

# **OPERATION HANDBOOK**

## **DIESEL ENGINE FOR INDUSTRIAL USE**






**W04C-T.W04D.W04D-T.W06D.W06D-T  
W06E.H06C-T.H06C-TI.H07C-T.H07D**




# FOREWORD

We thank you very much for having purchased a HINO engine this time.

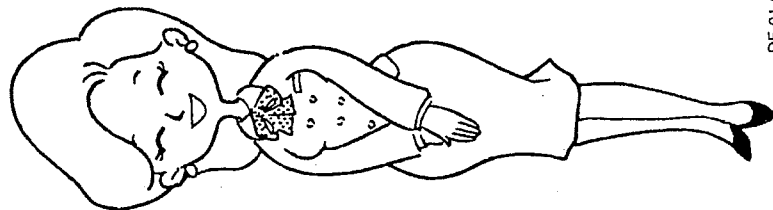
This handbook has been prepared to give you a thorough understanding of the operation of the HINO engine together with a guidance about a simple inspection and maintenance as well as about its periodicity. Be sure to read this handbook carefully before you start your engine so that you can operate it safely, comfortably and without embarrassing the social environment.

- Read very carefully those sections which have signs "Important fundamentals you must know", "DANGER", "WARNING", "CAUTION", "ADVICE" and "\*". They are particularly important.

	<b>DANGER</b>	Items that will result in death or severe personal injury if handled improperly.
	<b>WARNING</b>	Items that can result in death or severe personal injury if handled improperly.
	<b>CAUTION</b>	Items that can result in personal injury and/or property damage, such as engine damage, if handled improperly.
	<b>ADVICE</b>	Items that should be followed to ensure proper engine performance and to prevent engine from trouble and damage.
		Items that are referring to the engine handling, operating, inspection and maintenance.

- , ,  represents the items in accordance with the order.
- Depending upon the specifications of your engine, equipment with ★ marks mentioned in this handbook are not always available.
- The contents of this handbook are based on the standard specifications of HINO industrial engines. Depending on the machines, the standard specifications may be different for your engine. Please refer to the "Operation Manual" of your machine.
- For information about the handling of equipment other than HINO engines, refer to the "Operation Manual" supplied by your machine manufacturer.
- If you find any items which are not clear to you, please contact your dealer.
- Engine models covered by this handbook:

W04C-T	W06D	H06C-T	H07C-T
W04D	W06D-T	H06C-TI	H07D
W04D-T	W06E	—	—



Hino Motors, Ltd.

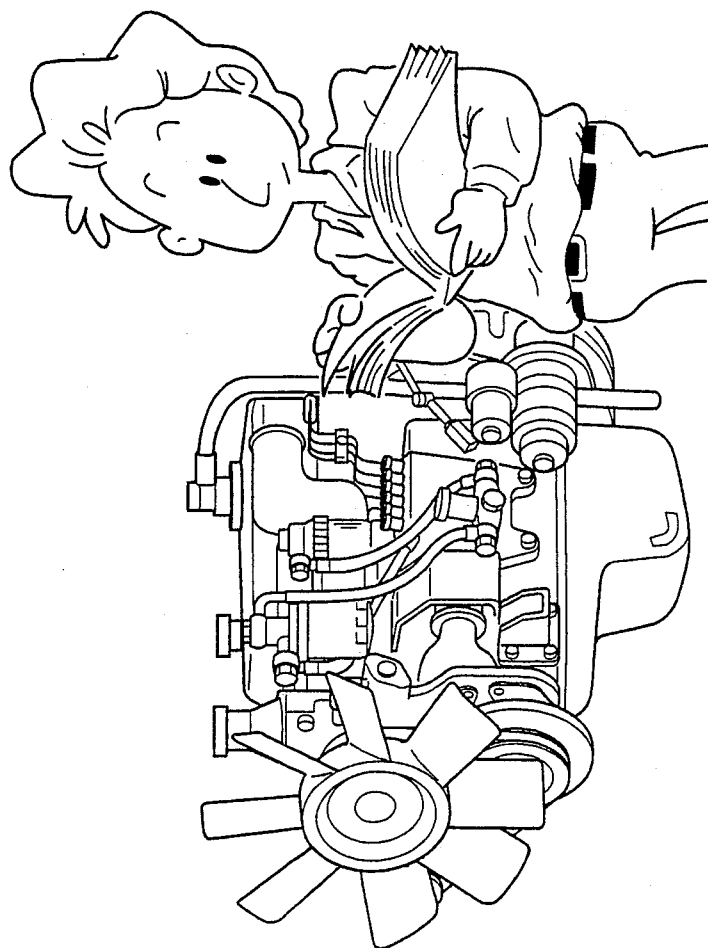
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# 1. IMPORTANT FUNDAMENTALS YOU MUST KNOW

1-1



- PRECAUTIONS DURING OPERATION ..... P1-2

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# IMPORTANT FUNDAMENTALS YOU MUST KNOW

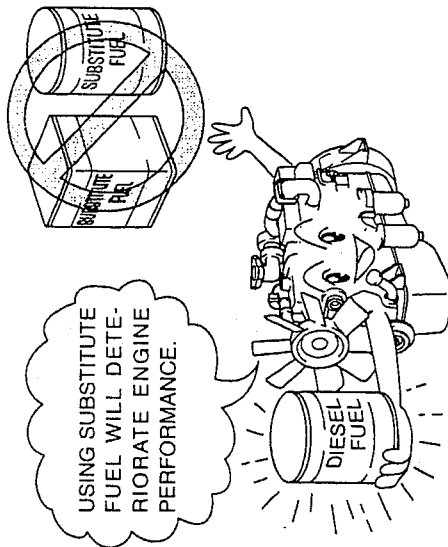
## PRECAUTIONS DURING OPERATION

### ■ USE THE SPECIFIED FUEL

#### ⚠ WARNING

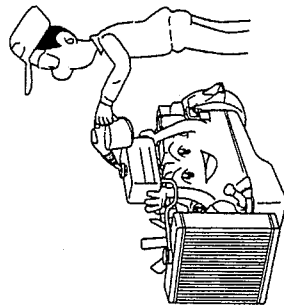
Never fill the tank with gasoline. If you pour the gasoline into the tank by mistake, extract the gasoline completely before starting engine. Starting the engine with gasoline in the tank is dangerous as it can result in a fire or engine damage.

- \* For fuel, use diesel fuel (ASTM 2-D).
- Use Winter 2-D when the outside temperature is lower than 0°C (32°F).
- Do not use fuel of bad quality or substitute fuel. It may deteriorate engine performance and may cause different troubles which will not be covered by the warranty.
- When filling fuel, make sure dust and water do not get into the tank.
- Be sure to fasten the fuel tank cap securely. Remove the drain plug below the tank, occasionally, and drain sediment and water content at the bottom of the tank together with the fuel.



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- THE COOLANT USED.....Page 5-18
- For coolant use water mixed with antifreeze.

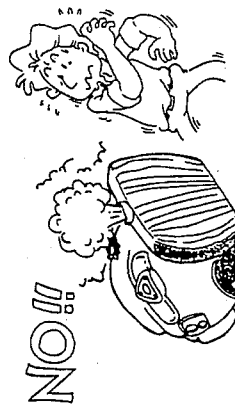


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- BE CAREFUL WITH THE RADIATOR CAP ..... Page 5-22

#### ⚠ WARNING

Never touch the radiator cap until the coolant temperature is below the normal temperature range. Opening the radiator cap carelessly can lead to scalding and other injuries due to spurt- ing out of hot coolant.



D1-06-01ZB

GRADE	FINAL BOILING POINT (MAX.)	CETANE NUMBER (MIN.)	SULFUR (MAX.)
Winter 2-D	357°C {675°F}	45	0.50%
Summer 2-D	357°C {675°F}	40	0.50%

NOTE: Fuel additives should not be used.

# IMPORTANT FUNDAMENTALS YOU MUST KNOW

1-3

## ■ USE THE PROPER ENGINE OIL

The engine oil must be able to withstand heat, oxidation, and changes in viscosity due to temperature. Be sure to use the proper oil recommended for the conditions under which your engine is operated. It is necessary to use oils of different viscosities in accordance with the outside temperature. Be sure to select the proper oil.

SAE Grade	Atmospheric temperature									
	-10	0	32	50	70	90	100	°F		
	-23	-18	0	10	21	32	39	°C		
40										
30										
20W/20										
15W/40										

## ■ PAY ATTENTION TO THE METERS, GAUGES AND LAMPS WHILE RUNNING THE ENGINE ..... Page 3-2

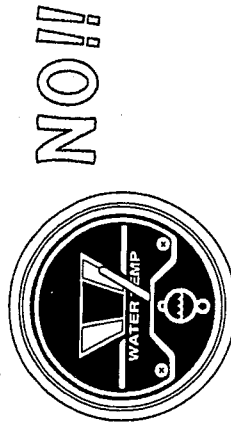
### ⚠ CAUTION

When the warning lamps light up or the instruments indicate any abnormality, be sure to idle the engine immediately and carry out inspections and repairs in accordance with this handbook. If you continue to operate ignoring the warnings of the warning lamps or the instruments, it might result in an unexpected accident. When you cannot find the cause or you cannot service it by yourself, have the engine inspected and repaired at your dealer.

- It is dangerous to continue to operate the engine without paying attention to the following instruments. Perform inspections in accordance with this handbook.

- ① When the needle of the coolant temperature gauge is in the dangerous temperature zone ..... Page 3-5

(EXAMPLE)

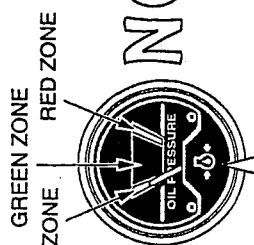


F-528

- Turning off the engine immediately may result in seizure of the engine. Before turning off the engine, be sure to idle the engine, and wait until the needle returns to the normal operating temperature zone.

# IMPORTANT FUNDAMENTALS YOU MUST KNOW

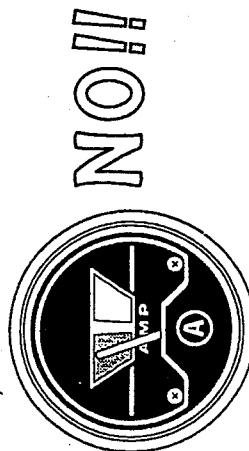
- ② When the needle of the oil pressure gauge is in the abnormal pressure zone ..... Page 3-6 (EXAMPLE)



PRESSURE IS BELOW THE STANDARD LEVEL! BE SURE TO STOP THE ENGINE IMMEDIATELY, IF THE NEEDLE IS SHAKING OR THERE ARE OTHER ABNORMALITIES.

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- ③ When the needle of the ammeter is in the discharging zone ..... Page 3-7 (EXAMPLE)



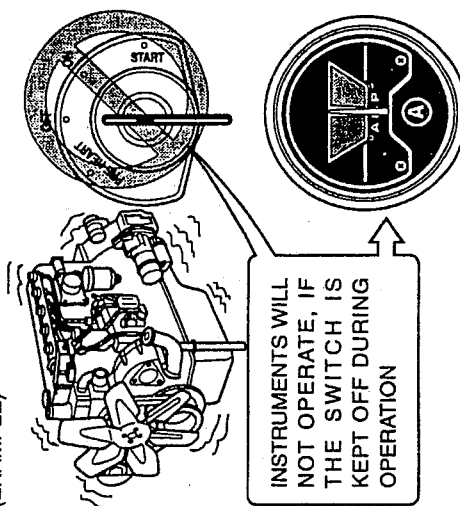
F-530

- NEVER TURN OFF THE STARTER SWITCH OR THE BATTERY SWITCH WHILE OPERATING THE ENGINE ..... Page 3-11, 4-2

## WARNING

Never turn off the starter switch or the battery switch while operating the engine. Turning these switches off while operating, will not work warning lamps and instruments necessary during operation and is extremely dangerous. It may also lead to the generation of high voltages in the electrical circuits, causing damage to the diodes.

(EXAMPLE)



F-660

- INSPECTION AND MAINTENANCE

## CAUTION

- If you touch or get close to turning parts such as the belt and the fan while the engine is running, your hands or clothes can get caught and you might cause an unexpected injury.
- After finishing the work, be careful not to leave rag, paper and any tool in the engine compartment. Especially, flammable materials can cause fire.

# IMPORTANT FUNDAMENTALS YOU MUST KNOW

1-5

## ■ BE SURE TO PERFORM INSPECTION AND MAINTENANCE OF ENGINES EQUIPPED WITH TURBOCHARGER WITHOUT FAIL

### ⚠ CAUTION

- When the engine is operated under a high load and at a high speed, continue warming up until the coolant temperature gauge starts moving.
- When the engine has been operated under a high load and at a high speed, keep the engine idling until the turbocharger has cooled down, before stopping the engine.
- In order to keep the turbocharger functioning properly, it is necessary to practice the periodical replacement of the engine oil of good quality and of the oil filter, as well as to clean the air cleaner periodically.

## ■ BE CAREFUL WITH EXHAUST GAS

### ⚠ WARNING

- Exhaust gas contains carbon monoxide (CO) which is colorless and odorless but harmful. Inhaling exhaust gas is dangerous as it can result in carbon monoxide poisoning.
- Do not keep the engine running in a poorly ventilated area. Surrounded areas such as indoor areas are especially dangerous because such areas will fill with exhaust gas and can result in carbon monoxide poisoning.
- Check your exhaust pipe occasionally. If you find a hole or crack, coupler damage, or anything unusual with the exhaust pipe, have the engine inspected and repaired at your dealer. Using the engine in such conditions can cause the exhaust gas to enter the indoor areas, and result in carbon monoxide poisoning.



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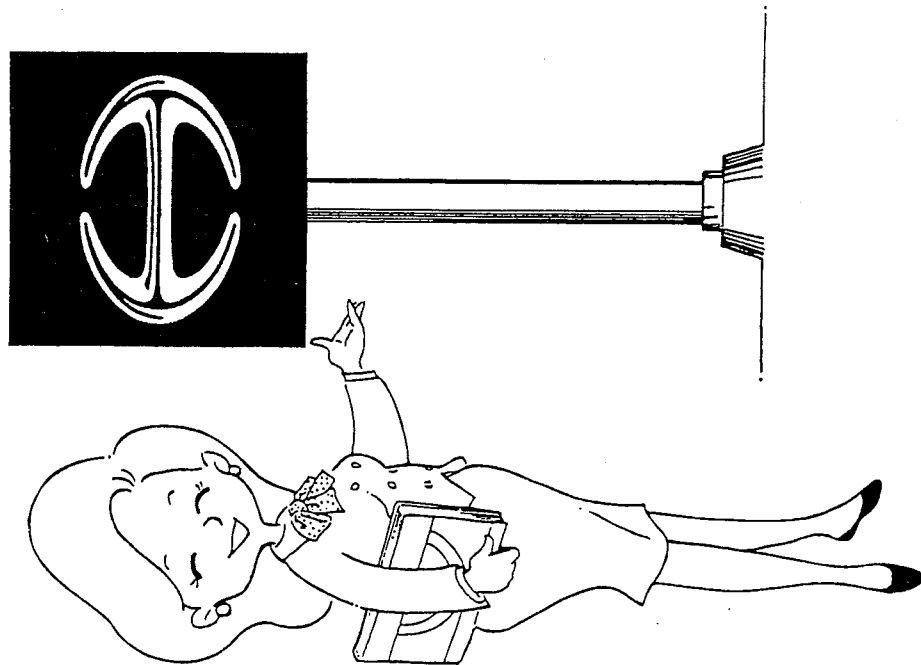
- Be sure to warm up the engine before operating it, and perform idling before stopping the engine.





## 2. BASIC ENGINE CARE

2-1



D2-00-01ZB

- WARRANTY ..... P2- 2
- ENGINE INSPECTION ..... P2- 3
- BREAKING-IN THE  
NEW ENGINE ..... P2- 4

## WARRANTY

HINO engines are produced using the latest production technologies and under conditions of thorough quality control. We are sure you will be satisfied with your engine's performance and functions. However, if there should be a manufacturing related problem, we will repair it without charge as long as it is covered by the conditions described in the warranty card. Please refer to the warranty card for details.

## ■ INSPECTION AND MAINTENANCE

- Regarding periodic and specific maintenance, please consult your dealer.

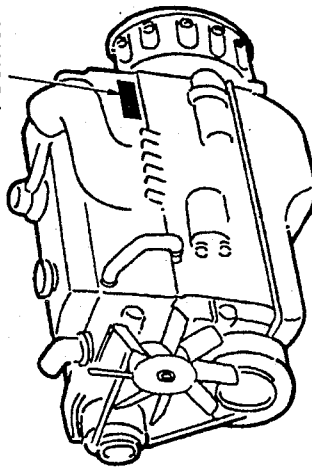
## ■ MAINTENANCE AND PURCHASING OF PARTS

- When you have your engine repaired or when you order spare parts, please contact your dealer quoting the "engine model" and the "engine number" to obtain smooth and prompt service.

## ■ ENGINE MODEL AND NUMBER

- The engine model and serial numbers are engraved on the engine block.  
EXAMPLE: H07D A10001

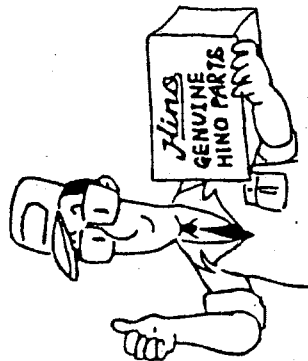
ENGRAVED  
POSITION



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## ■ GENUINE PARTS

- When purchasing parts, always specify "Genuine HINO parts". Since we guarantee the quality of "Genuine HINO parts", you can depend on their reliability.
- "Genuine HINO parts" carry the label HINO shown below on the products themselves or on the packing paper or packaging they come in.



D2-01-01ZB



HINO MOTOR

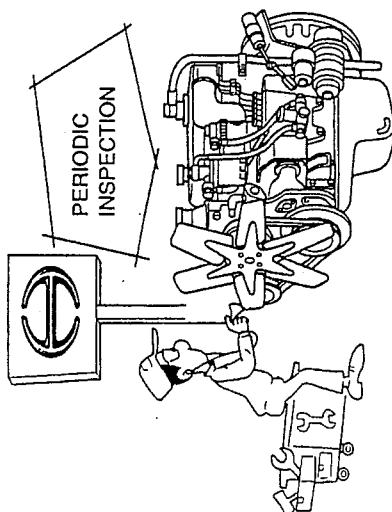
HINO

HINO MOTOR



A-189

## ENGINE INSPECTION



M2-356

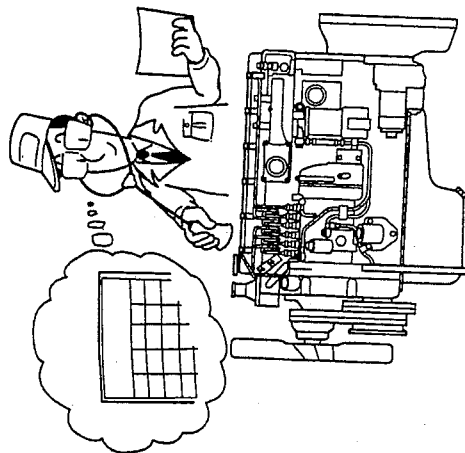
F-630

### ■ PERIODIC INSPECTION

Periodic inspection and maintenance are vital for ensuring maximum engine performance and long service life. Conduct periodic inspection and maintenance according to the methods described in the periodic inspection and maintenance chart. Note that problems caused by neglecting inspection or oil and/or grease replacement will not be covered by the warranty.

### 👉 ADVICE

The degradation of the engine progresses and the performance of the component parts and of its equipment reduces depending upon the length of operation period as well as the quality of care. Please make sure to perform regular inspections and maintenance, in order to avoid damage and to reduce exhaust gas and noises which adversely affect the social environment.



F-631

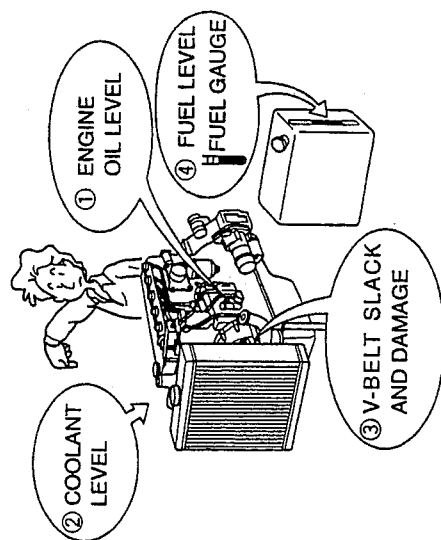
### ■ PERIODIC REPLACEMENT PARTS

With the passage of time, there are a reduction in quality and a progress in the degradation of engine parts such as rubber parts which are important from a safety viewpoint. It is hard to determine how much longer those parts can be used safely during periodic inspection. Since such component parts play an important role in ensuring their performance, function, and safety, make sure to replace these parts periodically according to the schedule specified by HINO.

### 👉 ADVICE

Please note that the periodic replacement of parts is to be the responsibility of and paid for by you, and is different from repair work covered by the warranty. Depending upon operating conditions and other considerations it may be necessary to replace such parts earlier than the time specified in the replacement schedule. At such time please consult your dealer.

### ■ DAILY (BEFORE STARTING THE ENGINE) INSPECTION



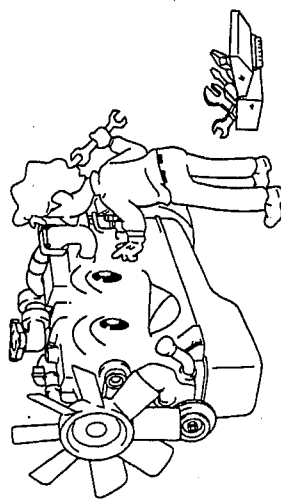
F-532

- To ensure safe and trouble-free use of the engine, inspect the following items everyday before starting the engine.

- ① Engine oil level
- ② Coolant level
- ③ V-belt slack and damage
- ④ Fuel level

### ■ INSPECTION AND MAINTENANCE

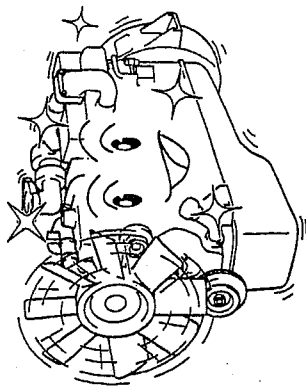
- To ensure optimum engine performance, check the following inspection items and conduct inspection and maintenance regularly which are included in the periodic inspection and maintenance chart. These items and procedures can be performed by a person with basic knowledge of engine structure and components.



F-535

- To ensure safety, follow the instructions contained in "PRECAUTIONS OF SAFETY" on page 5-2.

### BREAKING-IN THE NEW ENGINE



F-536

- The first 30 hours is the breaking-in period. Pay attention to the following points when breaking-in the engine.
  - Be sure to warm up sufficiently.
  - Avoid racing the engine. It is not only puts a strain on the engine, but also wastes fuel.
  - Make every effort not to operate the engine in overload.
  - After the 30 hours of break-in period, change the engine oil.

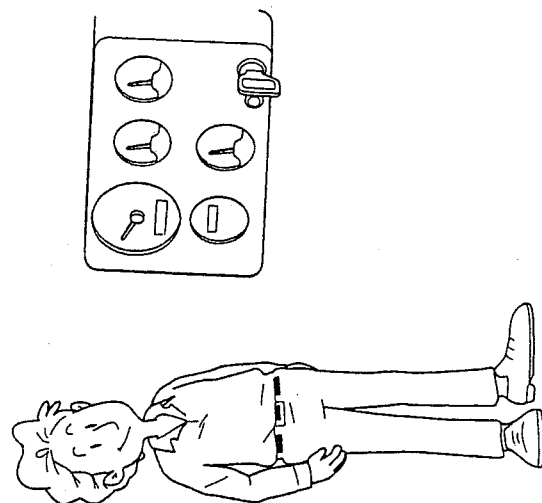
# 3. METERS, GAUGES AND LAMPS



When the warning lamps light up or the instruments indicate any abnormality, be sure to idle the engine immediately and carry out inspections and repairs in accordance with this handbook. If you continue to operate ignoring the warnings of the warning lamps or the instruments, it might result in an unexpected accident. When you cannot find the cause or you cannot service it by yourself, have the engine inspected and repaired at your dealer.

- The following instruments are equipped to engines of the standard specifications to check the engine conditions before starting it and during its operation.
- The instruments vary depending on the type of machines installed. Please refer to the machines' "OPERATION MANUAL" for details.

• METERS, GAUGES AND LAMPS NECESSARY FOR OPERATION ....	P3- 2
• COOLANT TEMPERATURE GAUGE .....	P3- 5
• OIL PRESSURE GAUGE .....	P3- 6
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• AMMETER AND CHARGE WARNING LAMP .....	P3- 7
• TACHOMETER AND HOUR METER .....	P3- 8
• HOUR METER .....	P3- 8
• BATTERY SWITCH .....	P3- 9
• ENGINE STOP BUTTON .....	P3- 9
• FUSE BOX .....	P3- 9

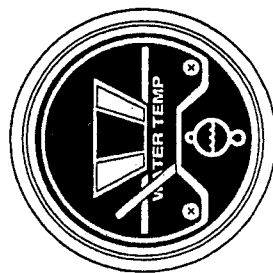


# METERS, GAUGES AND LAMPS

## METERS, GAUGES AND LAMPS NECESSARY FOR OPERATION

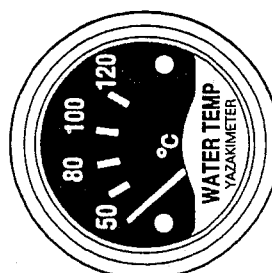
► Coolant temperature gauge ..... Page 3-5

[TYPE I]



F-614

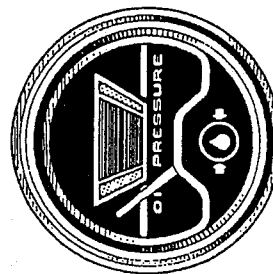
[TYPE II]



F-612

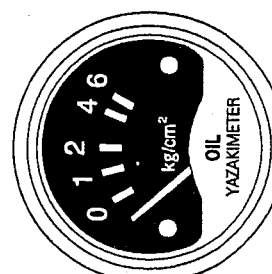
► Oil pressure gauge ..... Page 3-6

[TYPE I]



F-331

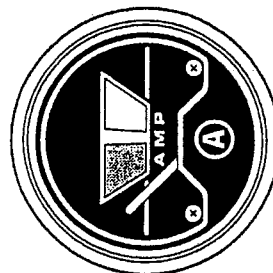
[TYPE II]



F-451

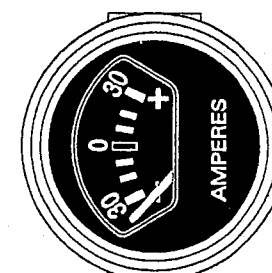
► Ammeter ..... Page 3-7

[TYPE I]



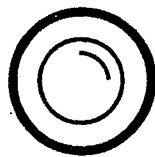
F-615

[TYPE II]



F-606

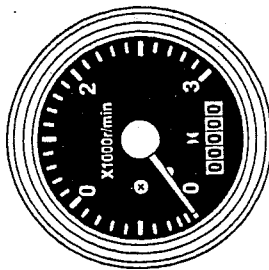
▶ Charge warning lamp ..... Page 3-8
 ▶ Tachometer and Hour meter .... Page 3-8
 ▶ Hour meter ..... Page 3-8



CHARGE

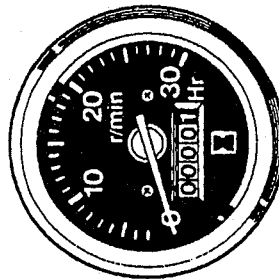
F-199

[TYPE I]

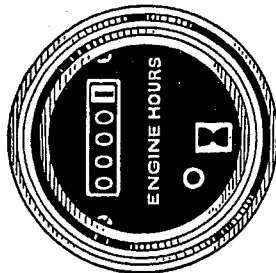


F-616

[TYPE II]



F-287

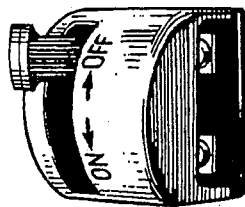


F-332



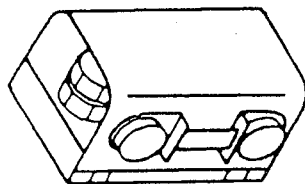
# METERS, GAUGES AND LAMPS

► Battery switch ..... Page 3-9      ► Fuse box ..... Page 3-9      ► Heater signal indicator ..... Page 4-2

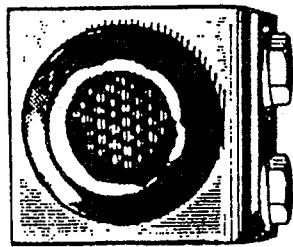


(The shape of this switch will differ depending on the machines model.)

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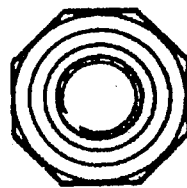


F-461



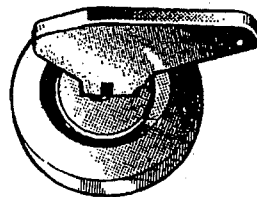
F-302

► Engine stop button ..... Page 3-9      ► Starter switch ..... Page 4-2      ► Preheat indicator lamp ..... Page 4-2

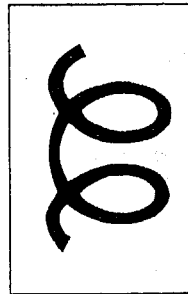


ENGINE STOP

F-200



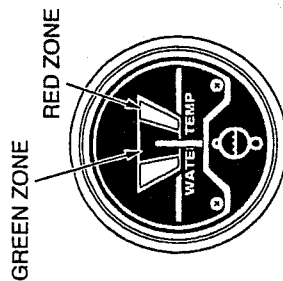
F-335



D6-01-08ZA

## COOLANT TEMPERATURE GAUGE

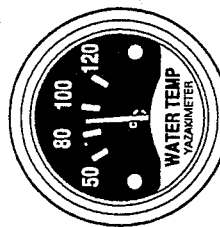
[TYPE I]



F-539

Green zone	Normal operating temperature zone
Red zone	Dangerous temperature zone

[TYPE II]



F-540

Normal operating temperature zone	80 – 95°C {176 – 203°F}
Dangerous temperature zone	98°C {208°F} or higher

- This gauge indicates the engine coolant temperature.
- If the needle enters the dangerous temperature zone, idle the engine until the needle returns to the normal operating temperature zone, then stop the engine and look for the cause of trouble.

### ADVICE

Turning off the overheated engine immediately risks seizure of the engine. Be careful not to do so.

- After having stopped the engine, check the amount of coolant and check the coolant leakage in the cooling system. If there is enough coolant and there is no leakage in the system, it is necessary to perform further inspection and maintenance work. Contact your dealer.

### ⚠ WARNING

D1-06-01ZB

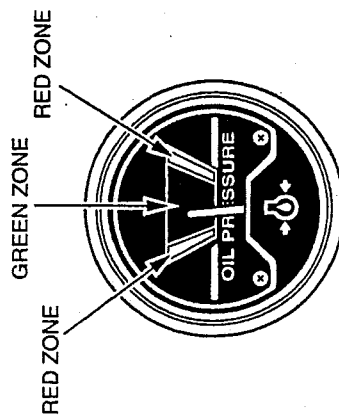
Never touch the radiator cap until the coolant temperature is below the normal temperature range. Opening the radiator cap carelessly can lead to scalding and other injuries due to spurt-  
ing out of hot coolant.

**NO!!**

- Depending on the machine model, a reserve tank may also be attached. When supplying coolant, be sure to fill up the reserve tank up to the "FULL" line and check the leakage.

## OIL PRESSURE GAUGE

[TYPE I]



F-629

- This gauge indicates the engine oil pressure.

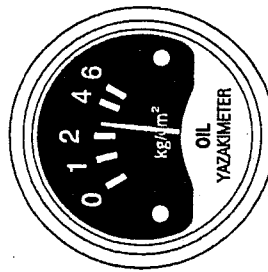
Green zone	Normal pressure
Red zone	Abnormal pressure

- If the needle is in the red zone, it indicates that the oil pressure is abnormally low or the lubricating system is malfunctioning.
- If the needle enters the red zone, stop the engine and make sure of oil leakage.
- If lowering of the engine oil level and oil leakage are noted, contact your dealer. If you continue to operate, it may result in the engine seizure.

### ADVICE

When the gauge is in the red zone, it indicates very abnormal. Be sure to stop the engine immediately and check for the causes of trouble. If you continue to operate, it may result in the engine seizure.

[TYPE II]



F-613

- This gauge indicates the engine oil pressure.

Engine condition	Oil pressure
At idling speed	197 - 294 kPa {2.0 - 3.0 kgf/cm <sup>2</sup> , 29 - 42 lbf/in <sup>2</sup> }
At maximum pressure	393 - 490 kPa {4.0 - 5.0 kgf/cm <sup>2</sup> , 57 - 71 lbf/in <sup>2</sup> }

- This gauge indicates a higher value as the engine revolution speed increases.
- \* When the engine is cold, the oil pressure may temporarily rise higher than normal immediately after starting the engine. However, the oil pressure will drop when the engine is warmed up.
- \* The oil pressure varies depending on the engine specifications as well as the operating environment and conditions.

### ADVICE

When the needle exceeds the maximum pressure range, it indicates abnormal. Be sure to stop the engine immediately and check for the causes of trouble. If you continue to operate, it may result in the engine seizure.

# METERS, GAUGES AND LAMPS

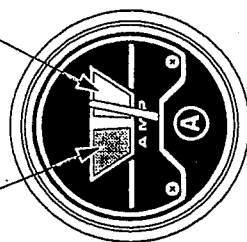
## FUEL GAUGE

## AMMETER AND CHARGE WARNING LAMP

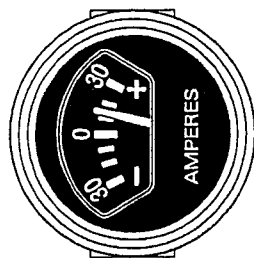
### ► Ammeter

[TYPE I]

RED ZONE GREEN ZONE



[TYPE II]



F-617

F-452

- \* Refer to the your machine's "OPERATION MANUAL".
- \* If the engine runs out of fuel, the fuel system must be bled of air. For details of air bleeding the fuel system, refer to "AIR BLEEDING OF THE FUEL SYSTEM" on page 5-11.

### ⚠️ **ADVICE**

To avoid engine trouble, do not use fuel of bad quality or substitute fuel and when supplying fuel make sure dust and water do not get into the tank.

- This gauge indicates the charging condition of the battery.

Green zone	Charging
Red zone	Discharging

- \* When the needle enters the red zone, it indicates that the battery has been over-charged or that the generated electricity is short.

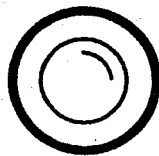
- This gauge indicates the charging condition of the battery.

(+) zone	Charging
(-) zone	Discharging

- \* When the needle enters the discharging (-) zone, it indicates that the battery has been over-discharged or that the generated electricity is short.

# METERS, GAUGES AND LAMPS

## ► Charge warning lamp



CHARGE

F-198

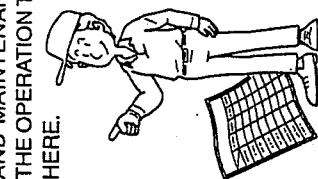
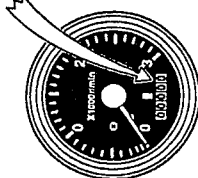
- When the charge warning lamp lights up, it indicates that the battery is not charged. Normally the lamp lights up when the starter switch is turned to the "ON" position, and turns off when the engine starts.

### ⚡ ADVICE

Never operate the engine while this lamp lights up. This may cause damage of electronic equipment or battery over-discharge.

## TACHOMETER AND HOUR METER

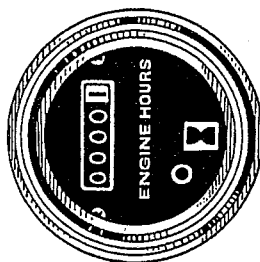
PERFORM REGULAR INSPECTION AND MAINTENANCE BASED ON THE OPERATION TIME DISPLAYED HERE.



F-541

- The tachometer indicates the engine speed in revolutions per minute. The hour meter housed inside of the tachometer indicates the total amount of operation time. Perform regular inspection and maintenance based on the operation time displayed here.

## HOUR METER



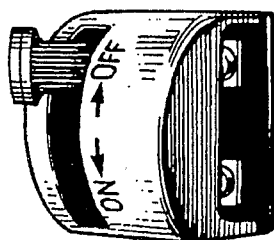
F-332

- The hour meter detects the rotation of the camshaft in the same way as a tachometer. Based on the camshaft rotation transmitted through the tachometer drive and flexible cable, the hour meter indicates cumulative operating hours.

# METERS, GAUGES AND LAMPS

3-9

## BATTERY SWITCH



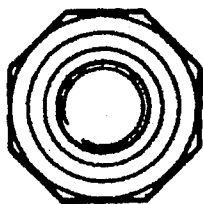
F-333

- It is the main switch for cutting off and connecting the electric circuit at the positive (+) terminal. Even if you turn the starter switch, the engine does not start until the battery switch is turned to the "ON" position. Also, be sure to turn this switch to the "OFF" position after turning off the starter switch.

### ADVICE

- Leaving this switch in the "ON" position for long periods while the engine is not operating may cause the battery to die.
- Do not turn this switch to the "OFF" position in the case of engines used for emergency own power plant, since such engines have to stand by and be ready for operation at anytime.

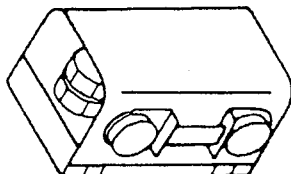
## ENGINE STOP BUTTON



ENGINE STOP

F-200

- This button is used for stopping the engine.
- Keep the button pushing until the engine stops.
- Be sure to turn off the starter switch and the battery switch after the engine has stopped.



## FUSE BOX

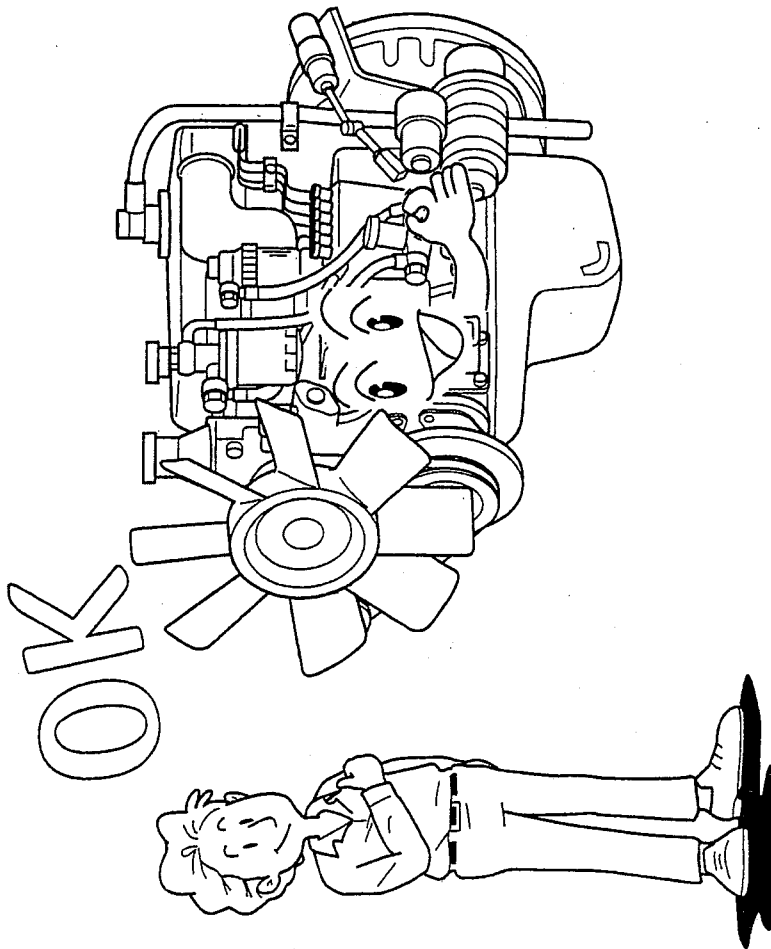
F-461

- When a fuse blows, turn off the starter switch and the battery switch, and then replace the affected fuse with a new one of the specified amperage. If a fuse blows repeatedly, have the electrical system inspected and repaired by your dealer.



## 4. PROPER OPERATION

4-1



F-634

### ADVICE

Items contained in this section are based on the standard specifications of HINO industrial engines. Depending on the machine model, they may not be the same as your engine. Please refer to the "OPERATION MANUAL" of your machine.

- STARTER SWITCH ..... P4- 2
- STARTING THE ENGINE ..... P4- 3
- ENGINE WARM-UP ..... P4- 5
- PRECAUTIONS TO TAKE WHEN OPERATING THE ENGINE ..... P4- 6
- STOPPING THE ENGINE ..... P4- 6
- HANDLING IN COLD WEATHER ..... P4- 7
- HANDLING IN HOT WEATHER ..... P4- 8
- LONG-TERM STORAGE OF THE ENGINE ..... P4- 9



## PROPER OPERATION

### STARTER SWITCH

#### ■ KEY POSITIONS

##### ► "OFF" position

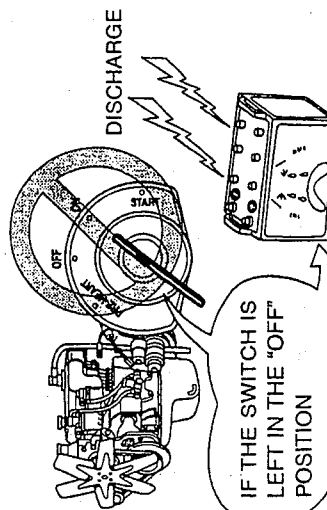
- In this position, the key can be inserted or removed.

\* Be sure to set the switch to this position after the engine is stopped.



#### ADVICE

Be sure to always set the switch to the "OFF" position when the engine is not running. Leaving the switch in the "ON" position for a long period of time when the engine is not running may result in loss of battery power and cause the engine not to start.



F-635

##### ► "ON" position

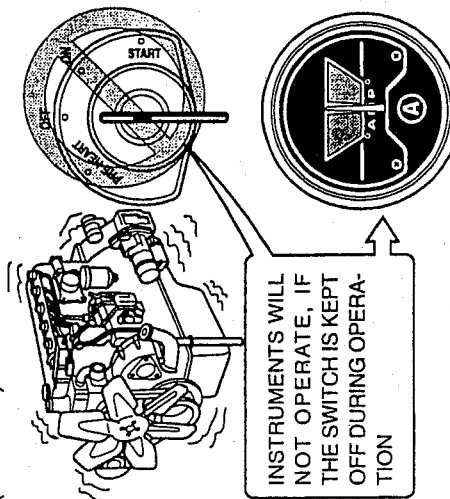
- This is the position in which the engine is running.



#### CAUTION

Always leave the key in the "ON" position while running. When it is in the "OFF" position the warning lamps and instruments necessary for operation will not operate and it is very dangerous. It also damages the electric circuit.

(EXAMPLE)



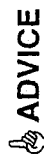
F-636

##### ► "START" position

- This is the position used to start the engine.

##### ► "PREHEAT" position

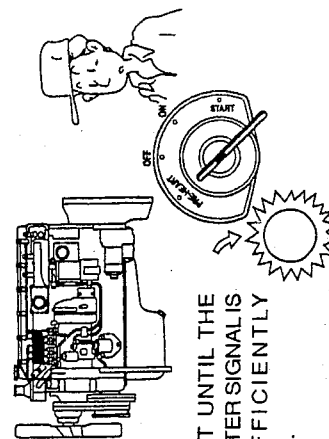
- This is the position used to preheat the engine.
- When the engine is cold, turn the key fully to the left and set it to this position.
- By using the heat generated by the intake air heater, the intake air is heated to facilitate engine start. The heating condition is indicated by heater signals or displayed by the preheat indicator lamp.



#### ADVICE

(MODELS EQUIPPED WITH THE HEATER SIGNAL INDICATOR)

Turn the starter key to the "PREHEAT" position and hold for about 20 to 25 seconds and heat until the heater signal indicator is sufficiently red.



F-637

# PROPER OPERATION

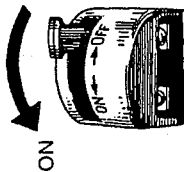
4-3

## STARTING THE ENGINE

Depending on the machines, they may be different in the way the engine is started or stopped. Please refer to the "OPERATION MANUAL" of your machine.

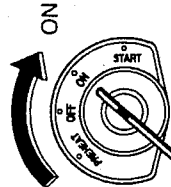
### NORMAL STARTING AND WHEN THE ENGINE IS WARMED UP

- ① Turn the battery switch to the "ON" position.



F-590

- ② Insert the starter key and turn it to the "ON" position. Check that all instruments are operating properly.



F-546

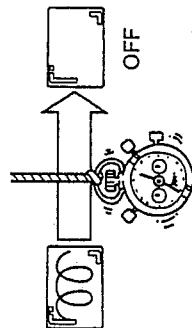
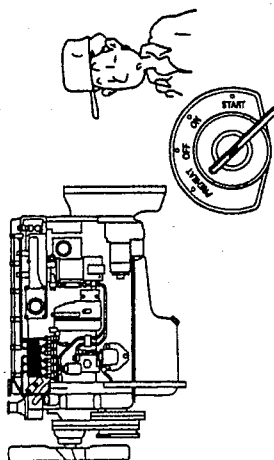
### ADVICE

If there is anything abnormal with the operation or the lighting up of any of the instruments or warning lamps, turn off the starter switch and the battery switch, and then inspect the abnormal area.

### ADVICE

[MODELS EQUIPPED WITH THE PREHEAT INDICATOR LAMP]

Turn the starter key to the "PREHEAT" position, the preheat indicator lamp turns on. And hold for about five seconds, the lamp turns off when preheating is completed.

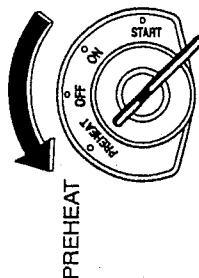


F-661

- ③ Turn the starter key to the "START" position and start the engine.

### STARTING THE ENGINE IN COLD WEATHER

- ① Turn the starter key fully to the left to the "PREHEAT" position.



F-547

- ② The intake air heater heats up and facilitates engine start.

[MODELS EQUIPPED WITH THE HEATER SIGNAL INDICATOR]

It takes about 20 to 25 seconds for the heater signal to turn fully red and preheating to be completed.

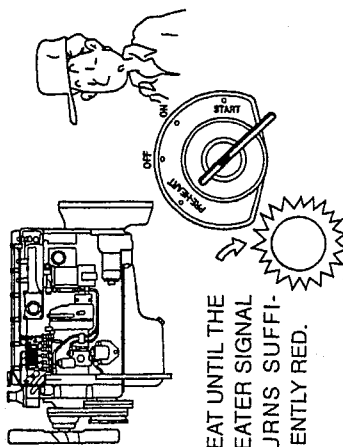
[MODELS EQUIPPED WITH THE PREHEAT INDICATOR LAMP]

When the starter key is set to the "PREHEAT" position, the preheat indicator lamp turns on. When the preheat operation is completed in about five seconds, the lamp turns off.

# PROPER OPERATION

## [MODELS EQUIPPED WITH THE HEATER SIGNAL INDICATOR]

- ③ Turn the starter key to the "START" position and start the engine after the heater signal has turned sufficiently red.

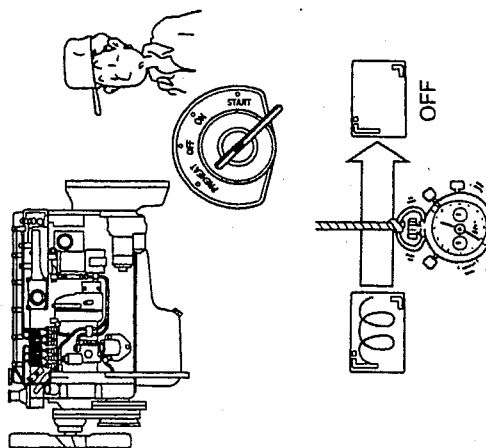


HEAT UNTIL THE  
HEATER SIGNAL  
TURNS SUFFI-  
CIENTLY RED.

F-637

## [MODELS EQUIPPED WITH THE PREHEAT INDICATOR LAMP]

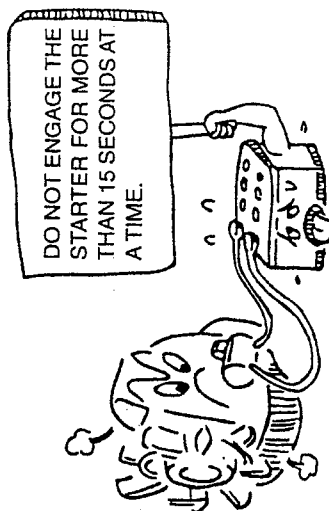
- ③ The preheat indicator lamp lights up and then turns off when preheating is completed. When the lamp turns off, turn the starter key to the "START" position and start the engine.



F-661

### ADVICE

- If the engine does not start on the first attempt, wait approximately 30 seconds for the batteries to recover before trying again.
- Do not engage the starter for more than 15 seconds at a time.



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### ADVICE

As the preheater consumes a great deal of electric power, avoid repeated operation as much as possible, because it will impose a great burden on the batteries.

# PROPER OPERATION

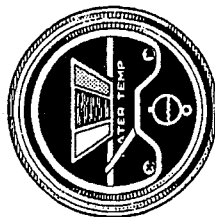
4-5

## ENGINE WARM-UP

① When the engine starts, use the accelerator lever to run the engine at a little higher than the normal idling speed.

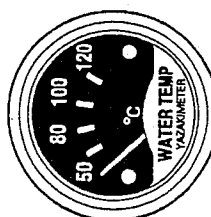
② Continue warm-up the engine until the needle of the coolant temperature gauge starts moving.

[TYPE I]



F-339

[TYPE II]



F-612

③ When the needle has started moving, return the engine to the normal idling speed. The normal idling speed rate is different depending on the machines. Please refer to the "OPERATION MANUAL" of your machine.

• After warm-up operation, observe the engine condition and inspect all sections of the engine to ensure proper operation.

① Normally, during idling and operating the engine, the needle of the oil pressure gauge is in the normal pressure zone. If the needle is in the abnormal pressure zone, it indicates that something is abnormal. In case of engine models equipped with the oil pressure warning lamp, the lamp lights up when the pressure is abnormally low.

In each of these abnormal cases, be sure to stop the engine immediately and perform inspection and repairs. Engines equipped with an "emergency relay" will shut down automatically.

② Pay attention to the engine noise and check the color of the exhaust gas. If you notice any abnormality in the engine noise, stop the engine immediately and perform inspection and repairs. Also, monitor the color of the exhaust gas to identify combustion conditions.

**Differences in exhaust gas color (when the engine is warm)**

**Colorless or light blue ..... Complete combustion**

**Black ..... Incomplete combustion**

**White ..... Oil combustion due to oil loss via the piston ring or the valve guides**



## CAUTION

**When operating the engine make sure there are no combustible material near the exhaust pipe.  
The heat from the exhaust can cause a fire.**

③ Check that the coolant temperature is normal. Through the action of the thermostat, the temperature of the coolant is kept within the normal operating temperature zone. The engine is started, and then the needle of the coolant temperature gauge starts moving to the right and enters the normal operating temperature zone.

If in cold weather the needle does not enter the normal operating temperature zone even after an extended period of time, use a radiator curtain or such to reduce the radiator core area and over-cooling.

[TYPE I]

Green zone	Normal operating temperature zone
Red zone	Dangerous temperature zone

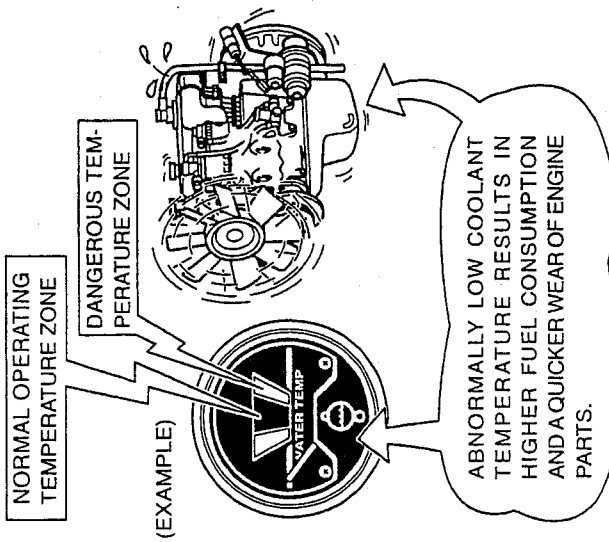
[TYPE II]

Normal operating temperature zone	80 - 95°C {176 - 203°F}
Dangerous temperature zone	98°C {208°F} or higher

## PROPER OPERATION

### PRECAUTIONS TO TAKE WHEN OPERATING THE ENGINE

- When the coolant temperature is abnormally low, it results in a higher fuel consumption and a quicker wear of engine parts.



F-638

### ⚠ WARNING

Do not warm up the engine in a poorly ventilated area. It is dangerous because the exhaust gas can cause carbon monoxide poisoning.

### STOPPING THE ENGINE

- **IDLING BEFORE STOPPING THE ENGINE**
  - Before stopping the engine, idle the engine for three to five minutes to cool down it.
  - To stop the engine, use the engine stop button or pull the stop lever completely. The fuel supply to the injection pump is shut off and the engine stops.
  - After stopping the engine, be sure to turn the starter key to the "OFF" position and then the battery switch to the "OFF" position.

### 👉 ADVICE

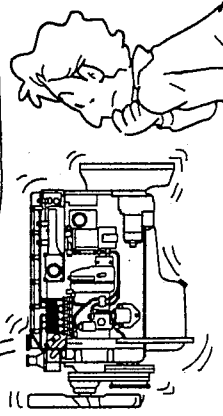
Stopping the engine immediately after operation without cooling down by idling is not good for the engine. Particularly in the case of engines equipped with a turbocharger or an engine that has been operated under a great load, the various parts of the engine will be in overheated condition. Therefore be sure to cool down the engine sufficiently by idling before stopping it.

- Pay attention to the following while operating.
- The oil pressure is normal.
  - The coolant temperature is normal.
  - The batteries are properly charged.
  - There are no fuel, coolant, oil, or gas leakages.
  - There are no abnormal noises from the engine or other sources.

(EXAMPLE)



- Is the engine oil pressure normal?
- What about the coolant temperature?
- What is the state of alternator power generation?
- Are there any fuel or coolant leakages?
- Are there any abnormal noises from the engine or other sources?



F-639

# PROPER OPERATION

4-7

## ■ INSPECTION OF ENGINE AFTER OPERATION

In addition to cleaning the engine after operation, perform the following.

- Inspect and repair areas which had appeared faulty during operation.
- Check to see that there are no loose or damaged parts and no oil or coolant leakages.
- If you are not using an antifreeze mixture during the winter season, drain all the coolant from the engine. If the coolant is not drained, it can freeze and crack the crankcase or the coolant system or cause other damage.

The engine needs special care in areas where there is a lot of snow, mountainous regions or other extreme cold areas.

## HANDLING IN COLD WEATHER

### ■ PRECAUTIONS TO TAKE WHEN STARTING THE ENGINE

- Preheat the engine before starting it.
- After starting the engine, warm up the engine by idling at a little higher than the normal idling speed.

#### 👉 ADVICE

When the engine is cold, do not race the engine or repeat racing of the engine without load just after starting the engine nor maintain a high engine speed because, if these are done, they can cause not only engine trouble but also waste fuel.

- Occasionally remove the drain plug of the fuel tank to drain the water content from inside the tank.

#### 👉 ADVICE

Summer 2-D diesel fuel may freeze when the outside temperature drops below -10°C {14°F}. When the fuel freezes, the engine cannot start. In cold areas, use Winter 2-D diesel fuel.

## ■ PRECAUTIONS REGARDING THE ENGINE OIL

- When operating the engine in cold areas, be sure to use the type of oil with the appropriate viscosity because engine oil viscosity increases as outside temperature falls.

## ■ PRECAUTIONS TO TAKE DURING FUEL REPLENISHMENT

- Be sure to fill up the fuel tank after the operation. In cold weather, if the fuel level is low and there is an increase in the amount of air inside the fuel tank, the vapor contained in the air can turn into drops of water, which may freeze or cause rust in the fuel system, resulting in engine trouble or breakdowns.
- Be sure to tighten the fuel tank cap firmly to prevent rain or snow from getting into the tank.

## ■ PRECAUTIONS REGARDING THE COOLING SYSTEM

- Always mix antifreeze with the coolant to prevent it from freezing and damaging the engine and radiator.

#### 👉 ADVICE

If you are not using an antifreeze with the coolant, always be sure to remove all the drain cocks from the crankcase and the radiator and drain all of the coolant after completing operation.

## PROPER OPERATION

### HANDLING IN HOT WEATHER

#### ■ PRECAUTIONS REGARDING THE BATTERY

- Battery power declines in cold weather and the battery freezes more easily. Therefore try to keep the batteries fully charged at all times.
- Always charge the battery by running the engine after adding replenisher, to prevent the battery from freezing.

#### 👉 ADVICE

When it is extremely cold temperature, remove the battery and store it indoors if it is not being used for an extended period of time.

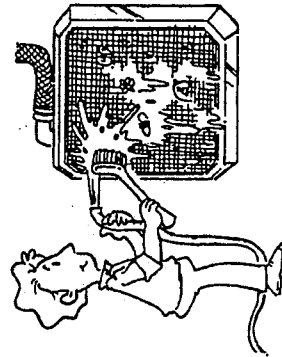
The engine can overheat more easily in hot weather. Therefore the handling of the cooling system needs special attention.

#### ■ PRECAUTIONS REGARDING THE ENGINE OIL

- Since engine oil viscosity decreases as outside temperature rises, always use oil with the appropriate viscosity when operating the engine in hot weather.

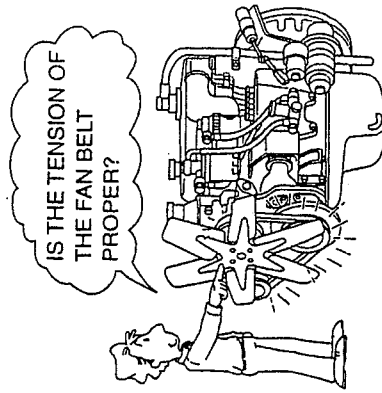
#### ■ PRECAUTIONS REGARDING THE COOLANT SYSTEM

- When the weather is hot, scale and rust will build up more easily in the cooling system, particularly inside the radiator. Therefore, replace the coolant occasionally and ensure that the coolant circulating inside the cooling system is always clean.
- The front of the radiator may get clogged with mud and dust, resulting in decreased cooling efficiency. Therefore, regularly wash off the front of the radiator with water.



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- Always check the fan belt for proper tension and make sure the tension conforms to the standard value.



F-640

#### ⚠ WARNING

Never touch the radiator cap until the coolant temperature is below the normal temperature range. Opening the radiator cap carelessly can lead to scalding and other injuries due to spurt-ing out of hot coolant.

#### ■ PRECAUTIONS REGARDING THE BATTERY

- Battery electrolyte consumption is higher in hot weather, therefore check the electrolyte level more frequently and make sure the battery is always filled up with replenisher or distilled water up to the "UPPER" level.

## LONG-TERM STORAGE OF THE ENGINE

**⚠ DANGER**

Since the batteries produce explosive hydrogen gas, keep open flame and electric sparks away from the batteries. It is very dangerous and could cause the batteries to catch fire and cause the batteries to explode.

**⚠ WARNING**

Battery electrolyte is sulfuric acid and can burn your skin and clothing. If battery electrolyte should contact your skin, wash the area thoroughly with soap and water. If it should contact your eyes, immediately flush your eye thoroughly with water and get prompt medical treatment.

**👉 ADVICE**

- When replenishing to the battery, be sure not to fill above the "UPPER" level. Filling above the "UPPER" level may result in the overflow of the replenisher causing the corrosion of terminals, etc.
- Always charge the battery by running the engine after adding replenisher.

When the engine is going to be idle for a period of time, it should be fully dried and put away for storage according to the procedure described below.

Regarding storage of the engine, please consult your dealer.

### ■ WHEN THE ENGINE CAN BE OPERATED WHILE IN STORAGE

Be sure to run the engine at least once a week, and let the oil and grease reach every part of the engine. Before operating the engine, be sure to idle the engine via the starter switch, and to check that the oil pressure is sufficient by the oil pressure gauge.

### ■ WHEN THE ENGINE IS NOT OPERATED FOR A LONG TIME

▶ When the engine is idle for a comparatively shorter period (approximately within one month)

Securely cover all fuel, oil, grease, air, and coolant related openings, and take care to prevent moisture.



F-641

▶ When the engine is idle for a long time (approximately for more than three months)

Store the engine according to the following procedure.

- **Rust prevention measures for engine body**
  - ① After removing the oil from the oil pan and the fuel injection pump, replace it with anti-rust oil 2 described on page 4-11, filling in the oil in the same way that engine oil is supplied.
  - ② By using the normal fuel, run the engine at a constant speed for about 15 minutes, then stop it.



## PROPER OPERATION

- ③ Next, drain all the fuel from inside the tank, replace it with antirust oil 1 and run the engine at idling speed until the antirust oil has spread throughout the fuel system.
- ④ A few seconds before you stop the engine, spray antirust oil 2 through the intake manifold, timing it to operate the stop lever or the stop button to stop the engine. Since, at such time, there is a danger of the engine speed rising suddenly, spray the oil in smaller quantities, carefully increasing the frequency gradually.
- ⑤ When the engine has cooled down enough to be touched, remove the nozzle. After making sure that the upper part of each piston is at the center of the cylinder liner, spray antirust oil 2 into the interior of the cylinder liner (until the oil accumulates up to a point above the pistons) and then mount the nozzle.
- ⑥ Remove the cylinder head cover, and spray antirust oil 2 on the rocker arms and other moving parts. After loosening the adjusting screw, install the head cover.
- ⑦ Drain the coolant completely, and then close all the drain cocks.
- ⑧ When the rust prevention measures are completed, be sure to completely seal all fuel, oil, grease, air, and coolant related openings with waterproof tape.

- ⑨ Apply paint as needed to mend damaged painted parts. Lightly apply antirust oil 2 to metal parts that do not need to be painted.

### ● Rust prevention measures for auxiliary devices

- ① After cleaning the air cleaner, seal it with waterproof tape.
- ② Clean the insides of the alternator, the starter and the relays with dry compressed air and cover them with dustproof, waterproof covers.
- ③ Loosen the tension of the V-belt.
- ④ Charging the battery fully after filling up it with replenisher or distilled water, and disconnect all its cables. Be sure to recharge the battery about once a month.

### 👉 ADVICE

If engine is kept idle for more than a year, perform the above procedure repeatedly.

■ **PRECAUTIONS FOR REUSING AN ENGINE THAT HAS BEEN IDLE FOR A LONG TIME**  
There should be no problems using an engine that has been idle for a long time, if it has been started and warmed up about once a week during the period it has been idle. However, when reusing an engine that has been idle for some time and has not been warmed up periodically, be sure to perform the following inspection and maintenance before using the engine.

- ① Check and adjust the injection value of the fuel injection pump and the injection starting pressure of the nozzle with a tester. Also check the injection performance. Check and adjust the valve clearance.
- ② If you have used antirust oil 1 and antirust oil 2, replace the oil filters and fuel filters.
- ③ Remove the cylinder head and check the inside of the cylinder liner to make sure it has not rusted. (Corrective measures will be needed, if there is too much rust.) Pour the engine oil on the cylinder liner walls and the top of a piston, and then let the engine rotate a couple of times.
- ④ Replace the antirust oil inside the oil pan and the injection pump with the engine oil and check that there is a specified amount of the engine oil.

- ⑤ Before the test run of the engine, idle the engine with the starter for about 10 seconds to make sure all of the parts are lubricated. Also, open the cylinder head cover and make sure the rocker arm bearing and the push rod are sufficiently lubricated.
- ⑥ During the test run check that there are no fuel, coolant or gas leakages or other abnormalities.

## ■ RECOMMENDED ANTIRUST OILS

Maker	Antirust Oil 1 (for fuel)	Antirust Oil 2 (for lubrication)
CALTEX	564 Rust Proof Oil	Preservative 30
ESSO	Rust-Ban 337	P1010 Antirust P1020 P1030
MOBIL	Mobil Kote 501	Mobil Kote 503
SHELL	—	Shell Ensiss Engine Oil 30

