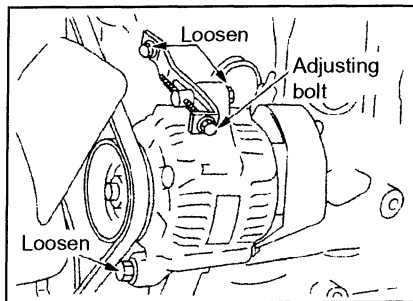
IMLE0012

Belt tension

Belt tension is normal when it is depressed with the thumb at the midway between the fan pulley and alternator pulley. (about 100 N (22 lb) depressing force.)

Fan belt slackness : With one belt : 5.5 – 6.0 mm (0.21 – 0.23 in)

With two belts : 7.5 – 8.5 mm (0.3 – 0.33 in)



Adjusting procedure

Belt tension adjustment is made by pivoting the alternator at the alternator mounting bolt.

- 1) Loosen the alternator adjusting plate bolt and the alternator mounting bolt.
- 2) Pivot the alternator at the mounting bolt by adjusting the adjusting bolt.
- 3) Tighten the mounting bolt and the adjusting bolt.

Mounting bolt tightening torque : 23.5 Nm (2.4 kgm) (24V-30A)

48.1 Nm (4.9 kgm) (24V-50A)

CAUTION: *Belt tension may vary slightly after the alternator is fixed.
Therefore, recheck the belt tension after tightening the bolts.*

- 4) After the adjustment, operate the engine about five minutes at a low idle speed and recheck the belt tension. Particularly, pay attention to this matter when installing new belts. Belt tension may vary due to the initial belt conforming.

(2) Fan Belt Change

Use of fan belt with poor quality will result in premature belt wear or belt elongation leading to engine damage such as overheating. Therefore use of the ISUZU genuine fan belts are highly recommended.

When you check the belt and find the following condition, replace the belt with new one.

- 1) No adjustment margin of the belt.
- 2) Abnormal wear, damages, or cracks on the belt.
- 3) Brake noise occurs while driving even if belt tension is adjusted.

(3) Coolant Change

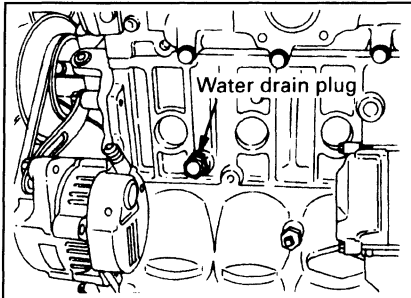
If oil is in coolant, contact "ISUZU Distributor" as soon as possible.

CAUTION: *The coolant must be changed at intervals of **six months**.
If the coolant is being fouled greatly, it will lead to engine
overheat or coolant blow-off from the radiator.*

Coolant draining

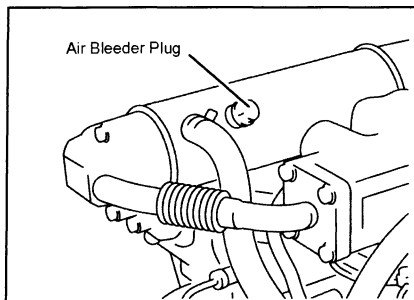
- 1) Remove the radiator cap.
Open the drain cock at the radiator lower part to drain the coolant in the radiator.

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



IMLE0021

- 2) Drain away the coolant from the engine by loosening the water drain plug at the rear of alternator on the left side of cylinder body.



IMLE0056

Filling with coolant

- 1) Close or tighten the coolant drain plug.
- 2) Fill up the radiator with the coolant until the level comes up to the filler port neck.

Fill gradually to prevent air entry.

Coolant volume (Engine only) :

Refer to "Main Data Specifications"

- 3) Loosen the air bleeder plug of the EGR cooler to bleed air from the EGR cooler.

- 4) Tighten the plug when the coolant spills over from the air bleeder plug.

CAUTION: 1. Take care to prevent the spilt coolant from getting the exhaust system parts wet.
2. If you spill coolant, wipe it properly, or this could lead to a fire.

Torque (Air bleeder plug) : 24.5 to 30.5 Nm (2.5 to 3.1 kgm)

-
- 5) Add coolant in the radiator and reservoir tank.
 - 6) With the coolant poured, operate the engine about five minutes at a low idle speed, then the air contained in the coolant circuit is bled. The coolant level will drop. Stop the engine to replenish with the coolant.

(4) Cleaning outside of Radiator

Mud or dried grass caught between radiator fins will block the air flow, resulting in lower cooling efficiency.

Clean the radiator fins with steam or compressed water.

For the cleaning interval, refer to the instruction manual prepared by the equipment manufacturer.

If the fins are stuffed, however, clean them at any time. Further, if the fins are deformed, repair or replace them.

(5) Cooling System Circuit Cleaning

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

Periodically clean the circuit interior with a cleaner.

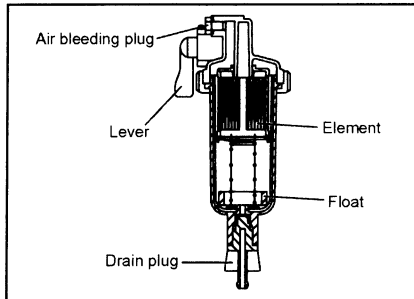
Cooling system cleaning interval : Every 1000 operation hours.

3. FUEL SYSTEM

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

In addition, clogged filter element can cause low output or automatic air bleeding failure.

Perform inspection and maintenance periodically as follows:



(1) Removal of Water from the Fuel

The water sedimenter is provided to separate the water contained in the fuel.

The sedimenter housing contains a float which moves up and down in accordance with level change of the separated water.

Be sure to drain the separated water when the float has come up to the element part.

Draining procedure:

With the water sedimenter lever positioned just above the fuel remains off, loosen the air bleeding plug at the top of the water sedimenter, and then loosen the drain plug at the bottom of the case to drain the separated water.

After draining, be sure to tighten the plugs and conduct air bleeding of fuel.

Be careful not to over-tighten the air bleeding plug.

Torque (Drain plug) : 1.0 to 2.0 Nm (0.1 to 0.2 kgm)

Torque (Air bleeding plug) : 7.9 to 11.7 Nm (0.8 to 1.2 kgm)

- CAUTION:**
1. If the cup is removed without turning the fuel filter lever just above, the fuel may flow out.
 2. The cartridge and cup contain fuel. Take care not to spill it during disassembly.
 3. Perform the "fuel system air bleeding" after the water in the fuel is drained.

(2) Fuel System Air Bleeding

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

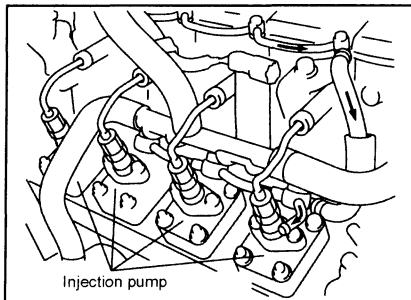
When once the servicing such as emptying the fuel tank, draining for the water sediment, and the fuel filter element change is done, be sure to conduct air bleeding.

Because of the "automatic air-bleeding system" being employed, turn the starter switch to the "Drive" position and activate the "electromagnetic pump" to bleed the air.

Air bleeding procedure:

- 1) When the "starter switch" is set to the "Drive" (ON) position to activate the electromagnetic pump, fuel is forcibly sent to the fuel valve of each injection pump and further to the leak-off pipe of each nozzle holder, where air in the fuel leaks off automatically to the fuel tank.
- 2) Start the engine and check the fuel system for leakage.

CAUTION: Start the engine and check the fuel system for leakage. Leakage causes a fire.



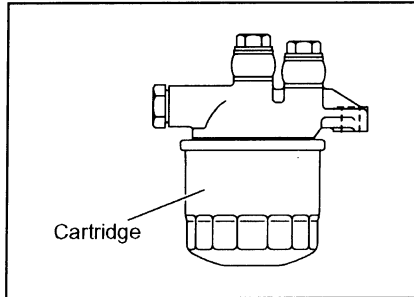
IMLE0022

(3) Fuel Filter Element Change

Change interval

Fuel filter element change interval: Every 500 operating hours

CAUTION: *The fuel filter element may be clogged faster depending on the amount of dust particles in the fuel. Therefore, the element may need to change more often than Change interval above. If the low engine output or engine stall is found, the change of fuel filter element may recover them.*



IMLE0058

Change procedure

- 1) Use a specified filter wrench to remove the cartridge.
- 2) Apply lightly fuel to the gasket of a new cartridge, and turn in the cartridge until its sealed face comes in contact with the O-ring. Then, tighten the cartridge to the correct tightening torque.
Torque (Cartridge) : 13.7 Nm (1.4 kgm)

(4) Water Sedimenter Element Cleaning

Cleaning interval

Fuel filter element cleaning interval : Every 500 operating hours

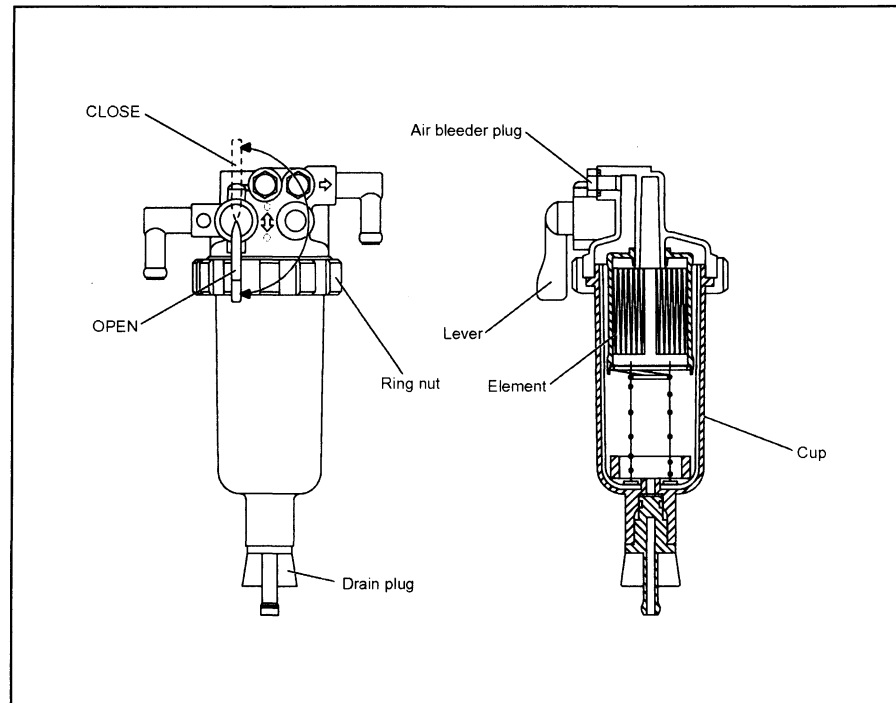
Cleaning procedure

- 1) Turn the water sedimenter lever to the closed position.

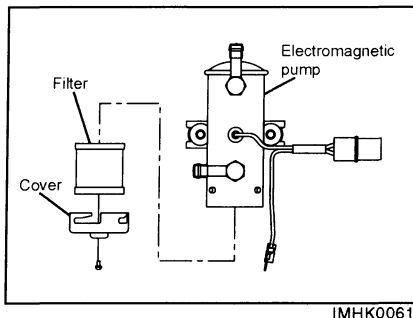
CAUTION: *If the cup is removed without turning the lever as instructed, the fuel may flow out.*

- 2) Loosen the ring nut, remove the cup, and take out the element.
- 3) Clean the cup and element, install new packing on the ring nut.
- 4) Tighten the cup to the body securely with the ring nut.
- 5) After installation, turn the water sedimenter lever to the open position.

CAUTION: *1. With the lever positioned just above the fuel remains off, and therefore, the engine cannot be started.
2. During removal, be careful not to stain the parts around with the fuel in the cup.
3. After changing fuel filter element, conduct fuel air bleeding.*



IMLE0059



(5) Filter Cleaning

Depending on the machine, the electromagnetic type fuel pump is equipped in this engine.

Clean the filter inside the pump at intervals of 500 operating hours.

- 1) Remove the "Wirings" attached on the pump cover, then turn the cover with your hands to detach it.

CAUTION: *In detaching the cover, place a tray to prevent the fuel contained in the pump from spilling over the engine. Also, make sure that there is no flammable near the fuel pump.*

- 2) Detach the filter element, clean it with the compressed air and rinse it in the fuel oil.

(6) Governor Control Seals

As the governor (timing gear case) is precisely adjusted, most of the controls are sealed, please do not break them. When the adjustment is necessary, contact with your machine supply source.

CAUTION: *The manufacturer does not warrant the claim on the engine with the broken governor seals.*

4. AIR INTAKE SYSTEM

(1) Air Cleaner

Engine performance and life vary with the air intake conditions.

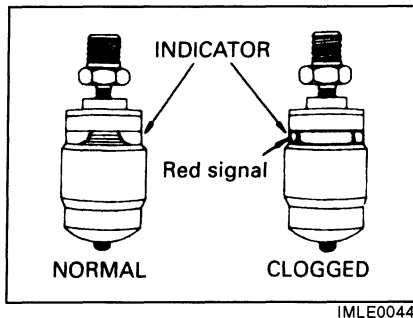
A dirty air cleaner element reduces the amount of intake air, causing reduced engine output or disordered engine.

Also, a damaged element leads to abrasion of cylinders and valves, resulting in increased oil consumption, reduced output and shortened engine life.

Handling of air cleaner varies with the equipment model.

Perform periodic inspection and maintenance following the equipment manufacturer's instructions.

- | |
|---|
| <p>CAUTION: 1. <i>Shorten the cleaning or change interval when the equipment is used in dusty areas.</i></p> <p>2. <i>Change the element, if element damage is found during air cleaner cleaning.</i></p> <p>3. <i>Take care not to cause air leakage (sucking) when reassembling the air cleaner.</i></p> |
|---|



(2) Air Cleaner with Dust Indicator

This indicator is attached to the air cleaner. When the air cleaner element is clogged, air intake resistance becomes greater and the dust indicator signal turns into red indicating the element change timing.

When the signal turns into red, clean the air cleaner or replace the element. Then press the dust indicator button to reset the indication.

5. ENGINE ELECTRICAL

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

CAUTION: 1. *Take care not to connect reversely the polarity of battery terminal. Reverse connection damage the electrical parts, causing a fire or accident.*

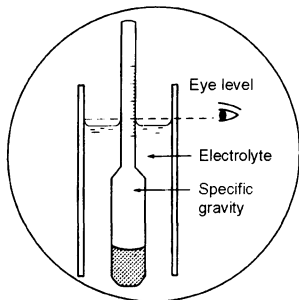
2. *When disconnecting the terminals, do the negative terminal first. When connecting the terminals, do the positive terminal first then negative terminal next.*

WARNING: 1. *When checking the battery and cables, be sure to stop the engine.*

2. *Dilute sulfuric acid is used as battery electrolyte. Be careful not to let your eyes, hands, skin, clothes or metals come in contact with it.*
If it gets on your eyes, hands or skin, wash with a large amount of water for five minutes at once. Then see a doctor for treatment.
If it gets on clothes or metal, wash with a large amount of water as well.

3. *Highly flammable hydrogen gas is generated from battery. Never make a spark or use fire near the batteries.*

4. *When handling such metallic articles as a tool near batteries, be sure not to contact positive terminal. As the machine body is negative, it may be very dangerous due to shorting causing a burn.*



IMWG0025

(1) Battery Servicing

Battery maintenance schedules will vary with equipment and battery types.

Follow the equipment manufacturer's instructions.

Gravity of the batteries

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

Periodically measure the electrolyte gravity of the batteries.

For the internal check follow the equipment manufacturer's standard.

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

Electrolyte Specific Gravity	Battery Conditions
Over 1.300	Over 100% (Over charged)
1.290 ~ 1.270	100%
1.260 ~ 1.240	75%
Below 1.230	Below 50% (Insufficiently charged)

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

Gravity conversion

The specified electrolyte temperature for the gravity measurement is 20°C (68°F).

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

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

S_{20} ; gravity at 20°C

S_t ; gravity measured

t ; electrolyte temperature when measured

Battery terminal connections

Periodically, check the battery terminals for loose connection and corrosion.

For the check interval, follow the machine manufacturer's standard. Loose connection will cause hard engine starting or deficient battery charging.

If the terminals are excessively corroded, disconnect the battery cables and polish them with a wire brush or sandpaper.

Never reverse the "+" and "-" terminals when reconnecting the cables. Even a short period of reverse connection could damage the electrical parts.

Cleaning of Battery

When the battery is fouled clean it with clean water or tepid water and wipe them with a dry cloth to remove the water.

Apply a light coat of vaseline or a grease to the battery post.

(2) Alternator Servicing

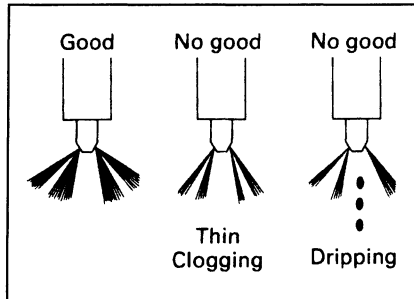
- 1) The polarity of the alternator is negative grounding type.
When an inverted circuit connection takes place, the circuit will be in short circuit instantaneously resulting the alternator failure.
- 2) Do not put water directly on the alternator. Entry of water into the alternator leads an electrolyte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

(3) Wiring Connections

Check all of the electric wiring connections for looseness and damage.

6. ENGINE ASSEMBLY AND OTHERS

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



IMLE0053

(1) Fuel Injection Nozzle

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

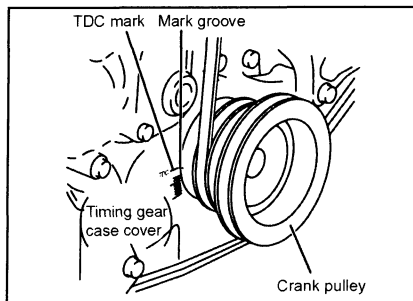
Injection nozzle pressure test interval : Every 1500 operation hours

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

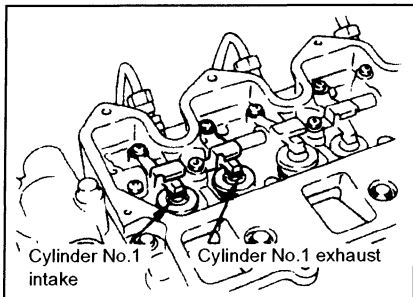
Injection starting pressure

Refer to the Engine Family Index.

WARNING: While using a nozzle tester, it may happen that high pressure blow off the fuel oil and injure the worker. Keep off the nozzle end.



IMLE0025



IMLE0026

(2) Valve Clearance Adjustment

The valve clearance must be adjusted **every 1000** operating hours, or whenever the tappet is abnormally noisy, or in an engine malfunction though the fuel system is properly working.

Valve clearance : 0.40 mm (0.0157 in) (When the engine is cold.)

The model 4LE2 engine has two types of the valve clearance adjusting method. Confirm the aligning marks (mark grooves) on the outside diameter of the crank pulley.

Type I method with an aligning mark on the outside diameter of the crank pulley.

Adjustment Procedure

- 1) Turn the crankshaft clockwise so that the mark groove on the crank pulley is aligned with the TDC mark (cast out) on the timing gear case cover.
- 2) Remove the cylinder head cover and check that the cylinder No. 1 is at TDC in the compression stroke or at TDC in the exhaust stroke. When the intake and exhaust valves are closed, the cylinder is at TDC in the compression stroke, and when the intake and exhaust valves are open, it is at TDC in the exhaust stroke.
- 3) In accordance with the conditions of cylinder No. 1, measure and adjust, if required the clearance of the valves marked with either ○ or ◎ in the table below.

Cylinder No.	1		2		3		4	
Valve arrangement	E	I	E	I	E	I	E	I
When No. 1 cylinder is at TDC in the compression stroke	○	○		○	○			
When No. 4 cylinder is at TDC in the compression stroke			⊙			⊙	⊙	⊙

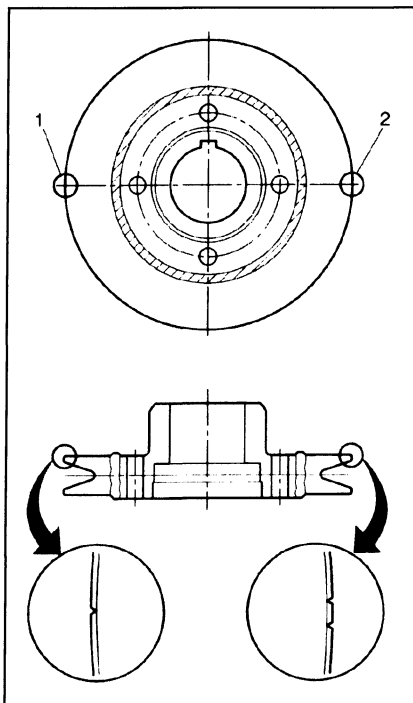
I: Intake E: Exhaust

- 4) On completion of the valve clearance adjustment in 3) above, make mark alignment as in 1) above by giving a turn to the crankshaft in normal direction.

Then measure and adjust the clearance of the other valves.

CAUTION: The rocker arm is made of die-cast aluminum. Therefore, be careful not to tighten the adjusting screw to excess.

Type II method with two aligning marks at point 180 degrees apart on the outside diameter of the crank pulley.



IMLE0027

Adjustment Procedure

- 1) Turn the crankshaft clockwise so that the TDC mark groove (1) on the crank pulley is aligned with the TDC mark (cast out) on the timing gear case cover.
- 2) Remove the cylinder head cover and check that the cylinder No. 1 is at TDC in the compression stroke or at TDC in the exhaust stroke. When the intake and exhaust valves are closed, the cylinder is at TDC in the compression stroke, and when the intake and exhaust valves are open, it is at TDC in the exhaust stroke.
- 3) Valve clearance is adjusted on 4 progressive steps as following.
 - Step 1: When the cylinder No. 1 is at TDC in the compression stroke, measure and adjust the valve clearance of the cylinder No. 1 marked with '○' in the table below.
 - Step 2: Turn the crankshaft clockwise 180 degrees from the step 1 condition to align the mark groove (2) with TDC mark on the timing gear case cover. Measure and adjust the valve clearance of the cylinder No. 3 marked with '○' in the table below.
 - Step 3: Turn the crankshaft clockwise 180 degrees from the step 2 condition to align the mark groove (1) with TDC mark on the timing gear case cover. Measure and adjust the valve clearance of the cylinder No. 4 marked with '○' in the table below.
 - Step 4: Turn the crankshaft clockwise 180 degrees from the step 3 condition to align the mark groove (2) with TDC mark on the timing gear case cover. Measure and adjust the valve clearance of the cylinder No. 2 marked with '○' in the table below.

Cylinder No.	1		2		3		4	
Valve arrangement	I	E	I	E	I	E	I	E
Step 1: Aligning mark groove (1) with TDC mark	○	○						
Step 2: Aligning mark groove (2) with TDC mark					○	○		
Step 3: Aligning mark groove (1) with TDC mark							○	○
Step 4: Aligning mark groove (2) with TDC mark			○	○				

I: Intake E: Exhaust

(3) Adjustment of Injection Timing

The injection timing may not be readjusted.

Take care not to forget to insert a shim on the mounting surface when reassembling the injection pump after it was removed.

(4) Cylinder Compression Pressure Measurement

The cylinder compression pressure measurement must be done **every 1000** operation hours, or whenever the engine output is reduced.

Compression pressure: 3.04 MPa (31.0 kg/cm² / 441 psi)

Test condition: Cranking speed 250 min⁻¹

Coolant temperature 70 – 85°C (158 – 185°F)

Repair the engine and/or replace some parts of engine if compression pressure is lower than 2.5 MPa (26 kg/cm² / 363 psi)

(5) Starter and Alternator Servicing

Do the starter and the alternator servicing **every 1000** operating hours on the following items.

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

(6) Radiator Pressurization Valve Check

A pressurization valve is incorporated in the radiator cap assembly. Check the valve actuating pressure with a radiator compression tester. For the pressurization valve actuating pressure and the check interval, follow the equipment manufacturer's standards.

6. ENGINE CARE IN COLD SEASON

1. FUEL

(1) Fuel Selection

In the cold zone, the fuel might be frozen resulting in hard engine starting; therefore, select a suitable fuel for such engine operation.

Use ASTM 975 No. 2-D fuel if you expect temperature above -7°C (20°F).

Use Number 1-D if you expect temperatures below -7°C (20°F).

If Number 1-D is not available, a "winterized" blend of 1-D and 2-D is available in some areas during the winter months.

Check with the service station operator to be sure you get the properly blended fuel.

2. COOLANT

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

A 50/50 Ethylene glycol base antifreeze/water mix.

(which provides protection to -37°C (-34°F) is recommended for use in these ISUZU diesel engines).

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

Never exceed a 60/40 antifreeze/water mix.

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

WARNING: *Under some conditions the ethylene glycol in the engine coolant is combustible. To help avoid being burned when adding engine coolant, do not spill it on the exhaust system or engine parts that may be hot. If there is any question, have this service performed by a qualified technician.*

CAUTION: *1. Methyl alcohol base antifreeze is not recommended because of its effect on the non-metallic components of the cooling system and because of its low boiling point.
2. High silicate antifreeze is not recommended because of causing serious silica gelation problems.
3. Usage and mixing ratio etc. should be followed to the antifreeze manufacturer's recommendations.*

3. ENGINE OIL

Engine oil viscosity largely affects engine startability, so the use of lubricant with selected viscosity according to the atmospheric temperature is important. (Refer to 3.2 LUBRICANT.)

At low atmospheric temperature, engine oil viscosity will increase to cause hard engine starting.

4. BATTERY

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

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

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

Pay attention to keep the batteries warm in the cold season.

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

CAUTION: <i>If the work is done after the engine has already been in an operation, the distilled water replenished will not be mixed with the original electrolyte, allowing the danger of freezing not mixed distilled water staying in the battery cell upper part.</i>

5. ENGINE STARTING

In cold engine starting at atmospheric temperature of below 0°C (32°F), pay attention to the following items:

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

CAUTION: Do not use starting "aids" in the air intake system. Such aids can cause immediate engine damage.
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7. ENGINE MAINTENANCE SCHEDULE

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

NO.	Description of check and maintenance	Daily	(operation hours)						Remark
			250	500	750	1000	1250	1500	
1.	Oil level and oil fouling	○							See "EXPLANATION OF MAINTENANCE SCHEDULE"
2.	Oil leakage check	○							
3.	Oil pressure gauge registration	○							
4.	Oil pressure warning lamp	○							
5.	Engine oil replacement			○		○		○	
6.	Oil filter element replacement			○		○		○	
7.	Fuel leakage check	○							
8.	Draining water in fuel filter	○							
9.	Fuel filter element replacement		○★	○	○★	○	○★	○	
10.	Water sedimenter element cleaning		○★	○	○★	○	○★	○	
11.	Electromagnetic pump filter cleaning		○★	○	○★	○	○★	○	
12.	Injection nozzle check (*)			○★		○★		○◎	

★ This is a recommended maintenance. The failure to perform this maintenance item will nullify the emission warranty or limit recall liability prior to the completion engine useful life. Isuzu, however, urges that recommended maintenance service is performed at the indicated intervals.

◎ This is a required maintenance. The failure to perform this maintenance item will nullify the emission warranty or limit recall liability prior to the completion engine useful life. Isuzu, however, urges that required maintenance service is performed at the indicated intervals.

NO.	Description of check and maintenance		Daily	(operation hours)						Remark
				250	500	750	1000	1250	1500	
13.	Coolant level and fouling check		○							See "EXPLANATION OF MAINTENANCE SCHEDULE"
14.	Coolant leakage check		○							
15.	Radiator filler cap fitting condition		○							
16.	Fan belt tension check (Replace if necessary.)		○							
17.	Coolant temperature registration		○							
18.	Coolant replacement									
19.	Intercooler and radiator external face cleaning									
20.	Cooling system circuit cleaning						○			
21.	Radiator filler cap function check (*)									
22.	Electrolyte level check		○							
23.	Battery cleaning		○							
24.	Battery charge condition	Ammeter registration	○							
		Charge warning lamp	○							

NO.	Description of check and maintenance	Daily	(operation hours)						Remark
			250	500	750	1000	1250	1500	
25.	Electrolyte gravity check								See "EXPLANATION OF MAINTENANCE SCHEDULE"
26.	Starter and alternator check and cleaning (*)					○			
27.	Wiring and connection check								
28.	Preheating condition check	○							
29.	Air cleaner element replacement								
30.	Engine starting conditions and noise conditions	○							
31.	Exhaust smoke condition	○							
32.	Cylinder compression pressure (*)					○			
33.	Valve clearance check (*)					○			
34.	Positive crankcase ventilation valve cleaning							○○	

◎ This is a required maintenance. The failure to perform this maintenance item will nullify the emission warranty or limit recall liability prior to the completion engine useful life. Isuzu, however, urges that required maintenance service is performed at the indicated intervals.

Note:

1. The service intervals after 1500 operation hours should also be made every 250 operation hours in accordance with this check and maintenance schedule.
2. When the servicing on the asterisked (*) items are necessary, consult the equipment supplier.

EXPLANATION OF MAINTENANCE SCHEDULE

The following is a brief explanation of the services listed in the preceding Engine Maintenance schedule.

1. **Oil level and oil fouling** Check that the oil level is between the max. level mark and the min. level mark.
Drain oil to the max. level mark if oil level is above the max. level mark. Add oil to the max. level mark if oil is below the min. level mark.
2. **Oil leakage check** Replace any damaged or malfunctioning parts which could cause leakage.
3. **Oil pressure gauge registration** Engine oil pressure is normal at about 290 to 590 kPa (43 to 85 psi) in warmed-up condition.
Check and repair the lubrication oil system, if it is abnormal.
4. **Oil pressure warning lamp** Warning lamp is off while engine running. If it stays on, check and repair the lubrication system.
5. **Engine oil replacement** Change oil every 500 hours.
6. **Oil filter element replacement** Change element every 500 hours.
7. **Fuel leakage check** Inspect the fuel lines for damage which could cause leakage. Replace any damaged or malfunctioning parts.
8. **Draining water in fuel filter** Drain water in fuel filter if water has collected in the fuel element.
9. **Fuel filter element replacement** Change element every 500 hours.
★ Shorten depending on fuel management.

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- | | |
|--|---|
| 10. Water sedimenter element cleaning | Clean the water sedimenter element every 500 hours.
★ Shorten depending on fuel management. |
| 11. Electromagnetic pump filter cleaning | Clean the electromagnetic pump filter every 500 hours.
★ Shorten depending on fuel management. |
| 12. Injection nozzle check | Clean the injection nozzle tips every 1500 hours. (This is a required maintenance)
Check injection opening pressure and spray condition. |
| 13. Coolant level and fouling check | Check coolant level and add coolant if necessary. |
| 14. Coolant leakage check | Repair part for coolant leakage. |
| 15. Radiator filler cap fitting condition | The radiator cap must be installed tightly. |
| 16. Fan belt tension check | Check and adjust fan belt deflection. Look for cracks, fraying and wear. |
| 17. Coolant temperature registration | Coolant temperature is normal at about 75 to 90°C (167 to 194°F). Check and repair the cooling system if coolant temperature is abnormal. |
| 18. Coolant replacement | Change coolant at intervals of 6 months or 12 months respectively if coolant is plain water, or long life coolant (LLC). |
| 19. Intercooler and radiator external face cleaning | According to the equipment manufacturer's specification. |
| 20. Cooling system circuit cleaning | Clean the cooling system circuit every 1000 hours. |

21. Radiator filler cap function check	Check radiator pressure cap periodically for proper operation according to the equipment manufacturer's specifications.
22. Electrolyte level check	Replenish with distilled water if necessary.
23. Battery cleaning	Clean the terminals.
24. Battery charge condition	Ammeter registration goes to plus (+) side while engine running. In the lamp type, the lamp is completely being off while engine running. Check charging circuit if the lamp is not off.
25. Electrolyte gravity check	Check according to the equipment manufacturer's specifications.
26. Starter and alternator check and cleaning	Check wear condition of brush and commutator.
27. Wiring and connection check	Check according to the equipment specifications.
28. Preheating condition check	Check preheating condition of the system.
29. Air cleaner element replacement	Change element according to the manufacturer's specifications.
30. Engine starting conditions and noise conditions	Check engine stability and noise.

-
- | | |
|--|---|
| 31. Exhaust smoke condition | Check exhaust smoke color. |
| 32. Cylinder compression pressure | Check every 1000 hours. |
| 33. Valve clearance check | Incorrect valve clearance will result in increased engine noise and lower engine output.
Thereby adversely affecting engine performance.
Check and adjust every 1000 hours. |
| 34. Positive crankcase ventilation valve cleaning | Perform the adjustment, cleaning, repair or replacement every 1500 hours.
(This is a required maintenance) |

8. SIMPLE ENGINE TROUBLESHOOTING

This item contains a simple troubleshooting. When a failure takes place on your ISUZU engine, diagnose the cause referring this troubleshooting. Should the cause of failure cannot be detected or you are unable to manage the failure consult to your machine supply source or nearest ISUZU engine service outlet.

Symptom		Cause	Action
Engine does not start.	Starter does not turn.	Battery discharged.	Charge or change.
		Imperfect cable connections.	⊙
		Starter or starter switch failure.	⊙
		Safety relay failure.	
	Starter turns but engine dose not ignite.	Engine stop solenoid return failure.	⊙
		No fuel in the fuel tank.	Make sure that there is no fuel leakage and replenish.
		Clogged fuel filter element.	Remove water and change element.
		Air in the fuel system.	Bleed air.
		Control rack is stuck at no fuel position.	⊙
		Unproper preheating operation.	⊙
		Glow plug malfunction.	⊙
Engine ignite but stall immediately.	Air in the fuel system.	Bleed air.	
	Improper low idling speed adjustment.	⊙	
	EGR valve fixing. (Open position.)	⊙	

Symptom	Cause	Action
Unstable engine running.	Crack in injection pipe.	⊙
	Injection nozzle failure.	⊙
	Engine stop solenoid return failure.	⊙
	Uneven compression pressure between cylinders.	⊙
	Incorrect control lever adjustment.	⊙
	Governor interior malfunction.	⊙
	Governor spring deteriorated.	⊙
	Air in the fuel system.	Bleed air.
	Clogged fuel filter element.	Remove water and change element.
	Piping failure (squeezed, etc.) in the fuel system.	⊙
	Uneven fuel injection amount between plungers.	⊙
	Incorrect valve clearance adjustment.	Make a readjustment.
	Deteriorated valve spring.	Change valve spring.
	Engine control restriction or seizure.	⊙
Engine overheat.	Insufficient coolant amount.	Replenish.
	Fan belt slippage.	Make an adjustment.
	Thermostat malfunction.	Change thermostat.
	Radiator filler cap malfunction.	Change radiator filler cap.
	Cooling system interior fouled.	Clean cooling system interior.

Symptom	Cause	Action
Engine overheat.	Radiator clogging.	Clean with soft brush.
	Engine over-loaded.	Check your driving.
	Air cleaner element clogging.	Clean or change element.
	Insufficient ventilator.	
	Stopped coolant flow (high concentration of antifreezer, etc.).	Clean inside of radiator and change coolant.
Low oil pressure.	Oil leakage.	⊙
	Large oil consumption.	⊙
	Wrong selection of kind and viscosity.	Change with oil of correct viscosity.
	Over heat	Stop vehicle operation, and reduce engine rotation to 1000 revolutions for cooling drive for five minutes, and stop engine.
	Clogged filter and strainer.	⊙
	Worn bearings and oil pump.	⊙
	Faulty relief valve.	⊙
Lack engine output.	Too advance of injection timing.	⊙
	Too retard of injection timing.	⊙
	Incorrect injection pressure adjustment.	⊙
	Incorrect spray condition.	⊙
	Lack of fuel in tank.	Make sure that there is no fuel leakage and replenish.

Symptom		Cause	Action
Lack engine output.		Air mixing in injection pump.	Bleed air.
		Fuel filter clogged.	Change element.
		Overflow valve malfunction.	☉
		Incorrect engine control adjustment.	☉
		Deteriorated governor spring.	☉
		Incorrect valve clearance adjustment.	Make a readjustment.
		Nozzle holder misalignment.	☉
		Cylinder bore wear.	☉
		Air cleaner clogging.	Clean element.
		Such as inferior ventilation.	Check engine condition. Ventilate and improve it.
At low speed, insufficient torque.		EGR valve fixing. (Open position.)	☉
Excessive oil consumption.	Improper oil.	Wrong selection of kind of viscosity.	Change with oil of correct viscosity.
		Too much oil quantity.	☉
	Oil coming up.	Wrong selection of cylinder liner and piston ring.	☉
	Oil coming down.	Faulty valve stem seal.	☉
	Oil leakage.	Damaged packing.	Change packing.
		Improper tightening.	Retighten oil filler cap.
		Improper installation of filter and piping.	Reinstall filter and piping.

Symptom		Cause	Action
Excessive fuel consumption.	Fuel leakage.	Damaged packing.	Change packing.
		Improper installation or tightening.	Reinstall or retighten air bleeder plug.
	Too much injection amount.	Injection pump misadjustment.	⊙
	Excessive mechanical loads.		
Improper exhaust.	Much black smoke.	Clogged air cleaner.	Clean or change element.
		Nozzle damage.	⊙
		Nozzle misadjustment.	Make a readjustment.
		Injection timing failure.	⊙
		Injection amount misadjustment.	⊙
		Improper fuel.	Use fuel in this instruction manual.
		EGR valve fixing. (Open position.)	⊙
	Much white smoke.	Oil coming up or down.	Change oil.
		Water mixing in fuel.	Remove water.
		Low compression pressure.	⊙
		Injection timing failure.	⊙
		Low coolant temperature.	Inspect or change thermostat.
Battery overdischarge.	Low electrolyte level.	Crack in battery body.	Change battery.
		Natural consumption.	Change battery.

Symptom		Cause	Action
Battery overdischarge.	Charging failure.	Loose or damaged belt.	Retighten or change belt.
		Faulty alternator.	Change alternator.
		Damaged wiring or contact failure.	Make an adjustment.
		Low speed driving.	Charge or change.
	Excessive electrical loads.	Insufficient battery capacity.	Reduce electrical load or change battery capacity.

2. INFORMATION GENERALE

1. CARACTERISTIQUES TECHNIQUES ET DONNEES DU MOTEUR CARTIFIE EPA ET CARB

(1) Modèle AU-4LE2X

Désignation du modèle du moteur ISUZU	AU-4LE2X
Famille de moteur	*SZXL02.2XXX
Code de moteur	4LE2XXXXX-XX
Type de moteur	Type de soupape en tête en ligne, quatre temps, à refroidissement à eau.
Type de combustion	Injection directe
No. de cylindres – alésage × course mm(in)	4 – 85 × 96 (3,35 × 3,78)
Cylindrée du moteur L(cid)	2,179 (133)
Rapport de compression	18,3 to 1
Séquence d'allumage	1 – 3 – 4 – 2
Puissance nominale: SAE NET kW(cv)/min ⁻¹	40,5 (54,3) / 2000
Débit de combustible au couple max. (mm ³ /course)	31,4
Système de commande d'émission d'échappement	EM, DFI, TC, EGR
Pompe à injection	Type PFR, Bosch
Régulateur	Type mécanique, vitesse variable

* Marque ; Placer un code de lettres pour l'année du modèle sur la partie supérieure des lattes.

Année du modèle Y : 2000, 1 : 2001, 2 : 2002, 3 : 2003, 4 : 2004, 5 : 2005, 6 : 2006, 7 : 2007, 8 : 2008

Le code du moteur varie selon chaque moteur.

Désignation du modèle du moteur ISUZU			AU-4LE2X	
Buses à injection			Type à orifices multiples	
Combustible spécifié			Combustible Diesel (ASTM D975 No.2-D)	
Démarreur		(V-kW)	24 – 3.2	
Alternateur		(V-A)	24 – 30	24 – 50
Huile moteur spécifiée (API grade)			Référez-vous à 3. LUBRIFIANT, choix D'Huile à moteur.	
Volume d'huile de lubrification		L(qts)	9,3 (9,8) – 12,1 (12,9)	
Volume du liquide de refroidissement (seulement moteur)		L(qts)	4,3 (4,5)	
Poids à sec du moteur		kg(lb)	210 (463)	
Dimensions du moteur	Longueur hors-tout	mm(in)	756,3 (29,8)	
	Largeur hors-tout	mm(in)	557 (21,9)	
	Hauteur hors-tout	mm(in)	747,3 (29,4)	
Jeu de soupape (à froid)		mm(in)	0,4 (0,0157)	
Pression d'injection d'injecteur		MPa(psi)	16,7 / 25,0 (2420 / 3625)	
Calage d'injection B.T.D.C.			2°	
Fabricant et type de turbochargeur			IHI, RHF-3	

(2) Famille indice de moteur

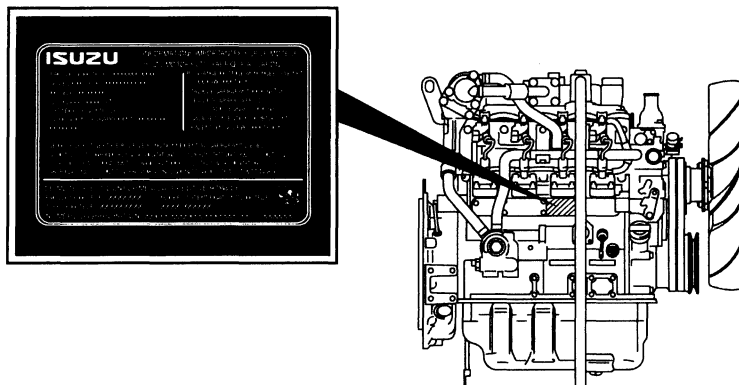
Moteur	Famille de moteur	Code de moteur	Pression d'injection d'injecteur MPa(psi)	Catage d'injection B.T.D.C. (degre)
4LE2X	8SZXL02.2UXA	Tout	—	—
4LE2	8SZXL02.2VNB	Tout	—	—

ETIQUETTE DE COMMANDE D'EMISSION : ETIQUETTE DU MOTEUR (TYPE COMBINÉ EPA, CE)

L'étiquette de commande d'émission est fixée au centre du couvercle de la pompe d'injection situé sur la droite du corps du cylindre, ou sur le couvercle de la culasse. L'emplacement de l'étiquette de commande d'émission fixée au moteur peut varier selon les spécifications du moteur.

Voici-ci après un échantillon requis pour les informations concernant la commande d'émission du moteur, ensemble avec son emplacement.

Ces étiquettes sont traduites de l'anglais en français.



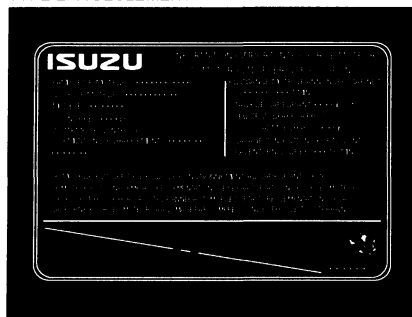
IMLE0054

ETIQUETTE DE COMMANDE D' EMISSION : ETIQUETTE DU MOTEUR

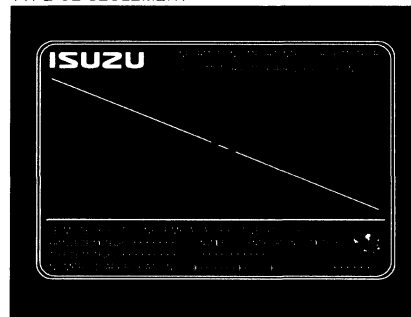
L'étiquette de commande d'émission est fixé sur un emplacement visible de l'équipement.

Ces étiquettes sont traduites de l'anglais en français.

TYPE EPA SEULEMENT



TYPE CE SEULEMENT



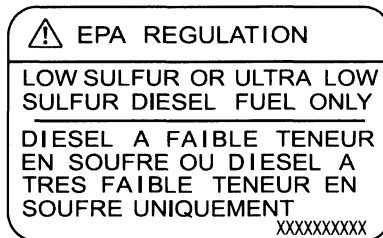
IMLE0052

ETIQUETTE DE RESTRICTION DE TYPE DE CARBURANT UTILISE (POUR EPA)

L'étiquette de restriction du type de carburant utilisé se trouve sur le goulot de remplissage du réservoir de carburant.

Contenu de l'étiquette:

DIESEL A FAIBLE TENEUR EN SOUFRE OU DIESEL A TRES FAIBLE TENEUR EN SOUFRE UNIQUEMENT



IMLE0066

ISUZU

IDE-6250

Service Record

MAC 400FHC Air Heater

DATE	HOURS	SERVICE PERFORMED	PERFORMED BY	NOTES



MAC 400FHC Air Heater

[illegible]

Notes

MAC 400FHC Air Heater

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

Notes

MAC 400FHC Air Heater

[illegible]

Isuzu engine break-in oil change intervals

- 50 Hour break-in (NO EXCEPTIONS)
 - Engine oil
 - Engine oil filter
 - Engine fuel filter
- 250 Hour regular interval
 - Engine fuel filter
 - Engine air filter
- 500 Hour regular interval
 - Engine oil
 - Engine oil filter
- 1000 Hour regular interval
 - Hydraulic fluid - Capacity 20.5 Gallons (77.6 Liters)
 - Hydraulic filters
- Annual Change
 - Hydraulic breather/separator
 - Carbon Monoxide (CO) test at outlet air duct by trained service technician
 - Blower/fan hardware for condition and tightness

Daily operational check

- Tire Check
- Lug nut check
- Lights
- Condition of warning decals
- Suspension components
- Axle bearings
- Engine coolant
- Fuses
- Visual inspection of hydraulic hoses



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