DAEWOO

65.99892-8003

Operation Manual

GENERATOR DIESEL ENGINE

DB33, P034Ti

GENERAL INFORMATION

DB33/ P034Ti Generator diesel engines which have been developed by the accumulated techniques of DAEWOO Heavy Industries R & D Center are the excellent engines in the respects of high performance, low emission, long life-time and high reliability. They are designed to be adapted to various generator systems.

This instruction describes the essential details in the operation, the usual inspection and the maintenance of DB33 / P034Ti generator diesel engine.

In order to operate the engine in the optimal conditions and to maintain its best performances, the contents in this instruction are to be thoroughly understood and observed.

All warranty claims to be addressed to;

Engine Export Team,
DAEWOO Heavy Industries LTD.
DAEWOO Center 541
Namdaemunro 5-ga, Chung-gu
Seoul, Korea
TEL.: (82-2-726-3205~8), FAX: (82-2-726-3168)

OR to your local DEALER or DISTRIBUTOR.

DAEWOO Heavy Industries LTD.
April. 1999

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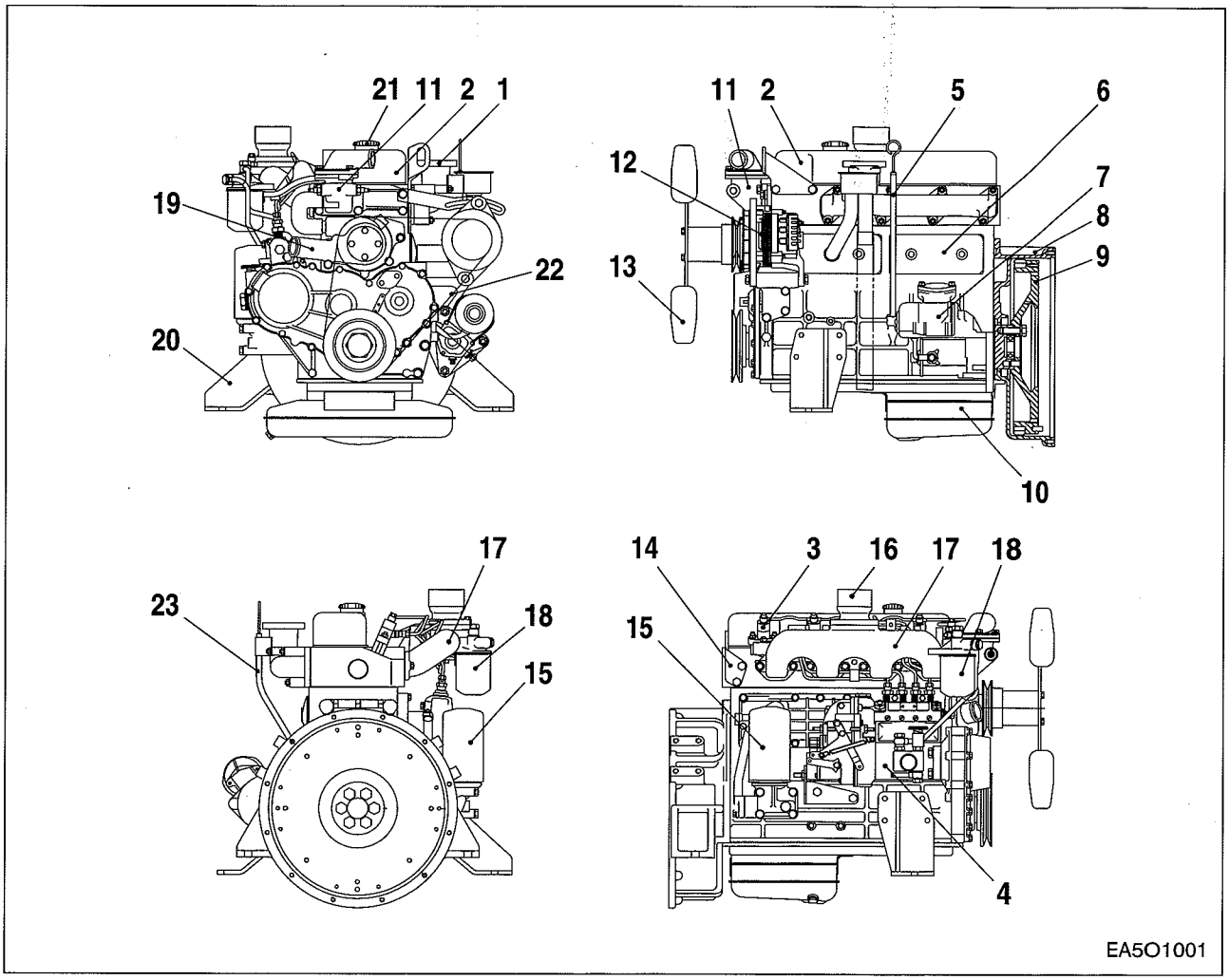
1.1. Engine Assembly

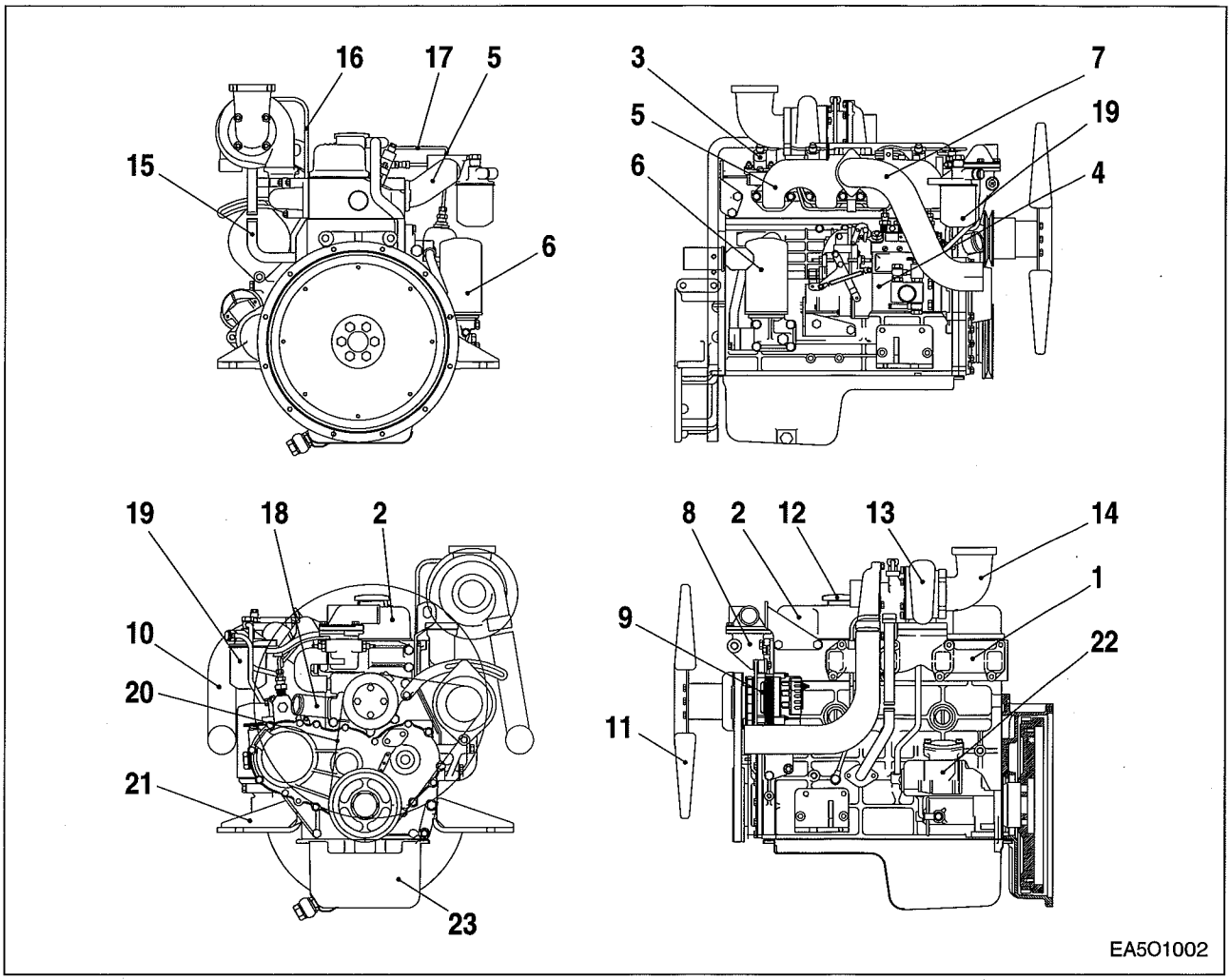
1.1.1. DB33



<Disassembly steps>

- ▲ 1. Exhaust manifold assembly
- ▲ 2. Cylinder head cover
- ▲ 3. Injection nozzle
- ▲ 4. Injection pump assembly
- 5. Oil level gauge
- 6. Push rod chamber cover
- 7. Starting Motor assembly
- 8. Flywheel housing
- 9. Flywheel
- 10. Oil pump assembly
- 11. Thermostat housing assembly
- 12. Alternator assembly
- 13. Cooling fan
- 14. Lifting hook
- 15. Oil filter assembly
- 16. Intake stake
- 17. Intake manifold assembly
- 18. Fuel filter assembly
- 19. Water pump assembly
- 20. Mounting bracket assembly
- 21. Oil filler cap
- 22. V-belt
- 23. Oil level gauge

1.1.2. P034Ti



<Disassembly steps>

- ▲ 1. Exhaust manifold assembly
- ▲ 2. Cylinder head cover
- ▲ 3. Injection nozzle
- ▲ 4. Injection pump assembly
- 5. Intake manifold assembly
- 6. Oil filter assembly
- 7. Air pipe assembly(from intercooler ass'y)
- 8. Thermostat housing assembly
- 9. Alternator assembly
- 10. Air pipe assembly(to intercooler ass'y)
- 11. Cooling fan
- 12. Oil filler cap
- 13. Turbocharger assembly
- 14. Exhaust elbow
- 15. Oil return pipe
- 16. Oil delivery pipe
- 17. Fuel return pipe
- 18. Water pump assembly
- 19. Fuel filter assembly
- 20. V-belt
- 21. Mounting bracket
- 22. Starting Motor assembly
- 23. Oil pan assembly

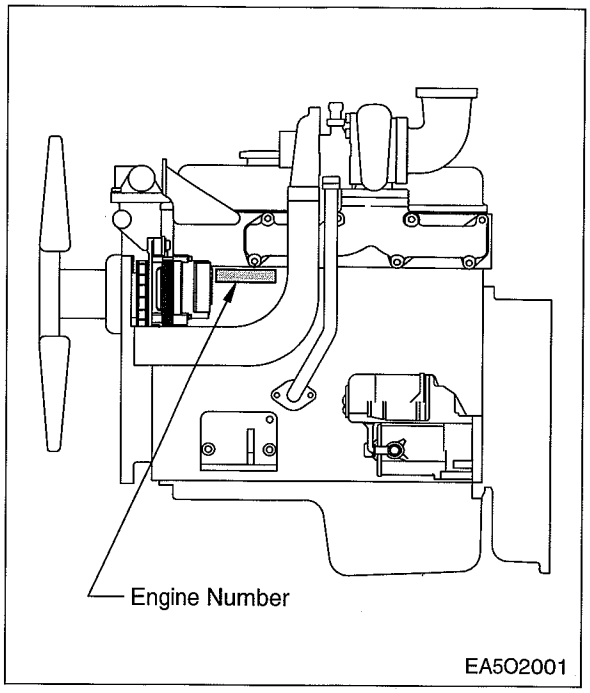
1.2. Specification

Items \ Engine Model		DB33		P034Ti (DB33TiB)	
Engine type		Water-cooled, 4 cycle in-line		← Turbo charged & intercooled	
Combustion chamber type		Direct injection type			
Cylinder liner type		Dry type, chromated or casting liner			
Timing gear system		Gear driven type			
No. of piston ring		Compression ring 2, oil ring 1			
No. of cylinder-bore X stroke (mm)		4 - 102 X 100			
Total piston displacement (cc)		3,268			
Compression ratio		17.5 : 1		17.2 : 1	
Engine dimension(length X width X height) (mm)		870 X 705 X 723		847.5 X 728 X 832	
Engine weight (kg)		310		335	
Fuel injection order		1 - 3 - 4 - 2			
Fuel injection timing (B.T.D.C static)		18°		13°	
Injection pump type		Zexel in-line A type			
Governor type		Mechanical governor RSV type			
Injection nozzle type		Multi-hole type (5 hole)			
Fuel injection pressure (kg/cm^2)		220			
Compression pressure (kg/cm^2)		28 (at 200 rpm)			
Power (ISO 3046)	CONDITION	60Hz (1,800rpm)	50Hz (1,500rpm)	60Hz (1,800rpm)	50Hz (1,500rpm)
	Continuous	-	-	69PS (51kW)	48PS (35kW)
	Prime	43PS (32kW)	35PS (26kW)	75PS (55kW)	57PS (42kW)
	Stand by	47PS (35kW)	39PS (29kW)	82PS (60kW)	65PS (48kW)
Intake and exhaust valve clearance(at cold) (mm)		0.4			
Intake valve	Open at	28° (B.T.D.C)			
	Close at	62° (A.B.D.C)			
Exhaust valve	Open at	70° (B.B.D.C)			
	Close at	28° (A.T.D.C)			
Lubrication method		Pressurized circulation			
Oil pump type		Gear type			
Oil filter type		Full-flow, cartridge type			
Lubricating oil capacity(max./min.) (lit)		7.5/ 6.5		6.5/ 5.5	
Oil cooler type		Water cooled			
Water pump		Belt driven impeller type			
Cooling Method		Pressurized circulation			
Cooling water capacity(engine only) (lit)		8.5			
Thermostat type		Wax pallet type (82 ~ 95 °C)			
Alternator voltage - capacity (V - A)		24 - 45			

* All data are based on operation without cooling fan at ISO 3046.

2. Engine Model and Serial Number

The engine model and serial number is located on the engine as illustrated. These numbers are required when requesting warranty and ordering parts. They are also referred to as engine model and serial number because of their location.



- **Engine serial No.(example 1)**

DB33900001 GA

- Suffix
- Serial No.
- Year
- Engine Model

- **Engine serial No.(example 2)**

P034Ti900001 GA

- Suffix
- Serial No.
- Year
- Engine Model

3. Operation

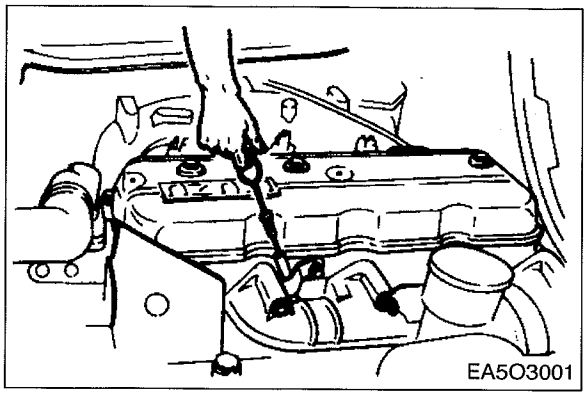
3.1. Inspection before Operation

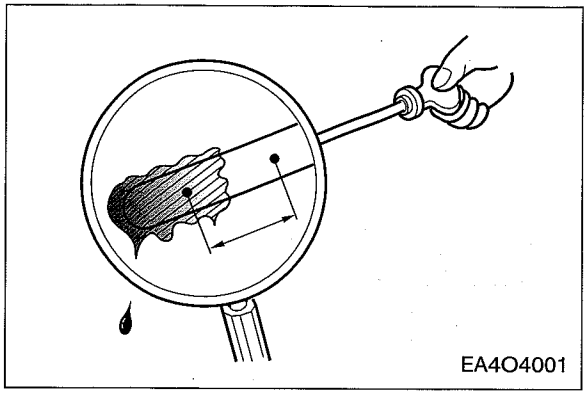
3.1.1. Lubricating oil

a). The notches in dipstick must indicate the oil level between the max. and the min. permissible.

b) The measurement of the oil level must be done on a even water line.

c) Examining the viscosity and the contamination of the oil smeared at the dipstick replace the engine oil if necessary.

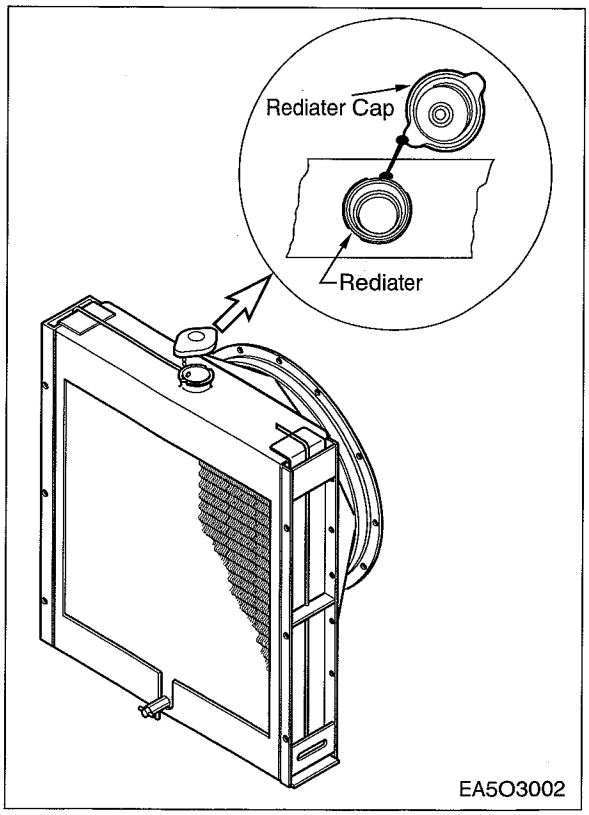




3.1.2. Cooling water

Checking the level of the cooling water in radiator.

Note : Because it is dangerous to open the radiator cap quickly when coolant is hot, after lowering the inside pressure of the radiator by slow-opening at first open it fully.



3.1.3. Starting

For engine starting, please confer the instruction.

Note : 1. Preheating devices ard attached to the engine for improving the starting abilities at extremely low temperature.

2. Do not actuate the starter for longer than 10 seconds. If starting fails regardless of the preheating, start the preheating again after 30 seconds.

1) Pre-heating system

Operation 1: Turn the key switch to the HEAT position, then the pilot lamp lights up for about 15 seconds When the pilot lamp is extinguished, do operation 2

Behavior - When the coolant temperature is below 10 °C in cold weather, you'd better operate the pre-heating system (Glow plug)

- If the pre-heating is not necessary, the pre-heating system is not operated with the pilot lamp.

Operation 2: After checking the pilot lamp, turn the key switch to the START position to crank the engine, at once.

Behavior - When the key switch is placed in the START position, glow plug is continuously heated to facilitate starting operation and to reduce white smoke during 15 seconds automatically.

- If the coolant temperature is above 10 °C, glow plug needs not be heated.

Operation 3: After the engine is cranked, convert the key switch to the ON position.

Behavior - As the engine is cranked, glow plug is heated for 20 seconds (after-heating) to reduce and to element quickly white smoke.

2) Audible Alarm

The generator gauge panel for DB33/ P034Ti is equipped with an audible alarm to alert the operator to the following:

* Low engine oil pressure
* Engine coolant overheat

The alarm horn will sound when the ignition is turned on and continue to sound until the engine is started and minimum oil pressure is obtained. This provides a functional test of warning system.

Should engine coolant overheat occur, the alarm horn will sound and the engine is stopped by stop solenoid at the same time automatically. Proceed as follows:

First, quickly observe the coolant temperature gauge for engine coolant overheat and/or needle oscillation indicating low coolant. If the temperature gauge indicates engine coolant overheat, throttle back to idle speed IMMEDIATELY and cut off the main circuit breaker of the generator control panel. Do not restart engine until cause for the alarm has been found and corrected. Refer to "Insufficient output" in Trouble Shooting Chart. If the coolant temperature gauge indicates low coolant, add some amount of required coolant to fill radiator. If cause for the alarm cannot be found, contact your DAEWOO dealer.

3.2. Starting and Operation

3.2.1. Operation of a new engine (Break-In)

Because the sliding surfaces of a new engine are not lapped enough, the oil film can be destroyed easily by overload or overspeed and the engine life-time may be shortened. Therefore the following things must be obeyed by all means.

Up to the first 2,000km(150 hours)

- ▲ Engine should be run at fast idling until the temperature of the engine becomes normal operating condition.
- ▲ Overload or continuous high speed operation should be avoided.
- ▲ High speed operation with no load should be prevented.
- ▲ Abrupt start and stop of the engine should be avoided.
- ▲ Engine speed must be under 70% of its maximum speed.
- ▲ Maintenance and inspection must be accomplished thoroughly.

3.2.2. Check points for break-in

During the break-in (the initial running of the engine) period, be particularly observant as follows:

1) engine oil level frequently. Maintain oil level in the safe range, between the "min." and "max." marks on dipstick.

   Note : If you have a problem getting a good oil level reading on dipstick, rotate dipstick 180° and re-insert for check.

   When adding engine oil, refer to Lubrication Section.

2) Watch the oil pressure warning lamp. If the lamp blinks, it may be the oil pick-up screen is not covered with oil. Check oil dipstick. Add oil to the oil pan, if required. Do not overfill. If level is correct and the status still exists, see your DEALER for possible switch or oil pump and line malfunction.

   Note : Oil pressure will rise as RPM increases, and fall as RPM decreases. In addition, cold oil will generally show higher oil pressure for any specific RPM than hot oil. Both of these conditions reflect normal engine operation.

3) Watch the engine water temperature gauge and be sure there is proper water circulation. The water temperature gauge needle will fluctuate if water level in expansion tank is too low.
   At the end of the break-in period, remove break-in oil and replace the oil filter. Fill oil pan with recommended engine oil. Refer to Lubricating System.

3.3. Inspections After Starting

- It is advisable to operate an engine at idling until the engine reaches up to normal operating temperature.
- Engine should be stopped if the color, the noise or the odor of exhaust gas is not normal.
- Confirm the following things through warning lamps and gauge panel.
  - Pressure of lubricating oil

    The normal pressure comes up to 80 kPa (0.8 bar) at idling and 300 ~ 480 kPa (3.0 ~ 4.8 bar) at maximum speed. If the pressure fluctuates at idling or does not reach up to the expected level at high speed, shut down the engine immediately and check the oil level and the leakage.
  - Temperature of cooling water

    The cooling water temperature should be 80 ~ 95 °C in normal operating conditions. Abnormally high cooling water temperature could cause the overheating of engine and the sticking of cylinder components. And excessively low cooling water temperature increases the fuel consumption, accelerates the wears of cylinder liners and shortens the engine life-time.

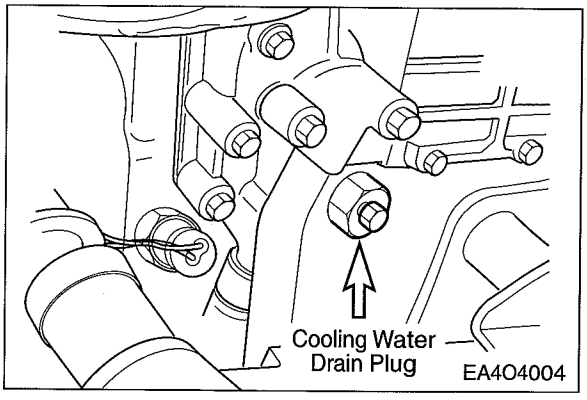
Note : When engine is overheated, do not stop the engine immediately. Lower the engine load and run the engine and its cooling systems continuously.

3.4. Operation in Winter Time

Pay special attention to the freezing of cooling water and the viscosity of lubricating oil.

3.4.1. Prevention against the freeze of cooling water

When not using anti-freeze, completely discharge the whole cooling water after engine running. The freeze of cooling water causes the fatal damages of the engine. Because the anti-freeze is used to prevent cooling water from freeze, consult "The amount of anti-freeze".



3.4.2. Prevention against excessive cooling

Drop of thermal efficiency caused by excessive cooling increases fuel consumption, therefore prevent the engine from excessive cooling. If the temperature of coolant does not reach to normal condition (80 ~ 95 °C) after continuous operation, examine the thermostat or the other cooling lines.

3.4.3. Lubricating oil

As cold weather leads to the rise of oil viscosity, engine speed becomes unstable after starting. Therefore the lubricating oil for winter should be used to prevent this unstability. Refer to Lubrication.(4.2.1)

3.4.4. Starting of engine in winter

It is necessary to preheat engine satisfactorily under 10 °C(50 °F) in winter. Refer to Starting. (3.1.3)

4. Inspection and Maintenance

4.1. Periodical Inspection and Maintenance

In order to insure maximum, trouble-free engine performance at all times, regular inspection, adjustment and maintenance are vital.

- Daily inspections in below figure should be checked every day.
- The following maintenance details should be executed thoroughly at regular internals.

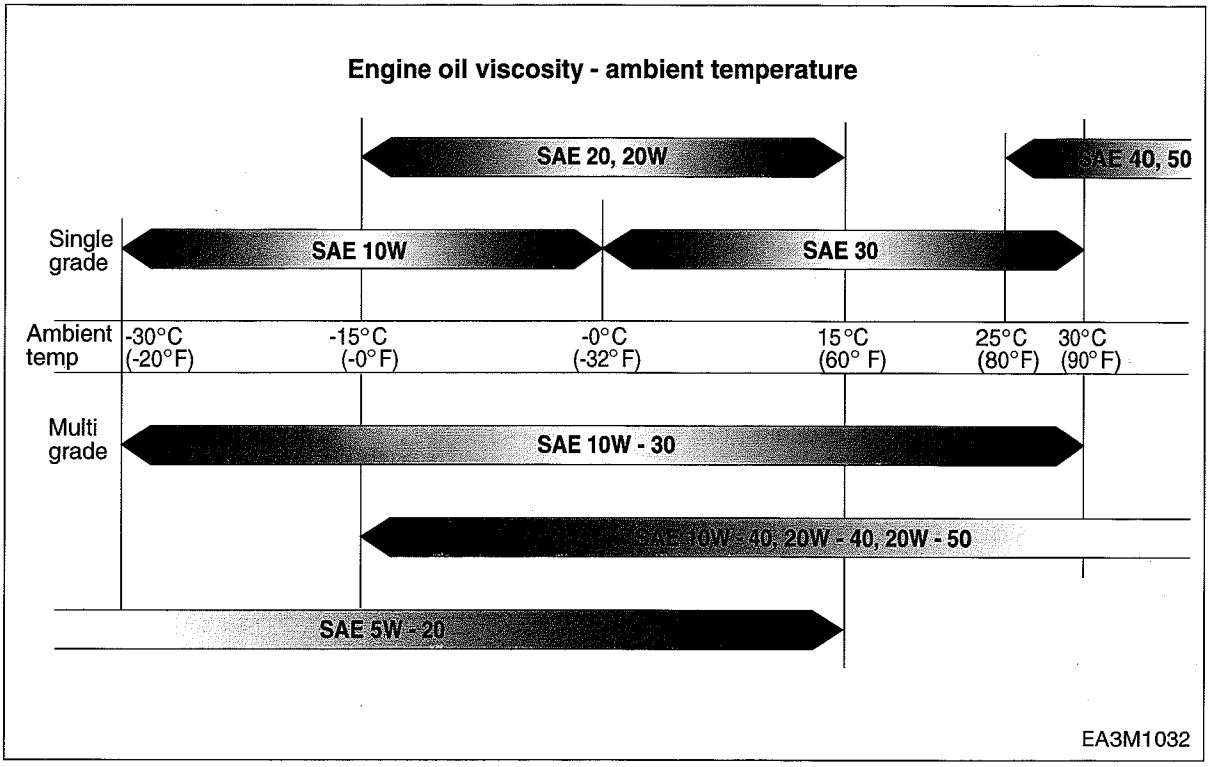
O : Check & adjust ● : Replace

Inspection		Daily	Every 50hrs	Every 200hrs	Every 600hrs	Every 800hrs	Every 1200hrs	Remark
Cooling System	Check for leakage(hoses, clamp)	O						
	Check the water level	O						
	Change the coolant water						●	
	Adjust the V-belt tension	O						Every 2,000hrs
	Clean the radiator						O	
Lubrication System	Check for leakage	O						
	Check the oil level gauge	O						
	Change the lubricating oil		●1st			O		
	Replace the oil filter cartridge		●1st			O		
Intake & Exhaust System	Check the leakage for intercooler(hoses, clamp)	O						
	Clean and change the air cleaner element			O clean	●			
	Clean the inter-cooler air fins				O			
	Clean the turbo-charger							Every 2,000hrs
Fuel System	Check the leakage fuel line	O						
	Clean the fuel strainer of fuel feed pump						O	
	Remove sediment from fuel tank						O	
	Drain the water in separator			O				
	Replace the fuel filter element						●	
	Check fuel Injection timing			O				When necessary
	Check the injection nozzles			O				When necessary
Engine Adjust	Check the state of exhaust gas	O						
	Check the battery charging	O						
	Check the compression pressure						O	When necessary
	Adjust Intake/Exhaust valve clearance		O1st					When necessary

4.2. Lubrication System

4.2.1. Recommend of lubricating oil

Initial factory fill is high quality oil for API Service CD or above. During the break-in period (50 hours), frequently check the oil level. Somewhat higher oil consumption is normal until piston rings are seated. The oil level should be maintained in the safe range between the Min. and Max. marks on the dipstick. The safe range between the marks represents approximately 2 liters. Diesel engine oils are specified by API Service, letter designations and SAE viscosity numbers. If the specified engine oil is not available, use a reputable brand of diesel engine oil labeled for API Service CD or above and SAE viscosity 30 or 15W40.

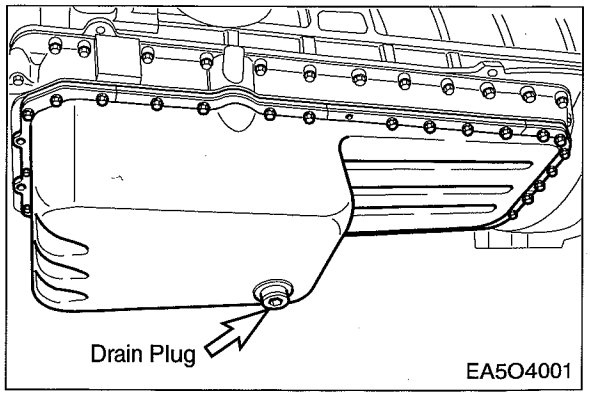


4.2.2. Exchanging of lubrication oil

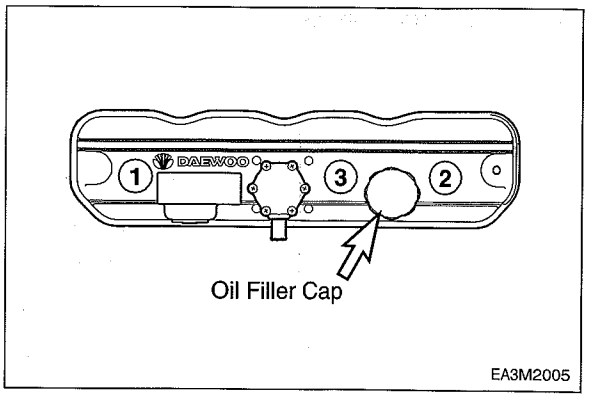
Engine oil and the oil filter are important factors affecting engine life. They affect ease of starting, fuel economy, combustion chamber deposits and engine wear. Drain and refill oil pan every 50 hours of operation or 6 months whichever occurs first.

1) Method to exchange

(1) While the oil is still hot, remove the drain plugs from oil pan and oil filter head, and discharge the lubricating oil.



(2) Refill the lubricating oil in accordance with the oil capacity of the engine through oil filler. Be careful about the mixing of dust or contaminator during the supplement of oil. Then confirm that oil level gauge indicates the vicinity of its maximum level.



(3) For a few minutes, operate the engine at idling in order to circulate oil through lubrication system.

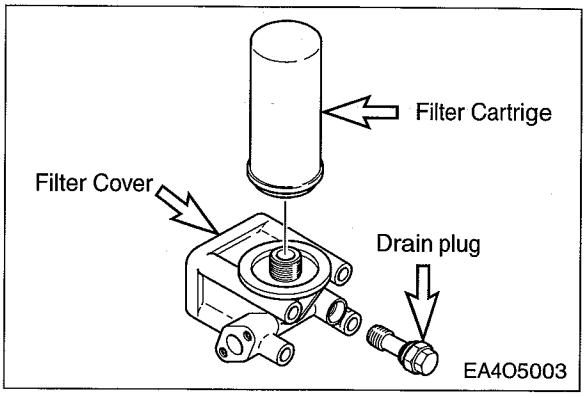
(4) Thereafter shut down the engine. After waiting for about 10 minutes measure the quantity of oil and refill the additional oil if necessary.

2) Replacement of oil filter cartridge

At the same times of oil exchanges, replace the oil filter cartridge.

(1) Drain engine oil by loosening about 15 mm (0.6 in.) the drain plug on the filter head.

Caution : Dont forget tightening the drain plug after having drained engine oil.



(2) Loosen the oil filter by turning it counter-clockwise with a filter wrench.

(3) With a rag wipe clean the fitting face of the filter body and the oil filter body so that new oil filter cartridge can be seated properly.

(4) Lightly oil the O-ring and turn the oil filter until sealing face is fitted against the O-ring. Turn 1-1/4 turns further with the filter wrench.

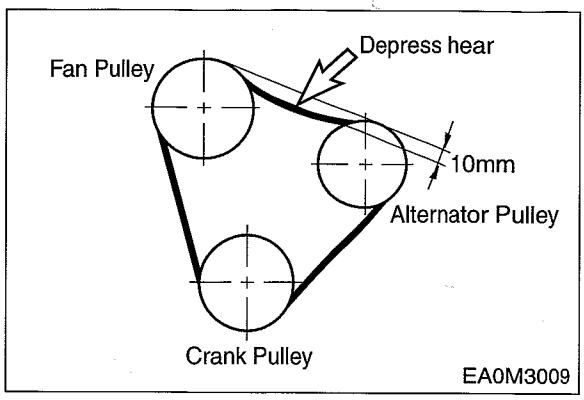
Note : It is strongly advisable to use DAEWOO genuine oil filler cartridge for replacement

4.3. Cooling System

4.3.1. Cooling fan belt

1) Tension check and adjust

By the finger-pressure the belt is pressed by 10mm among the water pump pulley, the alternator pulley in normal condition. For the adjustment of the tension, loosen the bolts in the adjusting plate which supports the alternator, adjusts the tension and tightens the bolts again.



2) Use of genuine V- belt

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

4.3.2. Coolant change

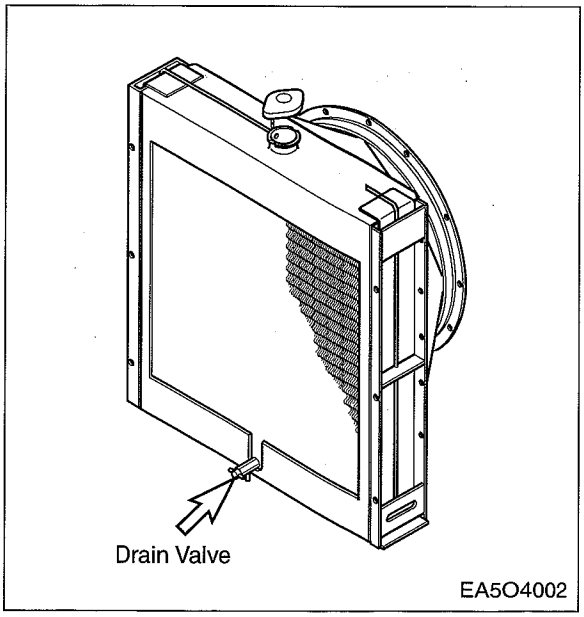
The coolant must be changed at intervals of 1,200 hours operation or six months whichever comes first. If the coolant is being fouled greatly, it will lead an engine overheat or coolant blow off from the radiator.

1) Coolant draining

(1) Remove the radiator cap

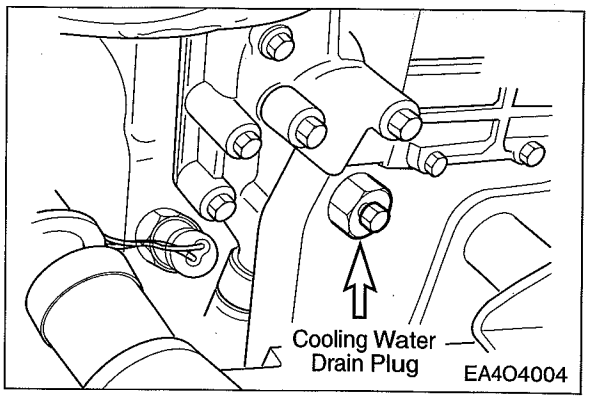
Open the drain plug at the radiator lower part to drain the coolant as the right figure.

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



(2) Loosen the coolant drain plug

Loosen the coolant drain plug at the cylinder block left hand side behind oil filter to drain the coolant in the engine.



3) Coolant filling

(1) Close or tighten the coolant drain plugs.

(2) Use clean water such as the city supply water as the coolant.

Fill up the tank with the coolant until the level comes up to the filler port neck.

Fill the coolant gradually to avoid air entry.

- Coolant capacity (Engine only): About 8.5 liter.

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

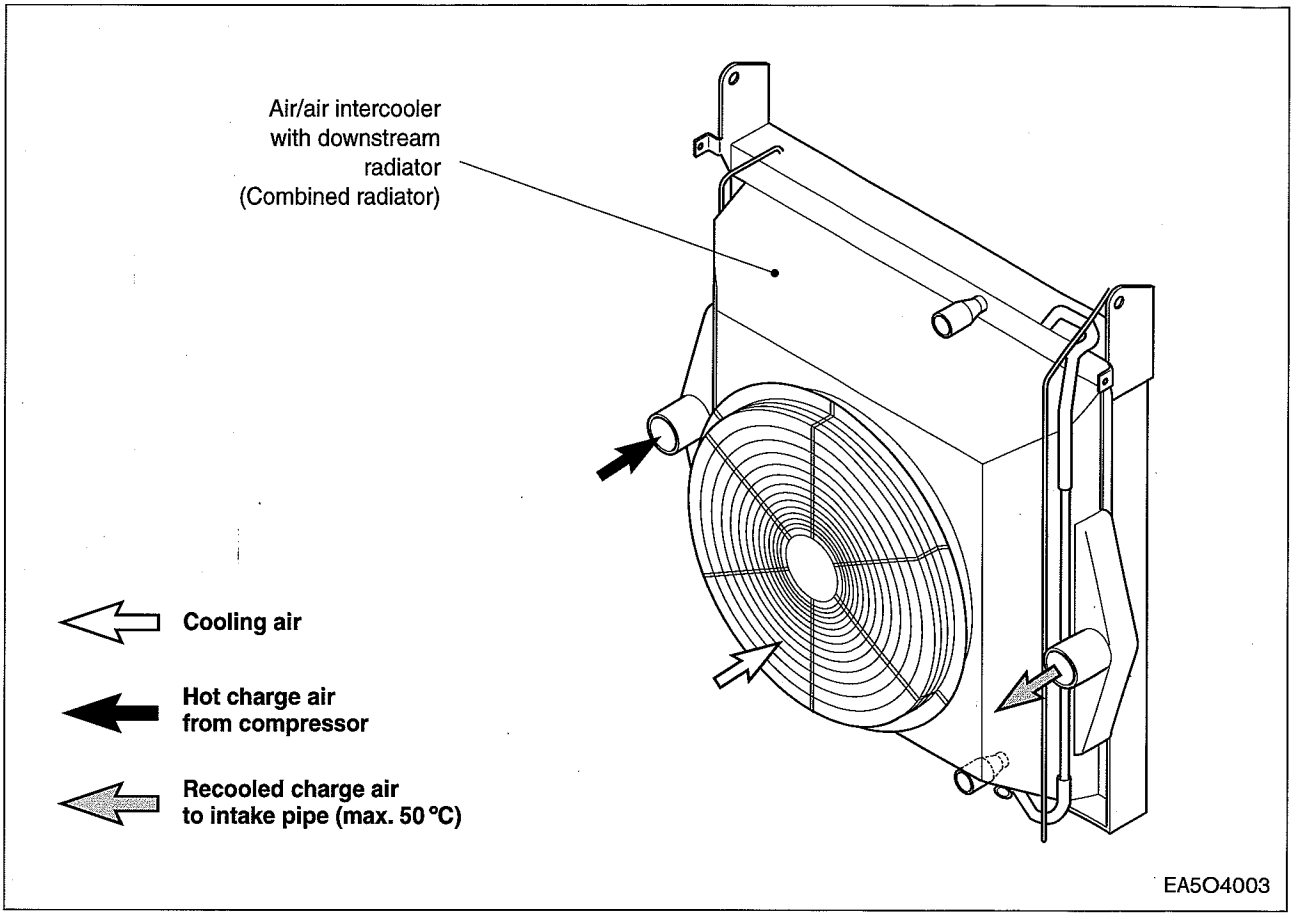
4.3.3. Cooling system circuit cleaning

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

Periodically clean the circuit interior with a cleaner.

- Cooling system cleaning interval: Every 1,200 hours.

4.3.4. Intercooler



The intercooler is air to air type and has a large cooling fan capacity. The intercooler life and performance depends on the intake air condition greatly. Fouled air pollutes and clogs the air fins of intercooler. As a result of this, the engine output is decreased and engine malfunction is occurred. So you always check whether the intake air systems like air filter element are worn or polluted.

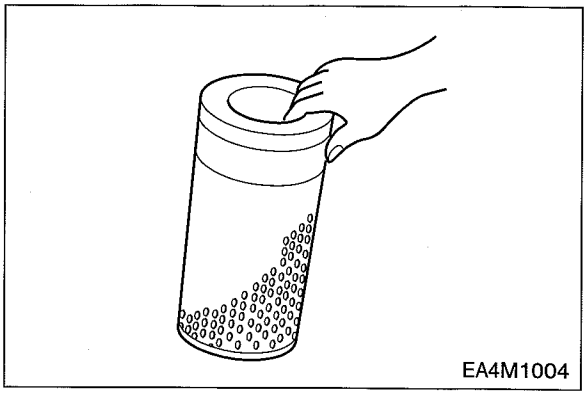
- Cleaning of inter cooler : Every 1000 hours.

4.3.5. Anti-freeze

The anti-freeze, 40% of the whole coolant, is always to be used to prevent the cooling system from the corrosion. And in winter the amount of anti-freeze shown in the following table should be used in accordance with the ambient temperature.

Ambient Temperature (°C)	Cooling water (%)	Anti-freeze (%)
Over -10	85	15
-10	80	20
-15	73	27
-20	67	33
-25	60	40
-30	56	44
-40	50	50

4.4. Air Intake System


EA4M1004

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

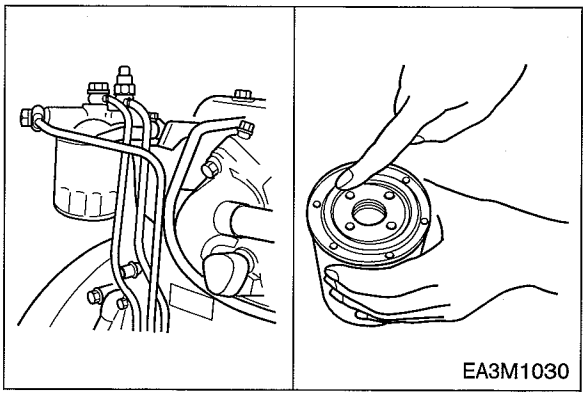
A fouled cleaner element results a decreased intake air amount leading the engine output is decreased and finally causes an engine malfunction.

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

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

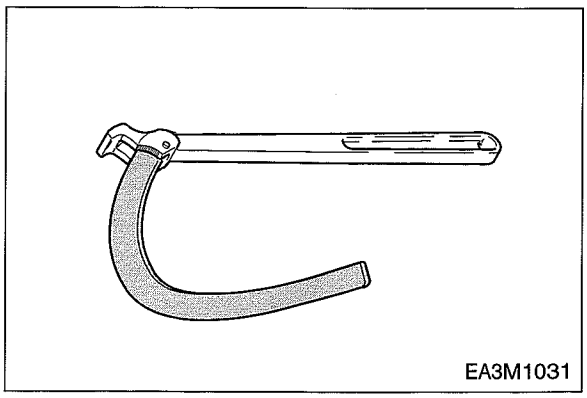
- Cleaning of the air filter element : Every 100 hours
- Exchange of the air filter element : Every 400 hours

4.5. Fuel System


EA3M1030

As fuel injection pumps and injection nozzles consist of very complicated and precise components, the contamination of fuel causes the clogging of the nozzle or the sticking of the components of injection pump. Therefore, the cleanness of the fuel system should be maintained at any time.

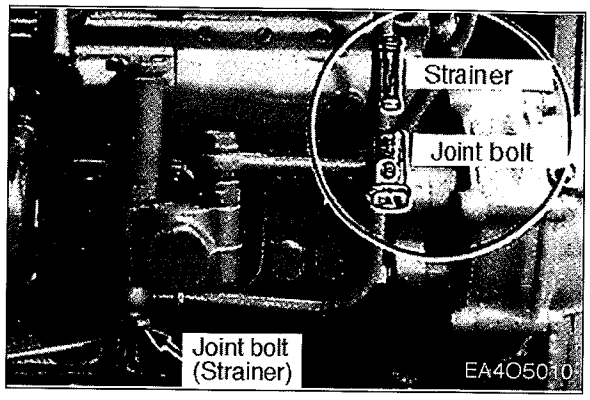
4.5.1. Fuel filter


EA3M1031

1) Loosen the fuel filter by turning it counter-clockwise with the filter wrench.
   - Discard the used filter.
2) Wipe the filter fitting face clean.
3) Apply a light coat of engine oil to the O-ring and supply fuel to the new filter.
4) Turn the new filter until the filter O-ring is fitted against the sealing face.
5) And then turn 3/4 more with the filter wrench.

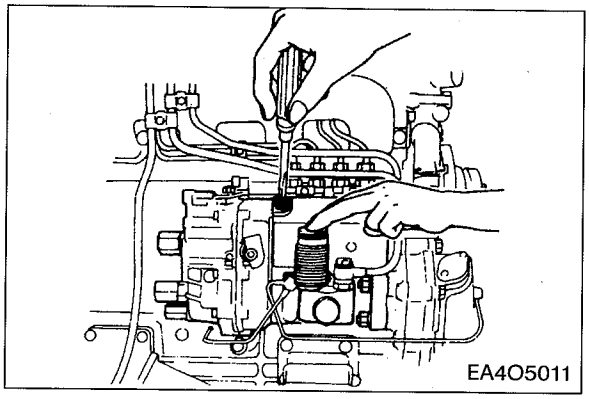
4.5.2. Priming pump strainer cleaning

Clean the priming pump strainer every 1,200 operation hours.
The strainer is incorporated in the priming pump inlet side joint bolt.
Clean the strainer with the compressed air and rinse it in the fuel oil.



4.5.3. Bleeding the fuel system

After the cleaning of the fuel filter or after the engine stop by the lack of fuel, the bleeding of the fuel system must be executed by all means.
Bleed the system by manually operating the priming pump with fuel filter outlet joint bolt and injection pump bleeder screw loosened.



4.5.4. Fuel requirements

DAEWOO generator diesel engines was designed to use Number 2-D diesel fuel or equivalent that meets specification DIN 51601-DK. For maximum fuel economy, Number 2-D fuel whenever possible. When temperatures are below -7 °C (20 °F), use Number 1-D fuel. If Number 1-D fuel is not available, the mixture of one kerosene to two gallons of Number 2-D fuel can be used. Once kerosene has been added, the engine should be run for several minutes to mix the fuel.

4.5.5. How to select fuel oil

Fuel quality is an important factor in obtaining satisfactory engine performance, long engine life, and acceptable exhaust emission levels. DAEWOO engines are designed to operate on most diesel fuels marketed today. In general, fuels meeting the properties of ASTM Designation D975 (grades 1-D and 2-D) have provided satisfactory performance.
The ASTM 975 specification, however, does not in itself adequately define the fuel characteristics needed for assurance of fuel quality.
The properties listed in the fuel oil selection chart below have provided optimum engine performance. Grade 2-D fuel is normally available for generator service. Grade 1-D fuel should not be used in pleasure craft engines, except in an emergency.

• Fuel Oil Selection Chart

General Fuel Classification	ASTM Test	No.1 ASTM 1-D	No.2 ASTM 2-D	DIN 51601
Gravity, API#)	D 287	40 ~ 44	33 ~ 37	0.815 ~ 0.855
Flash Point Min. °F (°C)	D 93	100 (38)	125 (52)	131 (55)
Viscosity, Kinematic cST 100 °F (40 °C)	D 445	1.3 ~ 2.4	1.9 ~ 4.1	1.8 ~ 10
Cloud Point °F#)	D 2500	See Note 1)	See Note 1)	See Note 1)
Sulfur Content wt%, Max.	D 129	0.5	0.5	0.15
Carbon Residue on 10%,wt%,Max.	D 524	0.15	0.35	0.1
Accelerated Stability Total Insolubles mg/100 ml, Max.#)	D 2274	1.5	1.5	
Ash, wt%, Max.	D 482	0.01	0.01	
Cetane Number, Min. +)	D 613	45	45	> 45
Distillation Temperature, °F(°C)	D 86			
IMP, Typican#)		350(177)	375(191)	
10% Typical#)		385(196)	430(221)	
50% Typical#)		45(218)	510(256)	680(360)
90% +)		500(260) Max.	625(329) Max.	
End Point#)		550(288) Max.	675(357) Max.	
Water & Sediment %, Max.	D 1796	0.05	0.05	0.05

#) Not specified In ASTM D 975

+) Differs from ASTM D 975

Note: 1. The cloud point should be 6 °C (10 °F) below the lowest expected fuel temperature to prevent clogging of fuel fitters by crystals.

4.5.6. Fuel system checks

Fill the tank with the recommended fuel. Keeping tanks full reduces water condensation and helps keep fuel cool, which is important to engine performance.
Make sure fuel supply valves (if used) are open.
To insure prompt starting and even running, the fuel system must be primed with the fuel feed pump manually before starting the engine the first time, or after a fuel filter change.
Refill at the end of each day's operation to prevent condensation from contaminating the fuel. Condensation formed in a partially filled tank promotes the growth of microbial organisms that can clog fuel filters and restrict fuel flow.
If the engine is equipped with a fuel water separator, drain off any water that has accumulated. Water in fuel can seriously affect engine performance and may cause engine damage.
DAEWOO recommends installation of a fuel water separator on generator units.

4.5.7. Fuel contamination

In the generator environment, the most likely fuel contaminants are water and microbial growth (black "slime"). Generally, this type of contamination is the result of poor fuel handling practices.
Black "slime" requires water in the fuel to form and grow, so the best prevention is to keep water content to a minimum in storage tanks.

Notice: A galvanized steel tank should never be used for fuel storage, because the fuel oil reacts chemically with the zinc coating to form powdery flakes which can quickly clog the fuel filters and damage the injection pump and nozzle.

5. Engine Body and Electricals

5.1. Adjustment of Valve Clearances

The valve clearances are to be adjusted at the times of the following situations.

1) After initial 50 operation hours
2) When the engine is overhauled and the cylinder heads are disassembled.
3) When severe noise comes from valve train.
4) When the engine is not normally operated even though there is no trouble in the fuel system.

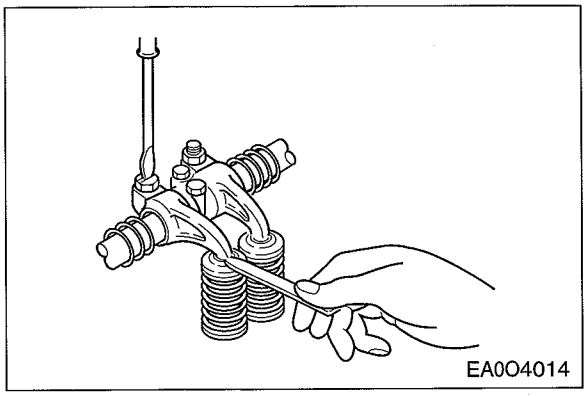
5.1.1. The valve clearances

The valve clearances of the cold engine are as follows:

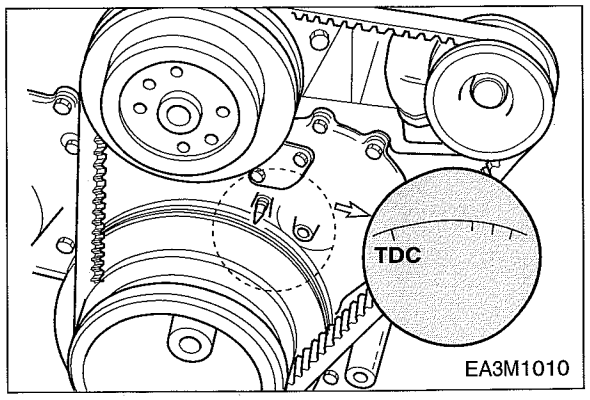
- Intake valves : 0.4mm
- Exhaust valves : 0.4mm

5.1.2. Order of adjusting the valve clearances

1) Bring the piston in either the No. 1 cylinder or the No. 4 cylinder to top dead center on the compression stroke by turning the crankshaft until the T.D.C (Top Dead Center) notched line on the crankshaft pulley is aligned the timing pointer.



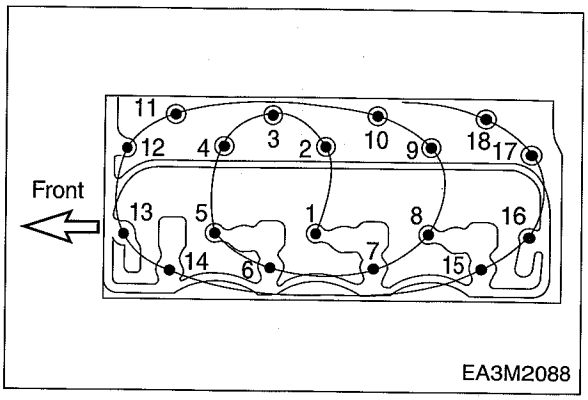
2) Check to see if there is play in the No. 1 intake and exhaust valve rocker arms. If the No. 1 cylinder intake and exhaust valve rocker arms are depressed, the NO. 4 piston is at TDC on the compression stroke.



5.2. Tightening the Cylinder Head Bolts

The cylinders head bolts are to be tightened in the sequence shown in the illustrations. First tighten the bolts slightly, then slightly more again and finally tighten with a torque wrench as follows.

The tightening by excessive torque may cause the damages of the cylinder head gaskets, the flanges of cylinder liners and the cylinder head bolts, therefore obey the regular torque.



DB33	1st step	2nd step
	7.0 kg.m	11.5 kg.m

P034Ti (DB33TiB)	1st step	2nd step	3rd step
	4.0 kg.m	+ 90°	+ 60°(+ 30°)

5.3. Cylinder Compression Pressure Measurement

The cylinder compression pressure measurement must be dome every 1,200 operation hours, or whenever the engine output is reduced.

Cylinder compression pressure standard value ··· 28 kg/cm² at 200 rpm at sea level.

5.4. Engine Electricals

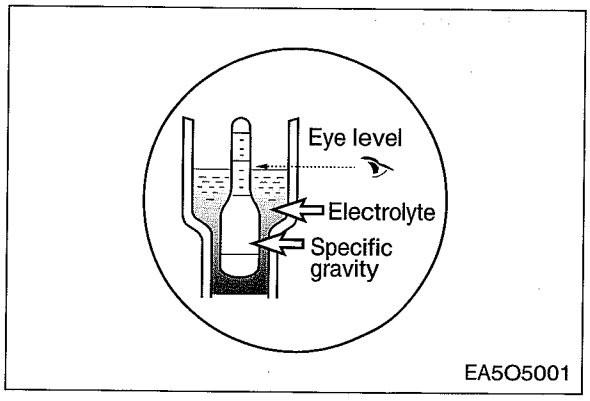
The DAEWOO engines uses a 12 or 24 volt system and a negative grounding type for the electrical system.

5.4.1. Battery servicing

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

Periodically measure the electrolyte gravity of the batteries.

Battery electrolyte gravity measurement interval : Every 400 operation hours



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

Electrolyte Specific Gravity	Battery Conditions
Over 1,280	Over charged (To be rectified.)
1,280~1,250	Normal
1,250~1,240	Nearly normal
Below 1,240	Insufficiently charged (To be rectified.)

* This is not for Maintenance Free battery.

5.4.2. Gravity conversion

The specified electrolyte temperature for the gravity measurement is 20 °C.
Measure the electrolyte temperature and do the conversion in accordance with the following formula when the temperature does not fall to the specified temperature.

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

S_{20} ; The gravity at 20 °C
S_t ; The gravity measured
t ; The electrolyte temperature when measured

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

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

5.4.3. Alternator servicing

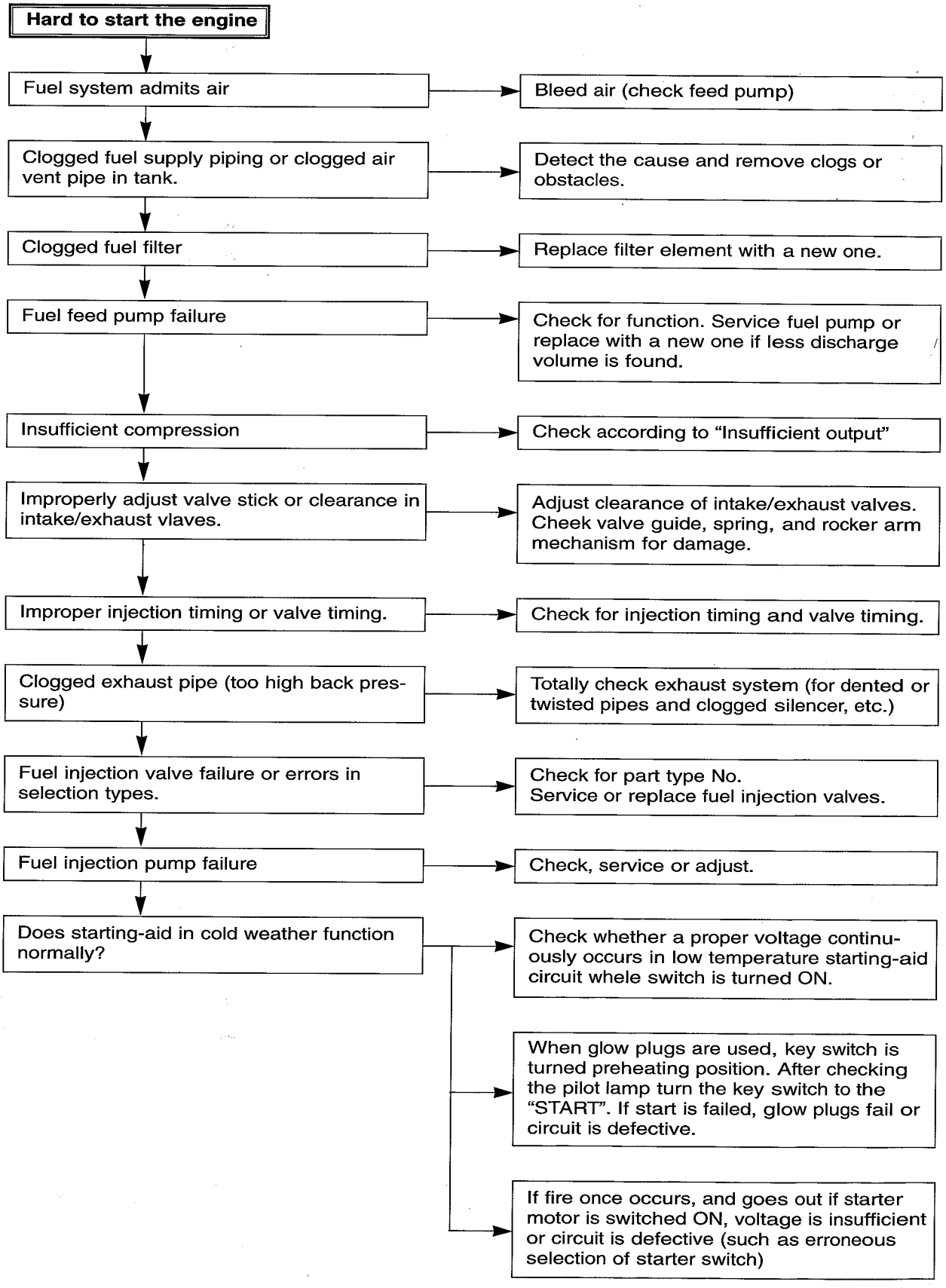
1) The polarity of the alternator is negative grounding type. When an inverted circuit connection take place, the circuit will be in short circuit instantaneously resulting the alternator failure.
2) Do not put water directly on the alternator. Entry of water into the alternator leads electrolyte corrosion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

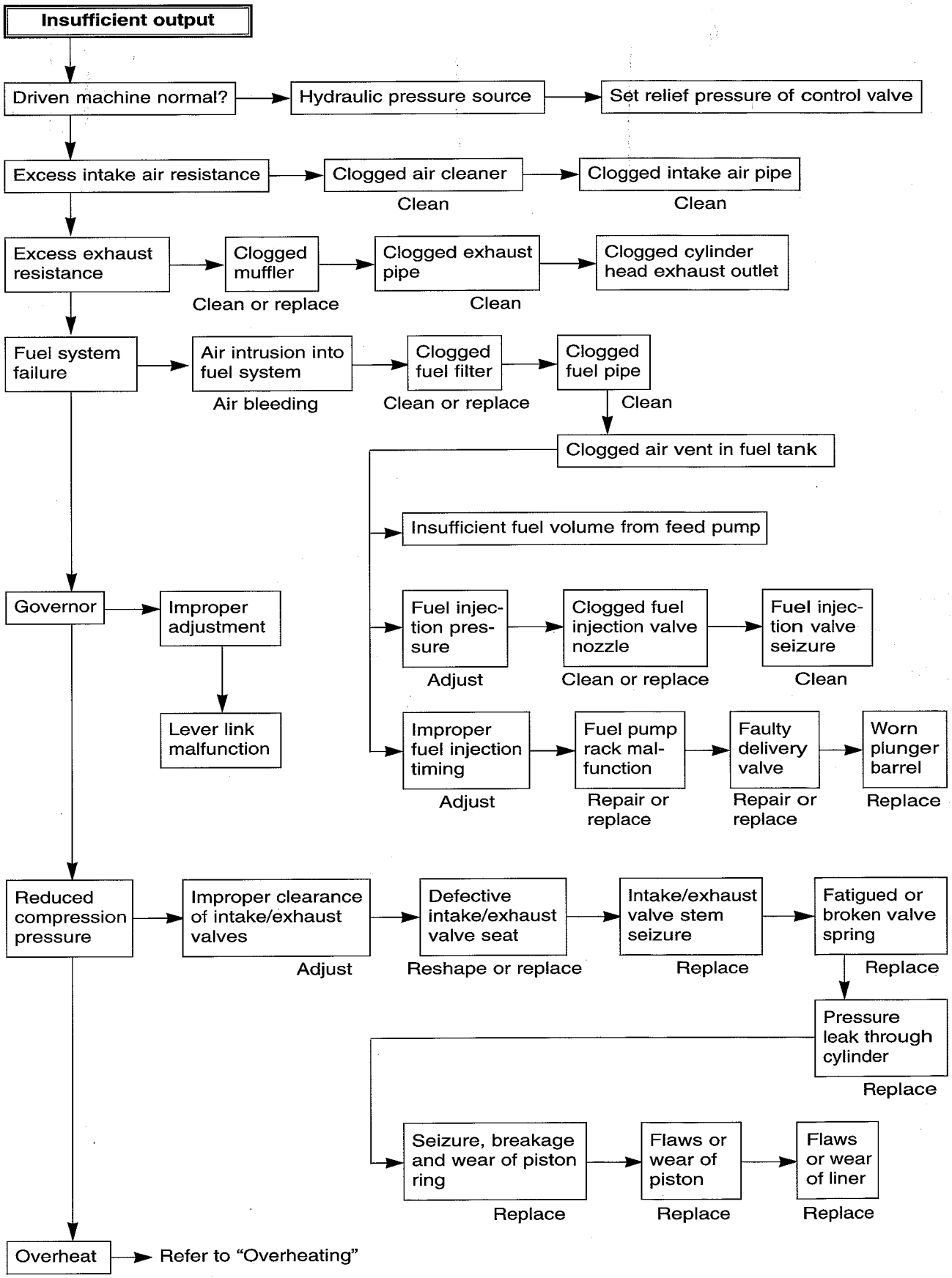
5.4.4. Wiring Connections

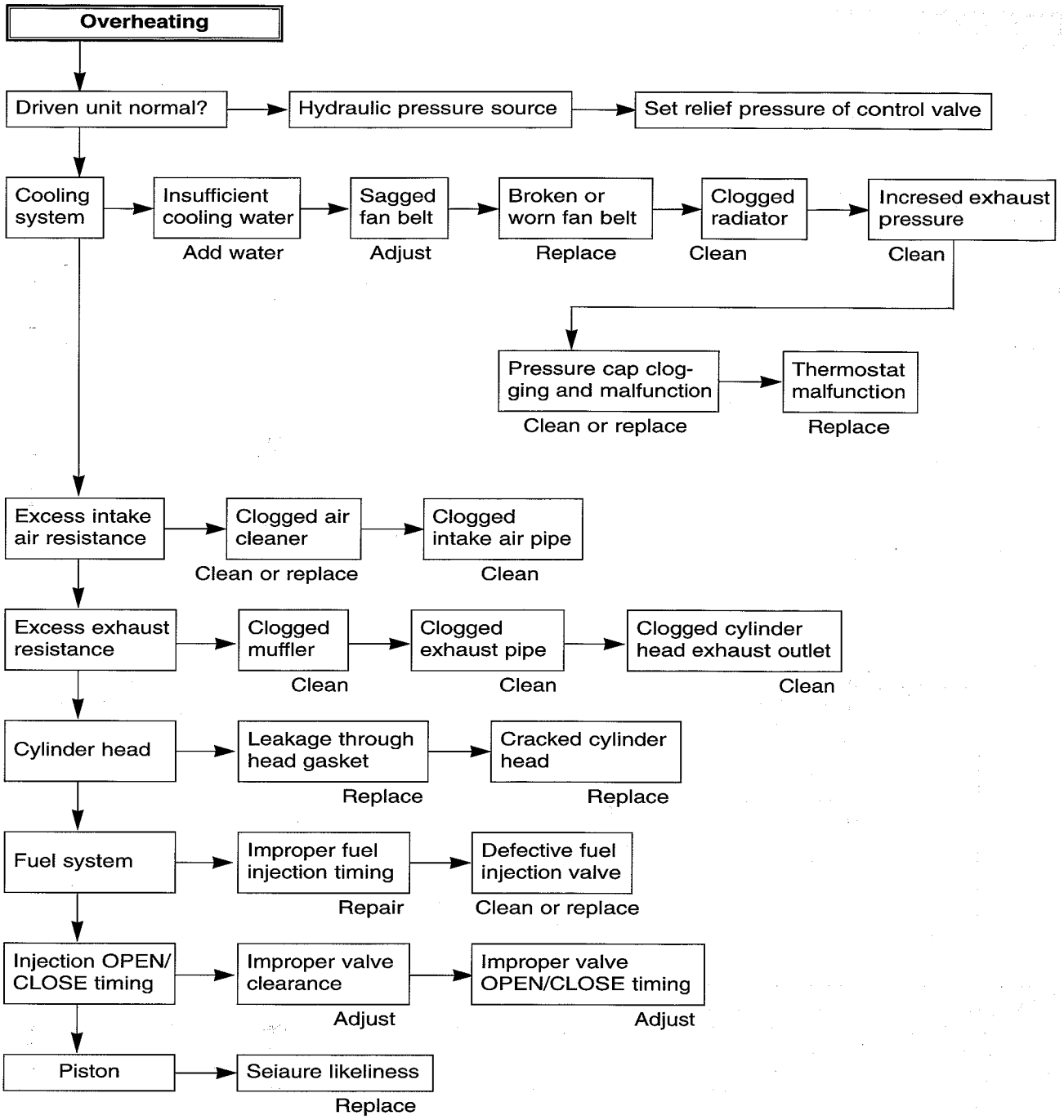
Check all of the electric wiring connections every 600 operation hours for looseness and damage.

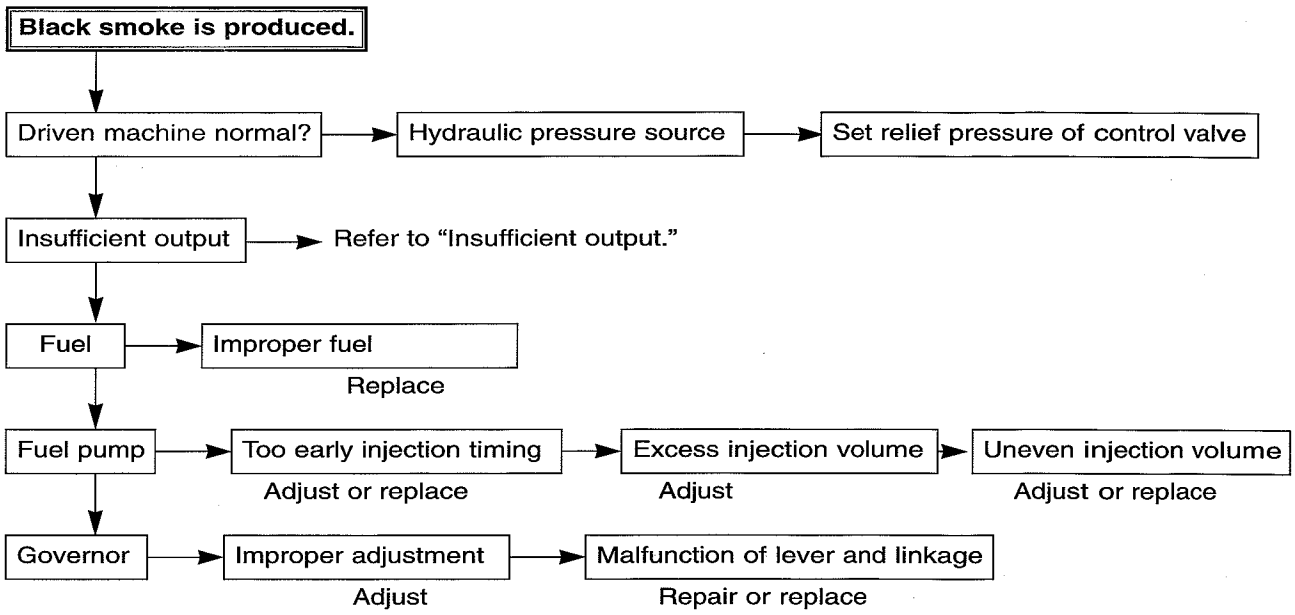
6. Troubleshooting

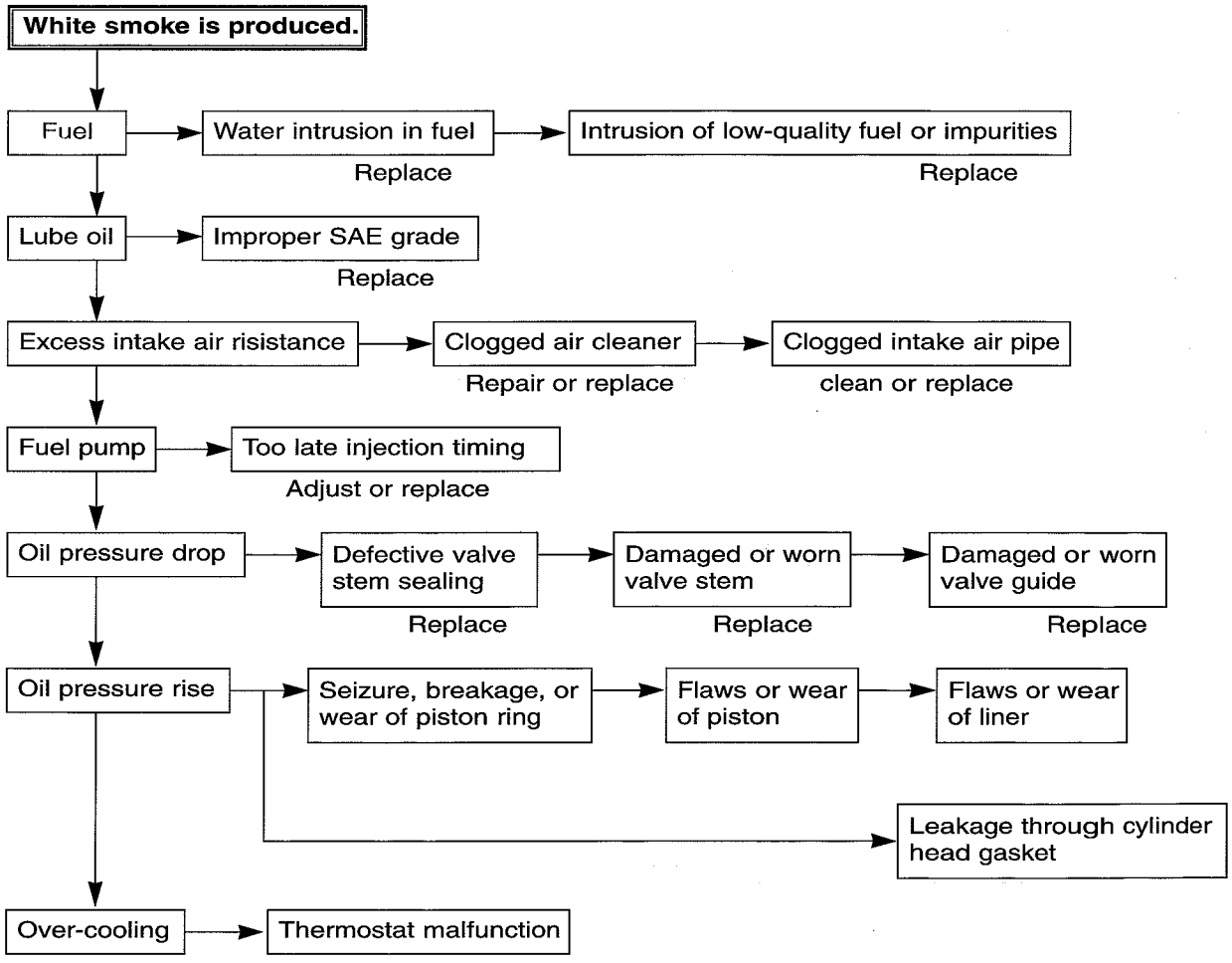
The following description summarizes the probable cause of and remedy for general failure by item. Immediate countermeasures should be taken before a failure is inflamed if any symptom is detected.

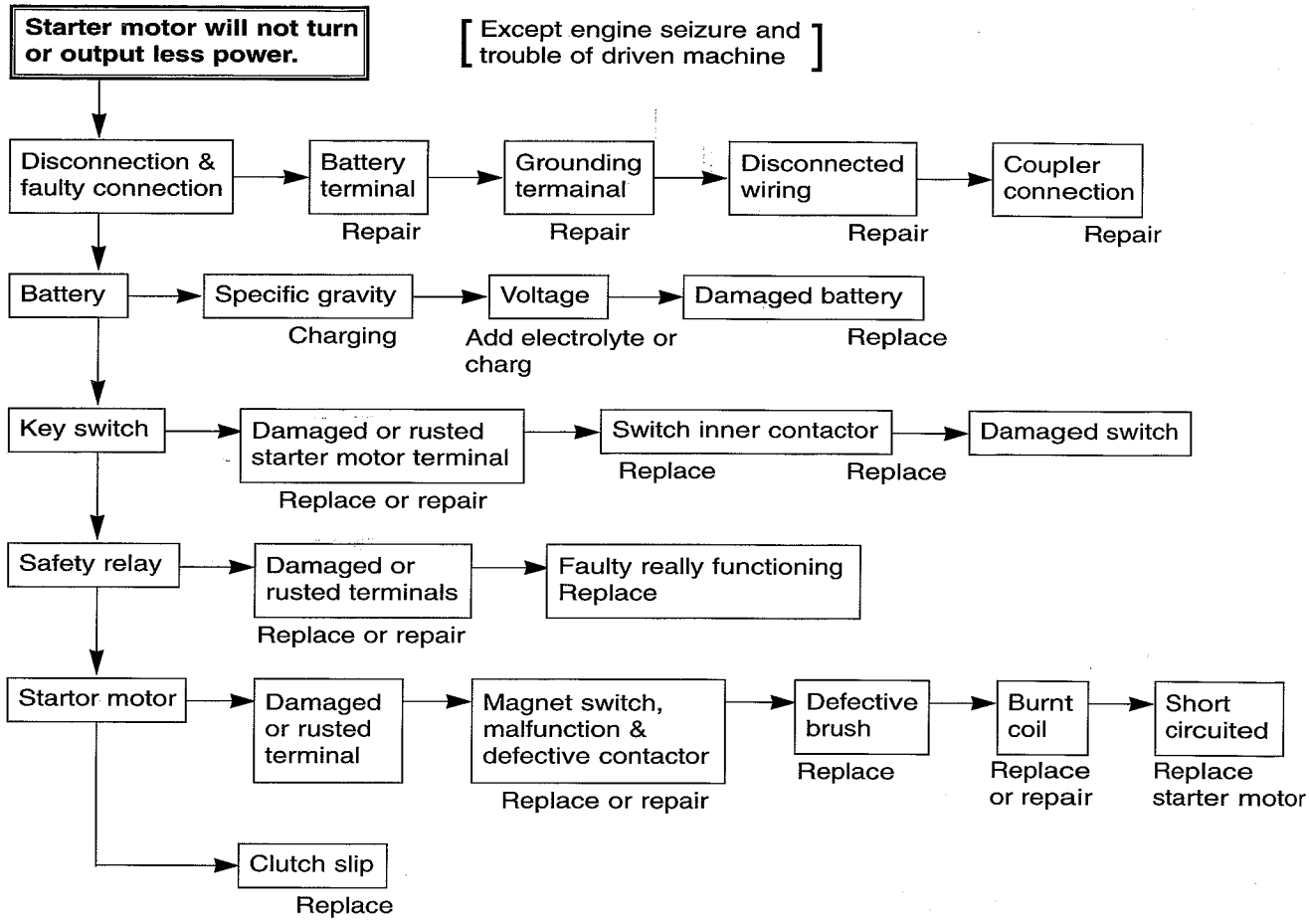



Insufficient output
Driven machine normal?
Hydraulic pressure source
Set relief pressure of control valve
Excess intake air resistance
Clogged air cleaner
Clean
Clogged intake air pipe
Clean
Excess exhaust resistance
Clogged muffler
Clean or replace
Clogged exhaust pipe
Clean
Clogged cylinder head exhaust outlet
Fuel system failure
Air intrusion into fuel system
Air bleeding
Clogged fuel filter
Clean or replace
Clogged fuel pipe
Clean
Clogged air vent in fuel tank
Insufficient fuel volume from feed pump
Governor
Improper adjustment
Lever link malfunction
Fuel injection pressure
Adjust
Clogged fuel injection valve nozzle
Clean or replace
Fuel injection valve seizure
Clean
Improper fuel injection timing
Adjust
Fuel pump rack malfunction
Repair or replace
Faulty delivery valve
Repair or replace
Worn plunger barrel
Replace
Reduced compression pressure
Improper clearance of intake/exhaust valves
Adjust
Defective intake/exhaust valve seat
Reshape or replace
Intake/exhaust valve stem seizure
Replace
Fatigued or broken valve spring
Replace
Pressure leak through cylinder
Replace
Seizure, breakage and wear of piston ring
Replace
Flaws or wear of piston
Replace
Flaws or wear of liner
Replace
Overheat
Refer to "Overheating"

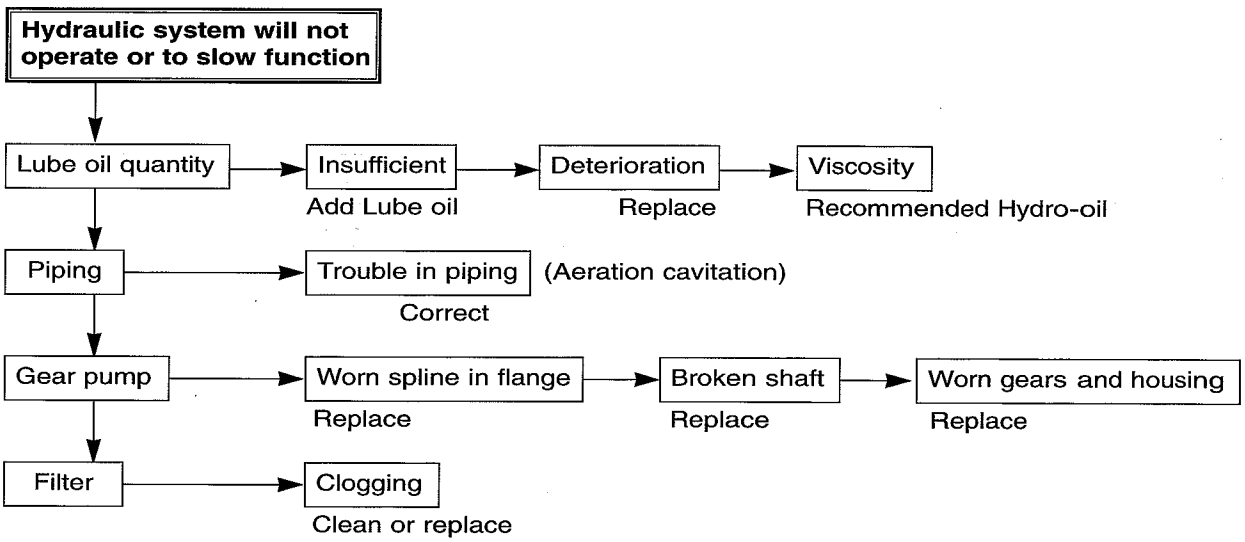

Overheating
Driven unit normal?
Hydraulic pressure source
Set relief pressure of control valve
Cooling system
Insufficient cooling water
Add water
Sagged fan belt
Adjust
Broken or worn fan belt
Replace
Clogged radiator
Clean
Incresed exhaust pressure
Clean
Pressure cap clog-ging and malfunction
Clean or replace
Thermostat malfunction
Replace
Excess intake air resistance
Clogged air cleaner
Clean or replace
Clogged intake air pipe
Clean
Excess exhaust resistance
Clogged muffler
Clean
Clogged exhaust pipe
Clean
Clogged cylinder head exhaust outlet
Clean
Cylinder head
Leakage through head gasket
Replace
Cracked cylinder head
Replace
Fuel system
Improper fuel injection timing
Repair
Defective fuel injection valve
Clean or replace
Injection OPEN/ CLOSE timing
Improper valve clearance
Adjust
Improper valve OPEN/CLOSE timing
Adjust
Piston
Seiaure likeliness
Replace

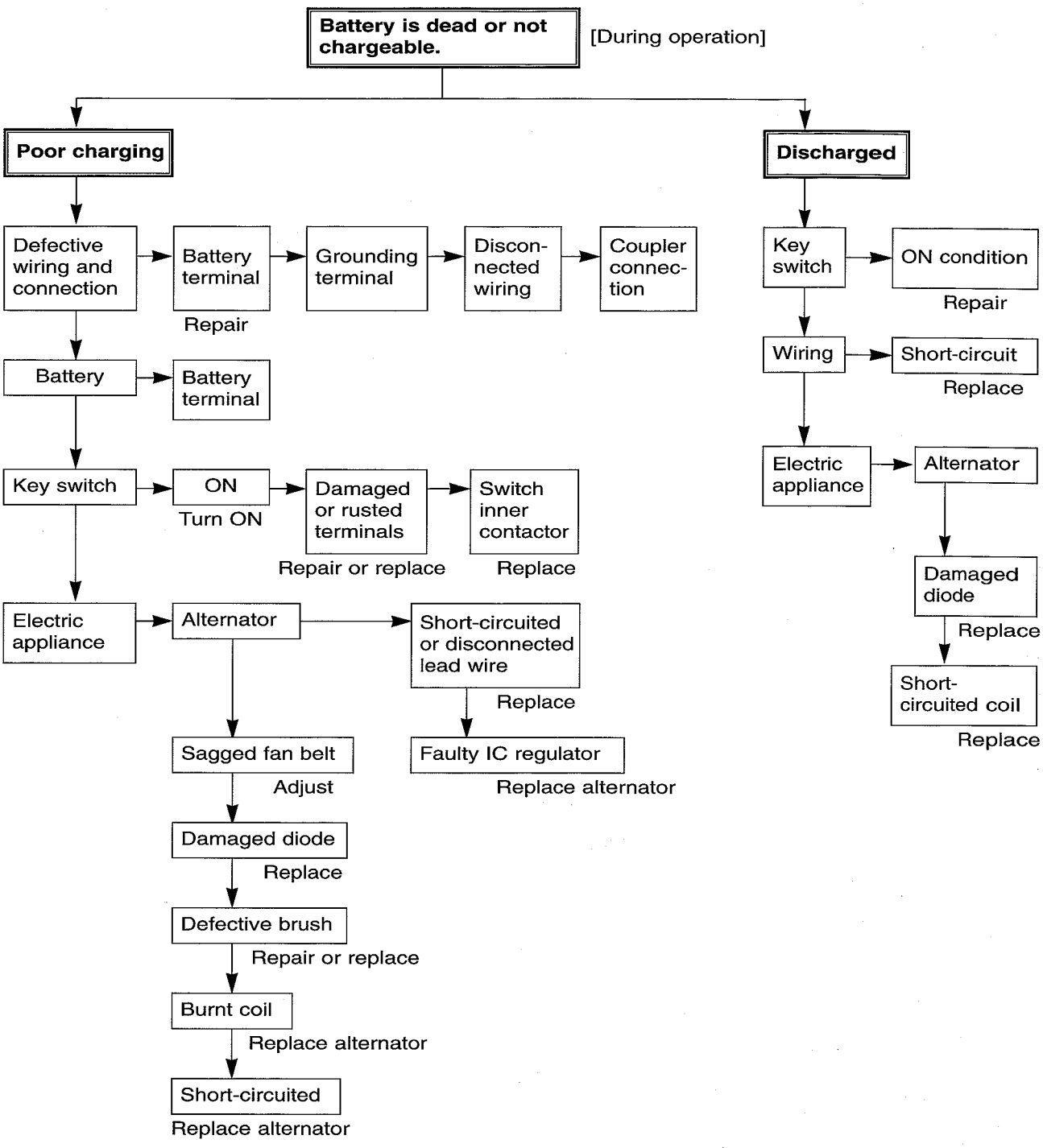

Black smoke is produced.
Driven machine normal?
Hydraulic pressure source
Set relief pressure of control valve
Insufficient output
Refer to "Insufficient output."
Fuel
Improper fuel
Replace
Fuel pump
Too early injection timing
Adjust or replace
Excess injection volume
Adjust
Uneven injection volume
Adjust or replace
Governor
Improper adjustment
Adjust
Malfunction of lever and linkage
Repair or replace


White smoke is produced.
Fuel
Water intrusion in fuel
Replace
Intrusion of low-quality fuel or impurities
Replace
Lube oil
Improper SAE grade
Replace
Excess intake air risistance
Clogged air cleaner
Repair or replace
Clogged intake air pipe
clean or replace
Fuel pump
Too late injection timing
Adjust or replace
Oil pressure drop
Defective valve stem sealing
Replace
Damaged or worn valve stem
Replace
Damaged or worn valve guide
Replace
Oil pressure rise
Seizure, breakage, or wear of piston ring
Flaws or wear of piston
Flaws or wear of liner
Leakage through cylinder head gasket
Over-cooling
Thermostat malfunction



Hydraulic pressure source




Battery is dead or not chargeable.
[During operation]
Poor charging
Discharged
Defective wiring and connection
Battery terminal
Repair
Grounding terminal
Disconnected wiring
Coupler connection
Battery
Battery terminal
Key switch
ON
Turn ON
Damaged or rusted terminals
Repair or replace
Switch inner contactor
Replace
Electric appliance
Alternator
Short-circuited or disconnected lead wire
Replace
Faulty IC regulator
Replace alternator
Sagged fan belt
Adjust
Damaged diode
Replace
Defective brush
Repair or replace
Burnt coil
Replace alternator
Short-circuited
Replace alternator
Key switch
ON condition
Repair
Wiring
Short-circuit
Replace
Electric appliance
Alternator
Damaged diode
Replace
Short-circuited coil
Replace

DAEWOO

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