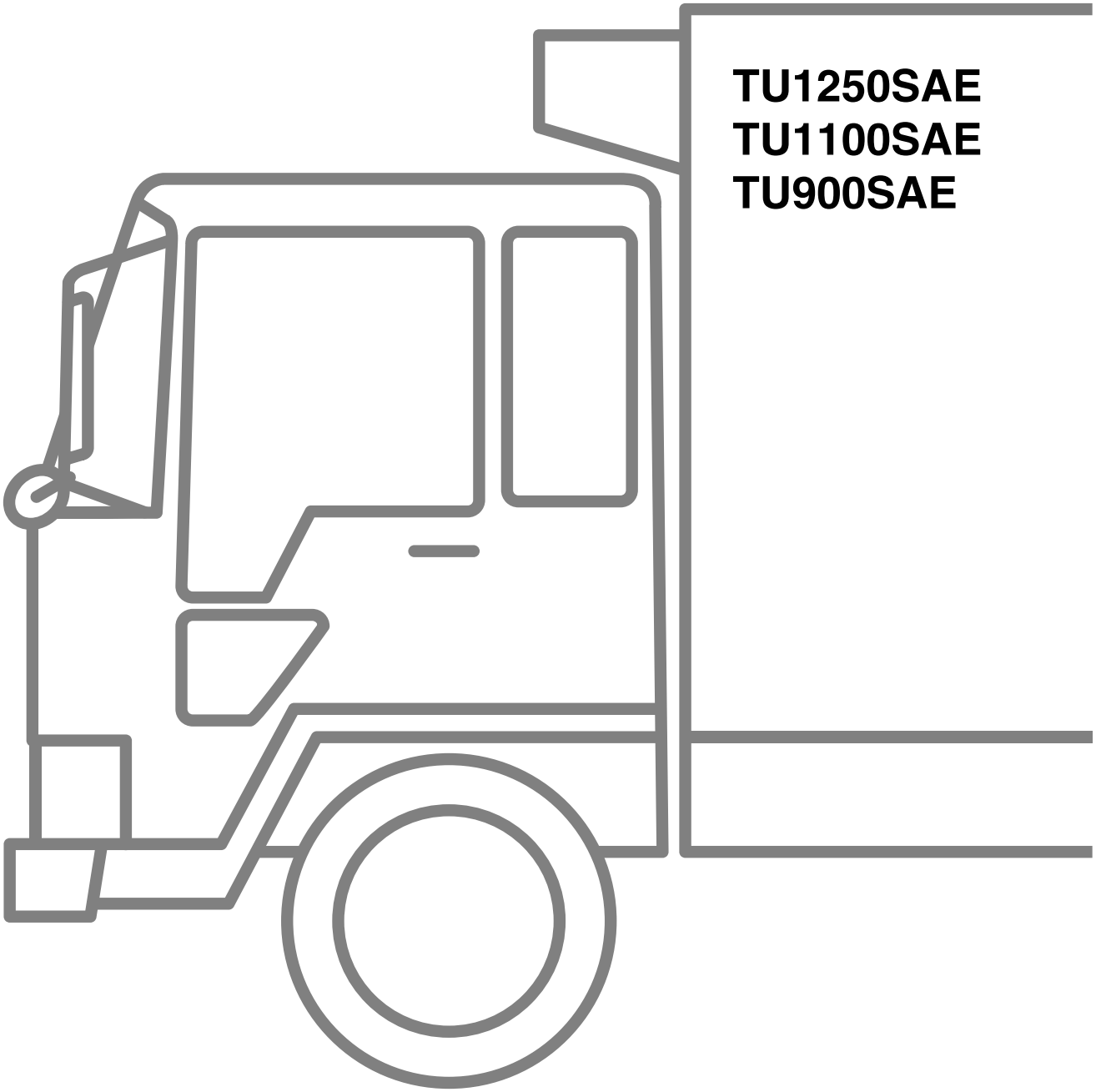
MITSUBISHI
TRANSPORT REFRIGERATION UNIT

SERVICE MANUAL



TU1250SAE
TU1100SAE
TU900SAE

CE

'20·TU-S·003

< TU1250SAE series: Main changes >

Model	Main change	Applicable unit serial No.
TU1250SAE-CN	－(Original specification)	007400001BL~

< TU1100SAE series: Main changes >

Model	Main change	Applicable unit serial No.
TU1100SAE-CN	－(Original specification)	007600001BL~

< TU900SAE series: Main changes >

* R

Model	Main change	Applicable unit serial No.
TU900SAE-CN	－(Original specification)	009300001BL~

< How to read unit serial No. >

First character shows the last digit of production year.
Next 3 characters shows the unit model and specification.
Next 5 characters shows the production number.

For example, 0 074 00001BL means unit was produced in 2020, unit model is TU1250SAE-CN and 1st at production in 2020.

< Main differences between TU1250, TU1100 and TU900 series >

* R

		TU1250SAE-＊	TU1100SAE-＊	TU900SAE-＊
Refrigerant amount		4.3kg	3.6kg	←
Economizer cycle		With	Without	←
Compressor		CSA130E	CSA130	←
Evaporator unit	TU100SAE-EV (*1)	○	○	－
	TU100SAE-EVX	○	○	－
	TU100SAE-EVMX	－	－	○
	TU100SAE-EVXMR (*1)	○	○	－

＊1 : ATP uncertified.

Introduction

This service manual describes fundamental matters and particular information of Mitsubishi transport refrigeration unit TU1250SAE, TU1100SAE and TU900SAE, and is intended to be used by the service personnel of the unit to perform test operation, inspection, trouble shooting and maintenance properly. *R

Read this manual thoroughly before working. Test operation, inspection, trouble shooting and maintenance of this unit must be done by the personnel fully understands the operation method and resulted movement of the machine.

To perform the proper installation of the unit, follow the instruction of the separated installation manual.

Important information

■ Purpose of use and application

This refrigeration unit is intended to carry the cargo (with the exception of volatile, inflammable, hazardous matters) on a transportation vehicle, keeping the inside container temperature at a certain temperature.

If the refrigeration unit is used for any purposes other than above, it may cause accidents or damages.

■ General

- To achieve above objective safely
  (a) Installation, test operation, inspection, trouble shooting and maintenance of this unit must be performed by the personnel who received a fundamental education of technical knowledge of refrigeration unit and have experienced a training about the hazard of the unit and prevention of such hazard.
  (b) Read this service manual thoroughly and fully understand the contents before executing installation, test operation, inspection, trouble shooting and maintenance of the refrigeration unit. Working with insufficient understanding may lead to an accident resulting in injury or death and a damage of refrigeration unit due to unexpected operation of the equipment.
  (c) Do not make modifications of the refrigeration unit and do not alter the contents of instructions regarding specification, operation and maintenance in principle. Otherwise, it may result in not only loosing capability of the unit but also being unable to secure the safety of the users. It may also lead to an accident resulting in injury or death and a damage of the equipment.
- All rights regarding the software of this unit are reserved by our company.
- Never use, reproduce or modify the software, in whole or part, to use with other product without prior written consent with our company.
- This service manual may contain descriptions for the items beyond the supply from our company.

■ Important matters for working safety

- The function of this product must be well understood in advance to maintain its function and to prevent potential hazard.
- Preventive measures for accidents must correspond with the operational function of this product to avoid occurrence of disasters.

- A safety-first activity must be performed systematically and continually by drafting a plan as a labor safety and health management system. The labor safety and health management system must include following items.
  (a) Proper arrangement of work place
  (b) Direction about preparation and usage of protective device for workers
  (c) Preparation of working management system such as fixing of working standard and clarification of directive structure
  (d) Implementation of education and training for workers
- Individual worker must participate in this activity positively and try to prevent happening of disasters by recognizing his/her role.
- Most important objective of safety measures is to prevent accidents resulting in injury or death as well as to protect products.
- Observe the precautions, advices and normal directions of the product described in this service manual with a thought of safety-first to prevent fatal disaster, injury, or damage of the refrigeration unit. If not observed,
  (a) your life could be threatened,
  (b) your health could be obstructed, and
  (c) the refrigeration unit could be damaged.
- We are not able to foresee all the potential risks inherent in this refrigeration unit itself, risks caused by people such as human error, and risks induced by the environmental conditions in which the refrigeration unit is used.
- There are so many things which「cannot be done」or which「should not be done」and it is not possible to convey everything by this service manual or by warning labels. Therefore, not only the items described in this service manual but also the safety measures generally required are necessary to perform test operation, inspection, trouble shooting and maintenance of the refrigeration unit.
- Our company is not responsible at all for any damage or injury introduced by not keeping the directions in this service manual or by not paying attention normally required.

■ Service manual

- This service manual is prepared for people who speak English. In case that person whose native language is not English handles this refrigeration unit, he or she must be instructed on safety by the dealer. Furthermore, the warning labels described in their native language must be prepared and stuck on the proper places.
- This service manual is copyrighted and all rights are reserved by our company. The drawings and technical information described in this manual may not, in whole or part, be published, copied, translated and reduced to any electronic medium or machine-readable form without prior written consent with our company.
- The refrigeration unit to be serviced may differ from the drawing of this service manual. Cover may be removed from the drawing to make the explanation of the inside easy.
- The contents described in this service manual may be changed without a prior notice.
- Keep this service manual in the prescribed place so that it is available for your reference when you need it.
- The part changed in a revised edition indicates「＊R」in the margin.

■ For disposal

- Contact your dealer when disposing the refrigeration unit.
- Observe the applicable laws and regulations in your country to dispose refrigeration unit and waste oil.

Contents

1. SAFETY

1.1 Summary

Safety matters described in this section is to be a guideline to prevent an accident of workers resulting in injury or death.

(1) Safety measures by the manufacturer
(Reference item) 1.4 Protective functions ……See page 12

(2) Understanding and practice by the users for the security of safety on machine operators
(Reference items) 1.3 Precautions ……See pages 8 ~ 12
1.5 Prevention of start during work ……See page 13
1.6 Clothing and protective equipment ……See page 13
1.8 For emergency ……See pages 13, 14

(3) Management by the users for machine operator and machine itself
(Reference item) 1.9 Labor safety and health management ……See pages 15, 16

The information related to safety and items related to installation, test operation, inspection, trouble shooting and maintenance described in this service manual must be used not only by itself but also in conjunction with periodical safety education and training in order to operate this refrigeration unit according to the labor safety and health management system elaborated by the entrepreneur.

This service manual contains the classification of importance (warning, caution and notice) explained in「1.2.1 Kinds and meanings of warning terms」(see pages 4, 5) and the warning messages in order to secure safety and to prevent damage of the refrigeration unit.
Understand and observe the contents of the warning message at each work.
These messages constitute important information at each work together with「1.3 Precautions」(see pages 8 ~ 12).

1.2 Warning

Following three measures are applied in the refrigeration unit to call worker's attention to a hazard.
・ Indication of the warning messages in this service manual
・ Warning labels on the refrigeration unit
・ Warning buzzer
Read carefully all the warning messages related to safety described in this service manual. Check all the places and contents of warning labels affixed on the refrigeration unit before test operation, inspection, trouble shooting and maintenance.

1.2.1 Kinds and meanings of warning terms

Expression related to safety
Warning messages shown on the warning labels and in this service manual give warnings to the expected dangerous situations during work together with「warning terms」classified in the following kinds.
Disregarding the warning message may lead to the accident corresponding to the「warning term」shown with the message. In an extreme case, it may result in a fatal accident, damage of important part for the refrigeration unit and its accessories, and environmental damage to the out side of the service facility.

Kinds	Description
⚠ **Danger**	Indicates high and imminent potentially dangerous situation, which if mis-handled, will result in death, injury, or serious accident such as damage of the refrigeration unit.
⚠ **Warning**	Indicates dangerous situation, which if mis-handled, will result in death, serious injury, and serious accident such as damage of the refrigeration unit.
⚠ **Caution**	Indicates potentially dangerous situation, which if mis-handled, will result in minor injury or moderate property damage.

Symbols

Symbols	Description	Symbols	Description
	Never perform.		Always observe the instructions.
	Disconnect power supply plug from socket.		Never touch.
	Repairs and disassembly must be done only by qualified personnel.		

Other symbol

Other advice for the refrigeration unit is described with the following symbol.

Kind	Description
	Useful information for function or performance of equipment.

1.2.2 Handling of warning labels

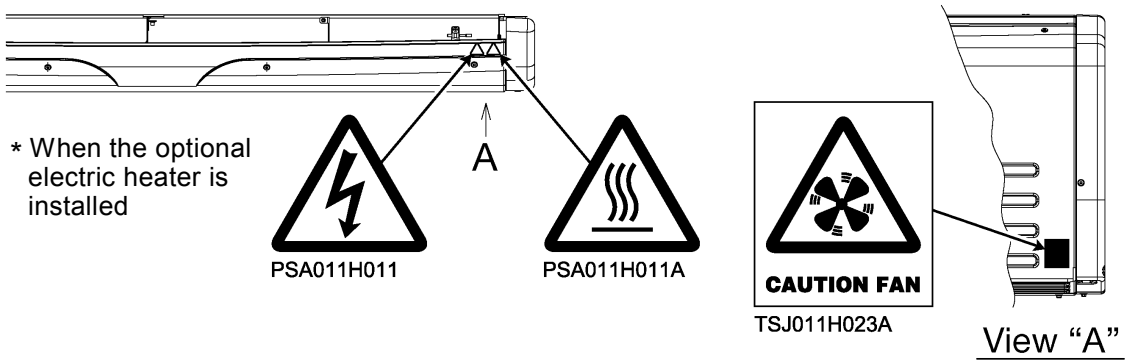
(1) Important precautions are stated on the warning labels. Never operate the refrigeration unit unless fully understanding the meanings of the warning labels. When you found some difficulties to understand, contact your dealer.

(2) Always keep the labels in good condition to read. Do not peel off, tear off or damage the labels or do not wipe with solvent or paint them.

(3) When the labels become illegible, purchase them from your dealer and change them.

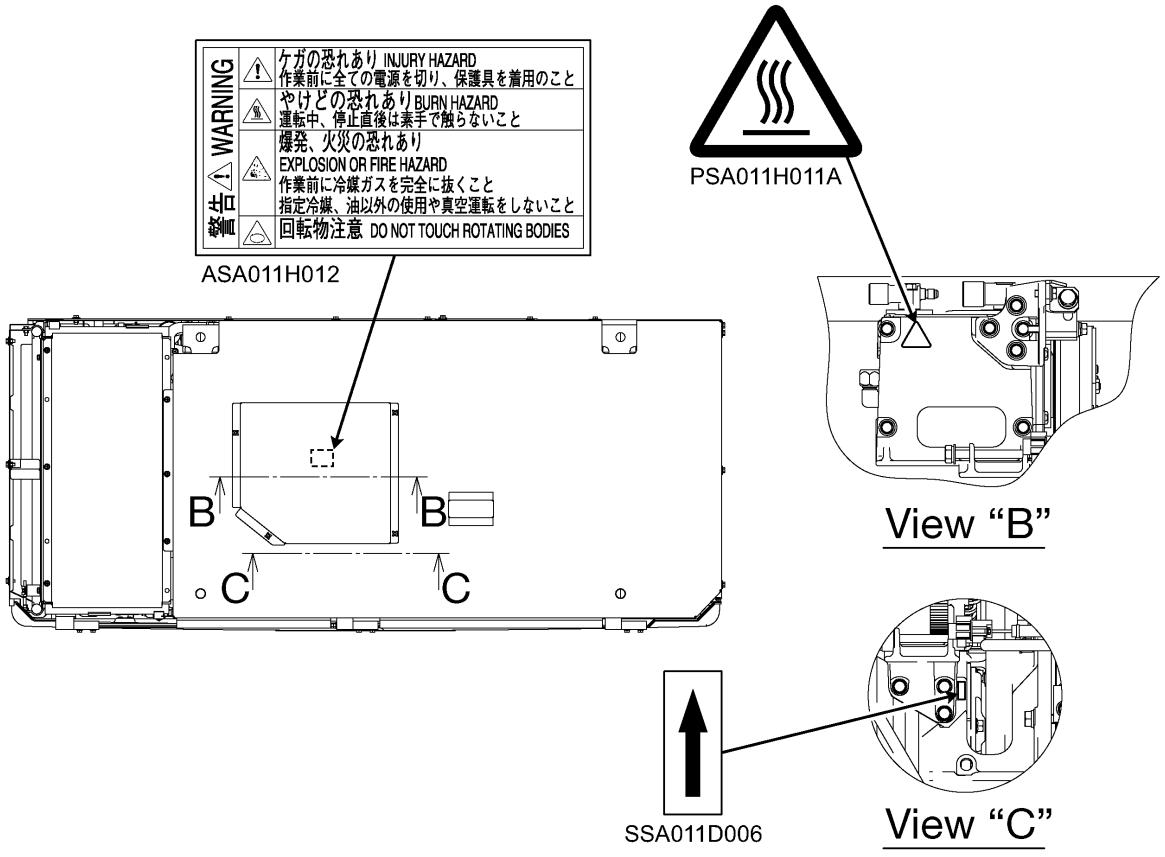
Evaporator unit

■ Front view

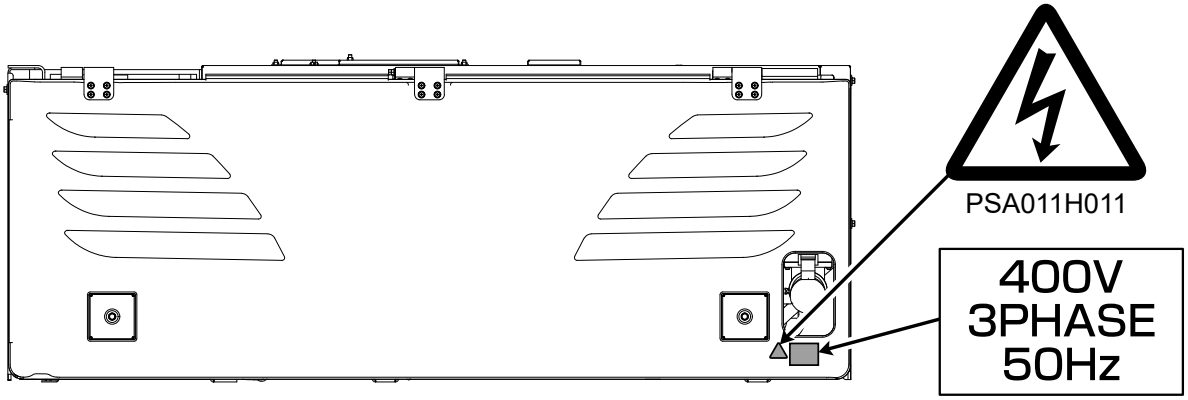


Condensing unit

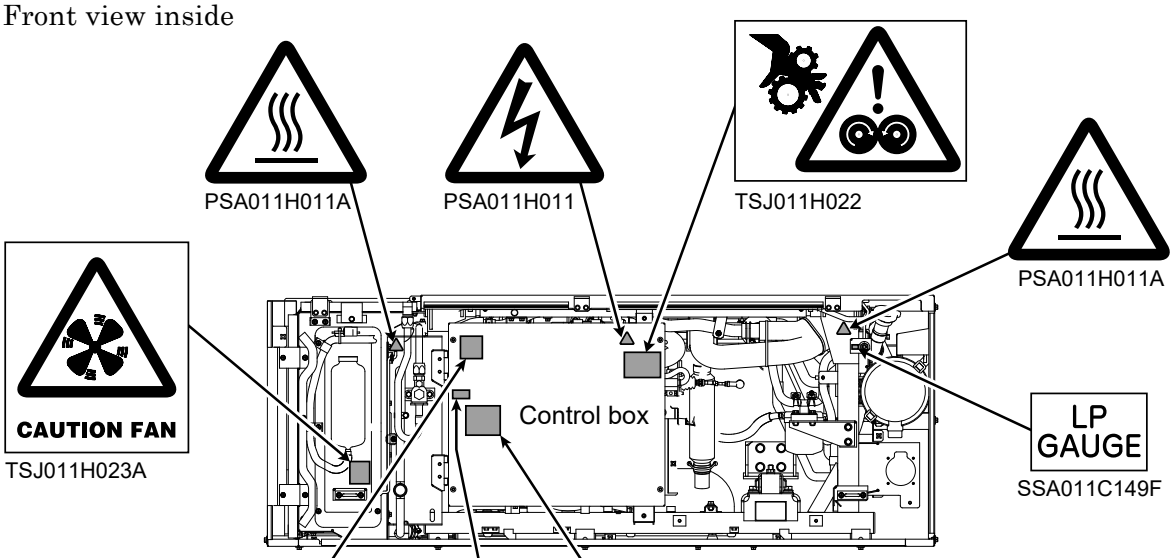
■ Top view



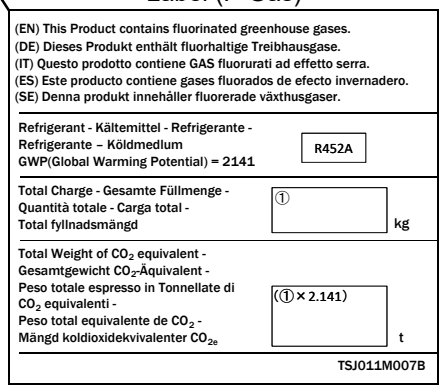
■ Front view



■ Front view inside



Label (F-Gas)



TSJ011H072N

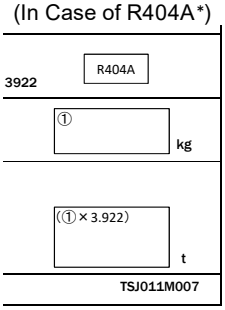
BSA011H009K

(In Case of R404A*)
BSA011H009F

TSJ011M007B

* Only R452A model is certified to ATP.

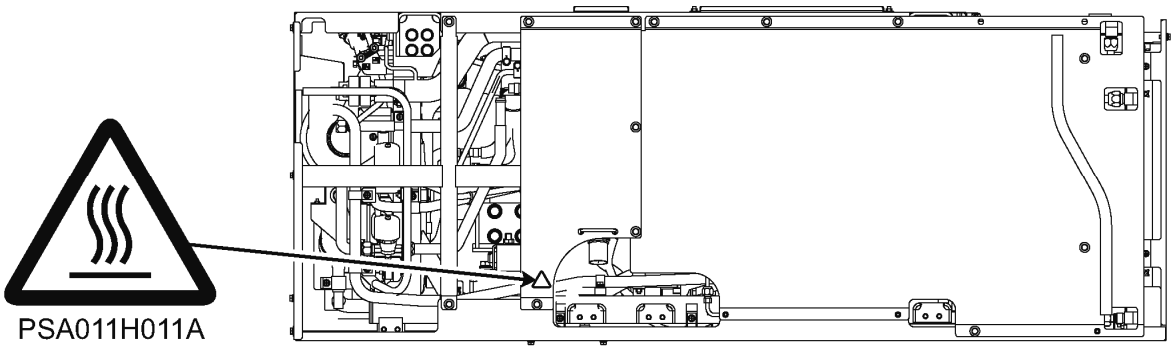
(In Case of R404A*)



TSJ011M007

* R

■ Back view



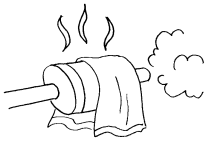
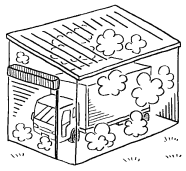
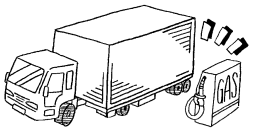
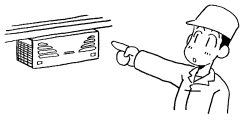
1.3 Precautions

1.3.1 General precautions

⚠ DANGERS
Do not modify or perform specification change for the refrigeration and vehicle. (This will make refrigeration unit out of warranty.) It may cause a serious accident if customer modify the refrigeration unit or change the specification by himself/herself.
Do not paint on resinic design panel. (This will make refrigeration unit out of warranty.) Cracking occurs in design panel, which cause a risk of falling down of panel while the vehicle is running.

⚠ CAUTIONS
Securely chock the front and rear wheels and apply the side breaks to prevent the vehicle from moving during the work. Otherwise, it may cause accidents such as worker injury from the vehicle advancing or retracting.
Put on helmets, gloves and protective devices as required when working. Otherwise, it may cause injury.
Make it clear to all persons related to the work that work is in progress. If work is being carried out jointly, an effort should be made so that the workers involved understand the other's work. Otherwise, it may cause accidents or failure.
If the refrigerant gas leaks during work, always ventilate the area. Toxic gas could be generated if the refrigerant gas contacts fire and it may cause poisoning.

1.3.2 Operation

⚠ WARNINGS	
Do not modify or removethe door limit switch. Otherwise, the refrigeration unit will start with the front panel opened and it may cause injury.	
Do not place combustible materials in the vicinity of muffler and exhaust pipe. Do not park on the area where combustibles such as falling leaves accumulate on. Otherwise, it may cause a fire because muffler and exhaust pipe will be hot.	
Do not start the engine in poorly ventilated places such as an indoor parking lot. Otherwise, it may cause carbon monoxide poisoning due to exhaust gas.	
Do not use the refrigeration unit in the atmosphere which could cause explosion at such place like gas station. Otherwise, it may cause an explosion or a fire.	
Make sure that the front panel of condensing unit is closed before starting operation. Otherwise, it may cause accidents.	
Make sure that no one left inside the container before closing the door. He or she might be frozen to death if the refrigeration unit is operated with someone in.	

⚠ CAUTIONS
Do not touch the muffler, exhaust pipe and refrigerant pipe during operation or immediately after the operation. Otherwise, it may cause burns as the muffler, exhaust pipe and refrigerant pipe will get hot.
Do not open the radiator cap during operation or immediately after the operation. High temperature steam may blowout and cause burns.
When refrigerant and compressor oil leak out or when you handle antifreeze coolant or sub-engine oil, be careful not to have them get in your eyes, not to have them contact with your skin, not to inhale them or not to drink them by mistake. Otherwise, it may cause health disorders such as frostbite, loss of eyesight and pneumonia.
Always use the specified fuel. Otherwise, it may cause trouble. (See page 109.)
Make sure that no tools, instruments or other parts have been left in the refrigeration unit or chassis before starting the refrigeration unit. If such items are left behind, it may cause damage of refrigeration unit or injury.
Confirm that there are no workers on all sides of the vehicle or under the vehicle body and inside of the container before starting the refrigeration unit and warn workers in the area that the refrigeration unit is to be started. Otherwise, it may cause accidents.
Whenever any abnormal operation, noise or error display has occurred during testing, stop the unit immediately and inspect. After removing the cause test operate and check the unit again. Otherwise, it may cause accidents.
Make it a rule to close the front panel when performing a test run. If it is inevitable to observe the inside of the operating unit by opening the front door, stand back from the refrigeration unit to prevent body parts, hands or legs from getting caught by rotary devices (pulleys, drive belts, condenser fan and evaporator fan). Otherwise, it may cause injury

1.3.3 Inspection

⚠ WARNINGS
Be sure to carry out the periodic inspections. Otherwise, it may cause troubles of the refrigeration unit or accidents. 
Use adequate tools and the specified tightening tools when tightening flare nuts and bolts and tighten them to the designated tightening torques. Otherwise, it may cause disasters and equipment damage due to refrigerant leakage by loosening of flare nuts and falling off of parts by loosening of bolts. 

⚠ CAUTIONS

When refrigerant and compressor oil leak out or when you handle antifreeze coolant or sub-engine oil, be careful not to have them get in your eyes, not to have them contact with your skin, not to inhale them or not to drink them by mistake.

Otherwise, it may cause health disorders such as frostbite, loss of eyesight and pneumonia.

Do not inspect or replenish engine oil just after the engine stops.

Otherwise, it may cause burns since the temperature of oil is very high.

Do not over charge engine oil.

Otherwise, it may cause to unable to stop the engine due to abnormal combustion of oil, generation of white smoke, or scattering of oil.

Do not wash the refrigeration unit with a steam washer or a high pressure washer.

Otherwise, it may cause a rupture due to pressure rise in the refrigeration unit or distortions of the condenser fin.

Do not charge refrigerant from the suction side while the refrigeration unit is stopped.

Otherwise, it may cause damage of the compressor due to liquid compression.

Wait till the temperatures drop sufficiently before starting inspection.

Otherwise, it may cause burns when touching since temperatures of engine, exhaust pipe and high pressure pipe could become extremely high.

Always use the specified fuel, engine oil, refrigeration machine oil, refrigerant and cooling water.

Otherwise, it may cause trouble. (See pages 19-20, 121.)

When inspecting the refrigeration unit, stop the unit by turning the "Main switch" to "OFF" and disconnect the battery terminals and power supply cord plug.

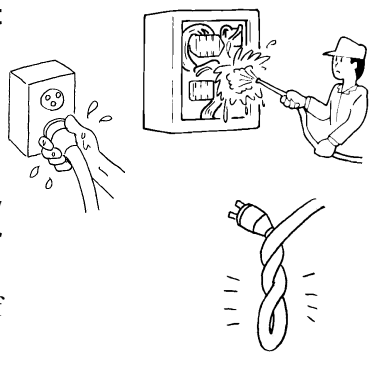
Otherwise, it may cause injury or an electric shock due to unexpected start.

1.3.4 Handling of electric equipment and power codes

⚠ WARNINGS

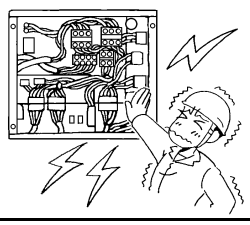
- **Do not directly splash water on the electric equipment or wash them with water.**
- **Never touch the electric equipment such as power plug and so on or operate the switches with wet hands.**
- **Do not modify the power code or apply force on it, by bending it by force, pulling it strongly or twisting it, or do not put cargoes on it.**

Otherwise, it may cause troubles of electric circuit, damages of power codes or an electric shock.



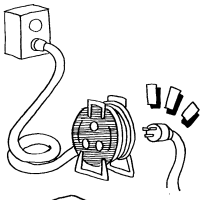
Refrain from touching the high voltage area when opening the control box.

Otherwise, it may cause electric shock.

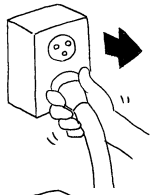


⚠ WARNINGS

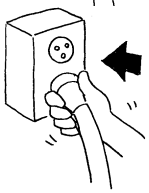
- **Use 4-core cabtyre cables (conductor cross section with 5mm^2 or more) for power cable. Do not connect it to extension code.**



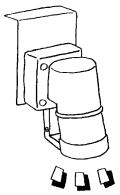
- **Pull out the power code by holding the plug part at the end of the code.**



- **Check the plug of the power code for dust. If there is no dust, insert it firmly.**



- **Surely protect the power socket with a cover when it is not used. When the cover is damaged, repair it immediately.**
- Otherwise, it may cause an electric shock or a fire due to the heat, breaking of wire and leaking of water, etc.



⚠ CAUTIONS

Take care of short circuit when touching the live parts such as terminals while checking the electric circuit.
Otherwise, it may cause electric shock or troubles.

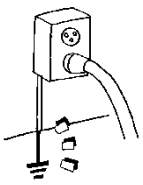
Take care of the polarity of the battery wiring.
Connecting the (+) and (-) poles in reverse may cause damage of electric parts.

Do not start and stop the operation with pulling out or inserting the power supply breaker or power code.
Otherwise, it may cause troubles of electric circuit, damages of power supply code or an electric shock.

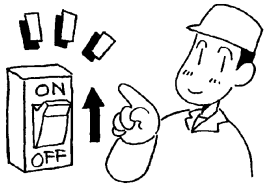
1.3.5 Power supply equipment

⚠ WARNINGS

Be sure to ground the power supply equipment to supply the electricity to the refrigeration unit.
Otherwise, it may cause an electric shock if the grounding work is not carried out properly.



Be sure to provide a dedicated circuit and an earth leakage breaker to the power supply.
Otherwise, it may cause an electric shock or a fire if there is capacity shortage of electric circuit or inadequate wiring work.



1.3.6 Dismounting

⚠ CAUTIONS	
⚠	**Pay attention not to be getting caught hands or feet by the refrigeration unit during dismounting.** Otherwise, it may cause injury.
❗	**When lifting the refrigeration unit by a forklift, use fork pocket to lift.** Otherwise, it may cause damage of equipment and injury.
	Lifting of refrigeration unit must always be done by qualified personnel by using proper slings suitable for the weight. Otherwise, it may cause damage of equipment and injury.
	When using a crane to move the refrigeration unit, lift it by the center of gravity position as a center. Otherwise, it may cause damage of equipment and injury.
⊘	**Do not attempt outdoor crane work in the strong windy day.** Otherwise, it may cause damage of equipment or injury fanned by the wind.

1.3.7 Disposal

⚠ CAUTIONS	
❗	**When disposing the refrigeration unit, dismantle or dispose with separation by type of parts according to the applicable laws, regulations and standards.** Otherwise, it may cause environmental destruction.

1.4 Protective functions

This refrigeration unit is provided with following protective functions to secure the safety of workers.

(1) Main switch
Main switch secures safety by turning it to "OFF" during inspection or servicing where the start of sub-engine could result in accident.

(2) Pre-operation buzzer
Alarm buzzer sounds for 6 seconds before the start of sub-engine and 5 seconds before the motor operation to announce the start of operation.

(3) Refrigerant system
・High・low pressure sensors and discharge gas temperature sensor and so on protect the refrigerant system.
・Fusible plug protects the refrigerant circuit from rupture.

(4) Sub-engine system
Water temperature switch, oil pressure switch and speed sensor protect the sub-engine.

(5) Electrical system
Fuse and over-current relay prevent failure and accidents.

(6) Others
・Door limit switch prevents accidents and injury by getting caught or the like.
・Back up operation will be done to protect cargoes when the sensors are abnormal.

The cabin controller displays the abnormal indication when the functions (3) ~ (6) are activated.
Handle this refrigeration unit safely with enough knowledge of protective functions. Never operate the unit with the protective device removed or deactivated. It is most important to maintain the functions of protective device continuously normal in order to secure safety.

1.5 Prevention of start during work

When several people are working simultaneously for inspection and so on, it is necessary to protect them from getting injured by accidental start of operation.
Remove the ignition key and keep it in a safe place during the work. Place a cautionary plate indicating “WORK IN PROGRESS! STARTING ENGINE PROHIBITED.” at a visible place in the driver’s seat.

1.6 Clothing and protective equipment

Necessary clothing and protective equipment differ by working environment and contents of work. Wear proper clothing and protective equipment by making a rule. Otherwise, it may lead to unexpected accidents such as getting rolled in, burns and electrical shock, etc.

- Wear the clothes such as long sleeves and long pants appropriate for the work and fasten the cuffs firmly.
- Wear the work clothes made of materials preventing electrical shock or static electricity.
- Do not wear accessories such as necklaces or a necktie to prevent it from getting rolled in. Long hair must be tied at the back or put under the working clothes.
- Wear gloves and protective eye glasses.
- Wear protective shoes, protective caps/helmets as required.

1.7 Refrigerant

This product contains fluorinated greenhouse gases.

- Refrigerant : R452A (GWP (Global Warming Potential) =2141)
  Refer to a label on unit about weight of fluorinated greenhouse gases and CO_2 equivalent. (Refer to page 7.).
- R452A is a mixture of R32 (11%), R125 (59%) and R1234yf (30%).
- R452A contains mildly flammable components R32 and R1234yf, so they should not be mixed with air to check for system leaks as mixture can become combustible.
- R452A is extremely volatile and has a boiling point at −47 °C under the atmospheric pressure.

1.8 For emergency

Prepare the followings in advance to deal with emergencies such as injury or death, property damage and environmental disaster.

(1) Assignment of people to call for as supplementary personnel for countermeasures to deal with emergencies such as a disaster resulting in injury or death, property disaster with equipment damage, and environmental disaster such as spilling of waste oil or chemical material.
(2) Preparation of a manual to release a part of hand, finger or body caught by machine.
Preparation of a manual to handle property accident such as equipment damage due to interaction of equipment and the works.
Preparation of a manual to handle accident affecting environment such as spilling of waste oil or chemical material.
(3) Inclusion of at least one personnel experienced training for emergency countermeasures in one work team.
(4) Preparation of adequate tools and equipment for the emergency countermeasures.

1.8.1 Countermeasures for a disaster resulting in injury or death

In case of a disaster resulting in injury or death, stop the work immediately and rescue the victims. If necessary, follow the instructions below as well.

(1) Make emergency calls to the relevant agencies listed below.
  (a) Fire station
  (b) Nearest dealer

Notice

- It may be necessary to disassemble or scrap the refrigeration unit depending on the place and situation of the disaster. As the refrigeration units are structurally complicated, disassembling and scrapping require a technical knowledge and cooperation between a rescue team of fire station and service personnel is inevitable to save victims in a short time. Be sure to contact above two places.

1.8.2 Countermeasures for property disaster

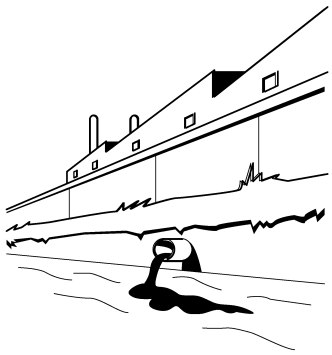
Follow the instructions below when the refrigeration unit is damaged due to miss operation or others.

(1) Make calls to the relevant agency listed below.
  (a) Dealer

Notice

- Visual inspection only is not sufficient for accurate judgment of damage conditions when the refrigeration unit is damaged. Cooperation of service personnel is inevitable so that contact them without fail.

(2) Stop the operation and follow the instruction of your dealer after the disaster to avoid expansion of damage.



1.8.3 Countermeasures for environmental disaster

Follow the instructions of public agencies when spilling waste oil or chemical materials from drainage or the like to the outside by mistake.

1.8.4 Countermeasures for earthquake・fire

When you have an earthquake or a fire during work:

- If someone is injured, move him or her to a safe place and give adequate medical treatment.
- If a fire started, make a call to fire station and fight the fire with fire extinguishers until arrival of fire engines.
- If refrigerant gushes out, take refuge since hypoxia could be resulted.
- If you have an earthquake or a fire started, move to a safe place except for some people to fight the fire.
- The person in charge is requested to call a dealer.

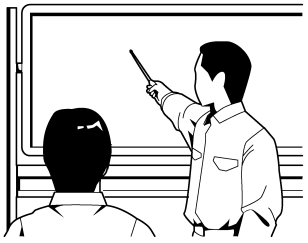
1.9 Labor safety and health management

This section describes the labor safety and health management related matters at servicing work. Apply the suggestions to prevent injury or property accidents and environmental accidents together with requirements from your government or local administrative agency and self-imposed safety management restraints.

1.9.1 Understanding and observance for the contents of service manual

Fully understand the contents of this service manual and observe the rules during work. It may cause serious accidents if working under the conditions of insufficient understanding of the contents or by disregarding the contents.

1.9.2 Safety related education and training



Safety related skills will be improved same as skills for other works by education and training. All workers must receive safety related education and training. Each worker is able to become recognizing potential risks, avoiding dangerous behavior and to enter dangerous places, and taking action to save him-self/her-self by improving sense of safety with the education and training.

1.9.3 Dangerous・harmful chemical materials

It may cause serious health problem (for example, cardiac disease, damage to kidney and lungs, sterility, cancer, burns and rash) if exposed to dangerous・harmful chemical materials. Furthermore, several chemical materials have risks to become causing generation of fire, explosion and other serious disasters if miss-handled.

■ Education・training

Execute transmission of information and provide education and training to a person in charge of chemical materials.

(1) Give appropriate ventilation in the area using chemical materials.
(2) Chemical materials must be handled by the recommended manual and SDS (Safety data sheet) of the manufacture.
(3) Wear protective equipment (protective gloves, apron, etc.) according to the recommended manual and SDS of the manufacture when handling the chemical materials.
(4) Put labels on the containers of the chemical materials and take custody of the containers according to the recommended manual and SDS of the manufacture. Keep the chemical materials away from hot places or the place having sparks or flames and keep them under the cool and dry conditions.
(5) Wash hands before eating, drinking or smoking when handling chemical materials.
(6) Let the workers aware of the place and its usage procedure of eye-washer in advance if it is expected to hurt their eyes by the chemical material.

■ **Usage of SDS (Safety data sheet)**

When purchasing chemical materials, obtain the SDS from the manufacture and keep it at the fixed place so that it can be available whenever necessary.

SDS contains such detailed information as dangerous matters for health and safety, influence to the environment, safe handling procedures, countermeasures against emergency situation, and so on. Let the people in charge of handling chemical materials know the contents of SDS and provide education and training for handling.

Give the SDS to a doctor when the worker has his or her physical condition diagnosed by the doctor for the effect of chemical material.

■ **Treatment of waste liquid, waste material and waste product**

Disposal of chemical material such as solvent and cleaning cloths stained with such chemicals and so on is controlled by many regulations from the stand point of environmental preservation. Follow the regulations of your government or local administrative agency for disposal.

1.9.4 Noise

There is fear of suffering from permanent hearing impairment under the environment of dangerous noise level. Take following measures to prevent hearing impairment.

- Wear adequate ear protectors when entering a place with sound level of over 85dB.
- Forbid a person not wearing ear protectors from entering a place with sound level of over 85dB.
- Do not stay longer in a place with sound level of over 85dB.

1.9.5 House keeping

Poor house keeping (sort out and order) may result in stumble and fall. Implementation of house keeping will lead to prevention of accident by stumble and fall.

1.9.6 Prevention of fire

General measures to prevent fire are listed below. Always execute fire preventive measures not limited to the below. Perform fire-fighting drills periodically.

- Do not leave combustible matters near the place using fire.
- Obtain permission from a manager before work when using fire temporarily.
- Take care of fire with incombustible sheet or the like when executing welding or fusing work.
- Prepare fire extinguisher or water while using fire.
- Clean the place after using fire.
- Place fire extinguishers and fire hydrants and replace them periodically.
- Immediately repair or replace the electric wire if any damage is found on the sheath.
- Inspect or replace the electric wires used for a long time.

1.10 First aid treatment

(1) Refrigerant

- **When refrigerant got in your eye**
  Wash your eye with lots of clean running water for more than 15 minutes immediately.
  Wash rear side of the eyelid as well. Then, consult a physician as soon as possible.

- **When refrigerant comes in contact with your skin**
  Take off wet clothes, shoes and socks immediately, as it may cause frostbite if you touch the refrigerant. Wash the part well with lots of water. If you still have irritation, consult a physician as soon as possible.

- **When inhaling evaporated gas**
  When someone inhaled high level of gas, move to the place with fresh air immediately holding him/her with a blanket or the like to keep warm. Then consult a physician as soon as possible.
  When he/she does not breathe or hardly breathe, loosen his/her clothes and practice artificial respiration after securing the air passage. Depending on the circumstance, have him/her inhale oxygen and take him/her to a physician as soon as possible.

- **When swallowing refrigerant**
  Do not throw up by force and consult a physician as soon as possible.

*** Precautions for physician**

Use of Catecholamine system medicine such as adrenaline and so on may cause heart arrhythmia. Therefore it is required to use only for the emergency life-sustaining treatment with special consideration.

(2) Compressor oil

- **When compressor oil got in your eye**
  Wash your eye with lots of clean running water for more than 15 minutes immediately. Wash rear side of the eyelid as well. If you still have irritation, consult a physician as soon as possible.

- **When compressor oil comes in contact with your skin**
  Wash the part with lots of water and soap well and apply conditioning cream on it.

- **When inhaling evaporated gas**
  Move to the place with fresh air immediately holding him/her with a blanket or the like to keep warm. Then, consult a physician if it is necessary.
  When he/she does not breathe or hardly breathe, loosen his/her clothes and practice artificial respiration after securing the air passage. Depending on the circumstance, have him/her inhale oxygen and take him/her to a physician as soon as possible.

- **When swallowing compressor oil**
  Do not throw up the oil by force and consult a physician as soon as possible.
  When inside the mouth is contaminated, wash it well with water.
  (When throwing up the oil by force, it easily gets into air passage and causes high fever if it gets into lung. It may cause hardly incurable hemorrhagic pneumonia accordingly.)

(3) Antifreeze coolant

- **When antifreeze coolant got in your eye**
  Wash your eye with lots of clean running water for more than 15 minutes immediately.
  Wash rear side of the eyelid as well. Then, consult a physician as soon as possible.
- **When antifreeze coolant comes in contact with your skin**
  Wipe the antifreeze coolant off his/her skins with a piece of paper or cloth.
  Wash the part well with lots of water and soap. If any visual changes or pain are observed, consult a physician as soon as possible.
- **When inhaling evaporated gas**
  When someone inhaled the gas a lot, move to the place with fresh air immediately holding him/her with a blanket or the like to keep warm. Then consult a physician if it is necessary.
  When he/she breathes irregularly or feels sick, consult a physician immediately.
- **When swallowing antifreeze coolant**
  Throw it up immediately and consult a physician as soon as possible.
  When inside the mouth is contaminated, wash it well with water.

(4) Sub-engine oil

- **When sub-engine oil got in your eye**
  Wash your eye with lots of clean running water for more than 15 minutes immediately.
  Wash rear side of the eyelid as well. Then, consult a physician as soon as possible.
- **When sub-engine oil comes in contact with your skin**
  Wash the part well with lots of water and soap.
- **When inhaling evaporated gas**
  Move to the place with fresh air immediately holding him/her with a blanket or the like to keep warm. Then consult a physician if it is necessary.
- **When swallowing sub-engine oil**
  Do not throw up the oil by force and consult a physician as soon as possible.
  When inside the mouth is contaminated, wash it well with water.

2. SPECIFICATIONS

Item			Model	TU1250SAE	
Refrigeration capacity	Conditions		℃	Ambient temperature 30	
				Return air temperature -20	Return air temperature 0
	Engine drive		W	6741	11601
	Motor drive			5070	9243
Working environment	Inside container temperature		℃	-35~30	
	Ambient temperature			-20~40	
Unit dimensions	Condensing unit	W×H×D	mm	1589×609×695	
	Evaporator unit			2000×200×744	
Unit weight	Condensing unit		kg	425	
	Evaporator unit			54	
Drive system				Dedicated engine (diesel) and motor	
Operating system				Automatic start/stop and continuous operation selection	
Engine	Model			3TNV76 (4-cycle water-cooled vertical diesel)	
	Displacement		cm^3	1116	
	Continuous operation fuel consumption		ℓ/h	2.8 (Outdoor 30℃/inside container 0℃, high speed, at shipment)	
	Oil capacity		ℓ	9.5 (Oil type: Class CE or higher of API classification, 10W-30)	
	Fuel			Diesel fuel (Intense cold season: cold weather diesel fuel)	
	Rated output / speed		kW/min	High speed: 12.5/2100, low speed: 9.0/1650 or more	
Compressor	Model			CSA130E (Open, 3D scroll type)	
	Speed		min^{-1}	High speed: 3650, low speed: 2850, Motor : 2550	
	Compressor oil charge volume		ℓ	1.25 (JXTG Nippon Oil & Energy MA32R, ester series)	
Evaporator	Type			Aluminum fin & copper tubes	
	Fan			ø222 mm turbo fan & DC brush-less motor×4 pcs.	
Condenser	Type			Aluminum multi-flow	
	Fan			ø440 mm propeller fan×1 pc.	
Standby motor	Power supply			3-phase AC 400V 50Hz	
	Output		kW	5.5	
Sound power level			dB	98	
Refrigerant charge volume			kg	4.6 (R452A), 4.3 (R404A*)	
Inside container temperature control				Electronic thermostat	
Operation control				Microcomputer controller	
Defrosting device				Hot gas defrost type (Automatic timer and manual)	
Safety device				High pressure switch, engine oil pressure switch, engine water temperature switch, fusible plug, motor over-current relay, DC circuit fuse, DC circuit fusible link, front panel open detection switch, automatic power supply anti-phase reversal switching and engine clutch temperature sensor	

* Only R452A model is certified to ATP. * R

Item			Model	TU1100SAE	
Refrigeration capacity	Conditions		℃	Ambient temperature 30	
				Return air temperature -20	Return air temperature 0
	Engine drive		W	5647	10421
	Motor drive			3967	7883
Working environment	Inside container temperature		℃	-30~30	
	Ambient temperature			-20~40	
Unit dimensions	Condensing unit	W×H×D	mm	1589×609×695	
	Evaporator unit			2000×200×744	
Unit weight	Condensing unit		kg	420	
	Evaporator unit			54	
Drive system				Dedicated engine (diesel) and motor	
Operating system				Automatic start/stop and continuous operation selection	
Engine	Model			3TNV76 (4-cycle water-cooled vertical diesel)	
	Displacement		cm^3	1116	
	Continuous operation fuel consumption		ℓ/h	2.8 (Outdoor 30℃/inside container 0℃, high speed, at shipment)	
	Oil capacity		ℓ	9.5 (Oil type: Class CE or higher of API classification, 10W-30)	
	Fuel			Diesel fuel (Intense cold season: cold weather diesel fuel)	
	Rated output / speed		kW/min	High speed: 12.5/2100, low speed: 9.0/1650 or more	
Compressor	Model			CSA130 (Open, 3D scroll type)	
	Speed		min^{-1}	High speed: 3650, low speed: 2850, Motor : 2550	
	Compressor oil charge volume		ℓ	1.25 (JXTG Nippon Oil & Energy MA32R, ester series)	
Evaporator	Type			Aluminum fin & copper tubes	
	Fan			ø222 mm turbo fan & DC brush-less motor×4 pcs.	
Condenser	Type			Aluminum multi-flow	
	Fan			ø440 mm propeller fan×1 pc.	
Standby motor	Power supply			3-phase AC 400V 50Hz	
	Output		kW	5.5	
Sound power level			dB	98	
Refrigerant charge volume			kg	3.9 (R452A), 3.6 (R404A*)	
Inside container temperature control				Electronic thermostat	
Operation control				Microcomputer controller	
Defrosting device				Hot gas defrost type (Automatic timer and manual)	
Safety device				High pressure switch, engine oil pressure switch, engine water temperature switch, fusible plug, motor over-current relay, DC circuit fuse, DC circuit fusible link, front panel open detection switch, automatic power supply anti-phase reversal switching and engine clutch temperature sensor	

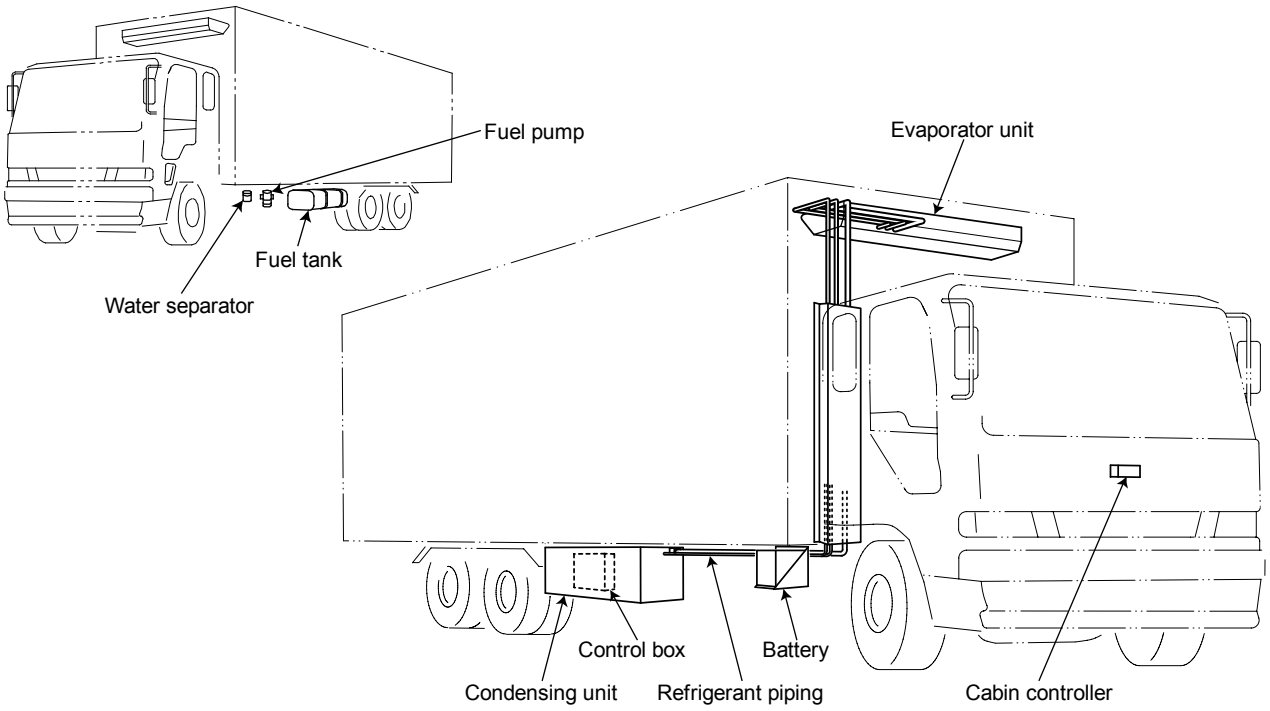
* Only R452A model is certified to ATP. * R

Item			Model	TU900SAE	
Refrigeration capacity	Conditions		℃	Ambient temperature 30	
				Return air temperature -20	Return air temperature 0
	Engine drive		W	—	—
	Motor drive			—	—
Working environment	Inside container temperature		℃	-30~30	
	Ambient temperature			-20~40	
Unit dimensions	Condensing unit	W×H×D	mm	1589×609×695	
	Evaporator unit			1450×200×744	
Unit weight	Condensing unit		kg	420	
	Evaporator unit			41	
Drive system				Dedicated engine (diesel) and motor	
Operating system				Automatic start/stop and continuous operation selection	
Engine	Model			3TNV76 (4-cycle water-cooled vertical diesel)	
	Displacement		cm^3	1116	
	Continuous operation fuel consumption		ℓ/h	2.8 (Outdoor 30℃/inside container 0℃, high speed, at shipment)	
	Oil capacity		ℓ	9.5 (Oil type: Class CE or higher of API classification, 10W-30)	
	Fuel			Diesel fuel (Intense cold season: cold weather diesel fuel)	
	Rated output / speed		kW/min	High speed: 12.5/2100, low speed: 9.0/1650 or more	
Compressor	Model			CSA130 (Open, 3D scroll type)	
	Speed		min^{-1}	High speed: 3650, low speed: 2850, Motor : 2550	
	Compressor oil charge volume		ℓ	1.25 (JXTG Nippon Oil & Energy MA32R, ester series)	
Evaporator	Type			Aluminum fin & copper tubes	
	Fan			ø222 mm turbo fan & DC brush-less motor×3 pcs.	
Condenser	Type			Aluminum multi-flow	
	Fan			ø440 mm propeller fan×1 pc.	
Standby motor	Power supply			3-phase AC 400V 50Hz	
	Output		kW	5.5	
Sound power level			dB	98	
Refrigerant charge volume			kg	3.9 (R452A), 3.6 (R404A*)	
Inside container temperature control				Electronic thermostat	
Operation control				Microcomputer controller	
Defrosting device				Hot gas defrost type (Automatic timer and manual)	
Safety device				High pressure switch, engine oil pressure switch, engine water temperature switch, fusible plug, motor over-current relay, DC circuit fuse, DC circuit fusible link, front panel open detection switch, automatic power supply anti-phase reversal switching and engine clutch temperature sensor	

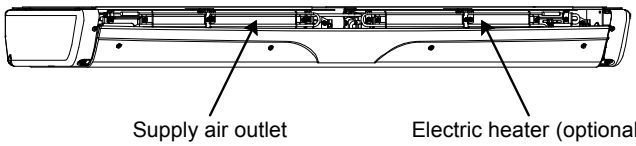
* R

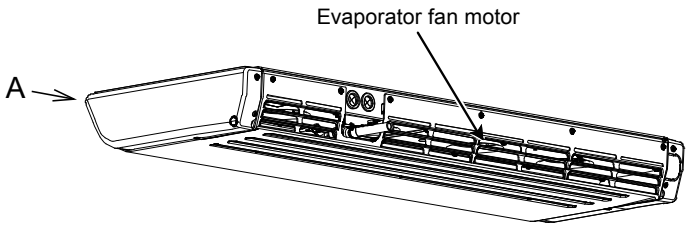
* Only R452A model is certified to ATP.

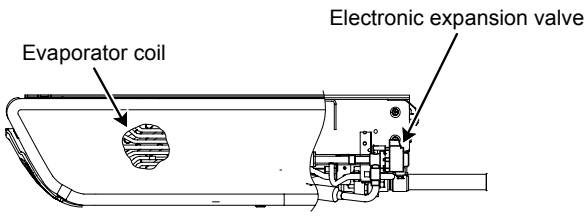
3. NAME OF EACH COMPONENT



(1) Evaporator unit

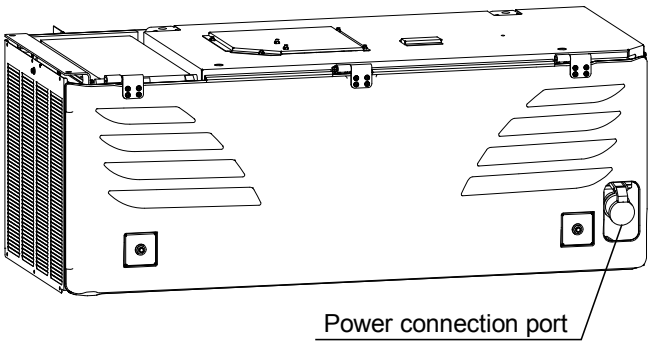






Inside of view "A"

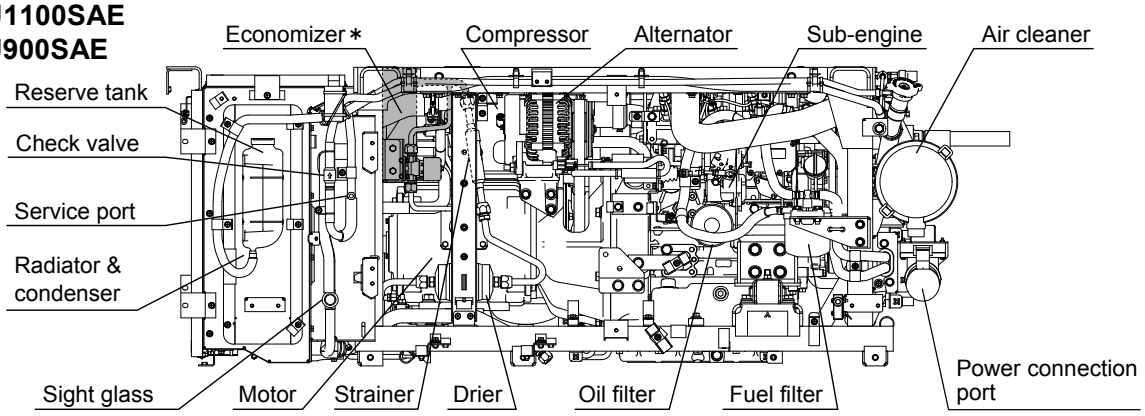
(2) Condensing unit



(3) Condensing unit detailed inside

(A) Front view

- **TU1250SAE**
  TU1100SAE
  TU900SAE

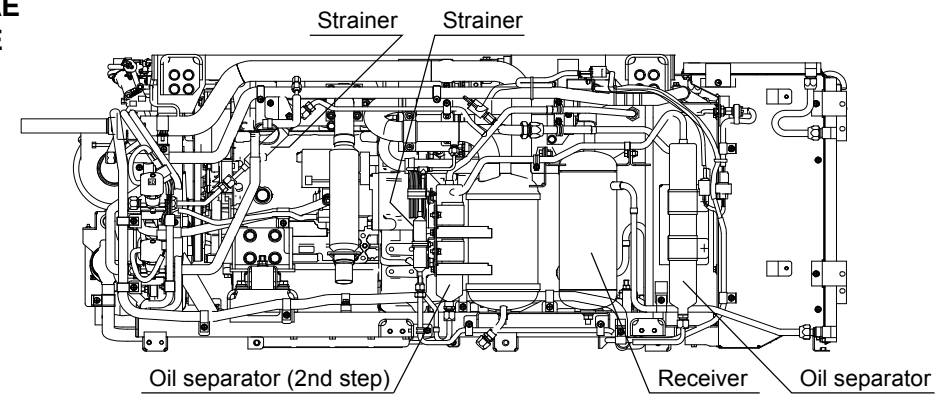


* R

* TU1100SAE and TU900SAE are not equipped with economizer assembly. * R

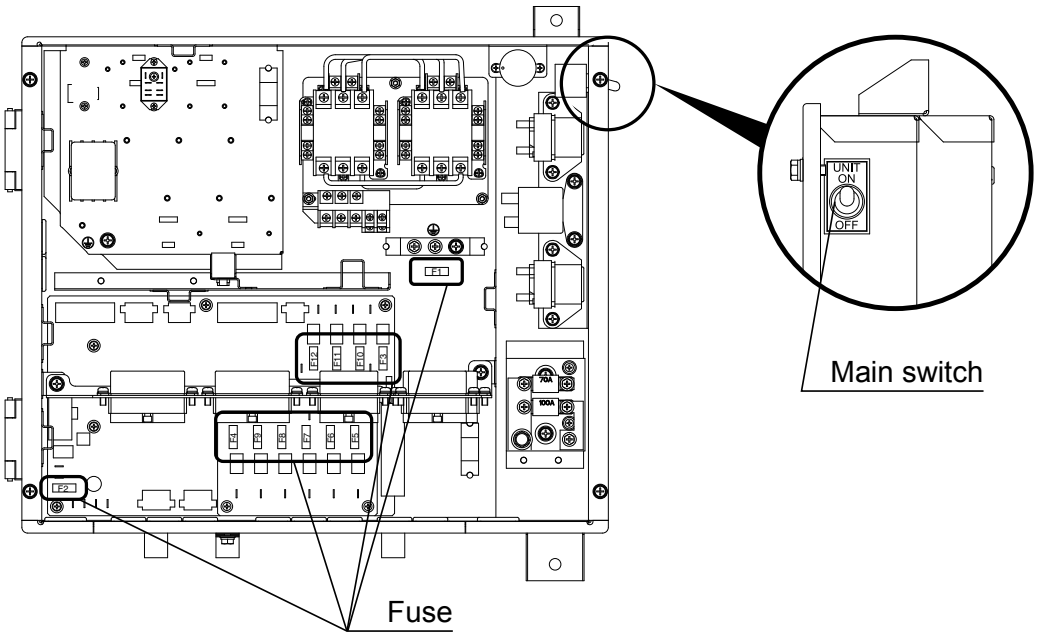
(B) Back view

- **TU1250SAE**
  TU1100SAE
  TU900SAE

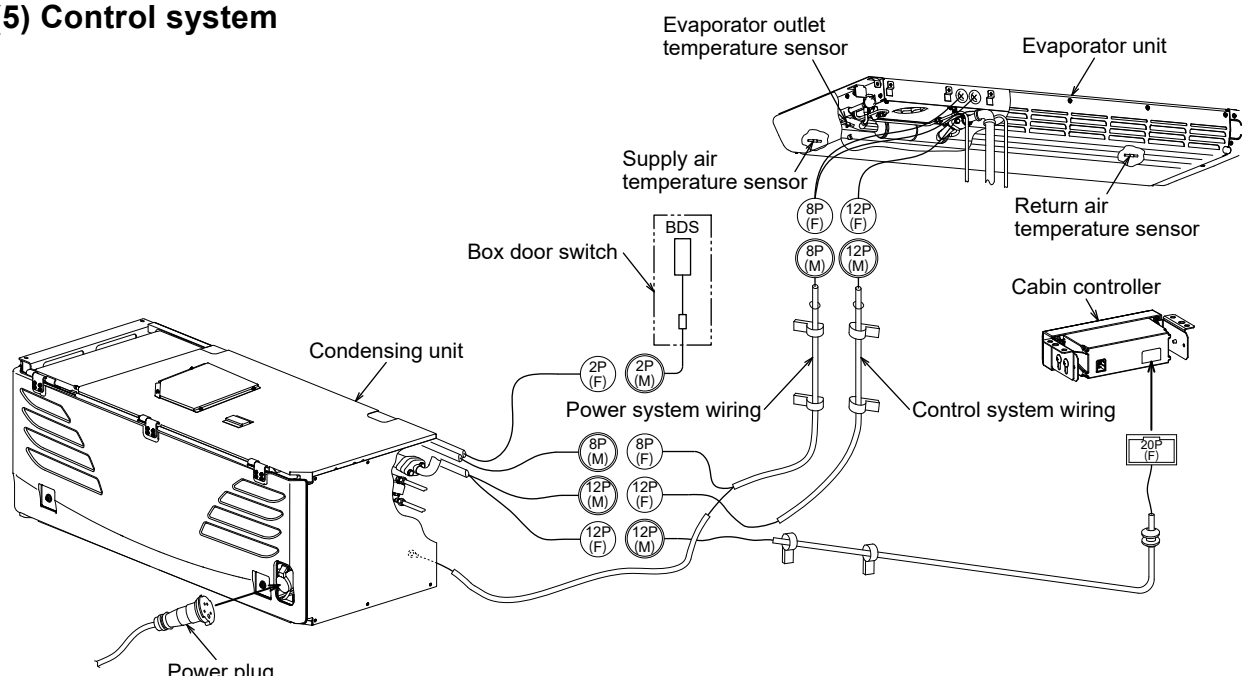


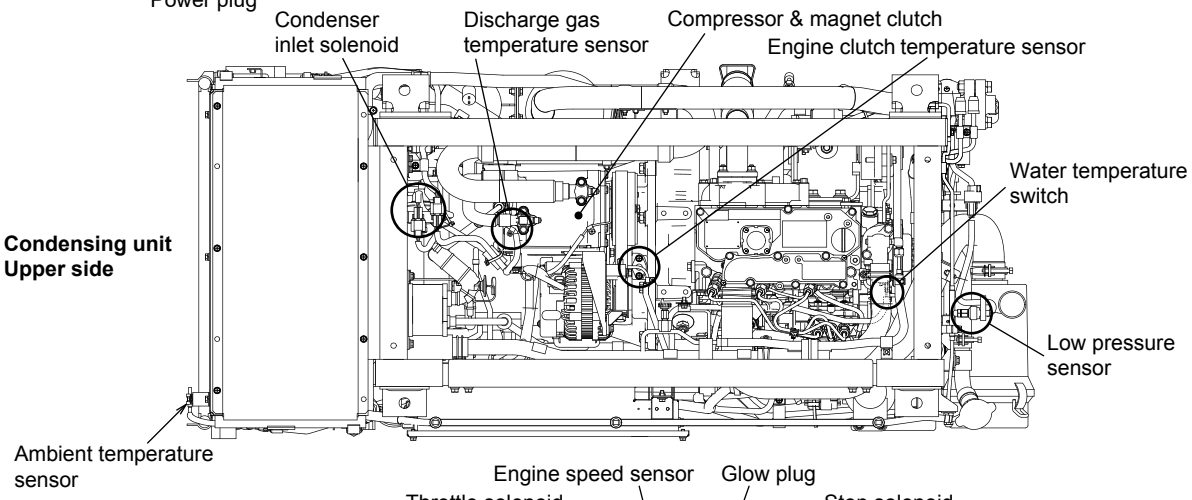
* R

(4) Control box

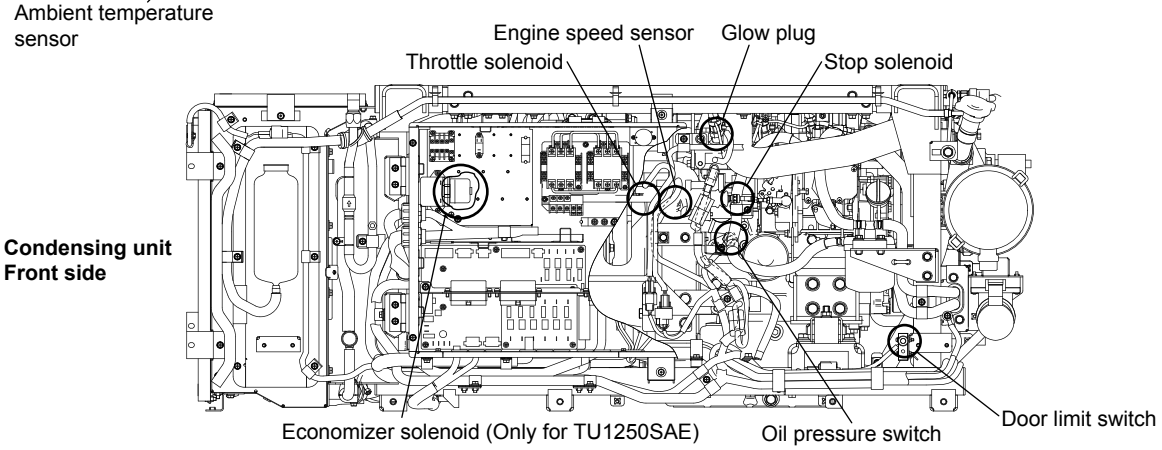


(5) Control system

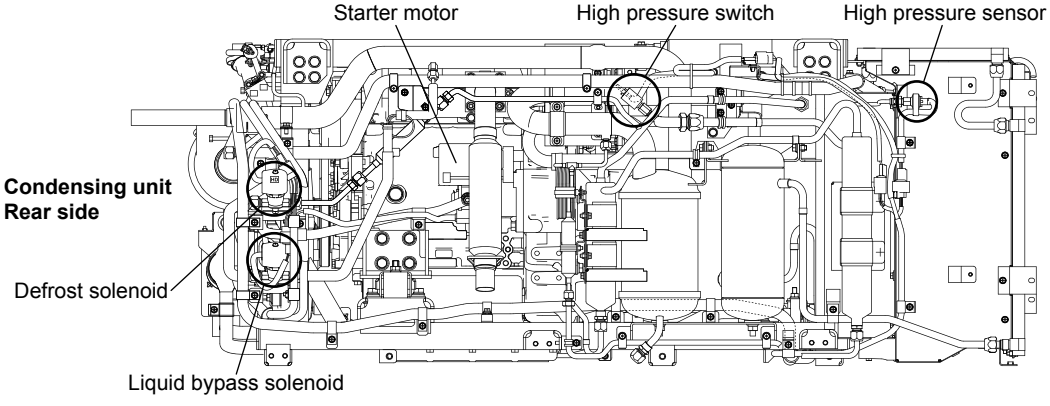




Condensing unit Upper side

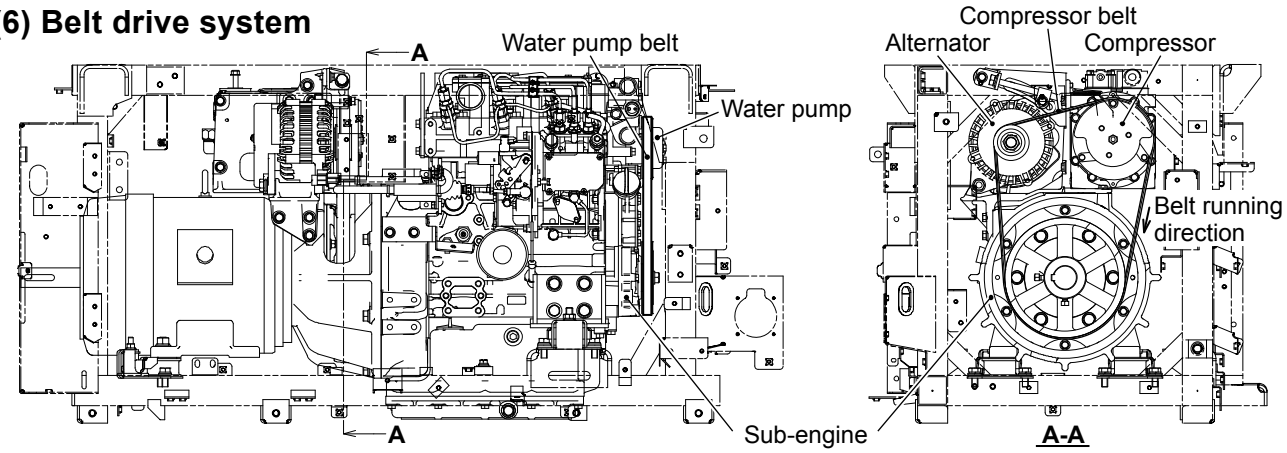


Condensing unit Front side

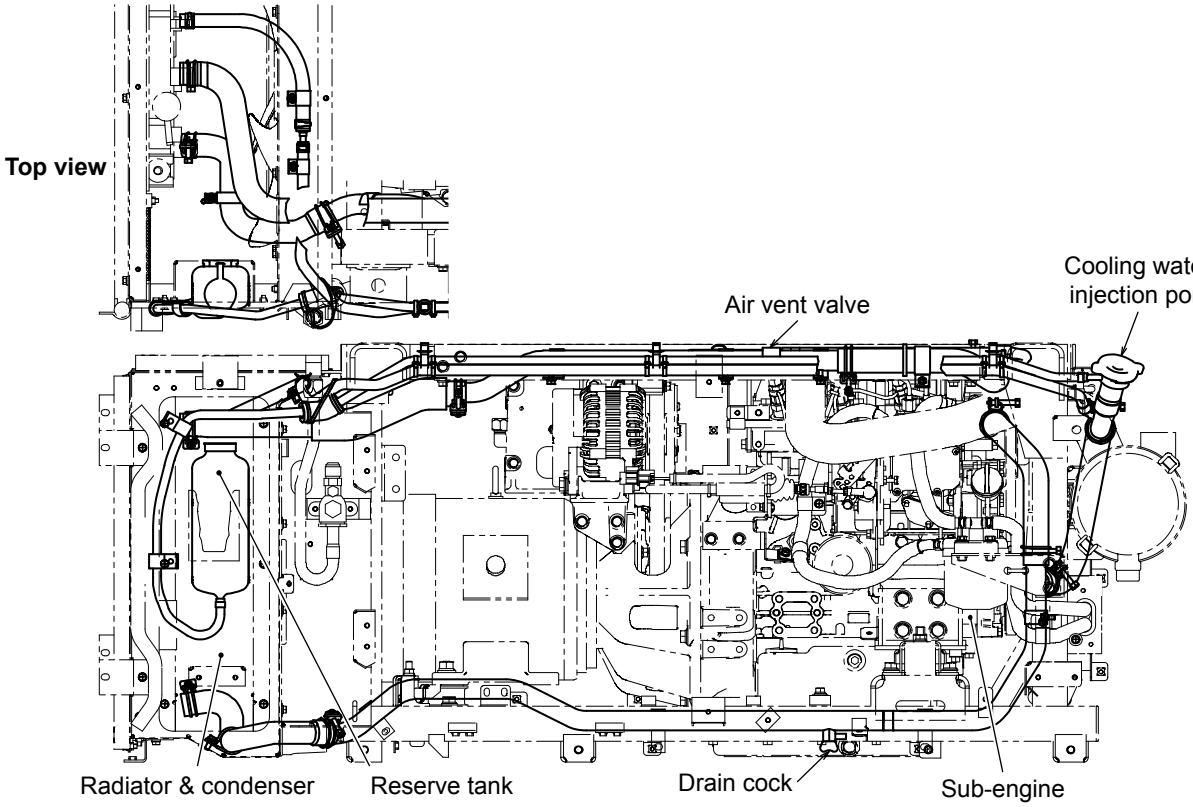


Condensing unit Rear side

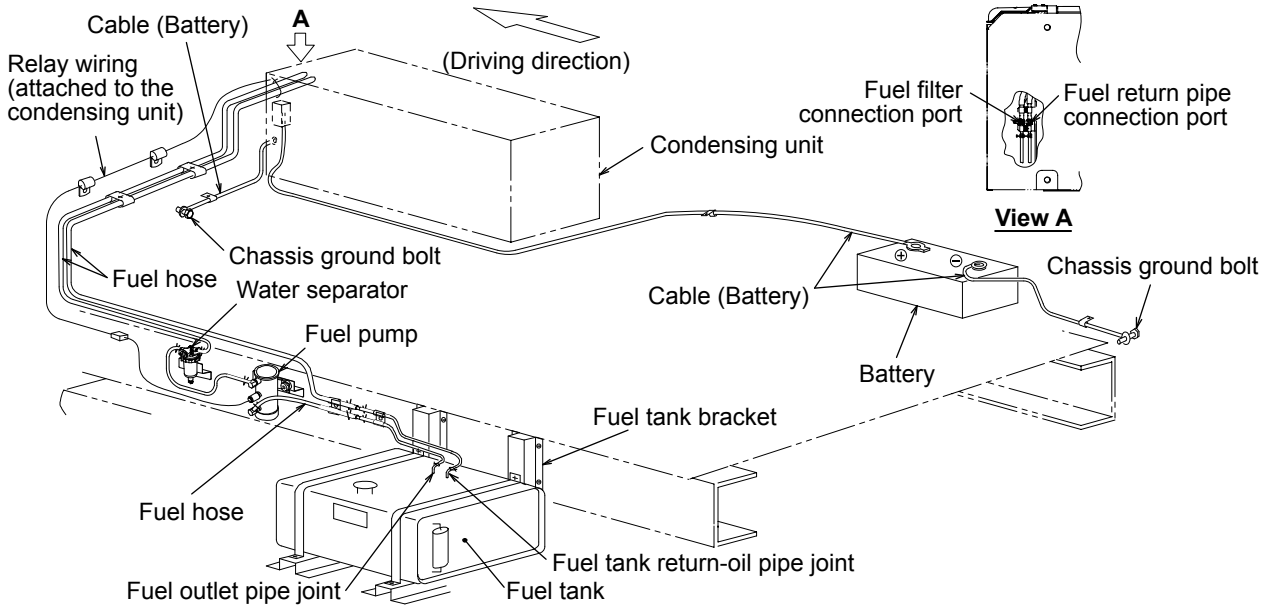
(6) Belt drive system



(7) Cooling water system

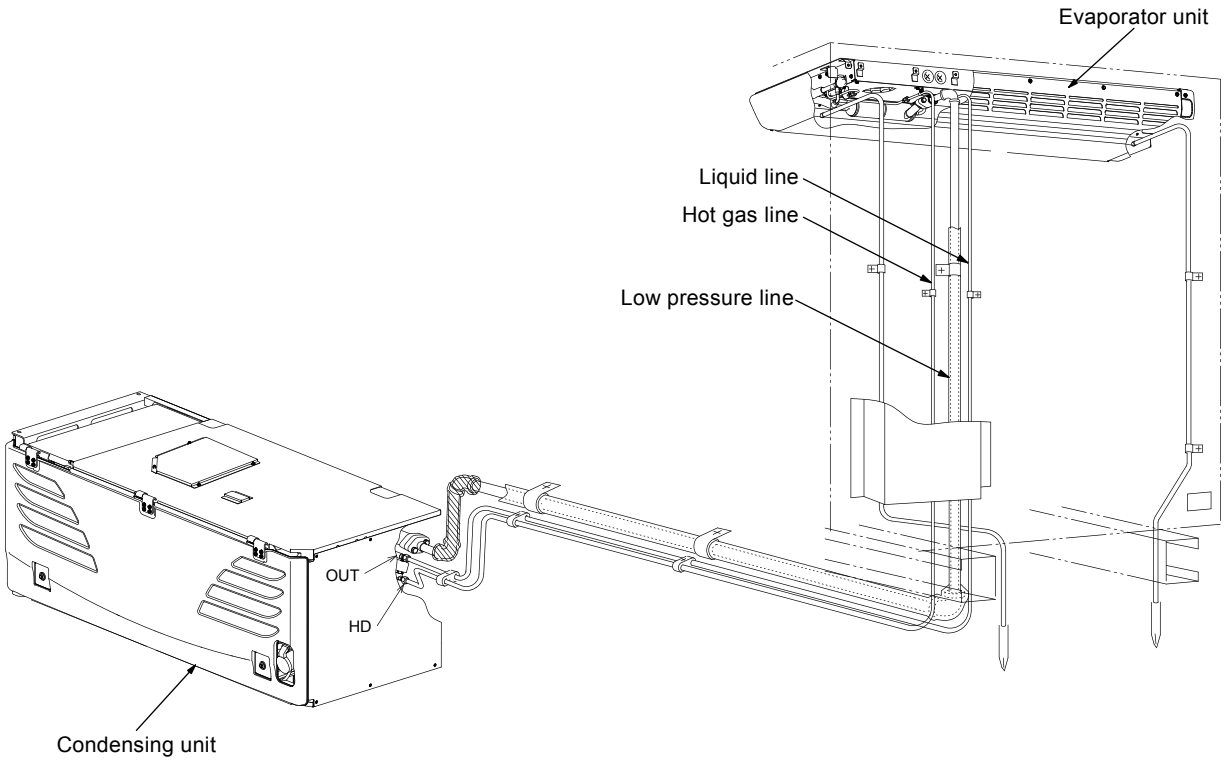


(8) Fuel piping system



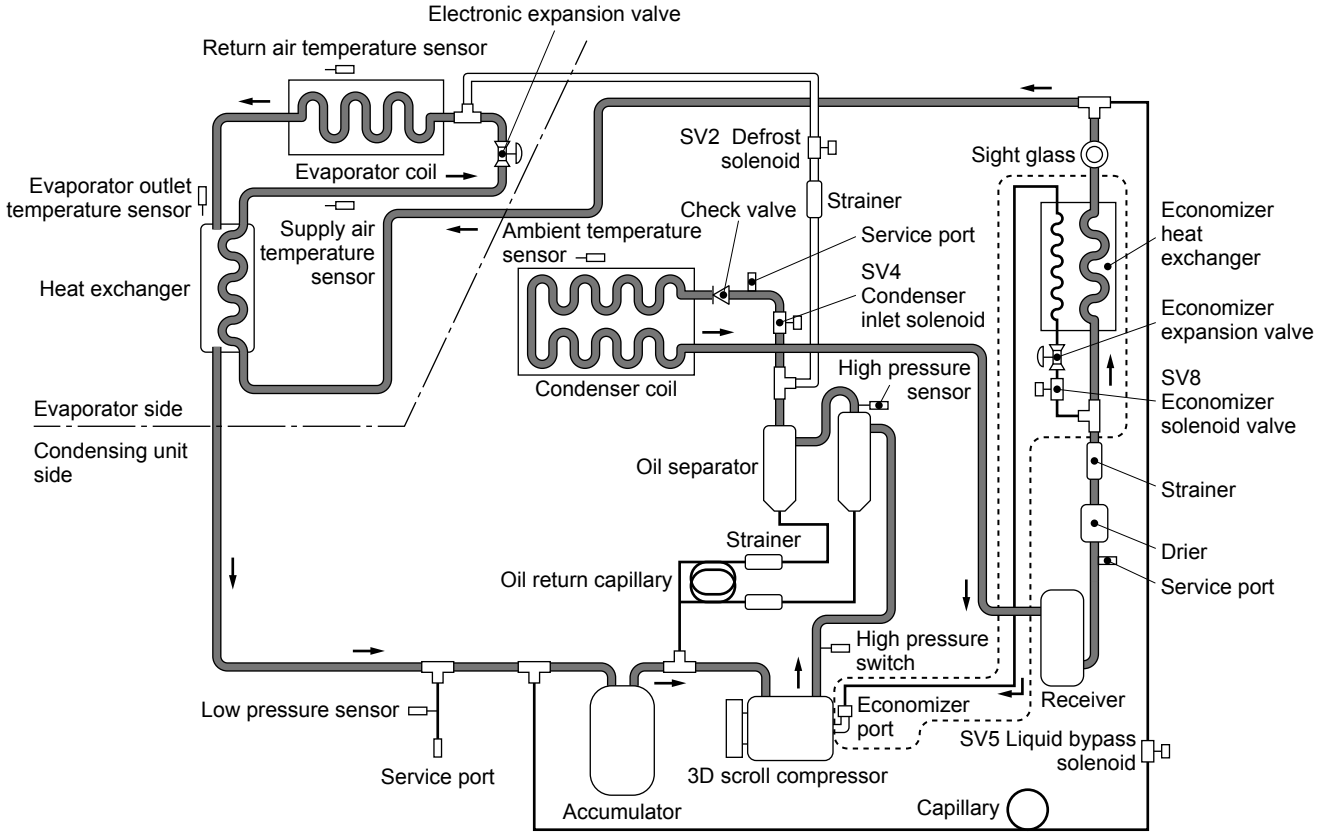
4. REFRIGERANT PIPING SYSTEM

4.1 Refrigerant piping diagram



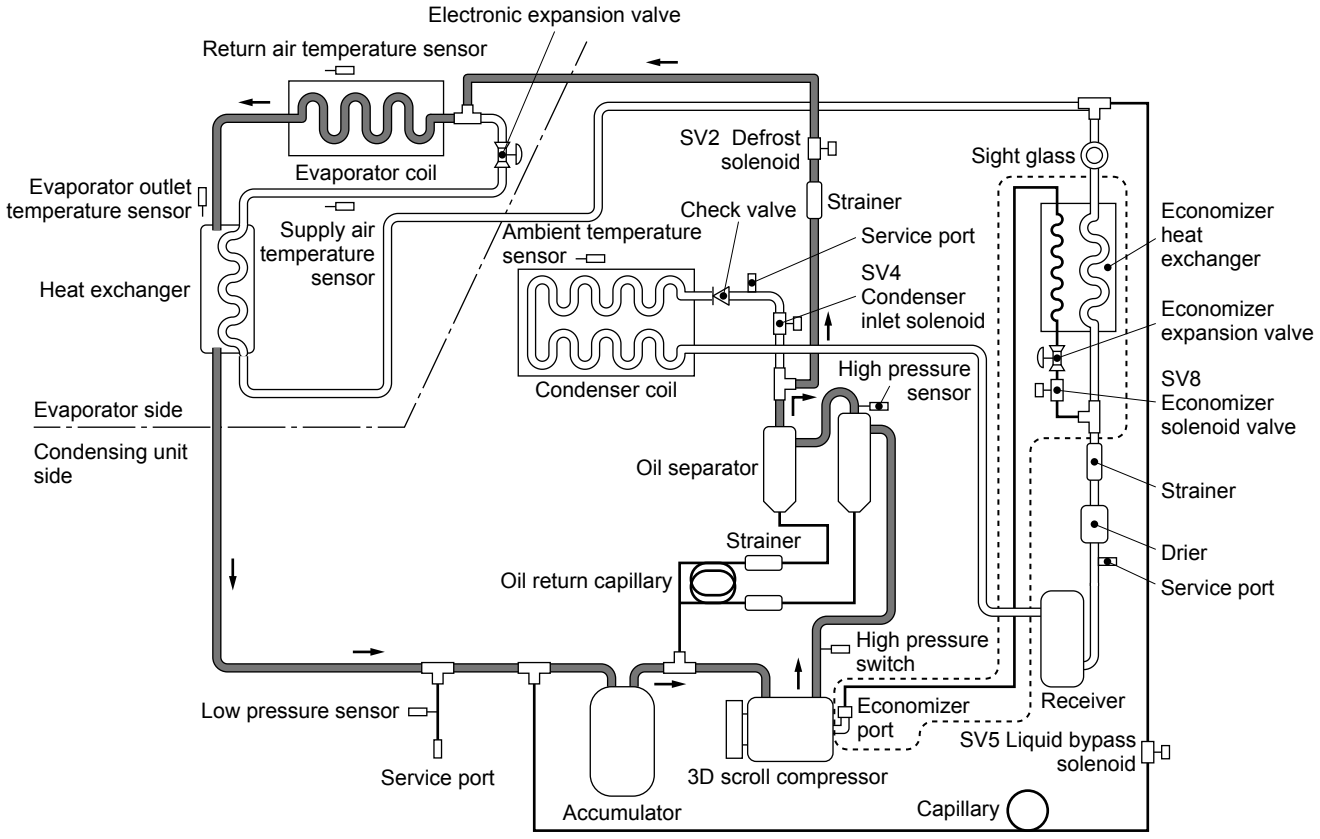
4.2 Refrigerant cycle

< Cooling cycle >



Note: - - - - shows economizer cycle for TU1250SAE.

< Defrosting・heating cycle >

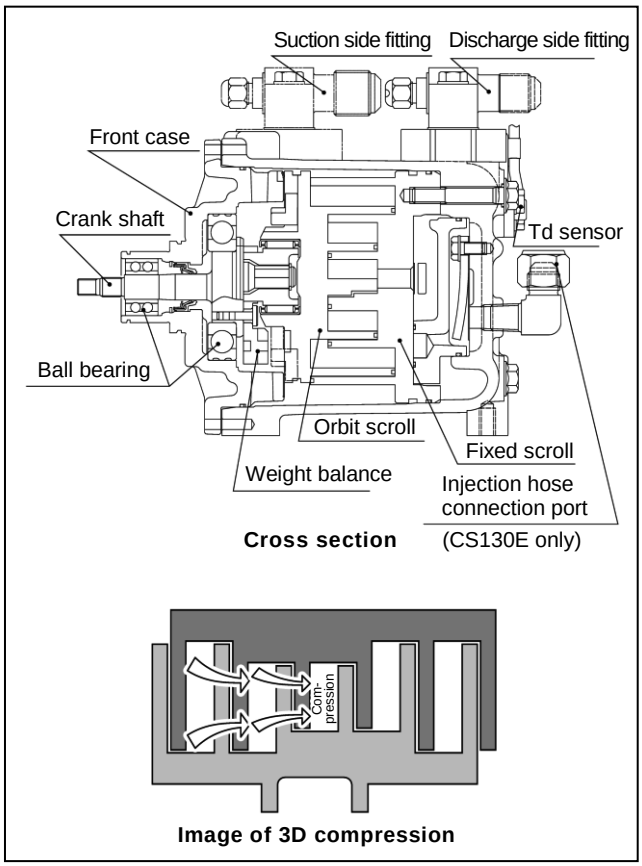


Note: - - - - shows economizer cycle for TU1250SAE.

5. DESCRIPTIONS OF MAJOR COMPONENTS

5.1 Compressor

This is a 3D scroll compressor which compresses refrigerant three dimensionally in axial direction as well in addition to traditional radial compression by reducing the blade height at the central portion than peripheral of the scroll. This kind of compressor is especially suitable for the low temperature refrigeration unit and substantial size down, capacity expansion and efficiency extension have been realized.



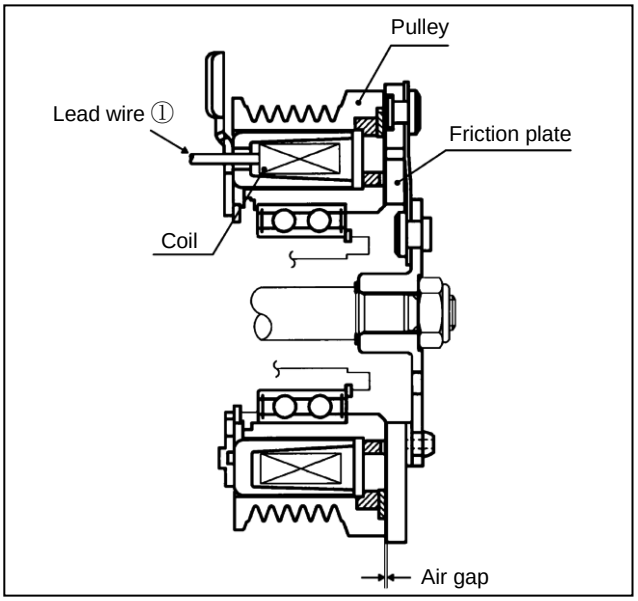
Compressor

Specifications

Model	Open 3D scroll compressor		*R
	TU1250SAE	TU1100/900SAE	
	CS130E	CSA130	
Displacement	125.6 cc/revolution		
Clutch diameter	ø115		
Working speed <High>	3650 min^{-1}		
Working speed <Low>	2850 min^{-1}		
Refrigeration machine oil	Diamond Freeze MA32R		
Dimension	ø119 x L284	ø119 x L270	

5.2 Magnet clutch

The magnet clutch is mounted on the crank shaft of the compressor, and turns ON or OFF the compressor as demanded by the thermostat.



Magnet clutch

Specifications

Voltage	DC12V
Power consumption	46 W
Static friction torque	33 N · m (3.4 kgf · m)
Revolving direction	Right (Looking from right side) See P100
Weight	With ribbed belt: 2.3 kg

Judgment of quality

Compressor will run if the pulley and the friction plate are contacted (a click is heard) when a battery voltage is applied between the lead wire ① and the main unit ground.

If it fails to run after applying the voltage, check the continuity between the lead wire ① and the main unit ground with a tester. If there is no continuity, the coil is broken. If any abnormal noise is heard, the bearing could be worn. When replacing the magnet clutch, replace it as an assembly.

When the air gap is not in the range of 0.3 ~ 0.5mm, replace.

5.3 Sub-engine

Specifications

Model	3TNV76
Rated output	13.2 kW/ 2200 min^{-1}
Displacement	1116 cc
Continuous operation fuel consumption	2.8 L (Ambient temp. 30°C, inside container temp. 0°C)
Bore x Stroke x Cylinders	ø76 x 82 x 3
Oil capacity	9.5L
Fuel	JIS 2 Light oil (Diesel fuel) (Intense cold season: Cold weather diesel fuel)
Cooling method	Water-cooled
Revolution speed	<High speed> 2100min^{-1}, <Low speed> 1650min^{-1}

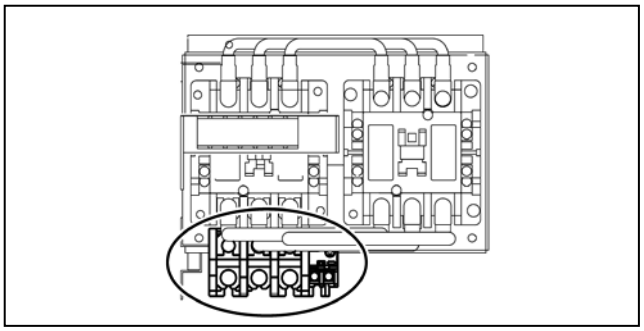
5.4 Motor

Specifications

Type	Totally-enclosed fan-cooled outdoor type
Power supply	3ø AC 400V(50Hz)
Rated output	5.5 kW
Number of poles	4

5.5 Over current relay (OCR)

When an over current flows into the motor during motor operation, the relay stops the motor to protect it. If it lapses more than 3 minutes after the current returned to the normal value, it is reset automatically.

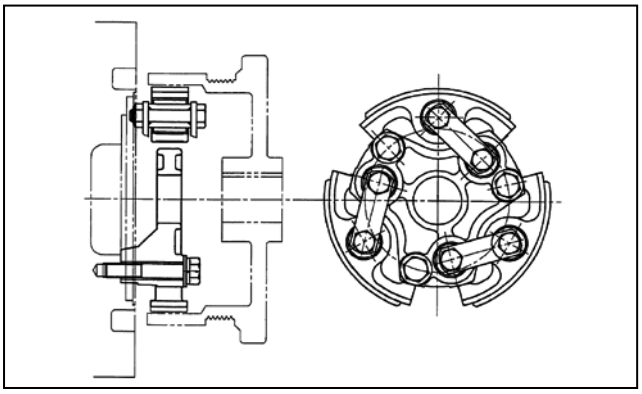


Over current relay

Setting value: 17A

5.6 Centrifugal clutch

The clutch is mounted on the flywheel of the sub-engine. When the sub-engine exceeds the specified speed, the centrifugal force of the engine overcomes the centripetal force of the spring to bring the frictional shoe into contact with the power transmission surface of pulley. Thus, the pulley starts rotating. As the revolution speed increases further, the contact pressure on the power transmission face will increase to generate the frictional force, which resists the load torque. Thus, the power will be transmitted from the sub-engine shaft. Moreover, when the electric motor runs, the centrifugal clutch does not operate, so the motor power is not transmitted to the sub-engine.

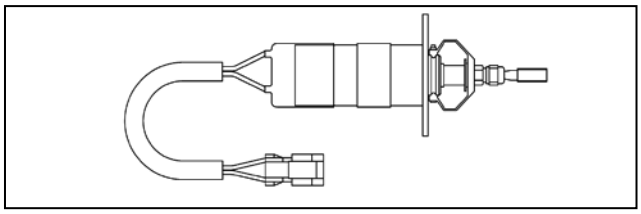


Centrifugal clutch

Engage speed: 750±150min^{-1}

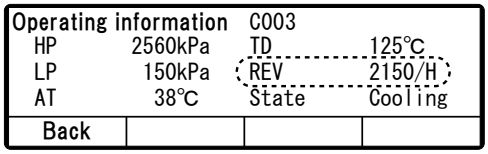
5.7 Sub-engine throttle solenoid

The sub-engine speed is changed to the high or low rated speed by this solenoid.



Sub-engine throttle solenoid

(1) To check the sub-engine speed, change the controller display to "the operation information display mode" while the refrigeration unit is operating. (See page 57.)



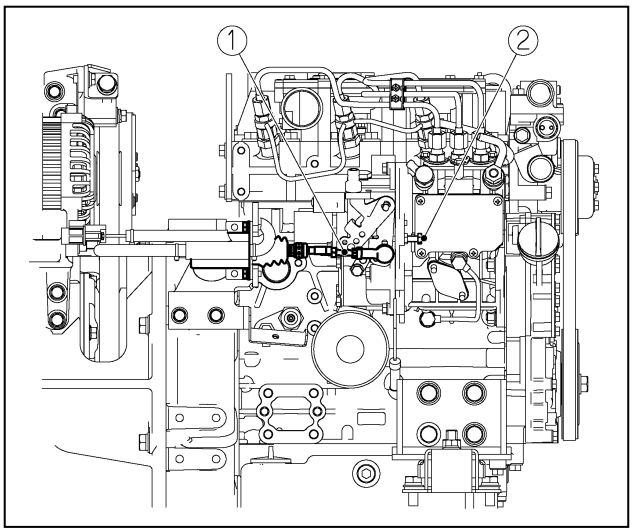
Display the sub-engine speed.
When the sub-engine speed display largely fluctuates, make sure to check it on the speed meter and carry out the following adjustment.

(2) Sub-engine speed adjustment procedure

(a) While running the sub-engine at a high speed, adjust the adjusting rod ① to set the speed at 2100min^{-1}.

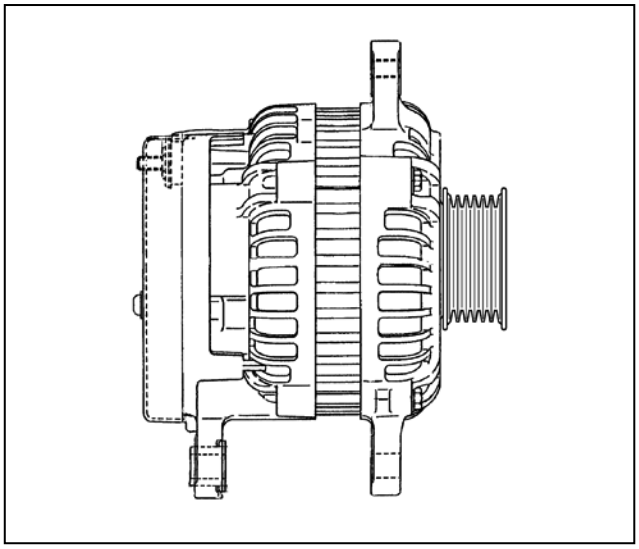
(b) After the high speed adjustment, run the sub-engine at a low speed, and adjust the slow speed set bolt ② to set the speed at 1650min^{-1}.

(c) After the installation and adjustment, be sure to make a test run and check to see that it operates and stops.

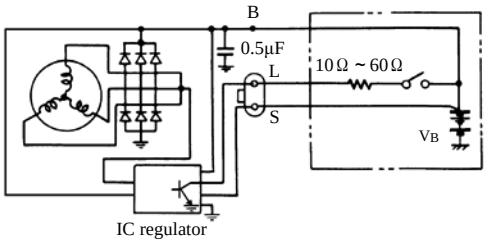


5.8 Alternator

(1) Alternator is driven by the sub-engine or motor via a belt, and generates power to charge the battery.
(2) Alternator has a built-in IC regulator and its controller is composed by an integrated circuit (MIC).



Alternator



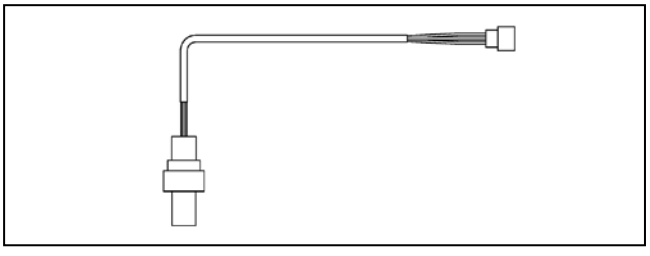
Circuit diagram

Specifications

Model	A003TB1591A
Rating	Continuous
Voltage	DC12V
Output capacity	75A
Weight	5.5kg

5.9 Low pressure sensor (LPT)

This sensor detects the low pressure. If it drops to the protective pressure, the sensor trips to stop the unit.



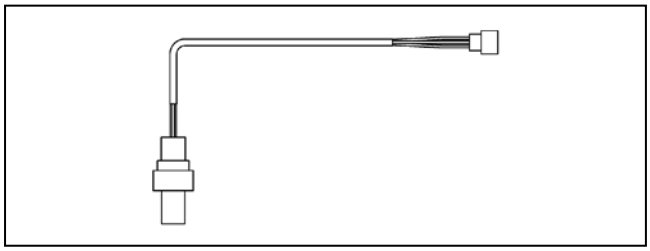
Low pressure sensor

Output characteristics

Low pressure	Output voltage
-0.1MPa (750mmHg)	0.2V
0MPa (0kgf/cm^2)	0.5V
0.5MPa (5kgf/cm^2)	2.0V
1.0MPa (10kgf/cm^2)	3.5V

5.10 High pressure sensor (HPT)

This sensor detects the high pressure. If it rises to the protective pressure, the sensor trips to stop the unit.



High pressure sensor

Output characteristics

High pressure	Output voltage
0MPa (0kgf/cm^2)	0.5V
2.08MPa (21.2kgf/cm^2)	2.0V
4.15MPa (42.3kgf/cm^2)	3.5V

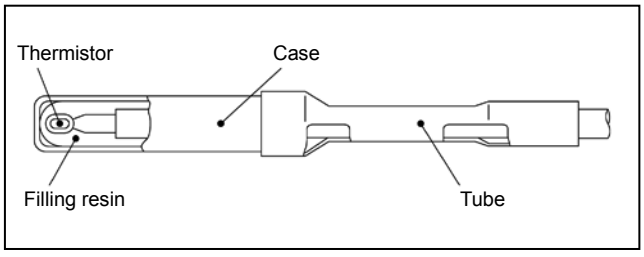
5.11 Evaporator outlet temperature sensor (EVT)

This sensor monitors the gas temperature at the evaporator outlet to control super-heat with the electronic expansion valve, and the stop of defrosting.

Defrosting stop temperature: 25.0 ± 1.5°C
(Defrost timer counting condition: 1.0 ± 1.5°C)

Judgment of sensor condition

(1) Disconnecting the thermistor sensor lead wire at the connector, measure the continuity.
(2) Check by referring to the temperature/ resistance characteristic value of thermistor.
(3) If the resistance value deviates largely, remove the sensor from the connector and replace.



Evaporator outlet temperature sensor

Unit: kΩ

°C	Minimum	Standard	Maximum
-30	25.293	26.316	27.376
-20	15.125	15.572	16.031
-10	9.342	9.524	9.709
0	5.940	6.000	6.060
10	3.810	3.882	3.955
20	2.505	2.573	2.644
25	2.049	2.113	2.179
30	1.687	1.746	1.808
40	1.163	1.213	1.265
50	0.819	0.860	0.903

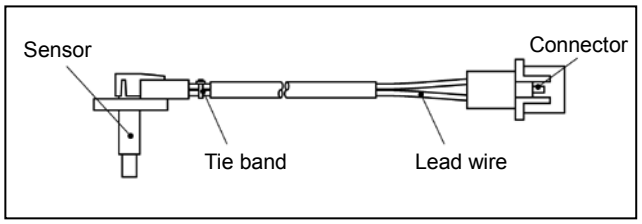
5.12 Return air temperature sensor (TH) and supply air temperature sensor (THD)

The return air temperature sensor and the supply air temperature sensor monitor the evaporator return and supply air temperatures in order to maintain them at the setting temperatures on the controller.
Specifications of these sensors are same as those of the evaporator outlet temperature sensor.

5.13 Discharge gas temperature sensor (TDS)

This sensor monitors the compressor discharge gas temperature so as to open the liquid bypass solenoid valve as the discharge temperature becomes higher or to stop the refrigeration unit.

- If the temperature becomes higher than 140°C, it opens the liquid bypass solenoid valve and closes the economizer solenoid valve to bring down the discharge temperature by the refrigerant.
- If the temperature becomes higher than 145°C, it stops the refrigeration unit.



Discharge gas temperature sensor

Solenoid valve open: 140°C (change by operating state)
Solenoid valve close: 130°C (change by operating state)
Unit stop : 145°C
Operation resume : 100°C

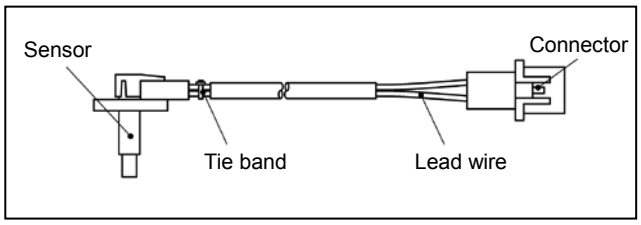
Judgment of condition
Removing the connector, measure the resistance value.

Resistance values under normal condition

200°C	0.430kΩ	100°C	5.228kΩ
175°C	0.738kΩ	25°C	80.470kΩ
115°C	3.352kΩ		

5.14 Engine clutch temperature sensor (ECS)

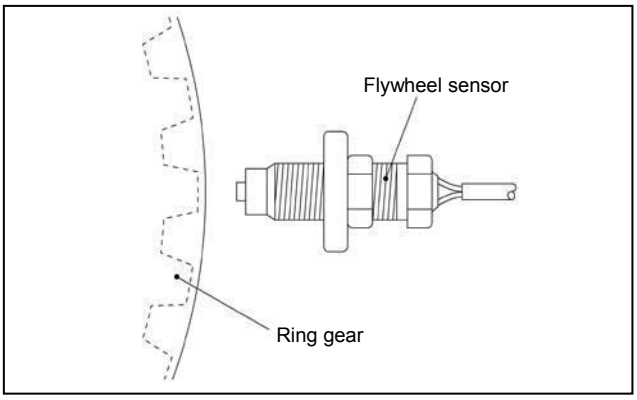
The temperature of pulley will increase due to friction force when the power transmission surface of engine clutch (centrifugal clutch) slips. The unit will stop with a display of alarm code E36 if the temperature of engine clutch temperature sensor increases to the specified value. This alarm cannot be reset to restart the unit with an ordinary procedure because it could result in a fire.
Check the centrifugal clutch and contact a service center for resolution of the alarm.



Engine clutch temperature sensor

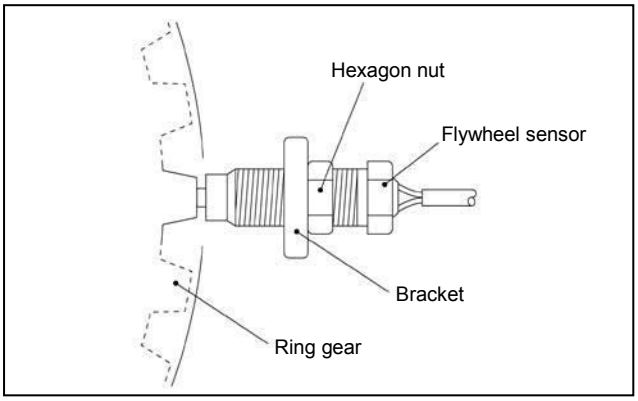
5.15 Flywheel sensor (FWS)

The sensor monitors the sub-engine speed and inputs the result to the controller. If it detects a speed lower than the setting speed, it stops the sub-engine.

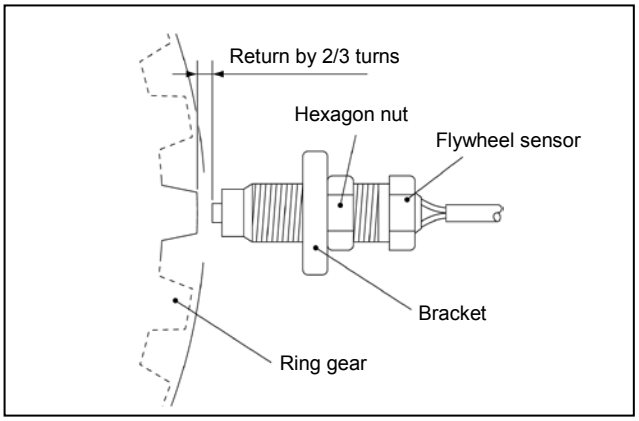


Flywheel sensor

(1) Flywheel sensor mounting procedure
(a) Assemble the sensor in the bracket, and turn it till it contacts the ring gear lightly. (See the figure.)

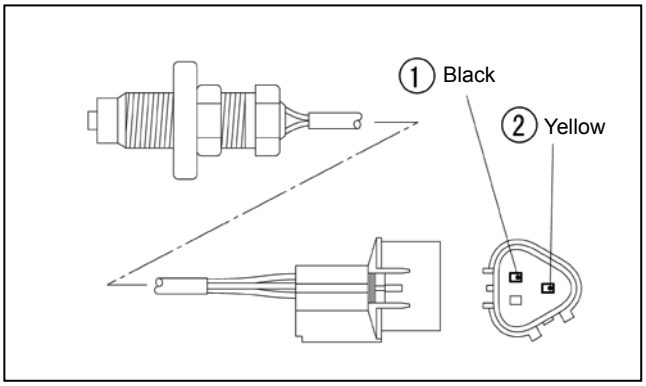


(b) Return the sensor by 2/3 turns from the position it contacted. (See the figure.)



(c) Fix the flywheel sensor on the bracket with the hexagon nut.
Tightening torque: 29.4 ± 4.9N·m (3 ± 0.5 kgf·m)

(2) Inspection



Removing the connector, measure the resistance between ① and ②.
Normal resistance: 2.3 ± 0.2kΩ

5.16 High pressure switch (HPS)

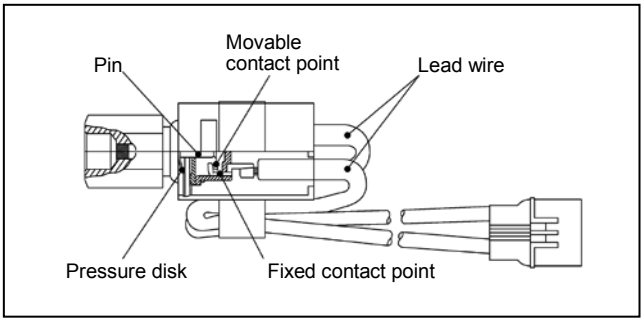
When the compressor discharge pressure goes up abnormally higher, the high pressure switch trips and stops the operation to prevent the dangerous situation.

Setting value MPa

CUT OUT	3.2
CUT IN	2.2 (Auto reset)

The switch cannot be adjusted. If it is defective, replace as an assembly.

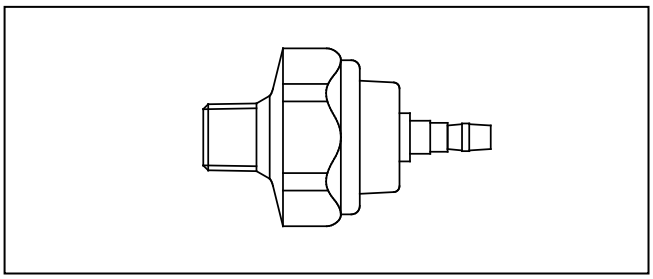
Judgment of quality
Connect a gauge manifold to the high pressure service port, seal suction side of the condenser with a sheet of paper or the like and operate the unit. It is normal if the unit stops when the high pressure reaches to 3.2 MPa.



High pressure switch

5.17 Engine oil pressure switch (OPS)

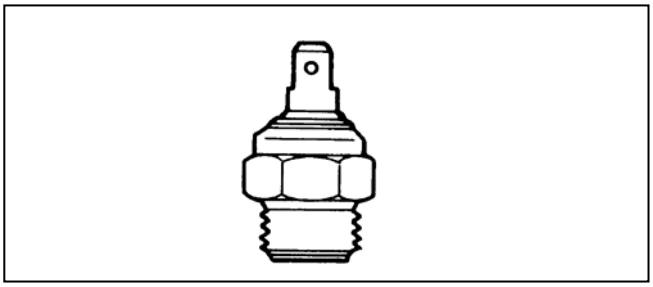
The oil pressure switch is mounted at the periphery of the oil pump. If the oil pressure drops below 0.05 MPa when the engine is running at 700 rpm or higher, the switch trips (ON = close) to stop the engine.



Engine oil pressure switch

5.18 Water temperature switch (WTS)

The water temperature switch detects the temperature of the engine cooling water and trips to stop the sub-engine when the temperature goes higher than the setting temperature.



Water temperature switch

Setting value

ON	110°C
OFF	100°C

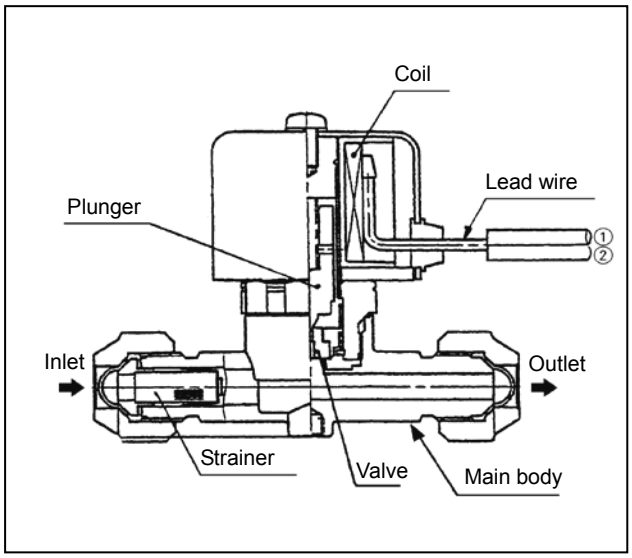
5.19 Solenoid valve

(1) Defrost solenoid valve, Liquid bypass solenoid valve, Economizer solenoid valve

① Defrost solenoid valve (SV2)
It is installed in order to flow hot gas of refrigerant into the evaporator side when defrosting and heating.

② Liquid bypass solenoid valve (SV5)
This valve is prepared to open when the compressor discharge temperature goes higher than the set value to prevent the discharge temperature from getting high.

③ Economizer solenoid valve (SV8)
(TU1250SAE only)
It is installed in order to open and flow refrigerant into the economizer circuit during cooling operation.



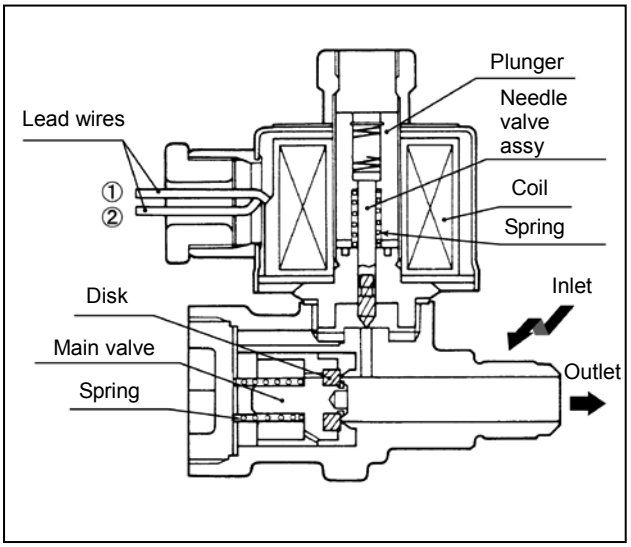
Defrost solenoid valve, Liquid bypass solenoid valve, Economizer solenoid valve

Judgment of quality
When testing the continuity between lead wires ①②, if there is the continuity, the coil is normal. Otherwise, the coil is defective.
If there is a difference in the refrigerant inlet and outlet temperatures before supplying the power to the coil, and the temperatures become same after supplying the power, the plunger is operating normally.
If there is a difference in the temperatures, the plunger is stuck.

Simple diagnosis
When the power is supplied to the coil, if a shock from the plunger, which hops up with a click, is felt by the finger placed on the solenoid valve, it is normal.

(2) Condenser inlet solenoid valve (SV4)

- It opens during cooling operation and let refrigerant flow into the condenser side.
- During defrosting, the solenoid valve is closed.
- This solenoid valve is closed while energized. When the power is not supplied, the plunger is at the top and the disk is open.
- This solenoid valve opens when the high pressure increases and let the refrigerant flow into condenser side to prevent high pressure from going too high during defrosting and heating operation.



Condenser inlet solenoid valve

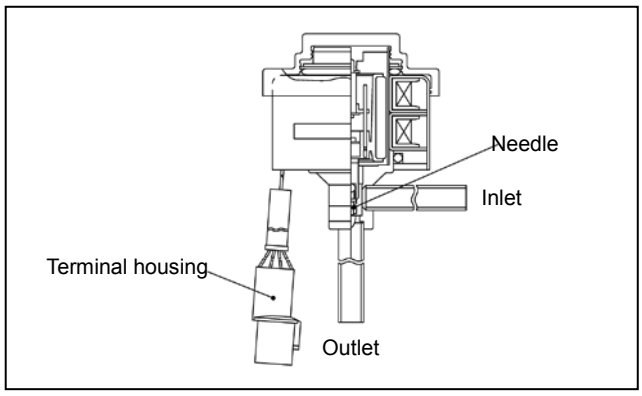
Judgment of quality
When testing the continuity between lead wires ①②, if there is the continuity, the coil is normal. Otherwise, the coil is defective.
If the temperatures are same at the refrigerant inlet and outlet before supplying the power to the coil, and the temperatures become different after supplying the power, the plunger is operating normally.
If there is no difference in the temperatures, the plunger is stuck.

Simple diagnosis
When the power is supplied to the coil, if a shock from the plunger, which hops down with a click, is felt by the finger placed on the solenoid valve, it is normal.

5.20 Electronic expansion valve

This valve controls super-heat at the evaporator outlet.

This valve is controlled by the cascade control using supply air temperature sensor and return air temperature sensor during the low speed cascade operation.

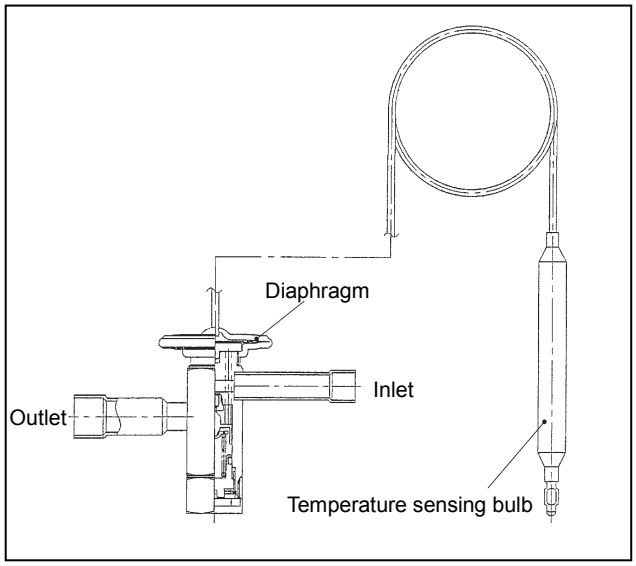


Electronic expansion valve

The electronic expansion valve has a built-in stepping motor and adjusts the valve aperture steplessly by the electric pulse signals.

5.21 Economizer expansion valve (TU1250SAE only)

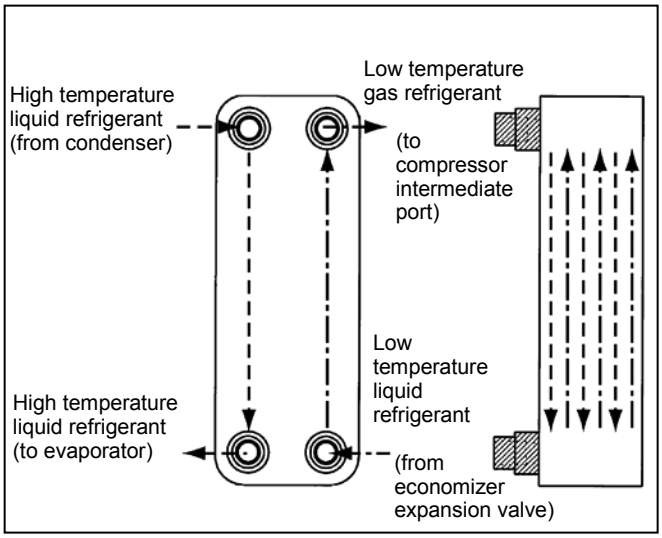
This valve automatically controls the refrigerant flow amount into the economizer heat exchanger to become proper by detecting the super-heat at the outlet of the economizer heat exchanger.



Economizer expansion valve

5.22 Economizer heat exchanger (TU1250SAE only)

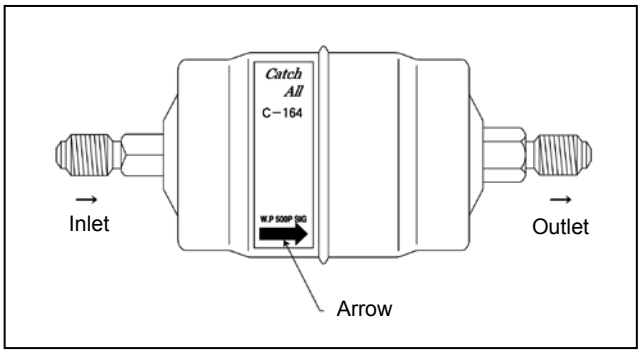
The refrigerating capacity is increased by exchanging the heat between the high temperature liquid refrigerant and low temperature liquid refrigerant.



Economizer heat exchanger

5.23 Drier

Drier removes moisture and foreign matters from the refrigerant. When the desiccant in the drier has become unable to remove moisture any more (check color in the sight glass is yellow), replace the drier.



Drier

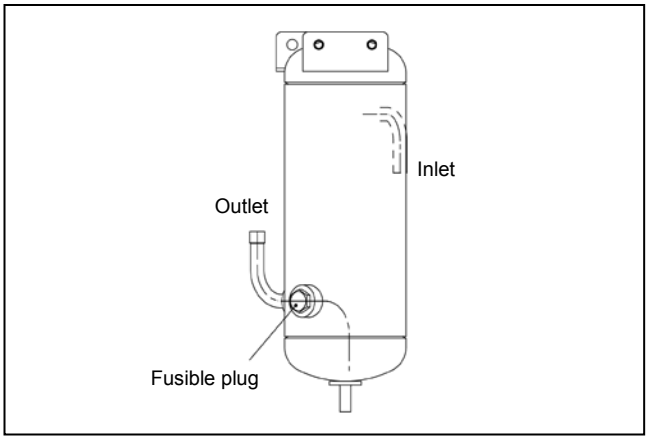
When mounting the drier on the refrigeration unit, align the arrow on the drier with the flow direction of refrigerant.

When the replacement of the drier is required, replace it quickly since the drier is highly absorbent.

5.24 Receiver

It reserves the refrigerant, which has been liquefied by the condenser.

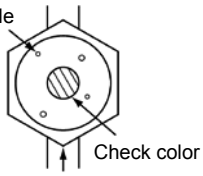
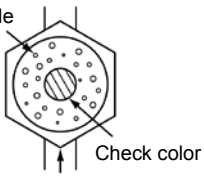
It has a fusible plug that melts under abnormally higher temperature (95°C) and discharges the refrigerant to the atmosphere to prevent the dangerous condition. When the plug has melted, replace with a new plug.



Receiver

5.25 Sight glass

Sight glass allows judging the circulation volume of refrigerant and moisture contained in the refrigerant.

	Amount of refrigerant is proper	Amount of refrigerant is short
Sight glass	Bubble  Check color (A few bubbles are moving or no bubbles)	Bubble  Check color (A lot of bubbles are seen and it looks like flushing when the refrigerant is extremely in shortage.)

Sight glass

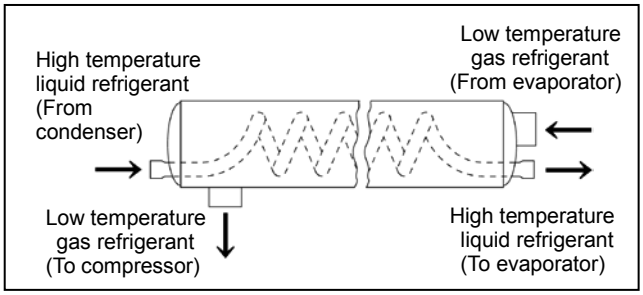
If the refrigerant is in shortage, repair the leaking place and charge the specified amount of refrigerant.

Check color	Judgment	Moisture amount (R452A) Refrigerant temperature 40°C
Green	Normal	< 30 ppm
Light green	Rather abnormal	30~140 ppm
Yellow	Abnormal	140 ppm <

When the color is yellow, evacuation and replacement of drier are necessary.

5.26 Heat exchanger

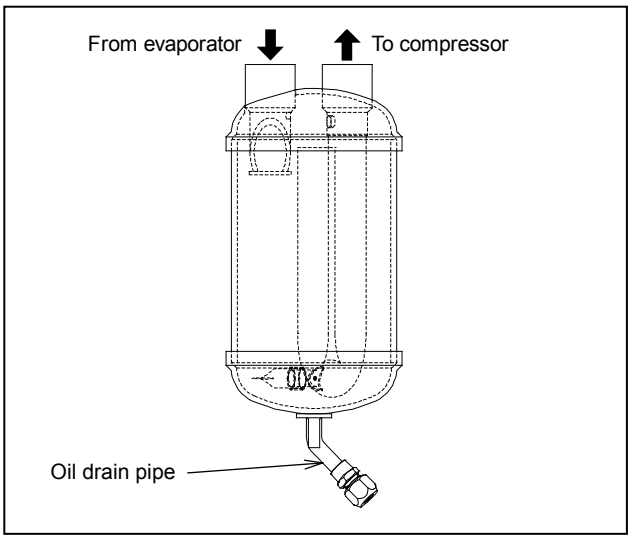
The heat exchanger increases the refrigerating capacity by exchanging the heat between the high temperature liquid refrigerant and the low temperature gas refrigerant.



Heat exchanger

5.27 Accumulator

In order to prevent the liquid refrigerant from being sucked into the compressor, the liquid refrigerant and gas refrigerant are separated.
An oil drain pipe that removes oil remaining in the accumulator is provided.



Accumulator

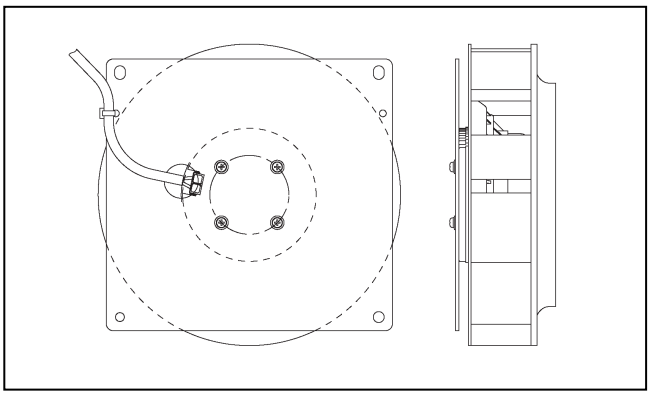
5.28 Evaporator fan & motor

A blushless type motor is adopted. Combined with turbo fan, it realizes characteristics of small, light weight and energy saving.

Elemental characteristics (without load):

Voltage	Revolution	Power	Propeller diameter
DC12V	2600 min^{-1}	80W	ø 222

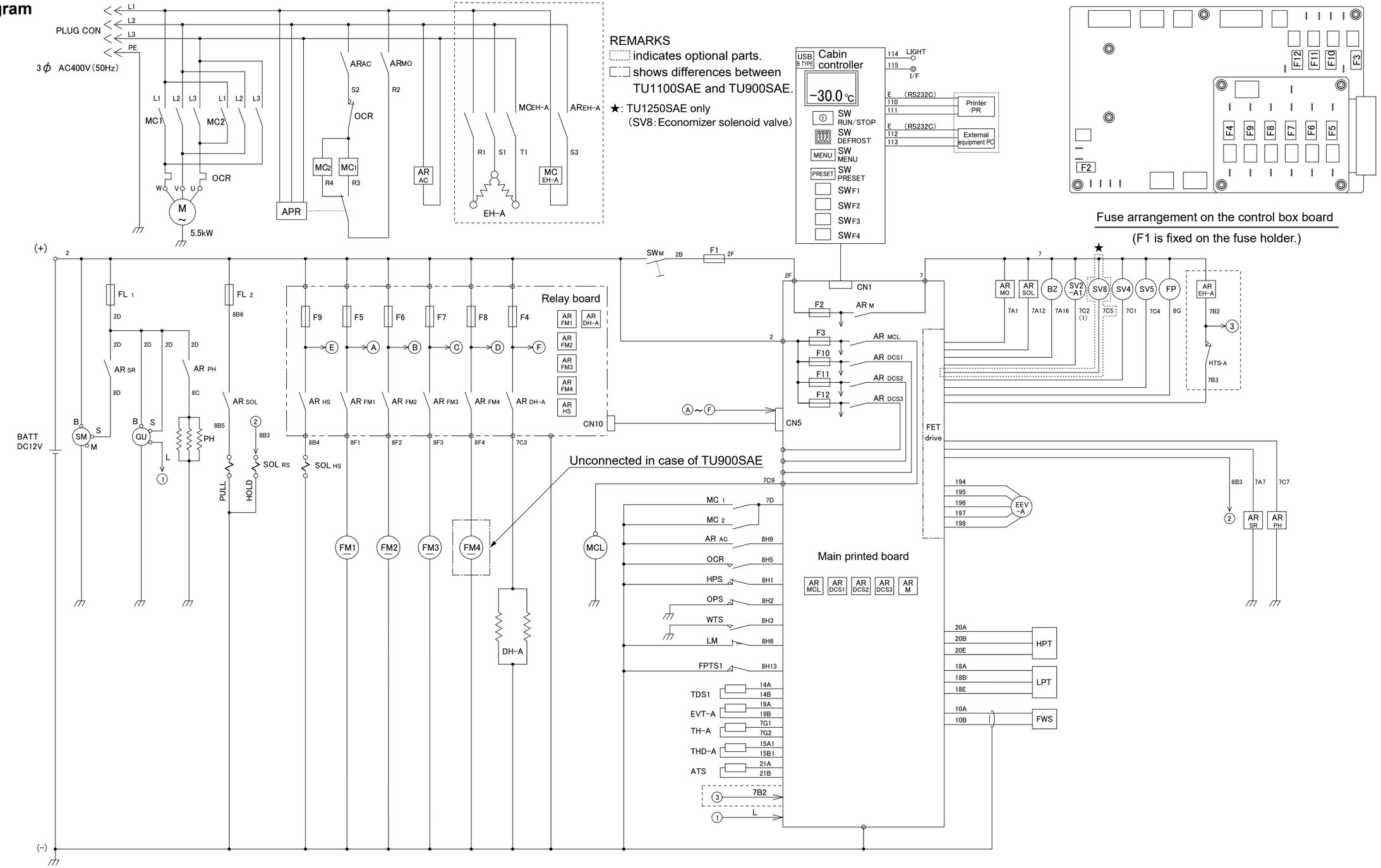
Lock detection circuit
When the motor is locked by sticking foreign materials, etc. the lock detection circuit shuts off the motor power circuit and prevent the motor from overheating.



Evaporator fan & motor

6. WIRING DIAGRAM

6.1 Ladder diagram

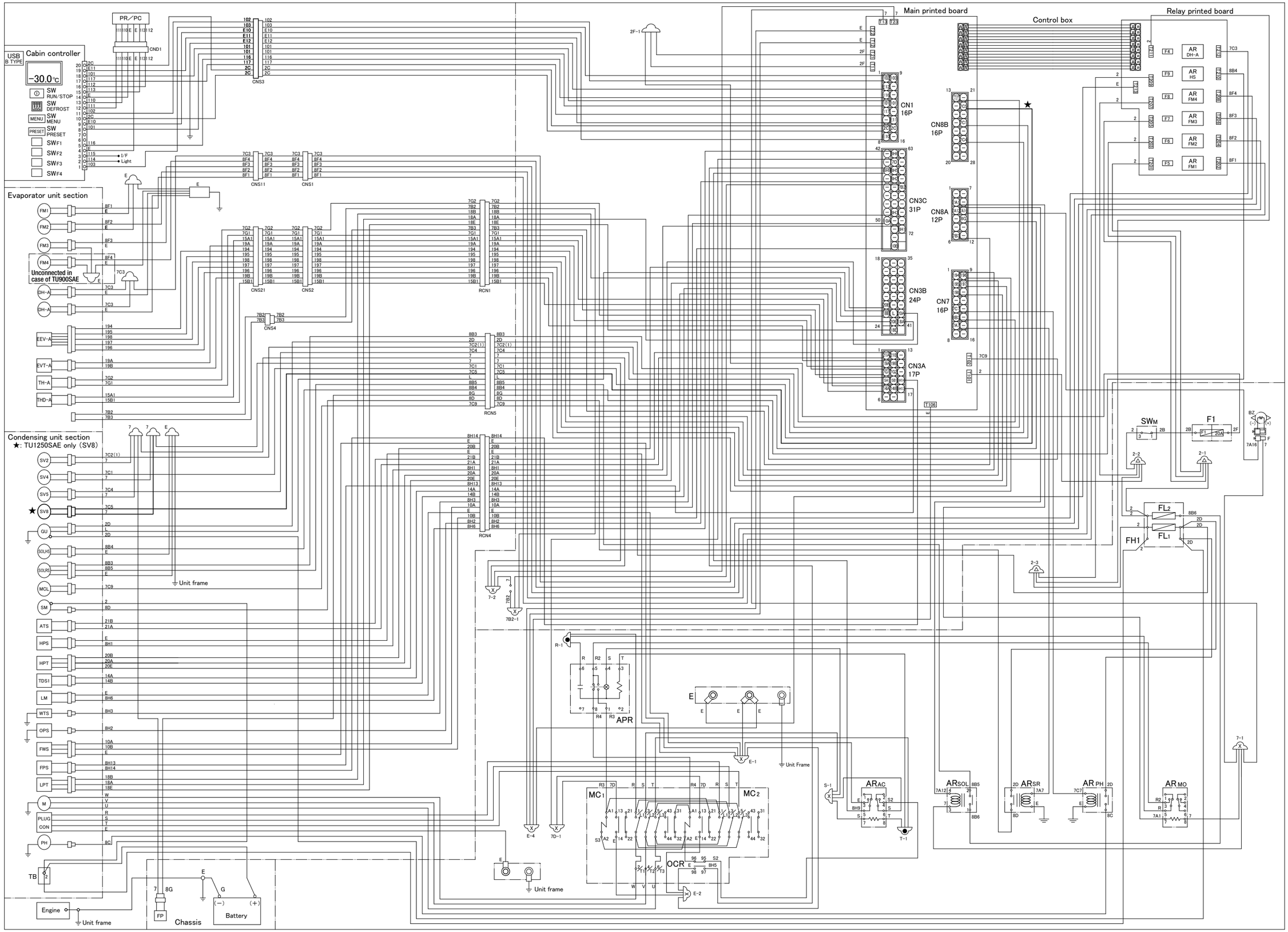


* R

* R

Installed on Control box						Installed on Cabin controller		Installed on Cabin controller harness		Installed on Condensing unit						Installed on Evaporator unit	
Code	Name	Code	Name	Code	Name	Code	Name	Code	Name	Code	Name	Code	Name	Code	Name	Code	Name
SW M	Main switch (operation ON/OFF)	MC1	Contactor (motor normal phase)	AR FM1	Relay (evaporator fan motor 1)	SW UP	Switch (up)	PR	Connector (printer)	GU	Alternator	SV 2	Defrost solenoid valve	HPT	High pressure sensor	FM 1-4	Evaporator fan motor
FL1	Fusible link(starter, alternator, glow plug)(100A)	MC2	Contactor (motor reverse phase)	AR FM2	Relay (evaporator fan motor 2)	SW DOWN	Switch (down)	LIGHT	Night illumination terminal	SM	Starter motor			LPT	Low pressure sensor	DH -A	Drain hose heater A
FL2	Fusible link(stop solenoid, PULL coil)(70A)	OCR	Over current relay	AR FM3	Relay (evaporator fan motor 3)	SW RUN/STOP	Operation switch	I/F	Operation management terminal	PH	Glow plug	SV 8	Economizer solenoid valve ★	FWS	Flywheel sensor	EEV -A	Electronic expansion valve A
F1	Fuse (control circuit)(20A)	APR	Anti-phase reversal relay	AR FM4	Relay (evaporator fan motor 4)	SW DEFROST	Switch (defrost)			SOL RS	Stop solenoid	SV 4	Condenser inlet solenoid valve			EVT -A	Evaporator outlet temperature sensor A
F2	Fuse (relay circuit)(15A)	MC EH-A	Evaporator heater contactor A (option)	AR HS	Relay (throttle solenoid)	SW MODE	Switch (mode)			SOL HS	Throttle solenoid	SV 5	Liquid bypass solenoid valve	TDS1	Discharge gas temperature sensor	TH -A	Return air temperature sensor A
F3	Fuse (compressor magnet clutch)(10A)	AR MO	Relay (standby motor)	AR M	Relay (main)	SW SET	Switch (set)			MCL	Compressor magnet clutch	HPS	High pressure switch	ATS	Ambient air temperature sensor	THD -A	Supply air temperature sensor A
F4	Fuse (drain hose heater)(10A)	AR AC	Relay (commercial power detection)	AR MCL	Relay (compressor magnet clutch)	SW WHISPER	Switch (whisper)			M	Standby motor	OPS	Oil pressure switch			HTS -A	High temperature thermo switch A
F5 ~ 8	Fuse (evaporator fan motor 1-4)(15A)	AR SR	Starter relay	AR DH-A	Relay (drain hose heater A)							WTS	Water temperature switch			EH -A	Evaporator heater A (option)
F9	Fuse (throttle solenoid)(30A)	AR SOL	Stop solenoid relay									ECS	Engine clutch temperature sensor			Installed on vehicle side	
F10 ~ 12	Fuse (external equipment power)(10A)	AR PH	Pre-heater (glow plug) relay	AR DCS1-3	Relay (External equipment power)							LM	Limit switch			BATT	Battery
		AR EH-A	Evaporator heater relay A (option)	BZ	Buzzer											FP	Fuel pump

6.2 Wiring layout drawing



7. DESCRIPTION OF OPERATION

(1) Automatic start/stop operation

In this operation pattern, the sub-engine or motor is started or stopped depending on the judgment of thermostat in order to maintain the inside container temperature (return air temperature of evaporator) at around the setting temperature.

As it reaches the setting temperature (the setting temperature + 1°C for the heating operation in the chilled range only), the thermostat turns OFF and the cooling or heating operation stops. (However, if it is shorter than the minimum power operation time, the sub-engine or motor continues to run even after reaching the setting temperature and the compressor only turns OFF.)

If the difference between the setting temperature and the return air temperature exceeds the specified value (see table below), the thermostat turns ON and the operation restores. (However, until the minimum power stop time is satisfied, the operation is suspended.) There is no heating operation in the frozen range.

(a) Setting temperature range

Temperature range	Setting temperature range
A	Setting temperature ≦ –12°C
B	–12°C < Setting temperature < –5°C
C	–5°C ≦ Setting temperature ≦ +10°C
D	+10°C < Setting temperature

(b) Thermostat judgment

	Temperature range	A	B	D	C
Cooling	Thermostat OFF→ON	Return air temperature sensor has detected higher than the setting temperature + 2°C (changeable between +1 and +6°C *) for more than 5 seconds.			
	Thermostat ON→OFF	Return air temperature sensor has detected lower than the setting temperature for more than 5 seconds.			
Heating	Thermostat OFF→ON		Return air temperature sensor has detected lower than the setting temperature –2°C (changeable between –1 and – 6°C *) for more than 5 seconds.		Return air temperature sensor has detected lower than the setting temperature –1°C for more than 5 seconds.
	Thermostat ON→OFF		Return air temperature sensor has detected higher than the setting temperature for more than 5 seconds.		Return air temperature sensor has detected higher than the setting temperature +1°C for more than 5 seconds.

*If this value (thermostat resetting temperature difference) of the return air temperature sensor is changed, both the cooling and heating sides are changed to the same value with different signs at soft frozen range and cooling・normal temperature range.

(c) Thermostat switching map

1) Setting temperature ≦ –12°C

There is no high speed operation in case of motor drive.

Electronic expansion valve will be controlled by super-heat at evaporator outlet during cooling operation. (Driving range of EEV is 40 ~ 500 pulses but it is controlled with the opening under 200 pulses normally.)

○: Energized (ON), △: Energized/de-energized (ON/OFF) control

Temperature / Operation No.	Temperature difference between setting and return air (°C) -3 -2 -1 0 1 2 3	Load SOL HS	SV8	SV2	SV4*	EEV
High speed cooling		○	△			Super-heat control at evaporator outlet
Low speed cooling						↑
Thermostat OFF	Thermostat OFF					Full close

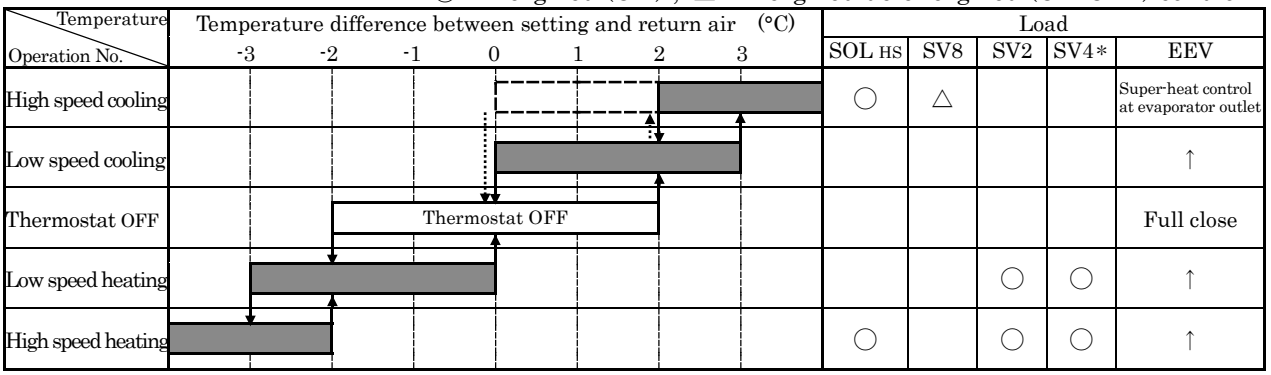
SOL HS : Throttle solenoid, SV8 : Economizer solenoid, SV2 : Defrost solenoid, SV4 : Condenser inlet solenoid,

*: SV4 closes when energized (ON) and opens when de-energized (OFF),

: When high speed cooling cannot be carried out.

2) –12°C < Setting temperature < –5°C, and Setting temperature > +10°C
There is no high speed operation in case of motor drive.

○: Energized (ON) , △: Energized/de-energized (ON/OFF) control

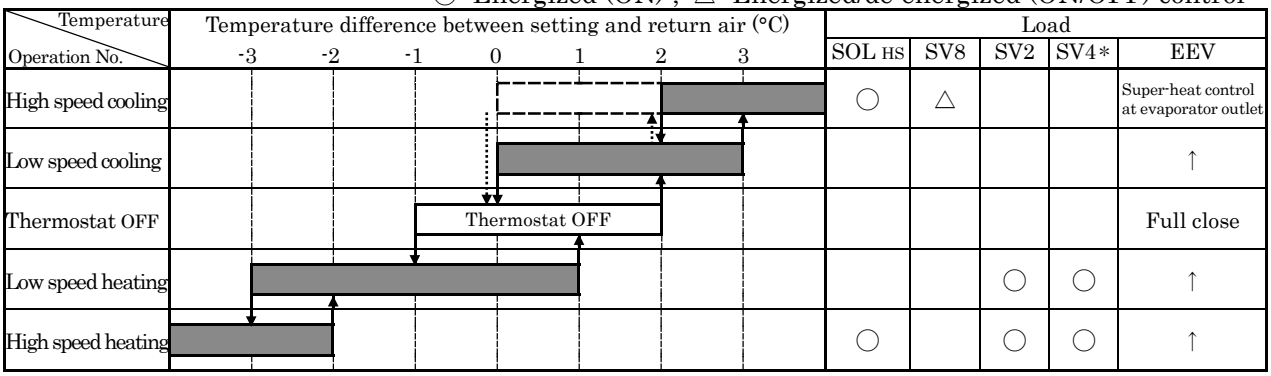


Operation No.	Load				
	SOL HS	SV8	SV2	SV4*	EEV
High speed cooling	○	△			Super-heat control at evaporator outlet
Low speed cooling					↑
Thermostat OFF					Full close
Low speed heating			○	○	↑
High speed heating	○		○	○	↑

SOL HS : Throttle solenoid, SV8 : Economizer solenoid, SV2 : Defrost solenoid, SV4 : Condenser inlet solenoid,
: Operation when the return air temperature drop is slow,
*: SV4 closes when energized (ON) and opens when de-energized (OFF).

3) –5°C ≦ Setting temperature ≦ +10°C
There is no high speed operation in case of motor drive.

○: Energized (ON) , △: Energized/de-energized (ON/OFF) control



Operation No.	Load				
	SOL HS	SV8	SV2	SV4*	EEV
High speed cooling	○	△			Super-heat control at evaporator outlet
Low speed cooling					↑
Thermostat OFF					Full close
Low speed heating			○	○	↑
High speed heating	○		○	○	↑

SOL HS : Throttle solenoid, SV8 : Economizer solenoid, SV2 : Defrost solenoid, SV4 : Condenser inlet solenoid,
: Operation when the return air temperature drop is slow,
*: SV4 closes when energized (ON) and opens when de-energized (OFF).

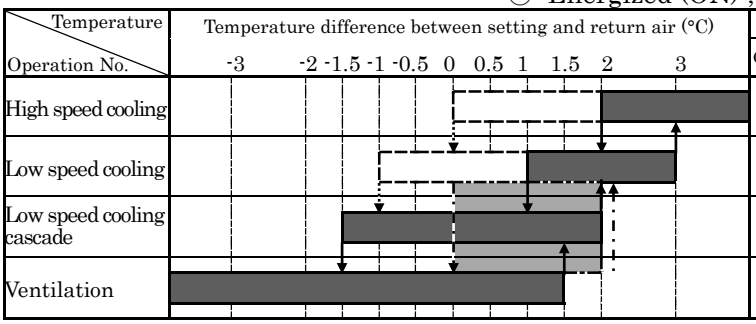
(2) Continuous operation

1) Setting temperature ≦ –12°C

With this operation pattern, the sub-engine or motor operates continuously and the capacity is controlled by the control of circulated amount of refrigerant, etc. in order to maintain the return air temperature at the setting temperature. There is no high speed operation in case of motor drive.

Electronic expansion valve will execute cascade control using supply air temperature sensor value and return air temperature sensor value during low speed cascade operation. (Driving range of EEV is 30 ~ 500 pulses but it is controlled with the opening under 200 pulses normally.)

○: Energized (ON) , △: Energized/de-energized (ON/OFF) control

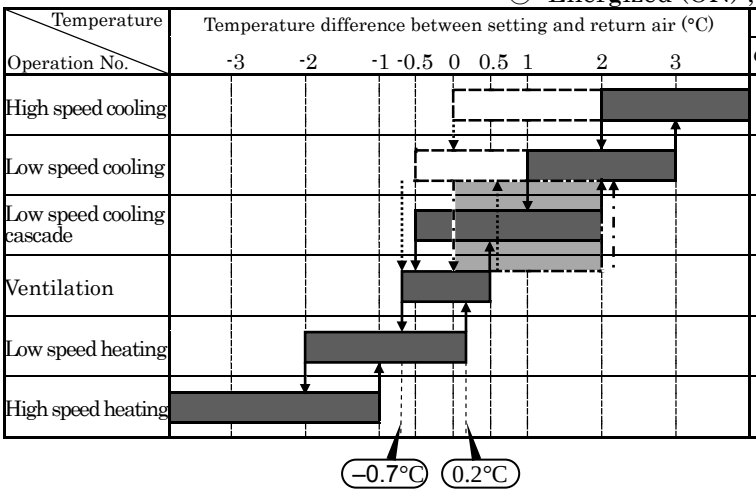


Load						
Compressor	Evaporator fan	SOL HS	SV8	SV2	SV4∗	EEV
○	○	○	△			Super-heat control atevaporator outlet
○	○					↑
○	○					Supply/return temp. cascade control
	○					Full close

SOL HS : Throttle solenoid, SV8 : Economizer solenoid, SV2 : Defrost solenoid, SV4 : Condenser inlet solenoid,
: Operation when the return air temperature drop is slow,
∗: SV4 closes when energized (ON) and opens when de-energized (OFF),
: In case E16 occurred twice during low speed cooling cascade or ambient temperature < 0˚C (Skip the low speed cooling cascade).

2) –12°C < Setting temperature < –5°C, –5°C ≦ Setting temperature ≦ +10°C, and Setting temperature > +10°C

○: Energized (ON) , △: Energized/de-energized (ON/OFF) control



Load						
Compressor	Evaporator fan	SOL HS	SV8	SV2	SV4∗	EEV
○	○	○	△			Super-heat control atevaporator outlet
○	○					↑
○	○					Supply/return temp. cascade control
	○					Full close
○	○			○	○	↑
○	○	○		○	○	↑

SOL HS : Throttle solenoid, SV8 : Economizer solenoid, SV2 : Defrost solenoid, SV4 : Condenser inlet solenoid,
: Operation when the return air temperature drop is slow,
∗: SV4 closes when energized (ON) and opens when de-energized (OFF),
: In case E16 occurred twice during low speed cooling cascade or ambient temperature < 0˚C (Skip the low speed cooling cascade).

(3) Defrost operation

Defrost operations consist of the timer defrost by the defrost timer, manual defrost by the defrost switch, backup defrost by the detection of frosting condition and forced one hour defrost after the start of cooling operation.

During the engine drive, the defrosting is implemented with the engine running at high speed. (When the WHISPER operation is selected, it runs at low speed.).

	Timer defrost	Backup defrost	Forced one hour defrost after start of cooling	Manual defrost
Defrosting start	When Defrost timer accumulation value > Defrost timer setting value (which is set at 6 hours at the shipping from factory) is detected during cooling operation.	When the low pressure is abnormally low compared to inside container temperature has continued during cooling operation.	When the cooling operation (including the thermostat OFF and the ventilation with inside container temperature at 5˚C or lower) is going on at 1 hour after the start of unit operation and cooling operation has continued for more than 10 minutes from the start of operation.	When the defrost switch is pressed during the cooling operation (including the thermostat OFF).
Defrost timer accumulating condition	Evaporator outlet temperature ≦ 1˚C during cooling operation (No count at the thermostat OFF)	—	—	—
Defrosting stop	Evaporator outlet temperature ≧ 25C˚ or defrost operation has continued for 30 minutes or more.			When the condition at left is met or the defrost switch is pressed once more.

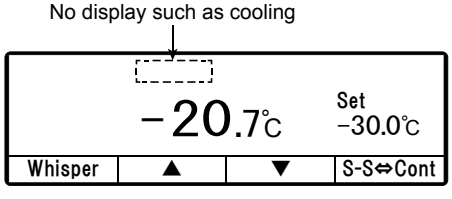
(4) Protection control

When controller judges limited operation is necessary in order to continue the unit running, protection control is conducted using opening control of EEV (Electronic expansion valve), SV (Solenoid valve) or engine speed change.

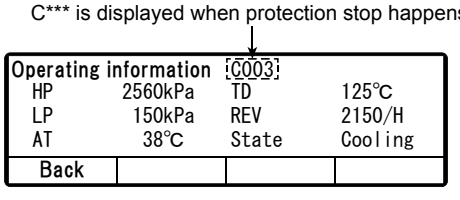
During the operation of protection control, there is no display such as cooling or heating on the cabin controller. When unit is thermostat OFF with evaporator fan motor OFF, there is also no display. (During intermediate fan motor operation for correct detection of return temperature, Fan is displayed.)

In order to confirm if unit is under protection control, it is necessary to check the operation information display mode on cabin controller.

When C*** is displayed on operation information display, protection operation is done.



Display during protection stop



Operation information display

(a) High pressure protection control (C001)

If High pressure detection value ≧ High pressure protection value (2.9 MPa∗) is detected during the cooling operation, EEV is squeezed to reduce the high pressure.

If High pressure detection value ≧ High pressure protection value (High speed operation: 2.3 MPa, Low speed operation: 2.0 MPa) is detected during the heating operation, SV4 is opened to reduce the high pressure.

(b) Low pressure protection control (C002)

If Low pressure detection value ≦ Low pressure protection value is detected during the cooling operation, sub-engine speed is switched to low, if it is operating at high speed, to prevent the drop of low pressure.

(c) Refrigerant high temperature protection control (C003)

If Discharge gas temperature detection value ≧ High temperature protection value (140°C∗) is detected during the cooling operation, SV5 is opened to reduce the discharge gas temperature. (If the economizer solenoid is energized, it is turned off.)

(d) Liquid return protection control (C004)

If Super-heat at evaporator outlet ≦ Super-heat at evaporator outlet protection value, or Super-heat at discharge ≦ Super-heat at discharge protection value are detected during the cooling operation, EEV is squeezed to prevent returning of refrigerant into compressor.

(e) Low pressure increase protection control (SPR control) (C005)

If Low pressure value ≧ SPR value is detected during the cooling operation, EEV is closed to reduce the low pressure and the load to sub-engine and stand-by motor is controlled not to become excessively high.

(f) High pressure protection control at start of compressor (C006)

When the ambient temperature ≧ 30°C, the compressor magnet clutch is turned ON or OFF according to the high pressure in order to reduce the load at the startup. (OFF at high pressure ≧ 2.8 MPa or ON at high pressure ≦ 2.5 MPa)

When the ambient temperature ≧ 38°C and the low pressure is high, SV2 is also opened to lower the high pressure in addition to the above ON/OFF of the compressor magnet clutch.

(g) Refrigerant discharge control

By turning ON/OFF the compressor magnet clutch in the engine low speed condition at the start of unit, the liquid refrigerant and oil accumulated in the compressor while it is stopped are discharged. (The compressor magnet clutch is turned ON at the starter ON, and turned OFF once at the engine speed of 1,000 rpm. It is turned ON again at 1,300 rpm.)

(h) Oil return control (C022)

If the operation continues for a long time in the state of excessively high super-heat at evaporator outlet, the refrigerating machine oil accumulates in the evaporator and the oil returning to the compressor decreases. To avoid this problem, EEV is opened bigger after operating in such condition for certain period of time to drain forcibly the refrigerating machine oil from the evaporator.

(i) Detection of short-circuit on solenoid valve output

If the short-circuit is detected on any of solenoid valve outputs, the operation stops temporarily. The cabin controller displays [**Self-diagnosis**], and identifies the short-circuited output.

It may start the backup operation depending on where it has short-circuited.

If the short-circuit is detected at two or more places, the operation stops.

(j) Engine start control

Time to energize the glow plug is changed depending on the ambient temperature and the number of engine starts.

[Glow plug energizing time]

Number of start / Ambient temperature	1st *1	2nd	3rd	4th	5th
Below 0°C	15 sec	15 sec	15 sec	15 sec	15 sec
0°C or higher	6 sec	15 sec	15 sec	15 sec	15 sec

*1: In case of the start of operation (When the operation is restored after a thermostat OFF or abnormal stop, if the engine has been stopped for more than 2 hours and the temperature is below 0℃, it is energized for 15 seconds.)

*: The value may be different depending on the operation condition.

(k) Protection control at high ambient temperature

When the ambient temperature ≧ 38°C, unit is operated following in order to prevent the happening of E010 and E021.

— Engine operation is fixed at high speed.
— Economizer is OFF (In case cooling speed is low, economizer is ON.)
— Engine continues operation for 30 seconds with compressor magnet clutch OFF after pump down operation when unit stops.

(5) PTI operation

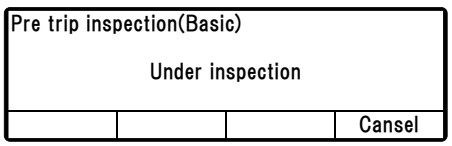
PTI (Pre-trip inspection) is a function to automatically self-diagnose the component parts of the unit. PTI consists of the self-diagnose operation "Basic (Min)" where the functional parts check only is executed and the self-diagnose operation "Detail (Max)" where cooling and defrost operation of refrigeration unit are also conducted.

To start the PTI, enter into the PTI selection mode and select "Basic (Min)" or "Detail (Max)", then press F4 switch to start the self-diagnose operation. (Refer to page 62.)

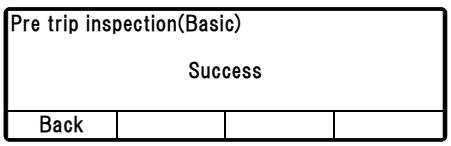
Basic (Min) : Self-diagnose operation of functional parts check only to be completed around 5 minutes.
Detail (Max): Self-diagnosis operation including the check of refrigeration unit operation. Operation ending time varies depending on the setting temperature. (Approx. 2.5 hours at the longest)

"**Under inspection**" will be displayed during the self-diagnose operation and as the PTI completes the unit stops and the result of diagnose is displayed.

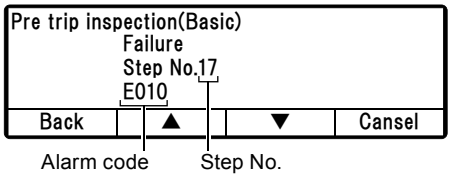
If no abnormal condition is detected by the self-diagnose operation, "**Success**" is displayed. If any abnormal condition is detected, "**Failure**", "**Step No.**" and alarm code corresponding to the failure condition are displayed.



Display during PTI process



Display when PTI passes successfully



Display when any abnormalities are detected

Contents of inspection by PTI

Step No.	PTI setting		Inspection Time	Inspection Item	Measures at Detection of Abnormal	Related alarm code
	L	H				
1	○	○	18 sec	Turn ON/OFF each relays and check breaking or short circuit of wires.	Discontinue PTI after step2 and display abnormal.	E260,264,265,266, 268,269,270,271, 272,273,274,282
2	○	○	9 sec	Check pressure sensor detection value.	Discontinue PTI after step2 and display abnormal.	E016, 017
3	○	○	5 sec (Max. 20 sec)	Check motor drive operation and check alternator. Skip if power supply is not connected.	Discontinue PTI immediately and display abnormal.	E031, 032, 202
4	△*1	△*1	300 sec	Check electric heater function.	Continue PTI and display abnormal after completion of inspection.	E273
5 - 8 is used for production line check						
9	○	○	35 sec	Check engine startup, check alternator and battery voltage, check engine low speed.	Discontinue PTI immediately and display abnormal. In case of E032, E221 and E280, continue PTI and display abnormal after completion of inspection. (If E032 and E280 occur simultaneously, discontinue PTI immediately and display abnormal.)	E023, 024, 032, 221, 223, 280
10	○	○	10 sec	Check throttle solenoid, check engine high speed.	Continue PTI and display abnormal after completion of inspection.	E054, 222
11	○	○	Less than 40 sec	Check compressor magnetic clutch (MCL), check close of EEV. Check for misconnection between liquid pipe and hot gas pipe. (If there is misconnection, low pressure doesn't lower.)	Discontinue PTI immediately and display abnormal.	E003, 010, 016, 017, 050, 210, 256, 266
12	○	○	Less than 90 sec	Check open of defrost solenoid and liquid bypass solenoid, check close of condenser inlet solenoid.	Discontinue PTI immediately and display abnormal.	E010, 016, 050, 256, 260, 264, 265
13	○	○	Less than 20 sec	Check open of condenser inlet solenoid.	Discontinue PTI immediately and display abnormal.	E010, 016, 017, 050, 256, 264
14	○	○	Less than 40 sec	Check close of defrost solenoid.	Discontinue PTI immediately and display abnormal.	E010, 016, 050, 256, 260
15	○	○	Less than 60 sec	Check open of EEV, check open of economizer solenoid.	Discontinue PTI immediately and display abnormal. In case of E282, continue PTI and display abnormal after completion of inspection.	E010, 016, 017, 050, 063, 256, 266, 282
16	○	○	Less than 40 sec	Check pump down.	Discontinue PTI immediately and display abnormal.	E010, 016, 050, 210, 256, 266
17 -18 is used for production line check						
19	×	○	Less than 2 hr	Check cooling operation. *2	Discontinue PTI immediately and display abnormal.	All error could be displayed.
20	×	○	Less than 1800 sec	Check defrosting operation.	Discontinue PTI immediately and display abnormal.	All error could be displayed.

Notes 1: *1 Execute checking when electric heater enable is selected at the cabin controller setting. (Electric heater is an optional part.)

2: *2 In case recorded setting temperature ≦ –5℃, cooling operation is done at recorded temperature.
In case recorded setting temperature > –5℃, following cooling operation is done.
Ambient temperature < +10℃ or return temperature < +10℃, cooling operation is done at –5℃.
Ambient temperature ≧ +10℃ and return temperature ≧ +10℃, cooling operation is done at 0℃.

3: During steps No.1 and 2, following checks are also executed; disconnection of fuse, battery voltage, door limit switch function and protection device.

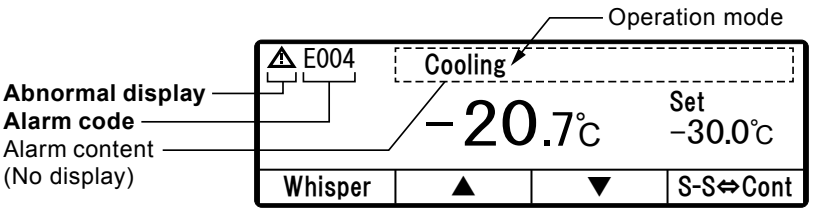
4: Steps No.11 ~ 16, 19 and 20 are executed only when the ambient temperature is 0 ~ 35 °C.

(6) Emergency operation

When the breaking or short circuit is encountered on temperature sensor or pressure sensor, the unit automatically switches to the emergency operation and continues operation using remaining normal sensors.

The objective of this function is to maintain inside container temperature for short period of time until the customer is able to have the unit repaired after the malfunction. Therefore, do not continue emergency operation for a long time and be sure to have the abnormal parts repaired promptly.

During emergency operation, abnormal display flickers, alarm code is displayed and alarm content is not displayed. (Operation mode such as cooling is displayed.)



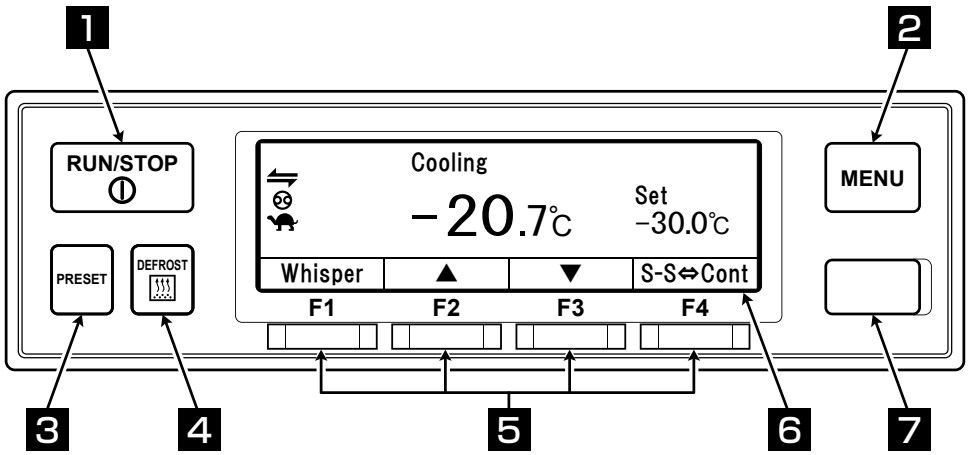
Alarm codes and contents of emergency operation

Alarm code	Alarm content	Contents of emergency operation
E004	Throttle solenoid fuse break	Continue operation with engine low speed.
E009	Commercial power supply defective	Continue operation by switching to engine drive. (Only when the automatic drive selection backup setting mode for power failure is enabled.)
E016	LPT failure	Continue operation with emergency operation without using low pressure sensor. (Only when the sensor is disconnected or shorted.)
E017	HPT failure	Continue operation with emergency operation without using high pressure sensor.
E031	OCR tripped	Continue operation by switching to engine drive. (Only when the engine drive automatic backup setting mode for power failure is enabled.)
E050	TH sensor failure	Continue operation with emergency operation without using return air temperature sensor.
E054	Throttle solenoid failure	Continue operation with engine low speed.
E063	Td sensor failure	Continue operation with emergency operation without using discharge gas temperature sensor.
E081	OCR failure	Continue operation by switching to engine drive. (Only when the engine drive automatic backup setting mode for power failure is enabled.)
E250	EVT sensor failure	Continue operation with emergency operation without using evaporator outlet temperature sensor.
E252	THD sensor failure	Continue operation with emergency operation without using supply air temperature sensor.
E256	ATS sensor failure	Continue operation with emergency operation without using ambient air temperature sensor.
E265	Liquid bypass SV failure	Continue operation with emergency operation without using liquid bypass solenoid.
E268	Buzzer failure	Continue operation with buzzer off.
E271	ARMO circuit failure	Continue operation by switching to engine drive. (Only when the engine drive automatic backup setting mode for power failure is enabled.)
E273	Electric heater relay failure (Option)	Continue operation with evaporator heater off.
E282	Economizer SV failure	Continue operation with economizer solenoid off.

Note: Emergency operation terminates when more than 2 of above abnormal occur simultaneously.

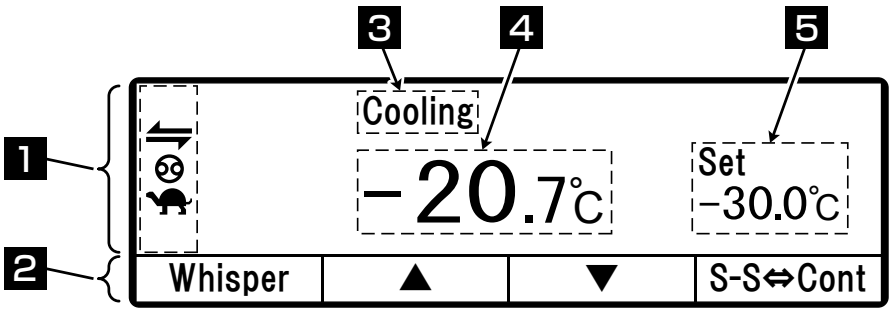
8. Cabin controller

8.1 Names of each part and function



1	RUN/STOP switch	Starts and stops the refrigeration unit.
2	MENU switch	Selects the normal display screen or the menu display screen. Displays the screen while the refrigeration unit is stopped.
3	PRESET switch	Selects the normal display screen or the preset display screen.
4	DEFROST switch	Starts the manual defrost.
5	FUNCTION switches 1 – 4	Functions corresponding to respective setting screens are allocated.
6	LCD	Displays the inside compartment temperature, setting temperature, state of operation, etc.
7	USB terminal (Type B)	Used to read/write data.

8.2 Names of sections of LCD



Description of monitor display item

1 Monitor displays following items corresponding to respective setting states.
The display items light or blink depending on the operation of respective functions.

- ……Abnormal display
  Lights or blinks when any error occurs.
- ……Display for the state of external communication.
  Lights when the operation administration input, such as the remote monitor device, etc., is turned ON.
- ……Displays for ON/OFF timer.
  Lights when the ON timer and the OFF timer are set simultaneously.
- ……Displays the ON timer.
  Lights when the ON timer operation is set.
- ……Displays for OFF timer.
  Lights when the OFF timer operation is set.
- ……Display for automatic operation start/stop.
  Lights when the automatic operation start/stop is selected.
- .....Display for commercial power supply.
  Lights when the unit is connected to the commercial power supply.
- .....Display for Whisper operation.
  Lights when Whisper operation is selected.

2 Displays the allocation of function switch corresponding to the screen.

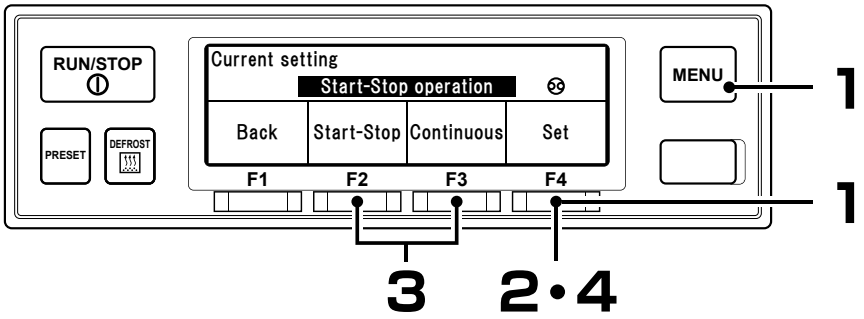
3 Displays the operation modes.
<Display contents> Cooling, Heating, Defrost, Sleep, Stop and Fan.
* There is no display when Thermostat is OFF with evaporator fan motor OFF.
Fan is displayed when Thermostat is OFF with evaporator fan motor ON.
If temperature is out of adequate range, the Cooling or Heating display blinks.

4 Displays the inside compartment temperature.

5 Displays the setting temperature.

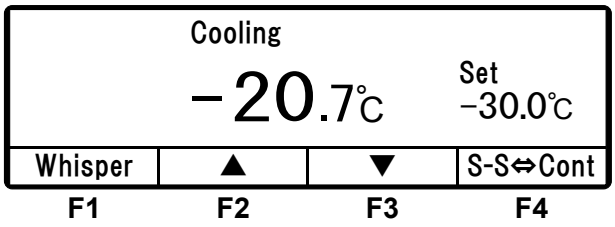
8.3 Start and stop of operation

(1) Selecting the operation pattern



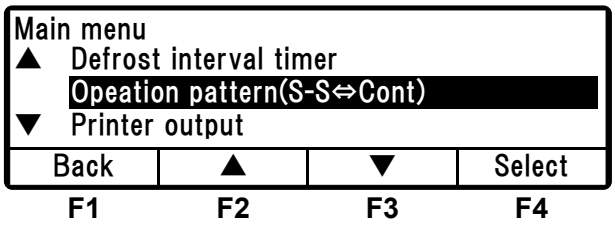
1 **On the normal display screen (Right figure), press "F4 (S-S⇔ Cont)" switch.**

⇒ The display changed to the mode screen of Step 2 below.

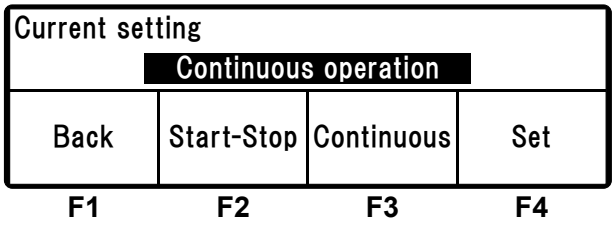


1 **Press "MENU" switch.**

⇒ The display changes to "Main menu" screen.

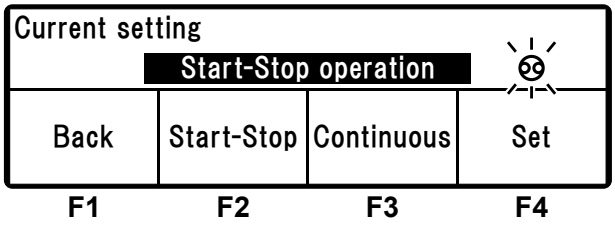


2 **Press "F4 (Select)" switch to change to "Operation pattern selection" screen (Right figure).**



3 **Press "F2 (Start-Stop)" or "F3 (Continuous)" switch to select the automatic Start/Stop operation or the continuous operation.**

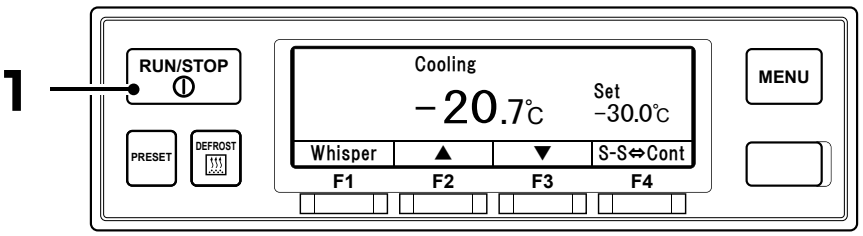
⇒ Start/Stop display lights when the Start/Stop operation is set.



4 **Press "F4 (Set)" switch.**

⇒ The setting completes, and the display returns to the normal display screen.

(2) Starting the operation



⚠ WARNING

Confirm that the front panel of condensing unit is closed before starting operation.

- It may cause accidents if the operation is attempted with the panel opened.

1 Press the “RUN/STOP” switch.
(Refrigeration unit is turned “ON”.)

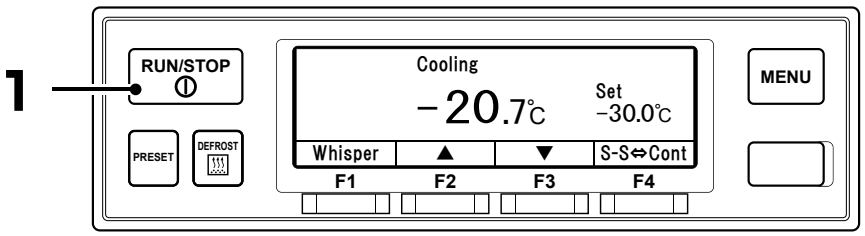
⇒ Inside container temperature and setting temperature are displayed on the LCD display.
Commercial power supply icon lights when the unit is driven by the motor.

⇒ Warning buzzer sounds before the engine or motor starts to run.
Operation starts with the selected drive (engine or motor) and operation pattern (automatic start/stop operation or continuous operation).

Notice

- The refrigeration unit will not start while the front panel of condensing unit is open, because the safety device is tripped. (Alarm code E030 is displayed. If you close the front panel, the unit starts to operate automatically.)
- Operation may not start if the inside container temperature is close to the setting temperature when the automatic start/stop operation is selected.

(3) Stopping the operation



Normal stop

1 Press the “RUN/STOP” switch.
(Refrigeration unit is turned “OFF”.)

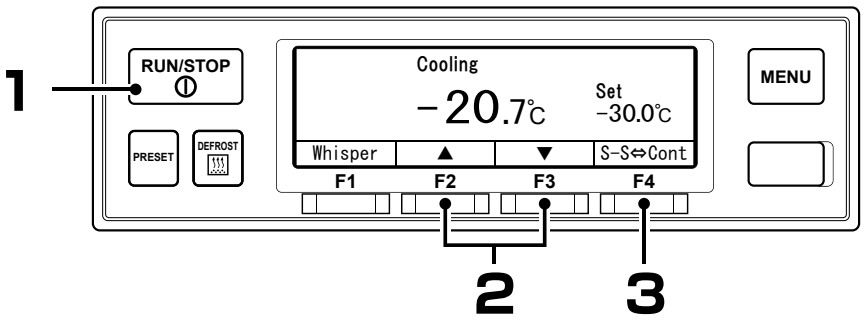
⇒ The refrigeration unit stops the operation automatically after performing the device protecting operation for 10 to 20 seconds. (During the device protecting operation, “**Stopping process ...**” is displayed on the LCD display.)

⇒ If all steps of operation stop are completed, the controller is turned off automatically.

Notice

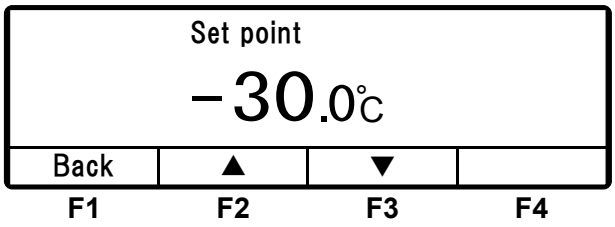
● When the motor operation stops, the buzzer sounds and “**Remove the power plug**” is displayed on the LCD display in order to prevent failure to disconnect the power plug from the AC power socket.

(4) Setting the temperature



1 **Start the operation of refrigeration unit. (☞ Page 50)**

2 **Press “F2 (▲)” or “F3 (▼)” switch, and set a temperature.**

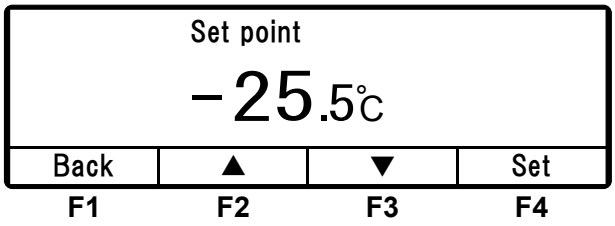


Notice

- Each push on “F2” switch increases the value by 0.5 while the value decreases by 0.5 at each push on “F3” switch. If the switch is held down, the value changes continuously.

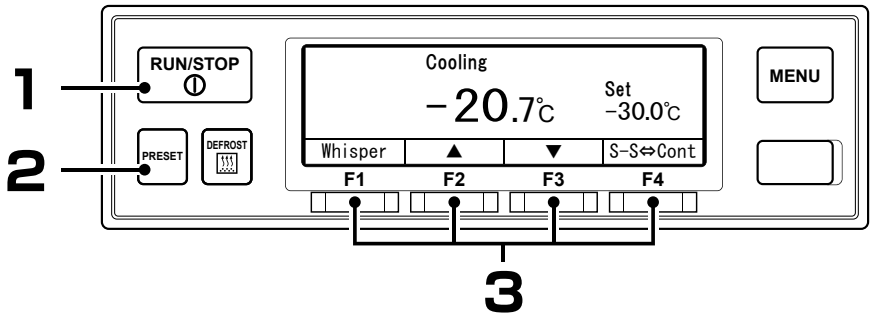
3 **Press “F4 (Set)” switch.**

⇒ The setting completes, and the display returns to the normal display screen.



Notice

- The “Preset” function is provided, with which it can be selected from 4 setting temperatures which have already been registered. (Next page)



Setting the preset temperature

1 **Start the refrigeration unit. (☞ Page 50)**

2 **Press the “Preset” switch.**

⇒ The display changes to the preset setting screen. Right figure shows the setting values at the shipping from factory.

Current setting −30.0℃			
−25.0℃	−18.0℃	−5.0℃	5.0℃
F1	F2	F3	F4

3 **Press “F1 (~ F4)” switch.**

⇒ Desired preset temperature is set, and the display returns to the normal display screen.

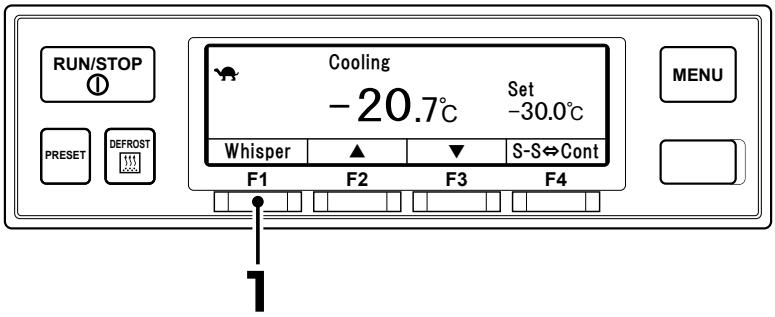
Current setting			
Set → −25.0℃			
−25.0℃	−18.0℃	−5.0℃	5.0℃
F1	F2	F3	F4

3 **[Preset registration of current setting temperature]**
Hold down “F1 (~ F4)” switch for 3 seconds.

⇒ The preset temperature is registered, and the display returns to the normal display screen.

Current setting			
Register → −30.0℃			
−30.0℃	−18.0℃	−5.0℃	5.0℃
F1	F2	F3	F4

(5) Whisper operation (Only for engine drive)



1 Press the “F1 (Whisper)” switch.

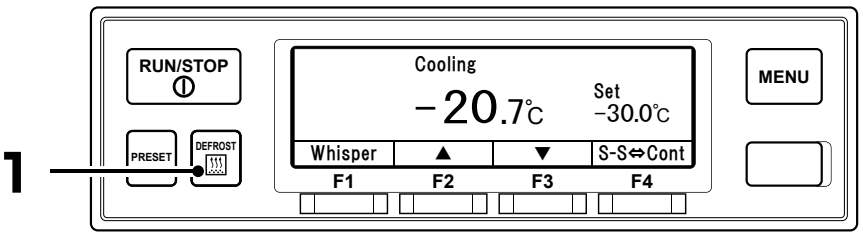
⇒ It changes to the whisper operation and one more press on the switch returns it to the normal operation.
When the whisper operation is enabled, the (whisper operation icon) lights on the LCD display.

If the operation is stopped when the whisper operation is selected, the setting is reset. If you need the whisper operation, you have to press the “F1 (Whisper)” switch at each time when the operation is started.

Notice

- The whisper operation is the function to run the engine at the low speed revolution only. Use this function when it is necessary to suppress the sound of unit operation temporarily during stopping time of the vehicle and so on.
- The setting of whisper operation can be kept even after the refrigeration unit stopped the operation by changing whisper operation setting in “User setting” by Ref-Monitor.

(6) Manual defrost operation



Starting the manual defrost operation

1 Press the “DEFROST” switch once during cooling operation.

⇒ The defrost operation starts.

Notice

- The defrost operation may not start when the inside container temperature is higher.

Ending the manual defrost operation

If the defrost operation completes, it returns to the cooling operation.
If it is necessary to interrupt the defrost operation and to return to the cooling operation, press the “DEFROST” switch once more.
If the “RUN/STOP” switch is turned “OFF”, it interrupts the defrost operation and stops the operation of refrigeration unit.

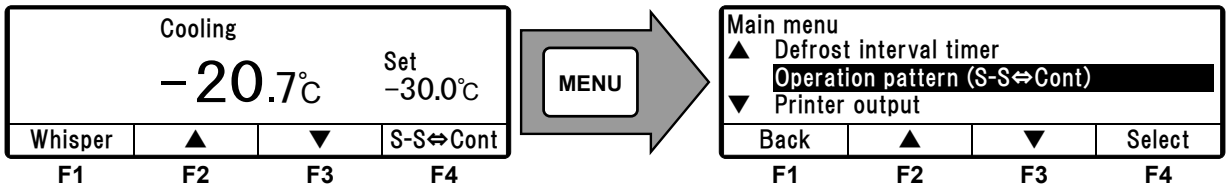
Notice

- The manual defrost operation can be made also during the thermostat OFF stop.
- The manual defrost operation cannot be made during the operation stop and the heating operation.

8.4 Setting the cabin controller

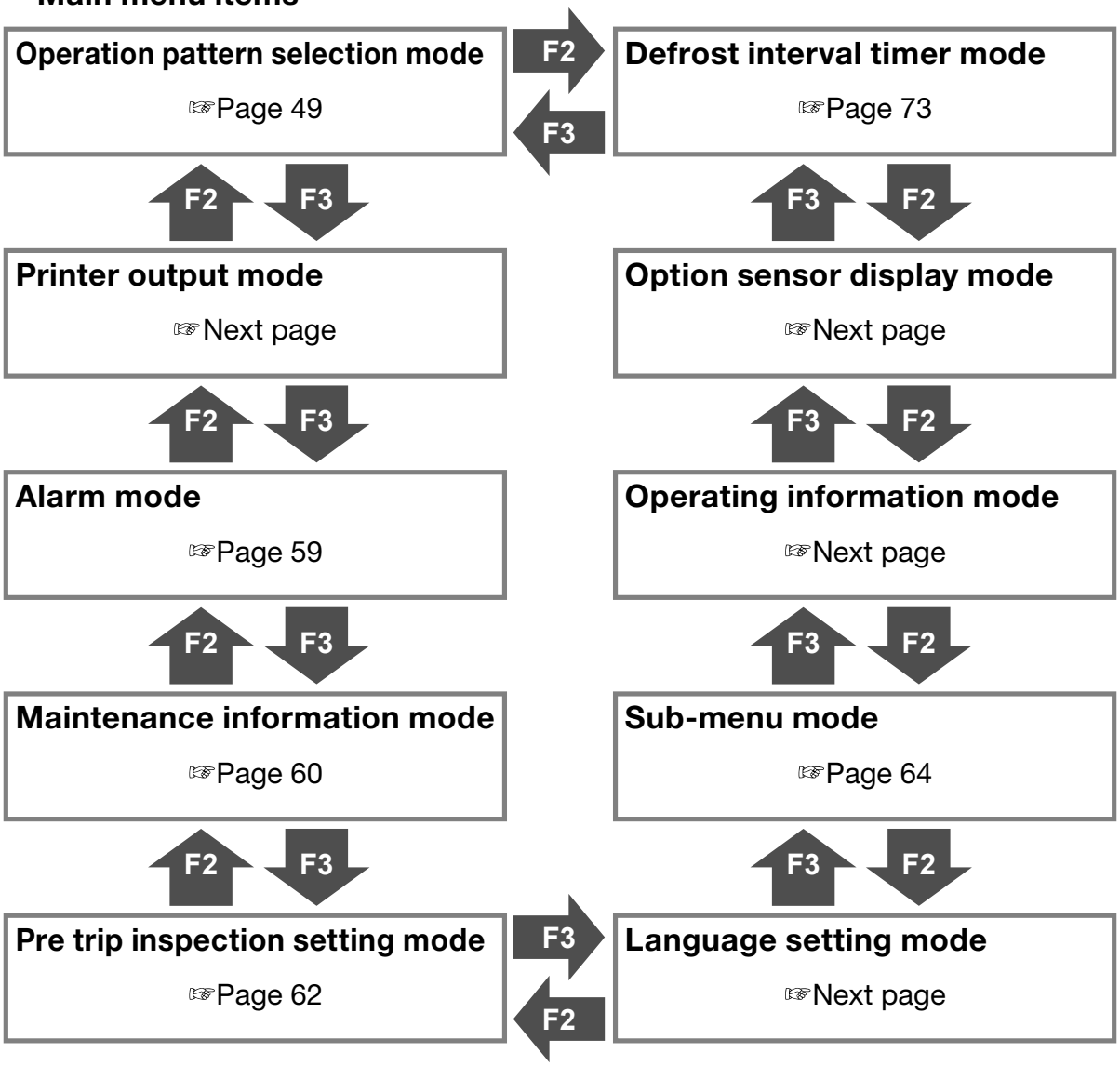
(1) Display and function of main menu

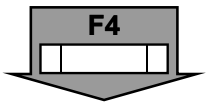
If you press the “MENU” switch once on the “Normal display screen” which is displayed when the refrigeration unit is stopped or operating, the display changes to the “Main menu” screen. Each push on “F2 (▲)” or “F3 (▼)” switch changes the display so that various settings can be made. In the following figure, “F2” switch changes sequence clockwise while “F3” switch changes counter clockwise.



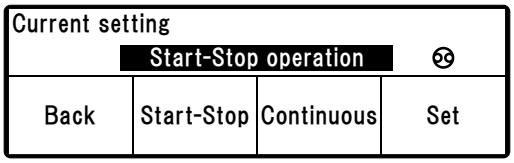
Normal display screen **Main menu screen**

- **Main menu items**

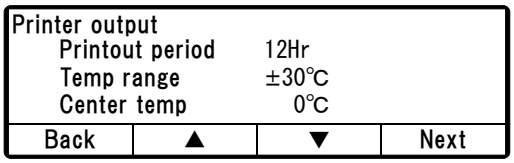




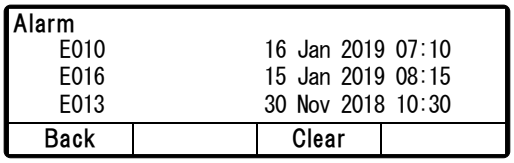
If you press “F4 (Select)” switch on each MAIN menu screen on previous page, the display changes to the following screens.



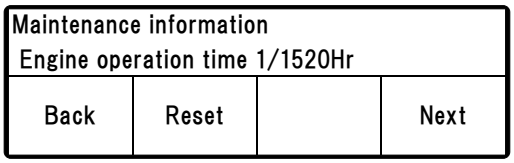
Operation pattern selection mode
Mode to select the operation mode start/stop or continuous operation
(☞ Page 49)



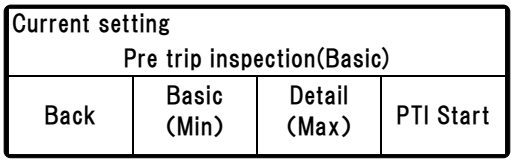
Printer output setting mode
The temperature graph is printed in this mode. Provide a printer to print the graph.
(Option)



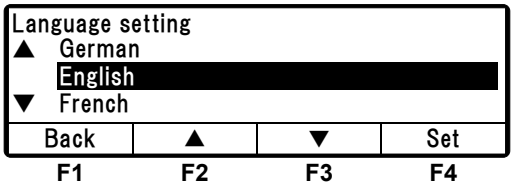
Alarm display mode
Up to 3 error codes and dates/times of alarm occurred are displayed. These are cleared by pressing “F3 (Clear) switch.
(☞ Page 59)



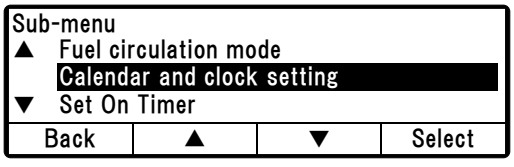
Maintenance information display mode
Operation time and number of operations of each device are displayed in this mode.
(☞ Page 60)



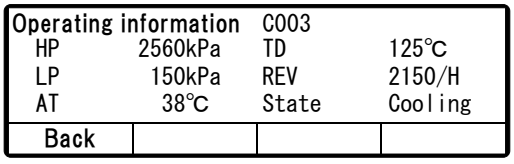
Pre trip inspection (PTI) setting mode
Mode to set the self diagnosis operation (PTI)
(☞ Page 62)



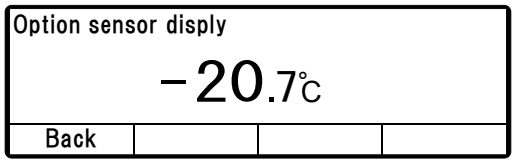
Language setting mode
Selects a language (English, French, Italian, Swedish or German). Press “F2 (▲)” or “F3 (▼)” switch to select a language, and finalize the selection by pressing “F4 (Set)” switch.



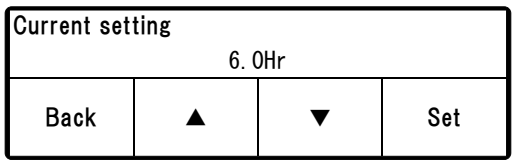
Sub-menu selection mode
Functions of the controller operability, or other, are displayed and set in this mode.
(☞ Page 64)



Operation information display mode
State of operation is displayed in this mode. State of engine operation (High speed; H, low speed; L) is indicated at the end of “Speed (rpm)”.



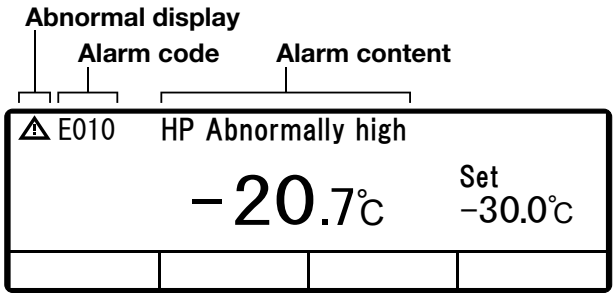
Option sensor temperature display mode
When the optional sensor is installed, the sensor temperature is displayed in this mode. Unless the option sensor is installed, it displays “**Lo**”.



Defrost interval timer setting mode
The defrost interval is displayed and set in this mode. Factory default is set at “6.0Hr”. The interval can be changed in steps of 1.0Hr.
(☞ Page 73)

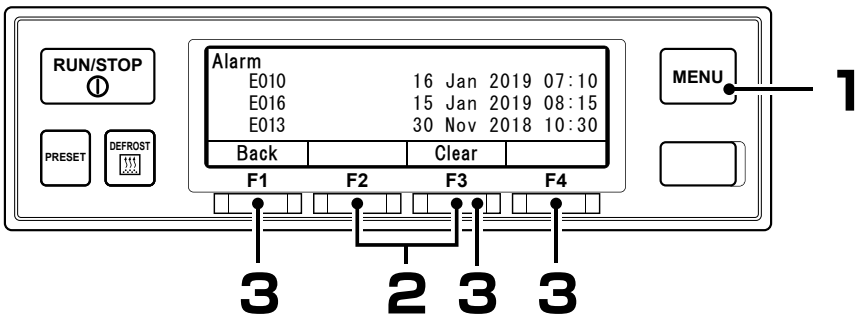
(2) Alarm display

Display at error occurrence



- If any error occurs, the abnormal display ⚠ lights or blinks on the LCD (the backlight lights or blinks).
- Check the alarm code displayed at the right-hand side of the abnormal display. (If it is a light error, the alarm content at the right-hand side of the alarm code is not displayed.)
  When no alarm code is displayed at the LCD, change to the alarm display as described below, and check the alarm content.

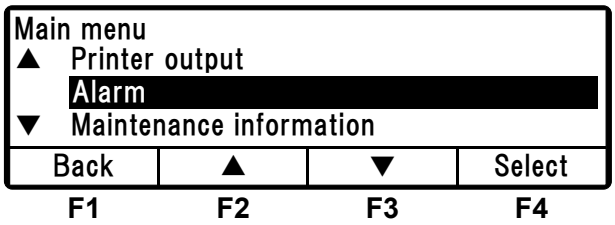
Displaying the alarm



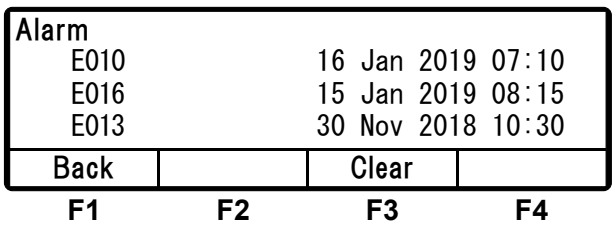
1 **Press “MENU” switch.**

⇒ The display changes to the Main menu screen.

2 **Press “F2 (▲)” or “F3 (▼)” switch till the display changes to the “Alarm” mode (Right figure).**



3 **Press “F4 (Select)” switch.**

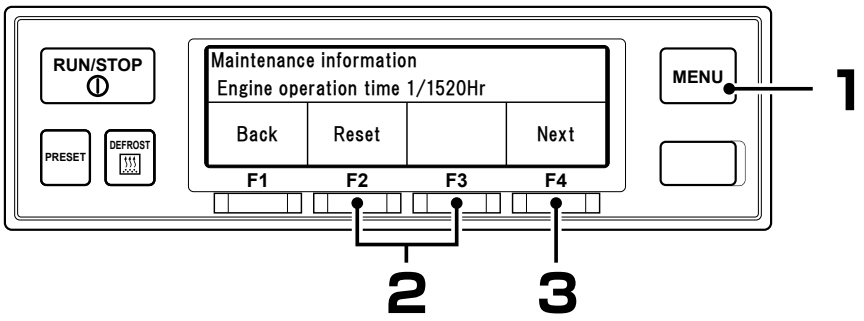


⇒ The display changes to the “Alarm display” mode.
If there is no screen operation, it returns to the normal display screen 20 seconds later.

⇒ If you press “F1 (Back)” switch once in the “Alarm display” mode, it returns to the “Main menu”. If you press the switch once more it returns to the normal display screen.

⇒ If you press “F3 (Clear)” switch in the “Alarm display” mode, the alarm is cleared.

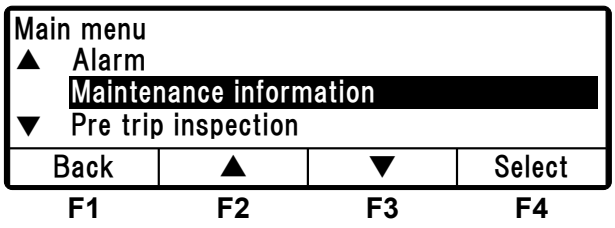
(3) Displaying the maintenance information



1 **Press "MENU" switch.**

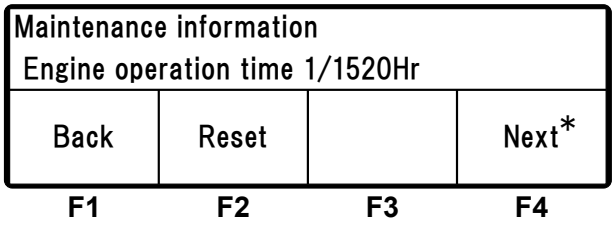
⇒ The display changes to the "Main menu" screen.

2 **Press "F2 (▲)" or "F3 (▼)" switch till the display changes to the "Maintenance information" mode.**



3 **Press "F4 (Select)" switch.**

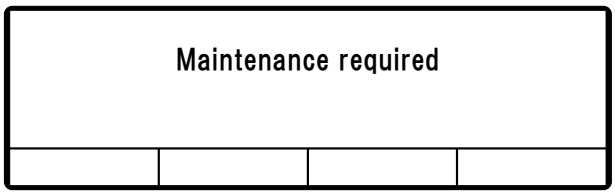
⇒ "Engine operation time 1" is displayed.



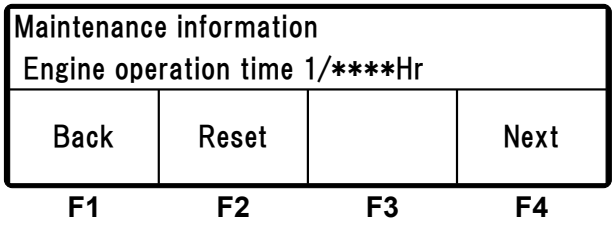
* "Next" is displayed only when there is any item which can be displayed.

Display of Maintenance required

- If the operation time or number of operations reaches the Maintenance required time on each device, this screen (Right figure) is displayed for 10 seconds after the start of operation of the refrigeration unit.



- Where there is any part requiring maintenance, if you press "F4 (Next)" switch after the display of Step 3 above on the Maintenance information screen, the part requiring maintenance is displayed.

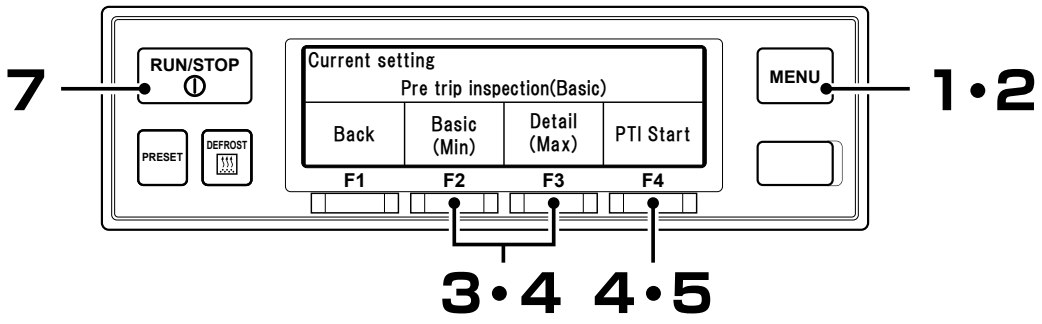


- If you press "F2 (Reset)" switch after replacing the part, the operation time and the number of START/STOP cycles are cleared.

- If you press “F4 (Next)” switch, the display changes to each display item in the table below. (Following items are always displayed in order everytime “F4 (Next)” switch is pressed.)

	Display item
1	Engine operation time 1 (Inspection of engine oil)
2	Engine operation time 2
3	Motor operation time

(4) Self diagnosis operation (PTI operation)



Notice

- Perform the self diagnosis operation without fail before the operation.
- The inspection of the commercial power supply is skipped when the power supply is not connected.

Starting the operation

1 **Press the "MENU" switch when the refrigeration unit is stopped.**

⇒ The controller becomes activated and the display changes to the "Normal display screen".

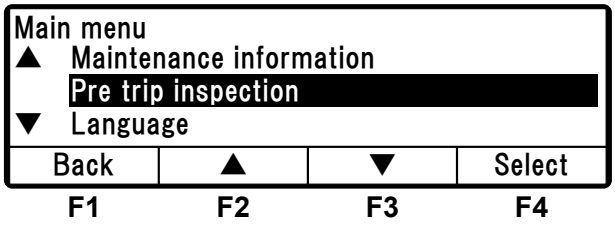
Notice

- Go to the procedure 2 while the refrigeration unit is operating.

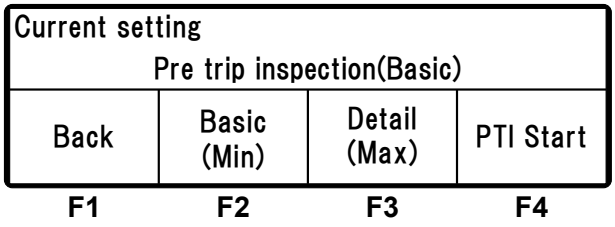
2 **Press the "MENU" switch.**

⇒ The display changes to the "Main menu".

3 **Press "F2 (▲)" or "F3 (▼)" switch till "Pre trip inspection" screen display.**



4 **Press "F4 (Select)" switch to change to "PTI selection" mode (Right figure).**



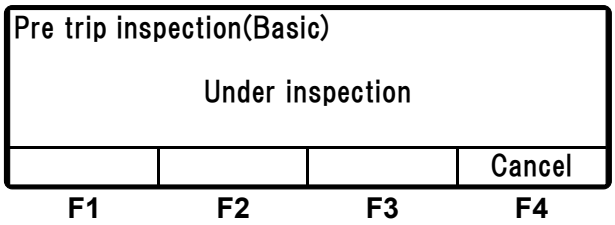
⇒ Press "F2 [Basic (Min)]" or "F3 [Detail (Max)]" switch to select the pre trip inspection.

[Basic (Min)] Self diagnosis operation
[Detail (Max)] Self diagnosis operation (With the cooling and defrost operations)

Notice

- Self diagnosis operation takes approx. 5 minutes for "Basic (Min)" or 2.5 hours (It may take a little longer depending on the setting temperature and the ambient air temperature.) for "Detail (Max)" from start to end.

5 **Press the “F4 (PTI Start)” switch.**



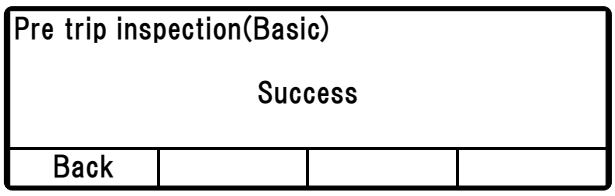
⇒ If the “F4 (PTI Start)” switch is pressed during operation, the refrigeration unit stops temporarily.

⇒ To interrupt PTI operation, press “F4 (Cancel)” switch.

⇒ When the dignosis is completed, the engine stops and the result of diagnosis will be displayed.

Finishing the operation when no defects are detected

6 **When no abnormal condition has been detected, “Success” is displayed.**



7 **Press the “RUN/STOP” switch to turn it “OFF”.**

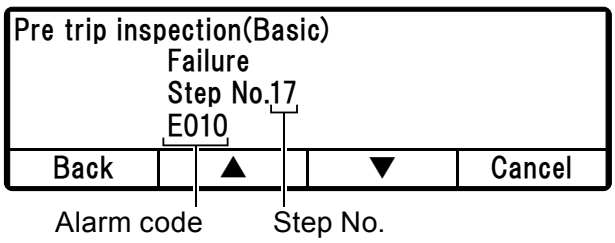
⇒ The controller will stop.

Perform the same procedures when stopping the PTI operation during the inspection.

When abnormal conditions are detected

“Failure”, “Step No.” and the error code corresponding to the abnormal condition are displayed.

When multiple abnormalities occur, display contents are switched and displayed every 2 seconds.



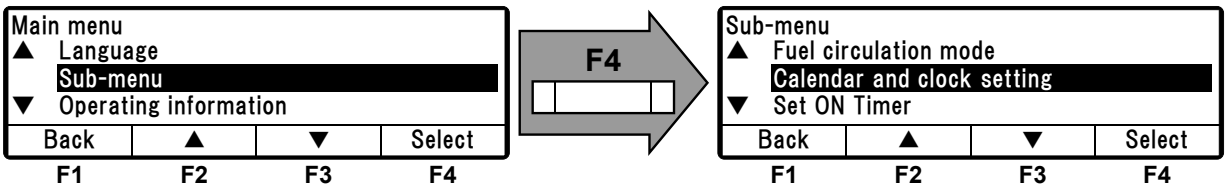
Check the alarm code (☞ Refer to pages from 134 to 137.) and perform proper treatment.

(5) Display and function of Sub-menu

On the “Sub-menu”, the screen changes in the following order at each push on “F2 (▲)” or “F3 (▼)” switch. In the following figure, “F2” switch changes sequence clockwise while “F3” switch changes counter clockwise.

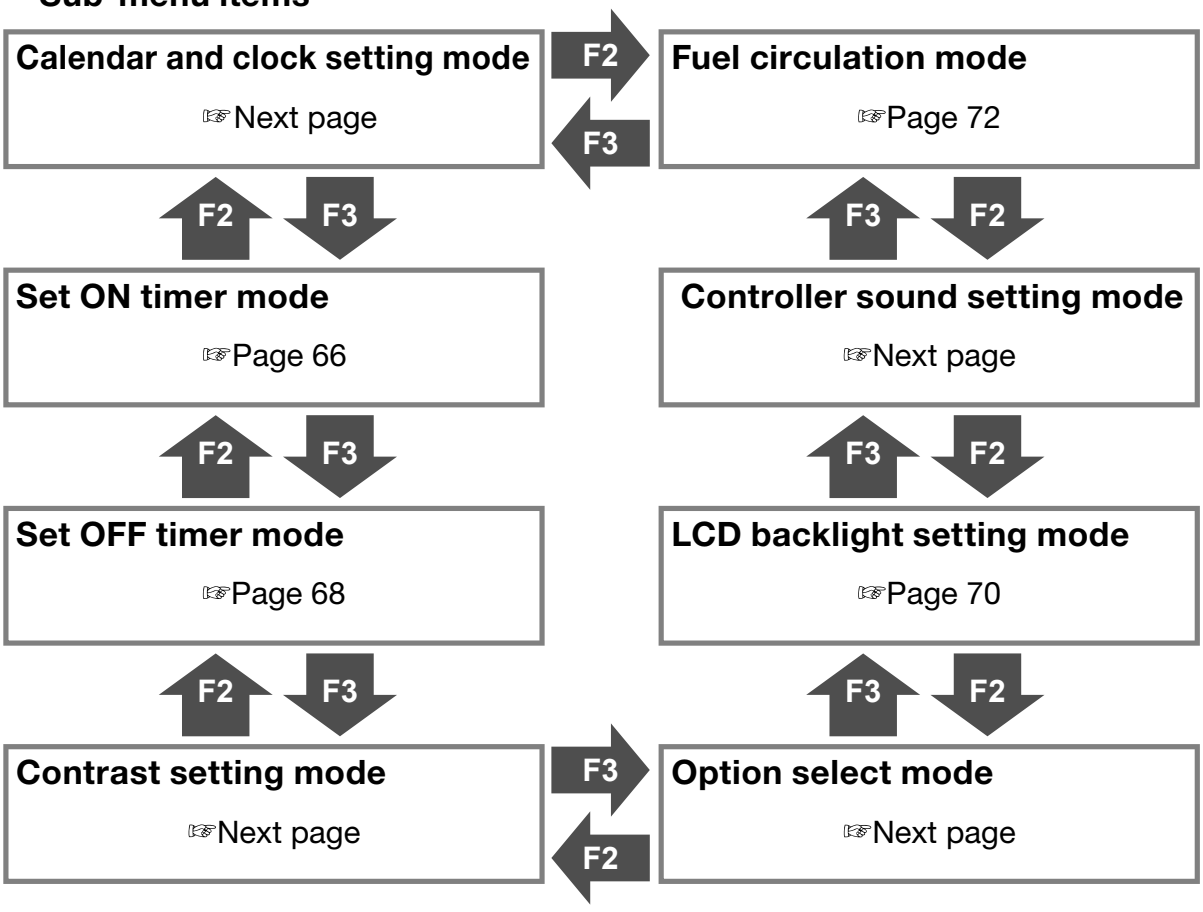
Notice

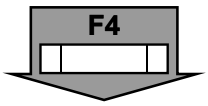
- If “MENU” switch is pressed for more than 1 second on the way of changing setting, the display returns to the normal display screen, and the change content is not reflected. The change content will be lost also when the setting change is aborted on the way.



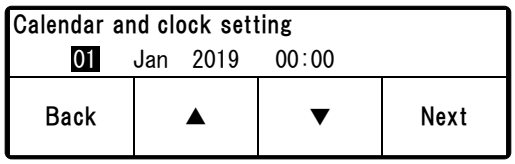
Main menu screen **Sub-menu screen**

• Sub-menu items

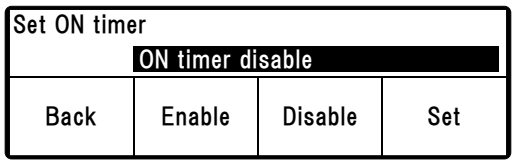




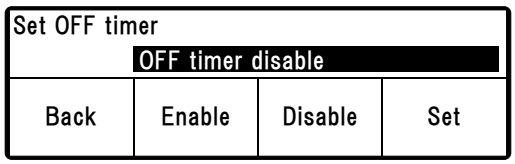
If “F4 (Select)” switch is pressed on each Sub-menu screen on previous page, the display changes to following screens.



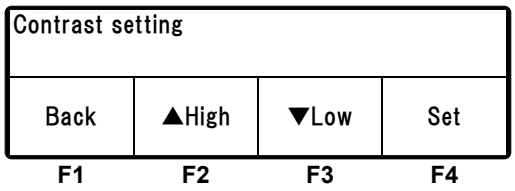
Calendar and clock setting mode
Date, Month, Year and current time are set in this mode.



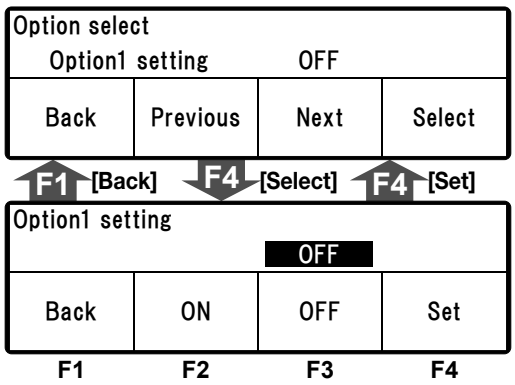
Set ON timer mode
Date and time to start the refrigeration unit automatically is set in this mode.
(☞ Page 66)



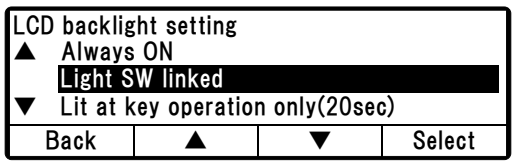
Set OFF timer mode
Date and time to stop the refrigeration unit automatically is set in this mode.
(☞ Page 68)



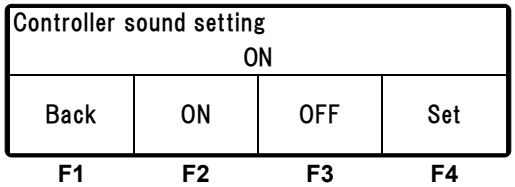
Contrast setting mode
Screen contrast is adjusted in this mode.
Use “F2 (▲)” switch to intensify the contrast or “F3 (▼)” switch to diminish the contrast.



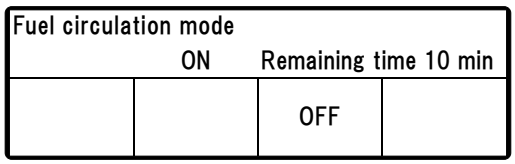
Option select/set mode
Press “F2 (Previous)” or “F3 (Back)” switch to select options 1 to 8.
Press then “F4 (Select)” switch to change to Option1 (~ 8) setting mode. Press then “F2 (ON)” or “F3 (OFF)” switch to select ON or OFF, and press “F4 (Set)” switch to finalize the selection.



LCD backlight setting mode
LCD backlight is set in this mode.
(☞ Page 70)

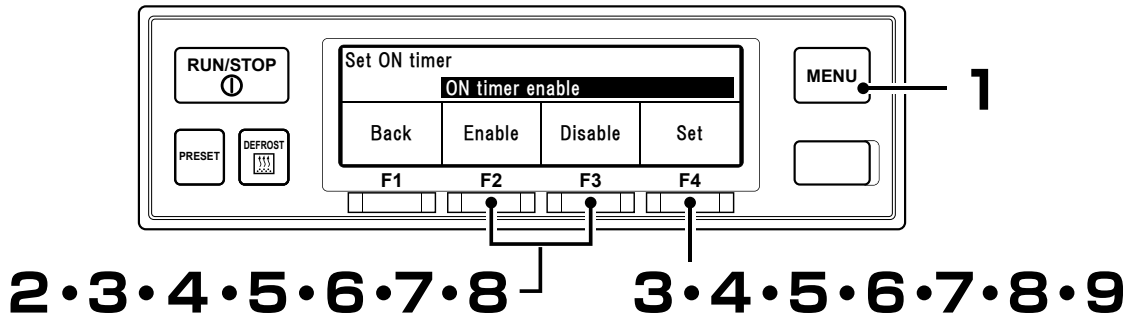


Controller sound setting mode
Whether the switch operating sound is turned on or off is set in this mode.
Select ON or OFF by pressing “F2 (ON)” or “F3 (OFF)” switch, and finalize the selection by pressing “F4 (Set)” switch.



Fuel circulation mode
Mode to circulate fuel forcibly in order to supply fuel to the engine and also to purge air trapped in the fuel system.
(☞Page 72)

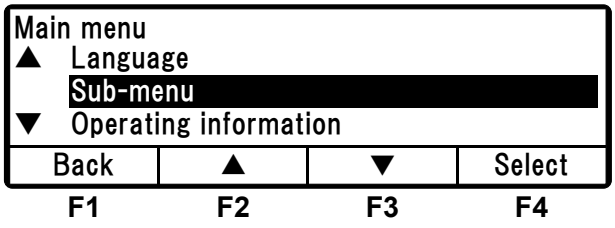
(6) Setting the ON timer



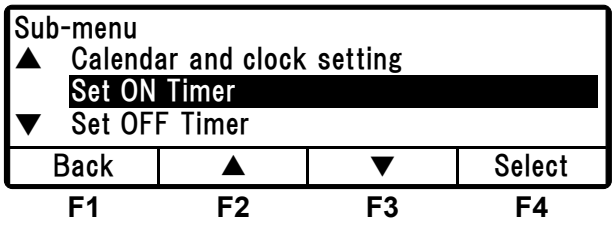
1 **Press “MENU” switch.**

⇒ The display changes to “Main menu” screen.

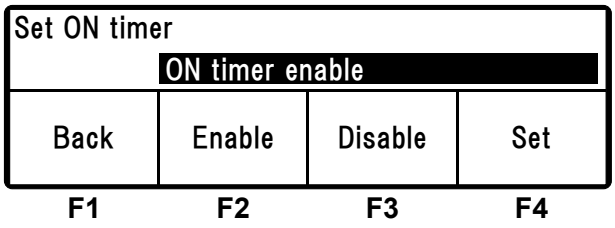
2 **Press “F2 (▲)” or “F3 (▼)” switch till the display changes to “Sub-menu” screen (Right figure).**



3 **Press “F4 (Select)” switch to change to “Sub-menu” screen. Press “F2 (▲)” or “F3 (▼)” switch till the display changes to “Set ON Timer” screen (Right figure).**



4 **Press “F4 (Select)” switch to change to “Set ON timer ” mode (Right figure).**

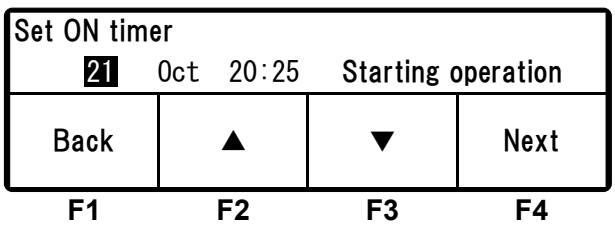


⇒ If Enable is selected by pressing “F2 (Enable)” switch, go to Step 5.

⇒ When Disable has been selected by pressing “F3 (Disable)” switch, if “F4 (Set)” switch is pressed, the display returns to the screen of Step 3.

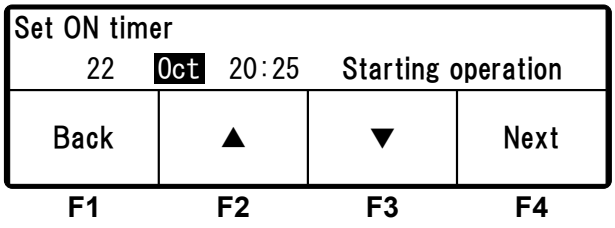
5 **Press “F4 (Set)” switch.**

⇒ Press “F2 (▲)” or “F3 (▼)” switch, and set the time (Date) of Set ON timer.



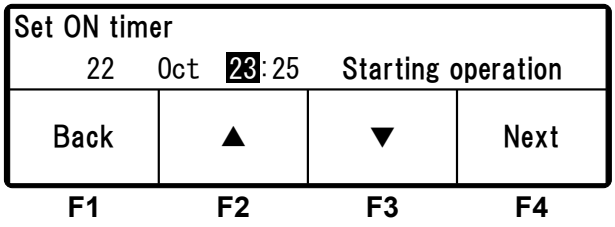
6 Press “F4 (Next)” switch.

⇒ Press “F2 (▲)” or “F3 (▼)” switch, and set the time (Month) of Set ON timer.



7 Press “F4 (Next)” switch.

⇒ Press “F2 (▲)” or “F3 (▼)” switch, and adjust the time (Hour) of Set ON timer.

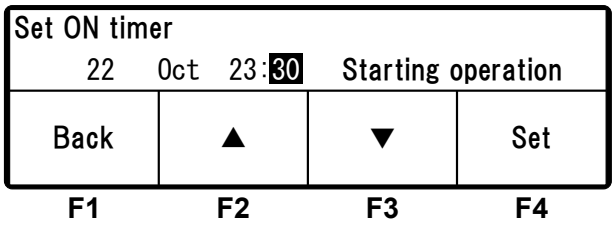


Notice

- Time is displayed in the 24-hour scale. If it is “7 PM”, set as “19:00”.

8 Press “F4 (Next)” switch.

⇒ Press “F2 (▲)” or “F3 (▼)” switch, and adjust the time (Minute) of Set ON timer.



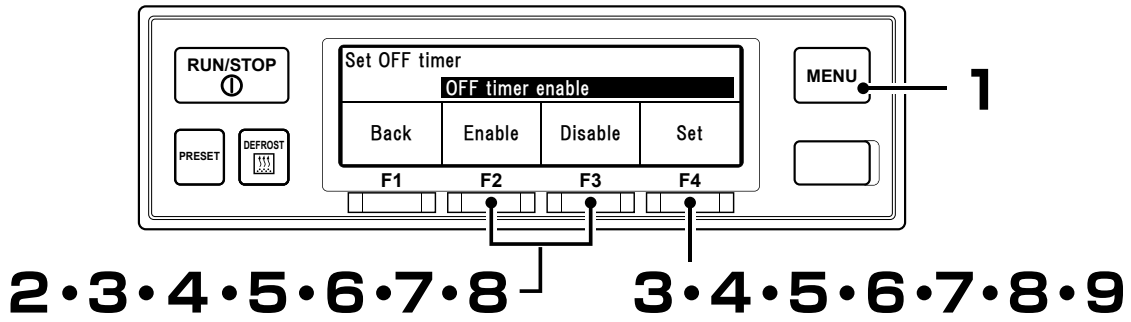
9 Press “F4 (Set)” switch.

⇒ The setting completes, and the display returns to the screen of Step 3, “Sub-menu”.

Notice

- When operating the unit with the ON timer using commercial power supply, confirm that the commercial power supply is connected to the refrigeration unit.
- Take note that the refrigeration unit starts the operation automatically at the setting time when the ON timer is set.

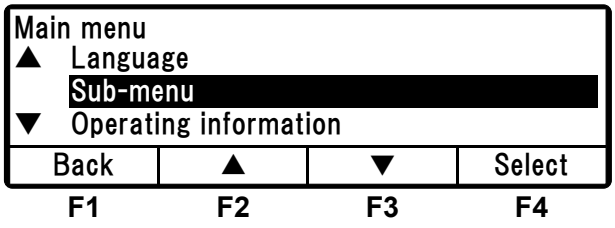
(7) Setting the OFF timer



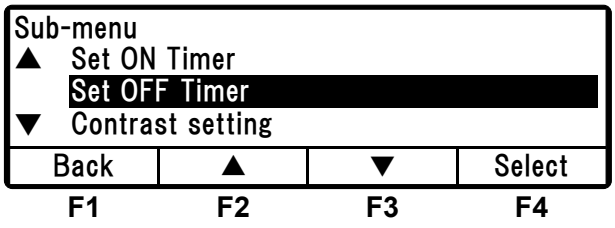
1 **Press “MENU” switch.**

⇒ The display changes to “Main menu” screen.

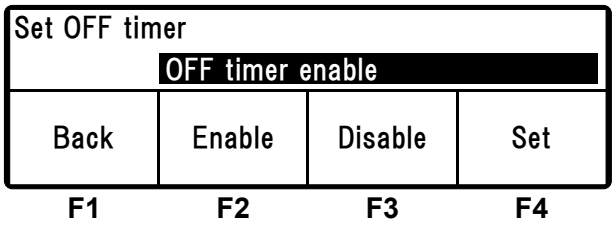
2 **Press “F2 (▲)” or “F3 (▼)” switch till the display changes to “Sub-menu” screen (Right figure).**



3 **Press “F4 (Select)” switch to change to “Sub-menu” screen. Press “F2 (▲)” or “F3 (▼)” switch till the display changes to “Set OFF Timer” screen (Right figure).**



4 **Press “F4 (Select)” switch to change to “Set OFF timer” mode (Right figure).**

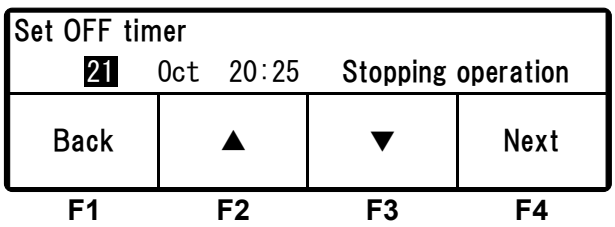


⇒ If Enable is selected by pressing “F2 (Enable)” switch, go to Step 5.

⇒ When Disable has been selected by pressing “F3 (Disable)” switch, if “F4 (Set)” switch is pressed, the display returns to the screen of Step 3.

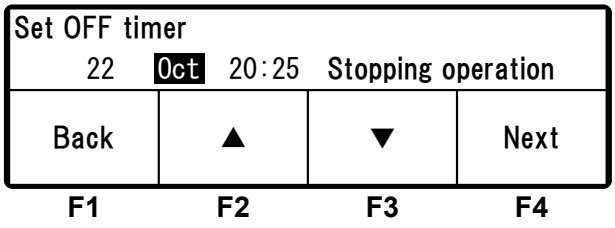
5 **Press “F4 (Set)” switch.**

⇒ Press “F2 (▲)” or “F3 (▼)” switch, and set the time (Date) of Set OFF timer.



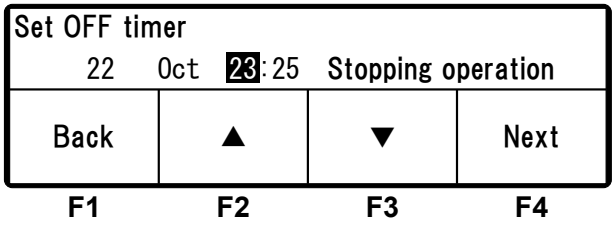
6 Press “F4 (Next)” switch.

⇒ Press “F2 (▲)” or “F3 (▼)” switch, and set the time (Month) of Set OFF timer.



7 Press “F4 (Next)” switch.

⇒ Press “F2 (▲)” or “F3 (▼)” switch, and adjust the time (Hour) of Set OFF timer.

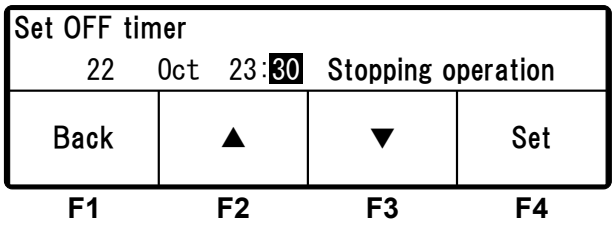


Notice

- Time is displayed in the 24-hour scale. If it is “7 PM”, set as “19:00”.

8 Press “F4 (Next)” switch.

⇒ Press “F2 (▲)” or “F3 (▼)” switch, and adjust the time (Minute) of Set OFF timer.



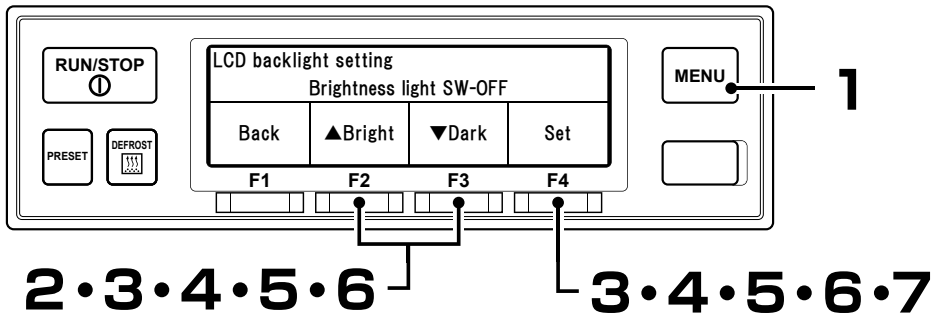
9 Press “F4 (Set)” switch.

⇒ The setting completes, and the display returns to the screen of Step 3, “Sub-menu”.

Notice

- Take note that the refrigeration unit stops the operation automatically at the setting time when the OFF timer is set.

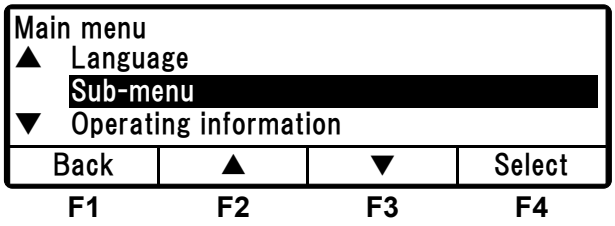
(8) Setting LCD backlight



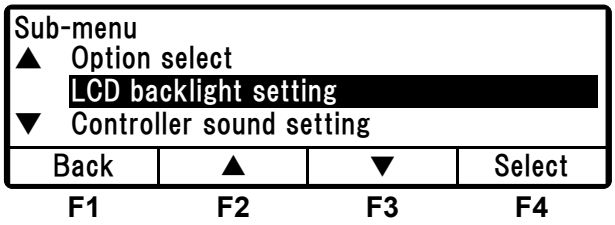
1 **Press “MENU” switch.**

⇒ he display changes to “Main menu” screen.

2 **Press “F2 (▲)” or “F3 (▼)” switch till the display changes to “Sub-menu” screen (Right figure).**

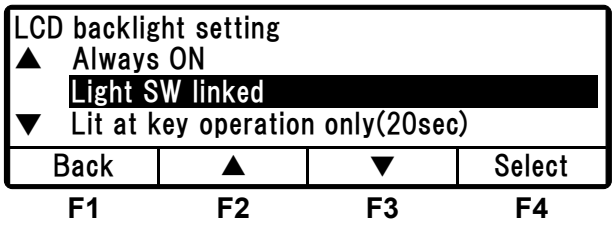


3 **Press “F4 (Select)” switch to change to “Sub-menu” screen. Press “F2 (▲)” or “F3 (▼)” switch till the display changes to “LCD backlight setting” screen (Right figure).**



4 **Press “F4 (Select)” switch.**

⇒ Press “F2 (▲)” or “F3 (▼)” switch to select the following LCD backlight setting.

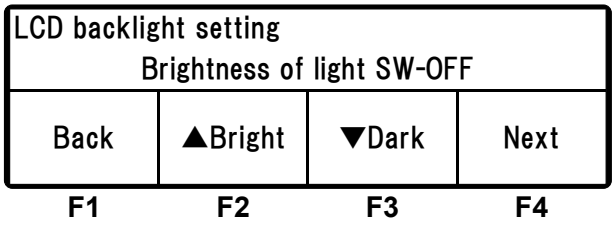


【Light SW linked】 : Lights interlocked with the lighting of vehicle’s light.
【Lit at key operation only(20sec)】 : Lights for 20 seconds only when the switch is operated.
【Always OFF】 : Always turning off the light.
【Always ON】 : Always lighting.

5 Press “F4 (Select)” switch.

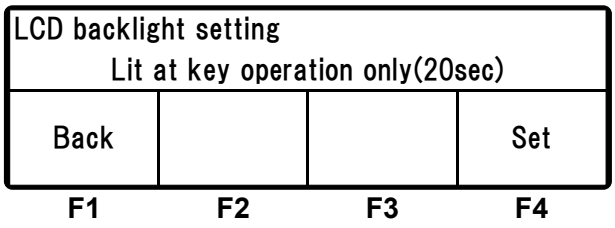
【Light SW linked】

⇒ Adjust the brightness of the LCD backlight, when the vehicle’s light is OFF, pressing “F2 (▲Bright)” or “F3 (▼Dark)” switch.
⇒ Step 6



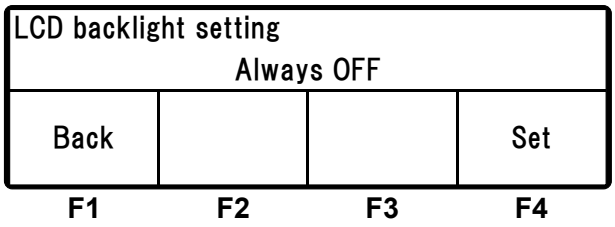
【Lit at key operation only(20sec)】

⇒ Step 7



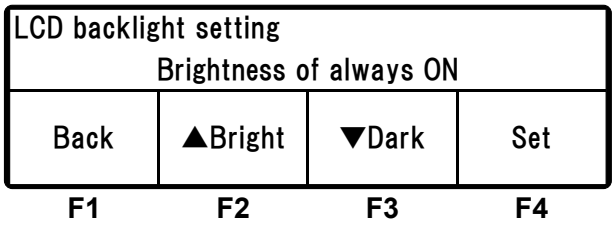
【Always OFF】

⇒ Step 7



【Always ON】

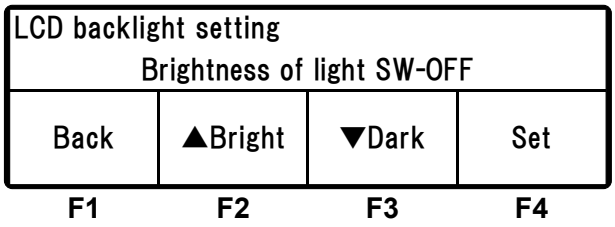
⇒ Adjust the brightness of the LCD backlight for Always ON by pressing “F2 (▲Bright)” or “F3 (▼Dark)” switch. ⇒ Step 7



6 Press “F4 (Next)” switch.

【Light SW linked】

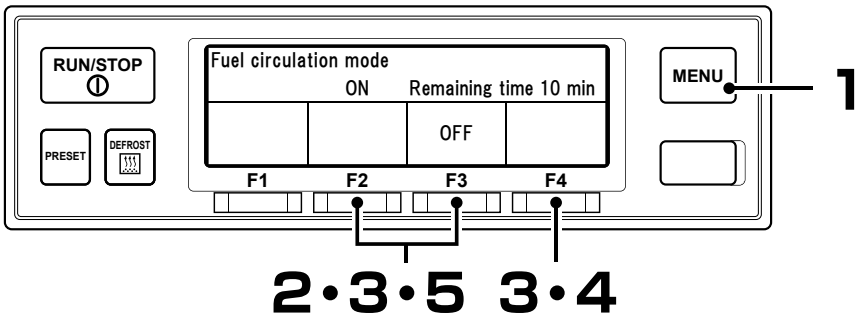
⇒ Adjust the brightness of the LCD backlight, when the vehicle’s light is ON, pressing “F2 (▲Bright)” or “F3 (▼Dark)” switch. ⇒ Step 7



7 Press “F4 (Set)” switch.

⇒ The setting completes, and the display returns to “Sub-menu” screen of Step 3.

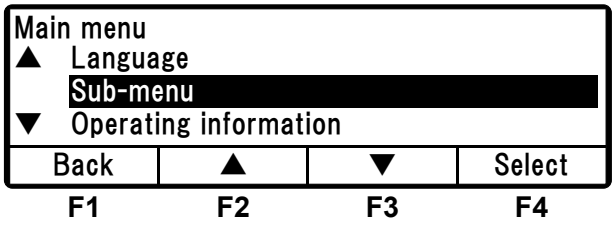
(9) Setting the fuel circulation



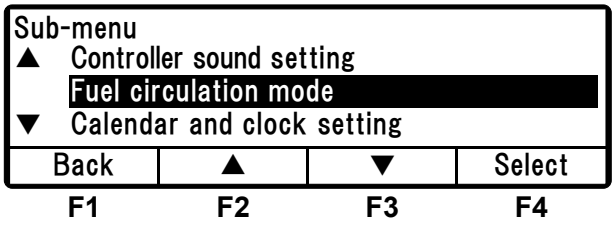
1 **Press “MENU” switch.**

⇒ The display changes to “Main menu” screen.

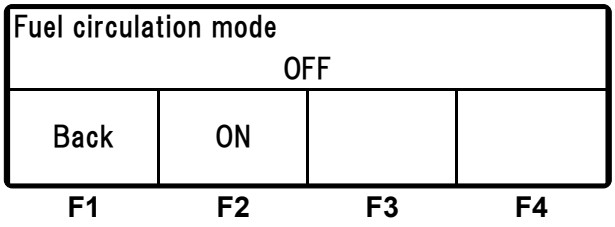
2 **Press “F2 (▲)” or “F3 (▼)” switch till the display changes to “Sub-menu” screen (Right figure).**



3 **Press “F4 (Select)” switch to change to “Sub-menu” screen. Press “F2 (▲)” or “F3 (▼)” switch till the display changes to “Fuel circulation mode” screen (Right figure).**

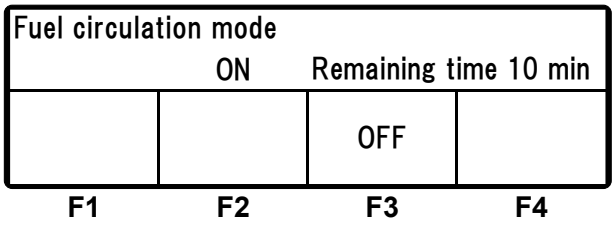


4 **Press “F4 (Select)” switch to change to “Fuel circulation mode” screen (Right figure).**



5 **Press “F2 (ON)” switch.**

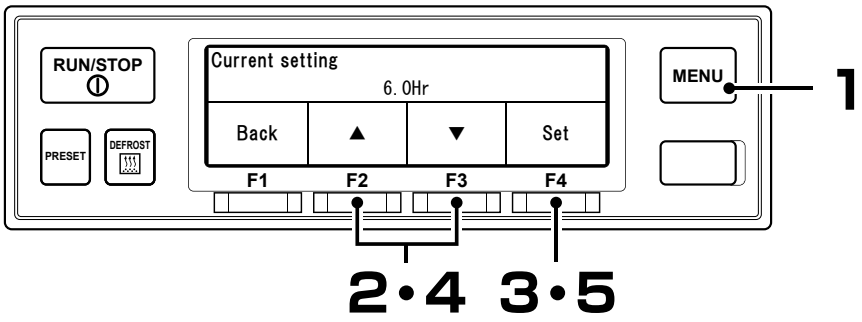
⇒ The remaining time (in minute) is displayed. Fuel circulation is completed 10 minutes later and the display returns to the normal display screen. To interrupt the fuel circulation, press “F3 (OFF)” switch to return to “Fuel circulation mode” screen of Step 4.



Notice

- **If fuel is used up, air may intrude in the fuel system such as the fuel hose, etc, so that the engine may become unable to start. In such occasion, purge air in the fuel circulation mode before starting engine.**

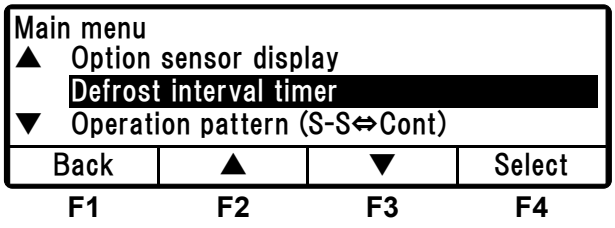
(10) Setting the defrost interval



1 **Press “MENU” switch.**

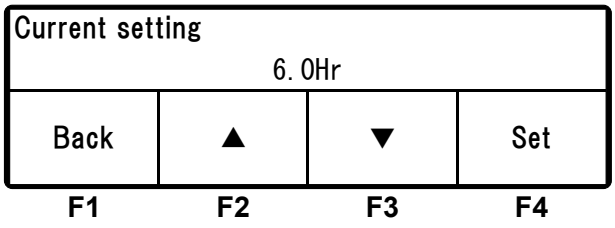
⇒ The display changes to “Main menu” screen.

2 **Press “F2 (▲)” or “F3 (▼)” switch till the display changes to “Defrost interval timer”.**

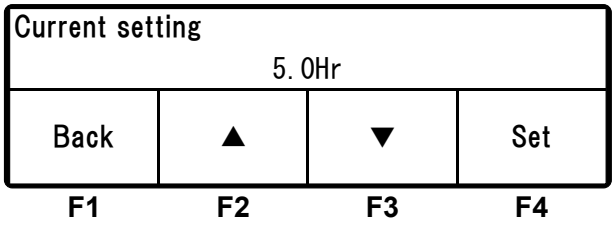


3 **Press “F4 (Select)” switch.**

⇒ Current setting of “Defrost interval time” is displayed.



4 **Press “F2 (▲)” or “F3 (▼)” switch to select a setting time.**



Notice

- The defrosting can be set at OFF, or at every 1 hour in the range of from 1 hour to 12 hours.

5 **Press “F4 (Set)” switch.**

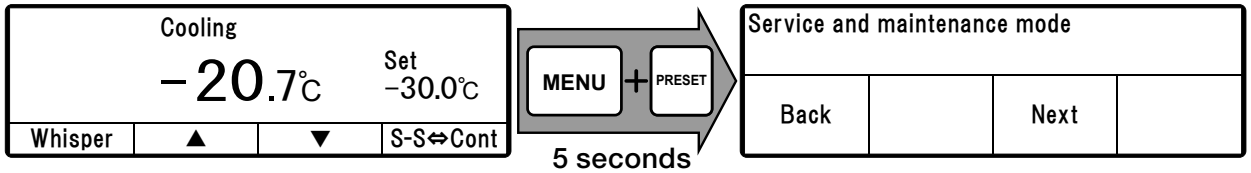
⇒ The setting completes, and the display returns to the screen of Step 2, “Main menu”.

(11) Display and function of service and maintenance mode

Hold down the [MENU] and [PRESET] switches simultaneously for 5 seconds on the normal display screen to select the service and maintenance mode. Following items are displayed in the service and maintenance mode.

Notice

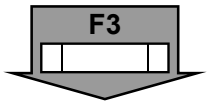
- In the service and maintenance mode, selected screen will be kept displayed unless any switch is operated except for the Special service screen mode. When starting up the controller while the unit is stopped, the power supply is turned off unless there is any switch operation for 10 minutes.



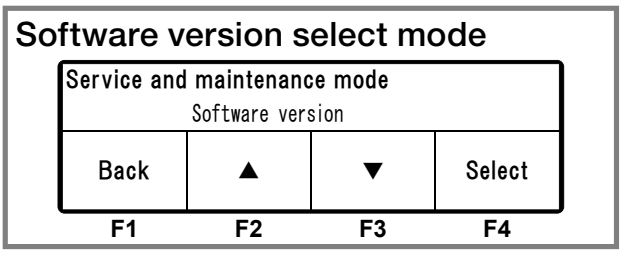
Normal display screen

5 seconds hold down

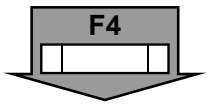
Service and maintenance mode screen



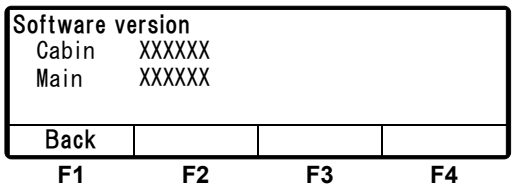
Press the [F3 (Next)] switch on the Service and maintenance mode screen to change the display as follows.



* Even when the [F2 (▲)] or [F3 (▼)] switch is pressed on this screen, the display does not change.



Press the [F4 (Select)] switch is pressed on the Service and maintenance mode Software version select mode screen to change the display as follows.



Software version check screen

The versions of the Cabin and Main board are displayed.

Press the [F1 (Back)] switch to return to the previous screen.

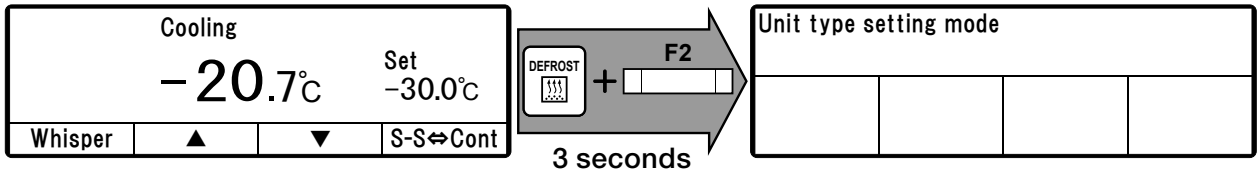
(12) Display and function of unit type setting mode

- Confirm that the vehicle engine is stopped and the unit power is OFF.
- Hold down the [DEFROST] and [F2] switches simultaneously for more than 3 seconds to display the screen for unit type setting mode within 20 seconds after turning on the cabin controller by pressing the [MENU] switch.

Notice

● When the unit is installed or when the main board is replaced, unit type setting is necessary. In order to set unit type setting, change to unit type setting mode by cabin controller and Ref-Monitor process is must.

<Changing to the unit type setting mode by cabin controller>

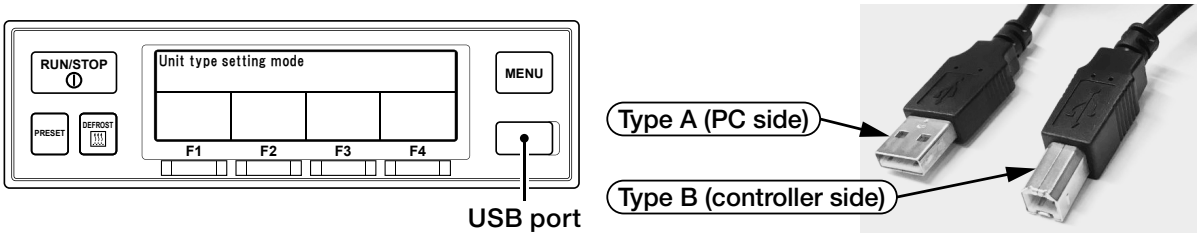


Normal display screen (After pressing MENU switch.)

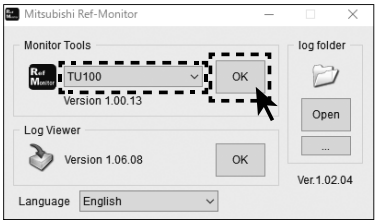
Unit type setting mode screen

<Setting the unit type using Ref-Monitor>

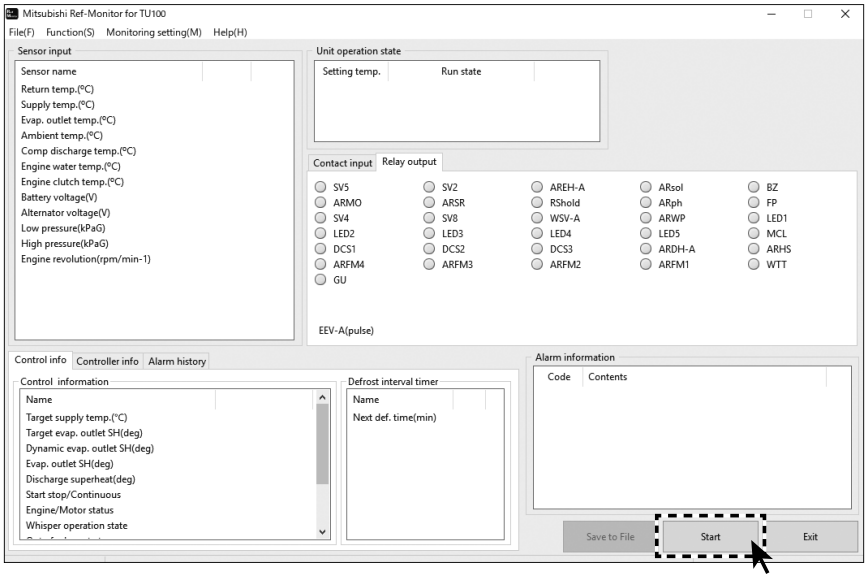
①After changing the mode to the unit type setting mode using the cabin controller, detach the cap from the USB port of the cabin controller and connect this port to the personal computer (PC) with the USB type A – type B cable.



②Start up the PC process software “Ref-Monitor”. After selecting [TU100] in the Monitor Tools area on the initial screen, press the OK button, and then press the [Start] button on the main screen.

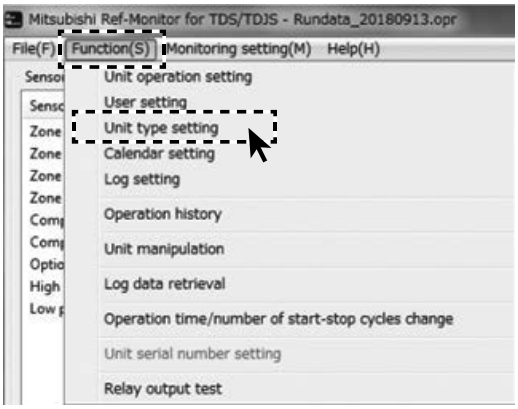


Ref-Monitor initial screen



Ref-Monitor main screen

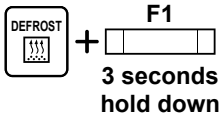
③After selecting [Function(S)] on the menu bar, select [Unit type setting].



④Press [Read] on the Unit type setting screen to display the current set values.

⑤Move the cursor to the item whose setting you want to change and double-click it. The relevant screen is displayed. Follow the instructions that appear on the screen to change the setting.

⑥Disconnect the cable, and then hold down the DEFROST and F1 switches for 3 sec. or longer to exit the unit type setting mode.



9. INSPECTION

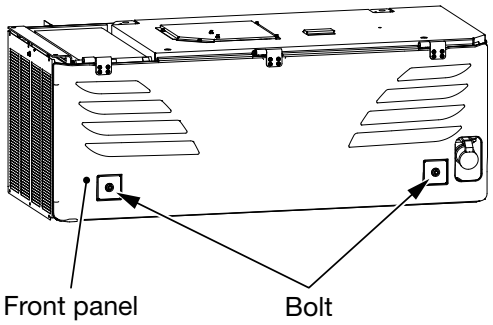
9.1 Opening/closing of condensing unit front panel

Opening of condensing unit front panel

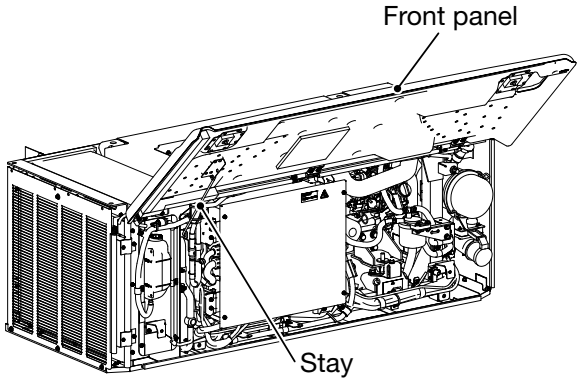
The front panel of the condensing unit which has to be opened or closed during inspection can be opened or closed by using tools. (Panel is fixed by bolt)

1) Remove a pair of bolts.

2) Open front panel with hands.



3) Fix front panel by inserting the tip of stay into the hole at the rear side of front panel.
   ⇨ Fixing angle of front panel can be selectable from 2 steps (90° and 135°).



Closing of condensing unit front panel

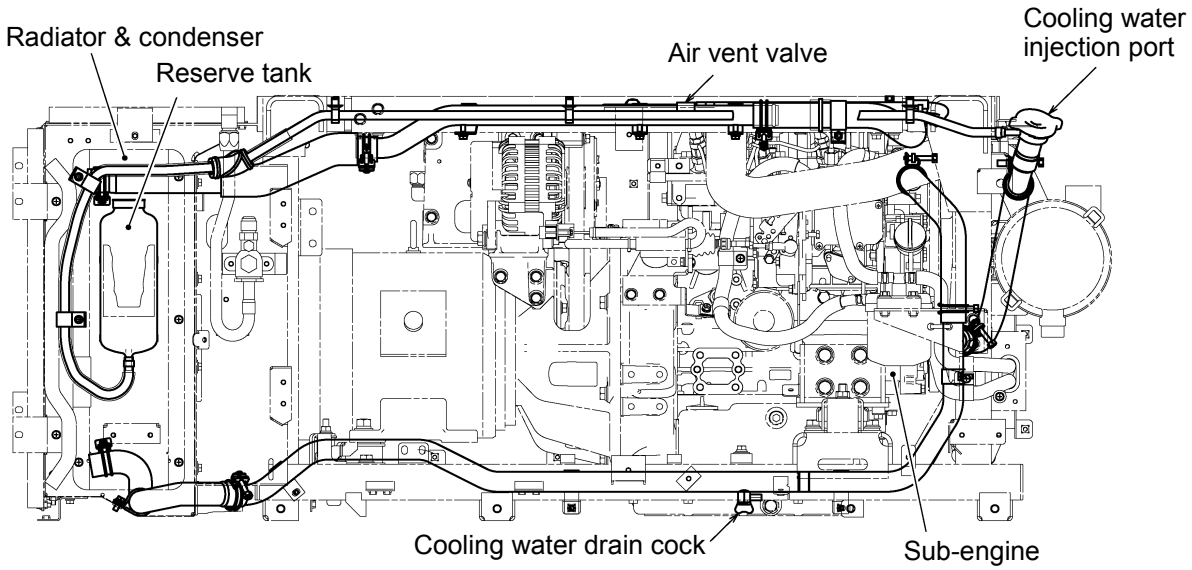
1) Removing the stay by holding the front panel and close.
2) Tighten the pair of bolts.
3) Confirm that the front panel is securely locked.

Notice

- Be sure to tighten a pair of bolts securely otherwise the front panel could accidentally open while driving the vehicle because of insufficient tightening due to lack of thrust pressure on the panel.

9.2 Daily inspection

(1) Inspection of cooling water



⚠ CAUTION

Do not perform inspection of the cooling water or refill it immediately after the sub-engine stopped.

※ High temperature steam may blow out and it may cause heat injury.

Use the designated antifreeze coolant with the specified concentrations.

※ Otherwise, it may cause troubles.

(A) Precaution for service

1) Check if the fluid level of reserve tank is between "MAX" and "MIN".
2) When the fluid level is below "MIN", replenish designated cooling water to the level of "MAX" of the reserve tank.
   [Designated cooling water: See page 121.]
3) Check if there is no leakage of cooling water from the cooling water system or the radiator.

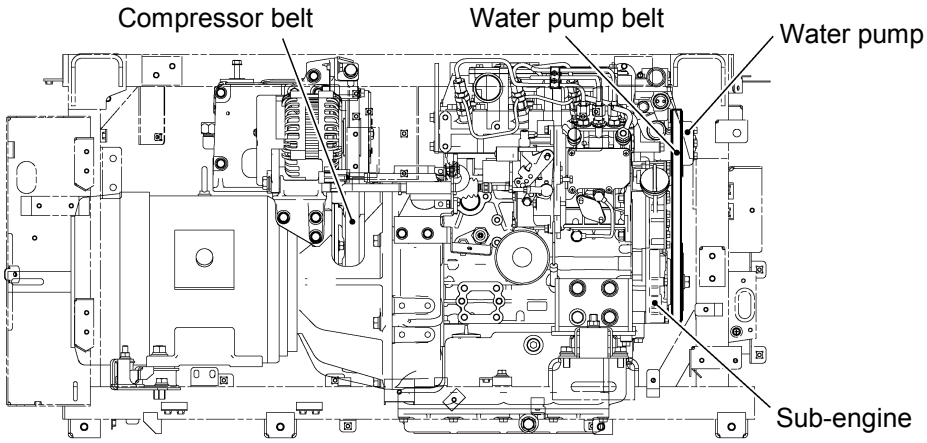
(B) Possible failure

- Engine over-heat. (Drop of engine speed, drop of out put power)
- Seizure of sliding surface such as crank shaft, piston and so on.
- Abnormal stop of refrigeration unit.
- Freezing of cooling water and crack or damage of radiator or cylinder block due to improper concentration of antifreeze coolant.

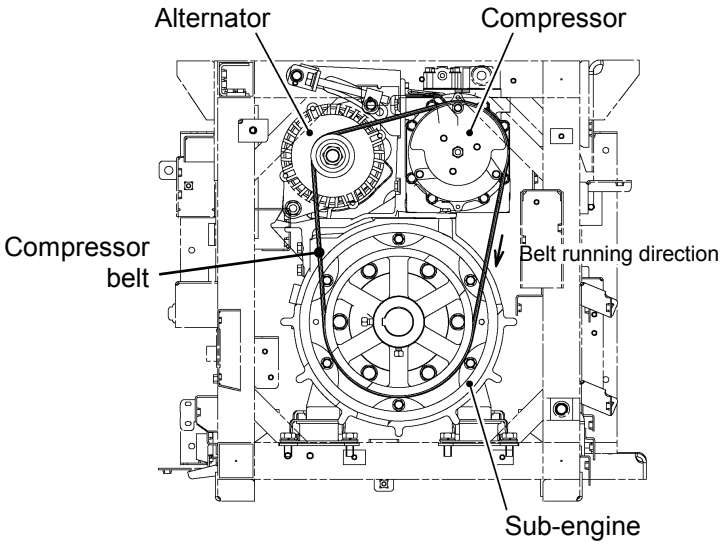
(C) Corrective action

- Check cooling water quantity and refill if necessary.
- Check the clamps on the cooling water hose connection for looseness, and retighten the clamp.
- Adjust proper concentration of antifreeze coolant.
- Use designated cooling water.

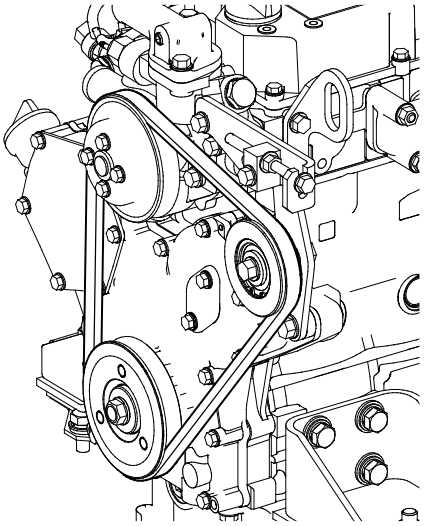
(2) Inspection of moving sections



● Detail of compressor belt



● Detail of water pump belt



(A) Precaution for service

1) Visually inspect the compressor belt and the water pump belt for defects such as scratches, crack or one-sided wear, etc.
2) Check the moving sections for interference with other parts.

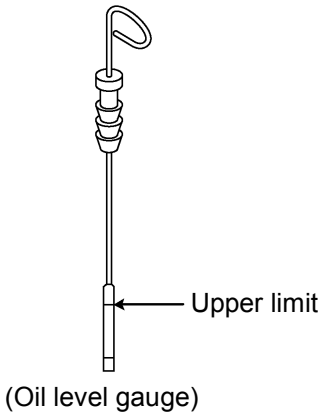
(B) Possible failure

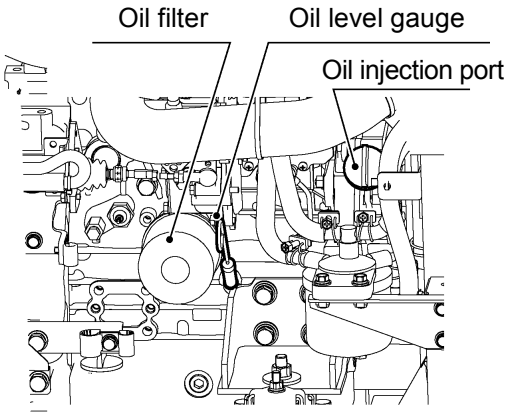
<Belt related>
・ Abnormal sound
・ Poor cooling, dead battery and engine over-heat due to broken belt.
<Interference>
・ Damaged piping, abnormal vibration and poor cooling due to broken fan.
・ Short circuit and fire due to improper contact of wiring.

(C) Corrective action

・ Replace belt if scratches, cracks and so on are found.
・ Amend the interfering portion.

(3) Inspection of sub-engine oil quantity





⚠ CAUTION

Do not perform inspection of the sub-engine oil or refill it immediately after the sub-engine stopped.

※ Since the sub-engine oil becomes very hot, it may cause heat injury.

Do not refill the sub-engine oil excessively.

※ Sub-engine may not be stopped due to abnormal combustion of the oil, or white smoke or oil may come up from the exhaust pipe.

Use the designated sub-engine oil.

※ Otherwise, it may cause troubles.

Surely wipe off spilled sub-engine oil during refilling.

※ If the oil is heated up, it may cause a fire.

(A) Precaution for service

1) Check if the fluid level of sub-engine oil is in the vicinity of the upper limit of the oil level gauge.
   * Tighten the screw of oil level gauge firmly before the check.
2) When the quantity of sub-engine oil is not enough, supply the designated sub-engine oil from the oil injection port to the level not to exceed the upper limit.
   [Refer to page 109 for the designated sub-engine oil.]
3) Surveying the entire sub-engine and check if the oil is leaking.

Notice

● If "**Maintenance required**" is displayed on the cabin controller at the start of operation and "**Engine operation time 1**" exceeds 1,000 hrs in the maintenance information mode, it is the time to change sub-engine oil. Change the oil and the oil filter. Reset the cumulative time after changing the sub-engine oil.

(B) Possible failure

- Engine over-heat
- Seizure of piston, connecting rod and crank shaft.
- Increase of oil consumption.
- Excessive blow-by gas.

(C) Corrective action

- Daily inspect quantity of engine oil.
- Be sure to exchange engine oil at every 1000 hours of operation. (Exchange at 100 hours at the first time only.)
- Use the designated engine oil when refilling or changing the engine oil.
- If the plug or bolt such as oil drain plug is loose, retighten it with the specified torque.

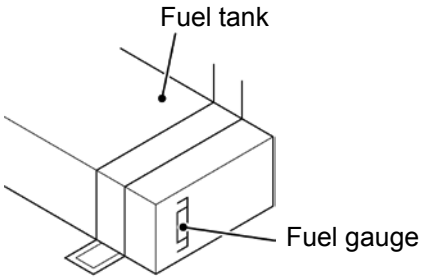
(4) Inspection of sub-engine fuel quantity

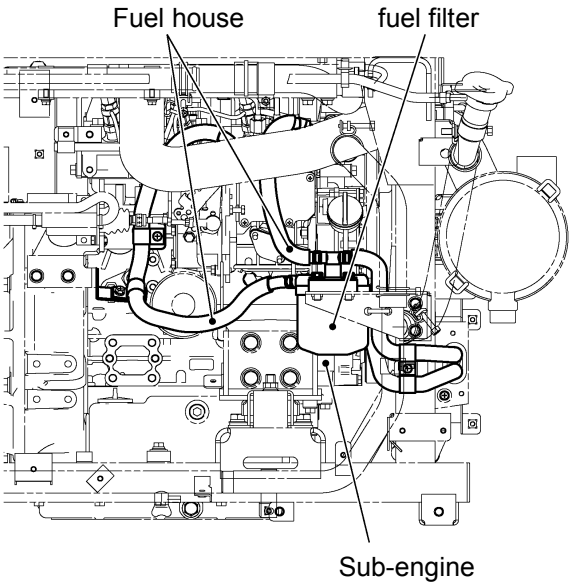
⚠ CAUTION

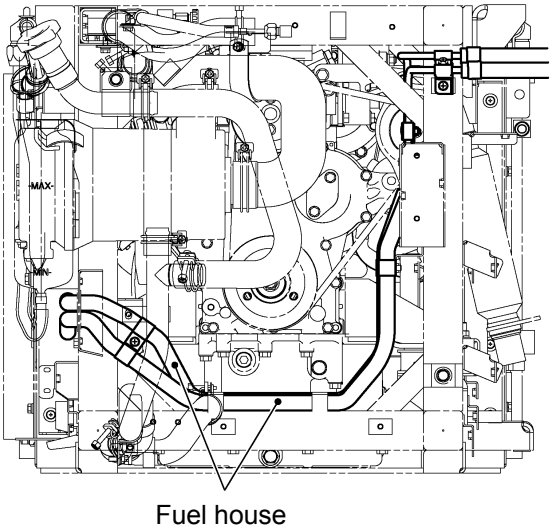
Use the designated sub-engine fuel.
※ Otherwise, it may cause damage of the sub-engine.

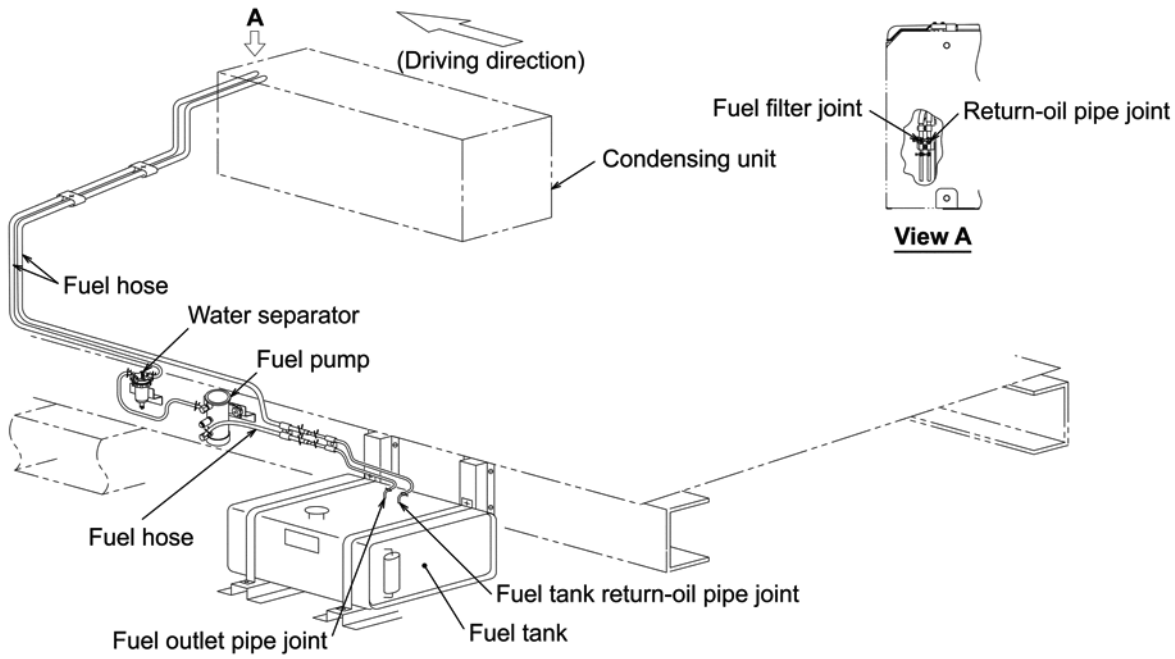
(A) Precaution for service

1) Always check the fuel quantity with the level gauge to avoid running short of fuel during transportation.
2) If there is not enough fuel left in the tank, refuel it. [Refer to page 121 for the designated fuel.]
3) Check if the fuel is leaking from joints of the fuel pipe, fuel filter and so on.









Notice

● To replenish fuel during operation, do so after stopping the unit with Run/stop switch.

(B) Possible failure

- Decrease of engine speed.
- Bad color of exhaust gas.
- Poor engine start up.
- Poor operation of fuel injection pump.
- Clogging of fuel injection nozzle.

(C) Corrective action

- Use designated engine fuel.

(5) Inspection of condenser coil and radiator coil

(A) Precaution for service

1) Check if the coil is dirt with dust or the like.
2) If dirt, wash with water using soft brush.

Notice

● Periodically clean the coil otherwise dirty coil could cause a decrease of freezing capacity and operation of protective device resulting in unable of the unit operation.

(B) Possible failure

- Abnormal high pressure and decrease of freezing capacity due to dirty condenser coil.
- Engine over-heat due to dirty radiator coil.

(C) Corrective action

- Clean the coils periodically.

9.3 Installation and test run check sheet

Customer		Signature		Van manufacturer	
				Unit installation company	
Refrigeration unit	Evaporator unit model			Delivery date	
	Condensing unit model			Inspection date	
Vehicle	Model			Inspection company	
	Serial No.			Inspector	

Inspection Item		Inspection Result	Remarks
Check if the condenser, evaporator, battery and fuel tank are installed at the proper position. (Drawing)			
Check if pipes/wires are arranged properly. (Layout drawing)			
Inspect if sealant is applied completely at the root of mounting bolts. (Evaporator)			
Inspect if mounting bolts are tightened properly.			
Inspect if the fuel and drain hoses are connected securely, or clamped properly.			
Inspect if drain hose has no trap and inclines properly toward discharging direction.			
Inspect if sealant is applied completely at bores where pipes/wires pass through.			
Inspect if electric wires are clamped properly.			
Inspect if proper quantity is reserved for engine oil/cooling water/fuel.			
Inspect drive belts for slackness.			
Inspect for leakage of gas / oil / fuel / cooling water from refrigerant system.			
Inspect for interference with movable sections.	Interference of fan and bell-mouth, cooling water hose.		
	Interference of cooling water belt, pulley and fuel hose, air hose, harness, etc.		
	Interference of compressor belt and wiring harness.		
Inspect for abnormal noise/vibration.			
Inspect if sub-engine operation sound is normal and fan motor speed is normal.			
Inspect the color on the sight glass and the extent of flush.			
Check if high / low pressures are normal.			
Check if the sub-engine starts or stops (changes high / low speed) properly.			
Check if the defrosting cycle operates properly.			
Check if the high-pressure switch operates properly.			
Check if the electric motor operates properly.			

Cooling inspection	Time / Item					
	Inside container temperature °C					
	High pressure MPa					
	Low pressure MPa					

Ambient temperature °C

Note) Operate till it cools down below the setting temperature.

Remarks

After installation, make sure cargo room temperature should be down to ATP certified set-temperature (∗) in order to confirm the test result.
(∗) FRA: 0 degree, FRB: −10 degrees, FRC: −20 degrees

9.4 Periodic inspection check sheet

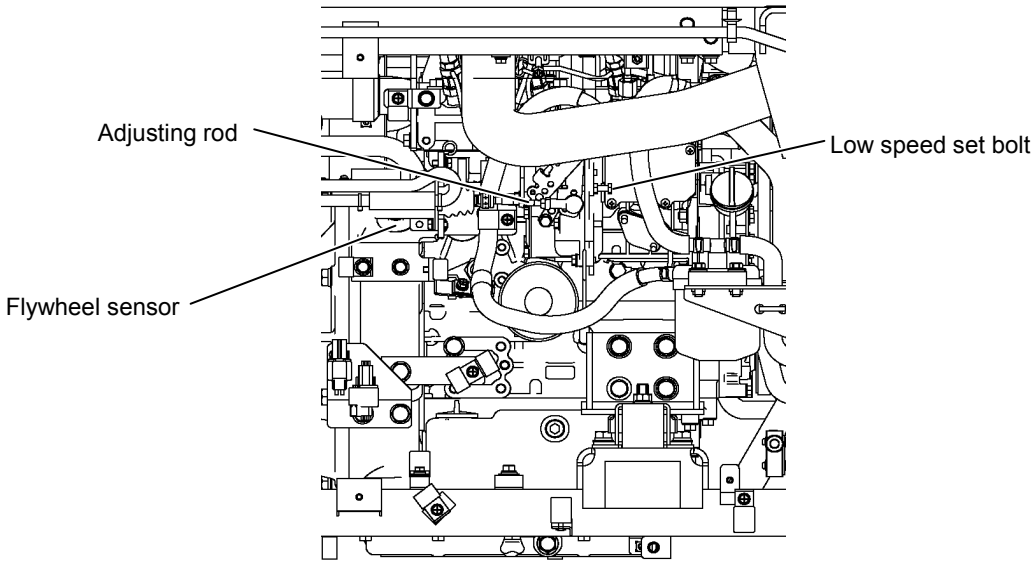
Customer name						Customer's signature	
Inspection interval *1				Refrigeration unit	Evaporator unit model	Delivery data	
					Condensing unit model	Inspection date	
				Vehicle	Model	Inspection company	
					Serial No.	Inspector	
Every 9000 hrs	Every 3000 hrs	Every 1000 hrs	Daily inspection	Inspection Item		Inspection Result	Remarks
			△	Inspection of sub-engine oil quantity (Replenish up to upper level of gauge marking)			
			△	Inspection of fuel quantity			
			△	Inspection of sub-engine oil, fuel leakage			
			△	Inspection of interference with moving sections			
			□	Cleaning of condenser coil, entire condensing unit			
			△	Inspection of cooling water quantity, leakage (water hose, radiator, water pump)			
		△		Inspection of sub-engine speed			
		△		Inspection of refrigerant sight glass color, degree of flush			
		○		Replacement of air cleaner			
		○		Replacement of sub-engine oil (100 hours at initial inspection only)			
		○		Replacement of oil filter (100 hours at initial inspection only)			
		△○		Inspection and replenishment of cooling water			
		△		Inspection of sub-engine governor lever link and related parts			
		□		Cleaning of fuel tank			
		△□		Inspection of fuel pump and cleaning of fuel pump filter			
		○		Replacement of fuel filter			
		△		Inspection of glow plug			
		△		Inspection of starter			
		■		Retightening of condensing unit mounting bolts			
		■		Retightening of mounting bolts (Sub-engine and so on)			
		△		Inspection of slackened belt, damage on belt (Compressor, water pump) Inspection of belt groove of pulley (Rust, abrasion)			
		△		Inspection of fuel hose and water hose			
		■		Operation check of stop solenoid			
		△		Inspection of dirty compressor oil			
		■		Check of motor-driven movements			
		△		Inspection of cooling (inspection of temperature display, high/low pressure)			
		△		Inspection of defrost operation			
		△		Inspection of battery			
	■			Operation check of front panel opening detection switch (door limit switch)			
	○			Replacement of water pump belt			
	△			Inspection of slackened electric wiring terminals, broken wire cover			
	△			Inspection of motor insulation resistance			
	△			Inspection of alternator			
	□			Cleaning of condenser coil			
	□			Cleaning of evaporator coil			
	□			Cleaning of drain port			
	△			Inspection of damage on rubber cushion			
	○			Replacement of cooling water (or 2 years)			
○				Replacement of centrifugal clutch shoe			
△				Inspection of valve clearance			
○				Replacement of glow plug (or 30,000 times)			
○				Replacement of starter (or 30,000 times)			
○				Replacement of stop solenoid (or 30,000 times)			
▲				Sub-engine overhaul (Injection nozzle, injection pump)			
○				Replacement of compressor belt			
○				Replacement of electric wiring terminal, wiring harness			
○				Replacement of alternator			
○				Replacement of magnet clutch			
○				Replacement of throttle solenoid			
○				Replacement of fuel hose and water hose			

*1 △Inspection, ▲Overhaul, ○Replacement, □Cleaning, ■Operation check or retightening

9.5 Inspection and service/repair methods

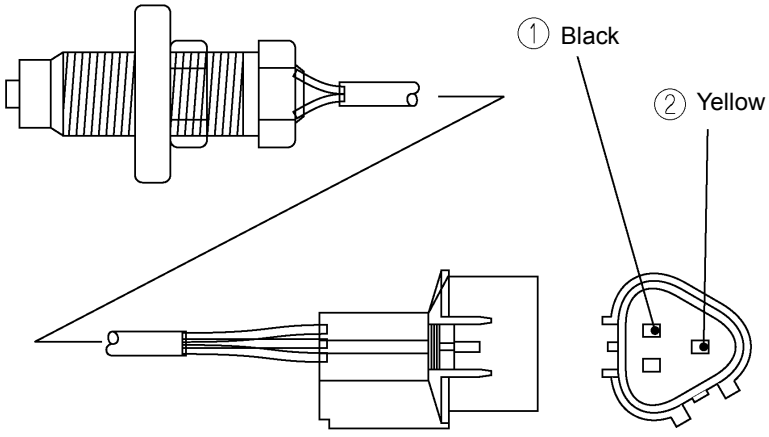
Turn off the main switch located at the side of the control box when inspecting the electric system. If the power supply is interrupted for more than 3 hours due to turning off of the main switch or disconnection of battery for inspection and so on, the clock built in the controller is delayed. Reset the calendar.

(1) Inspection of sub-engine speed, inspection and cleaning of flywheel sensor



(A) Precaution for service

1) Remove flywheel sensor and clean the tip of the sensor.
2) After cleaning, assemble the sensor and adjust the gap by turning it 2/3 turns backward from the point it contacted the ring gear lightly. See pages 34 and 35 for assembly procedure.
3) Confirm engine revolution speed according to the service and maintenance mode. See page 58. Normal speed: Low speed 1500 min^{-1}, High speed 2100 min^{-1}
4) Remove the connector of flywheel sensor and check the resistance value.



Remove the connector and measure the resistance between ① and ②.
Normal resistance value: 2.3 ± 0.2 kΩ.

Notice

- Excessive tightening or excessive gap of the flywheel sensor could cause problem.

(B) Possible failure

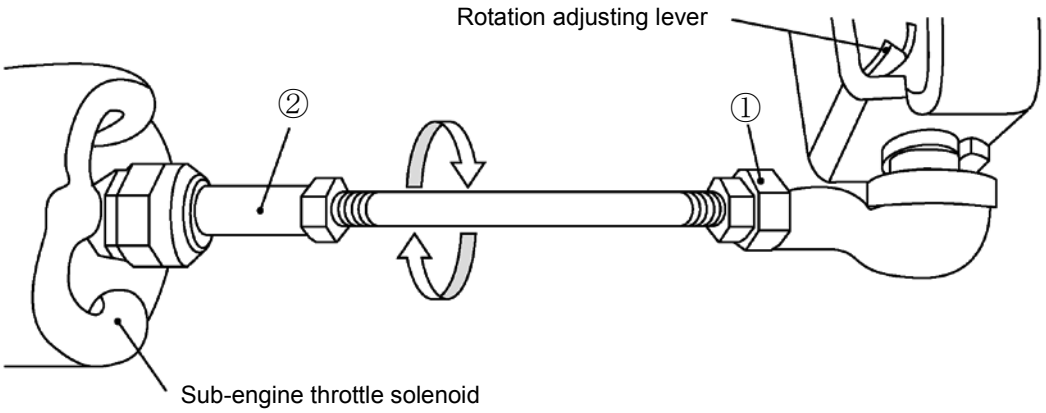
- Poor cooling capacity
- Early abrasion of centrifugal clutch
- Crack of piping due to vibration
- Excessive fuel consumption

(C) Corrective action (Reference)

- Replace flywheel sensor if the resistance of the sensor is abnormal.
- Adjust engine speed if it is not normal.

<Adjusting procedure of sub-engine speed>

1) Loosen nut ①.
2) While operating the sub-engine at high speed, adjust the length of the adjusting rod by turning the grip portion of ② and set the rotation speed of sub-engine at high speed to 2100 min^{-1}.
3) Be sure to tighten nut ① after adjustment.

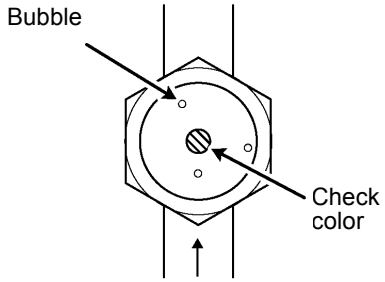
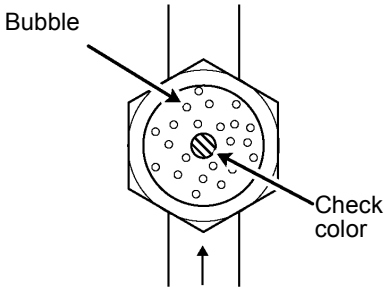


4) After adjusting high speed rotation, operate the sub-engine at low speed and adjust the rotation to 1500 min^{-1} by low speed set bolt.
5) Be sure to test operate the engine after assemble and adjustment and confirm proper starting and stopping.

(2) Inspection of color and degree of flushing in the refrigerant sight glass

(A) Precaution for service

<Inspection of refrigerant amount>

	Amount of refrigerant is proper	Amount of refrigerant is short
Sight glass	 (A few bubbles are moving or no bubbles)	 (A lot of bubbles are seen when the refrigerant is in shortage. Flushing may be seen when the inside container temperature is high even if the amount of refrigerant is proper.)

1) Operate refrigeration unit for 10 minutes.
2) Check the degree of flushing.
3) If the shortage of refrigerant is suspected, measure high and low pressures and compare with the standard operating pressure shown in page 123.

<Inspection of water content>

Check color	Judgment	Water content of R452A
		Refrigerant temperature 40°C
Green	Normal	30 ppm or less
Light green	Rather abnormal	30 ~ 140 ppm
Yellow	Abnormal	140 ppm or more

1) Operate refrigeration unit for 10 minutes.
2) Check the color of check color.

Notice

- When the color is yellow, replace the drier and execute evacuation since the moisture has been introduced.

(B) Possible failure

<Shortage of refrigerant quantity>

- Poor cooling, no cooling
- Abnormal rise of exhaust gas temperature

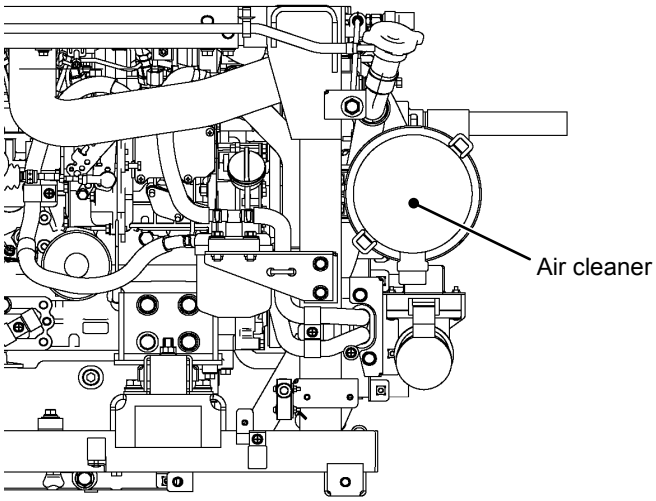
<Entering of water content>

- Clogging of expansion valve
- Clogging of drier

(C) Corrective action (Reference)

- If a lot of bubbles are seen, operate the unit for a while and reconfirm when the inside container temperature becomes low. Also, connect gauge manifold to the system and check high and low pressures.
- If the refrigerant is leaking, identify the leaking place and repair. Be sure to use refrigerant recovery equipment since releasing refrigerant into atmosphere is prohibited.
- When the check color is yellow, replace the drier and execute evacuation since the moisture has been introduced.

(3) Replacement of air cleaner



(A) Precaution for service

1) Remove dust pan of air cleaner and replace the element at every 1000 hours.

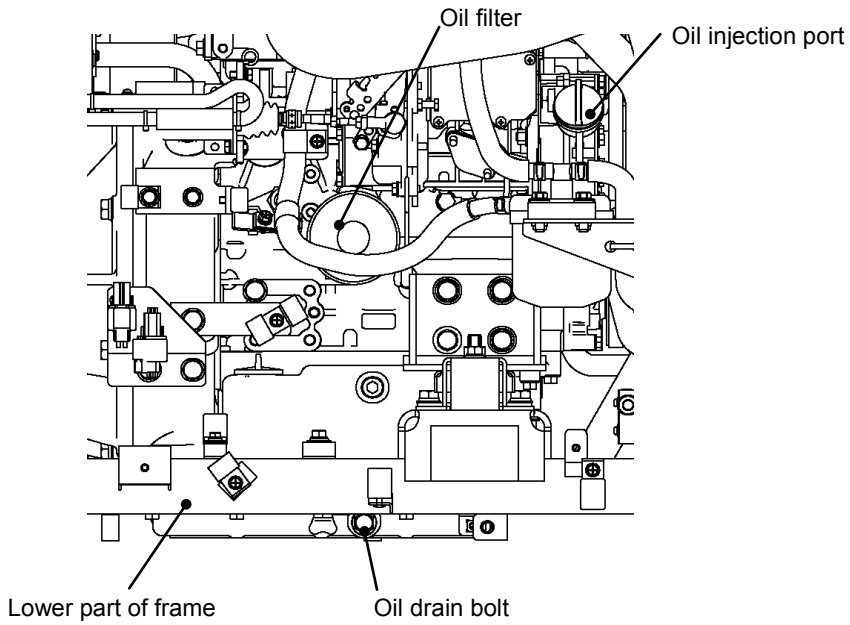
(B) Possible failure

- Slow down of engine speed, decrease of power.
- Burning of centrifugal clutch
- Insufficient cooling capacity
- Bad color of exhaust gas
- Carbon accumulation around combustion chamber such as suction/exhaust valve, top of piston, and so on,

(C) Corrective action (Reference)

- Replace air cleaner element at every 1000 hours to avoid incomplete combustion inside of combustion chamber due to shortage of oxygen caused by clogging of element.

(4) Replacement of sub-engine oil (oil leakage inspection)



(A) Precaution for service

1) Prepare oil pan and waste to avoid spill of oil
2) Remove oil drain bolt from lower part of the engine to take off the oil.
3) Be sure to use specified brand of oil.
4) Replenish specified amount of engine oil from oil injection port.
   Oil amount: 9.5 liter
5) Be sure to execute test operation after the replacement, and check oil amount again.
   (Be careful not to over charge the oil.)

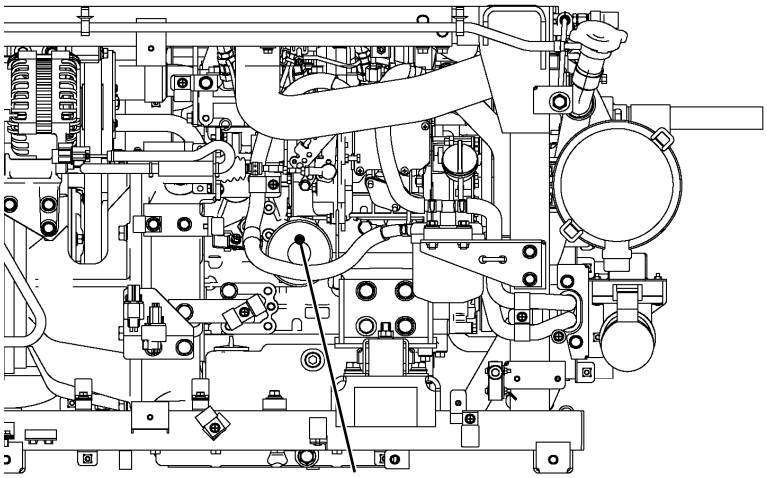
(B) Possible failure

- Over heat.
- Seizure of piston
- Wear of crank shaft

(C) Corrective action (Reference)

- Be sure to replace engine oil at every 1000 hours. (Replace oil at 100 hours only at the first time. Execute inspection of oil leakage at the same time.)

(5) Replacement of oil filter



(A) Precaution for service

1) Remove oil filter by using filter wrench after preparing waste so that the oil inside of filter will not spill off during removal.
2) Clean up filter attaching surface and install new gasket and oil filter.
3) Be sure to test operate after the replacement of filter, and check there is no leakage.

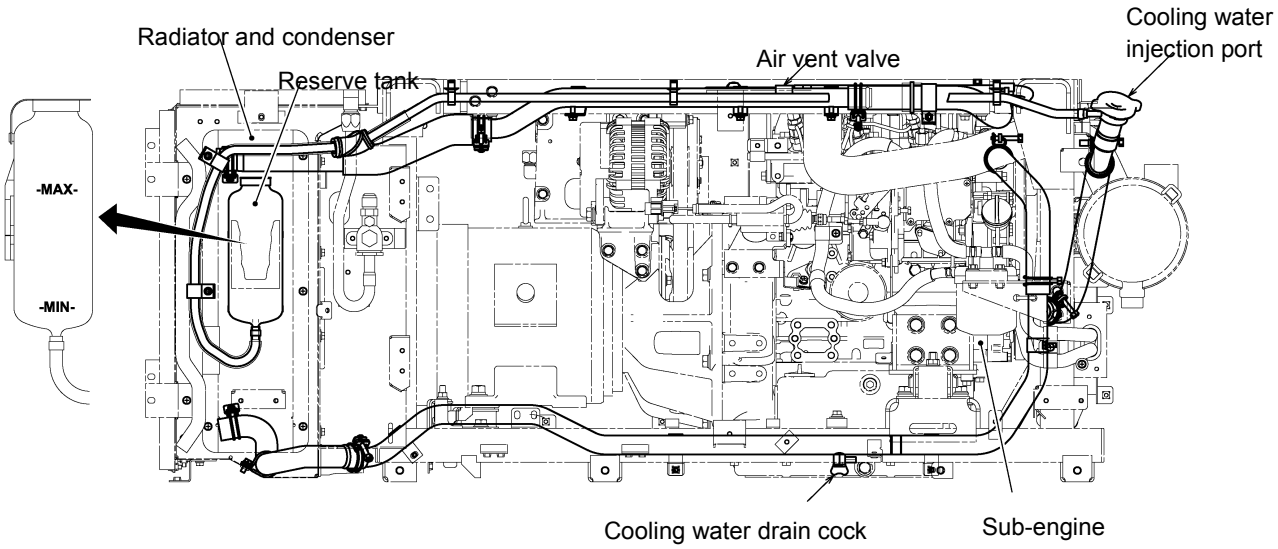
(B) Possible failure

- Abnormal wear and seizure of sliding part of sub-engine.
- Excessive blow by gas.
- Increase of oil consumption.

(C) Corrective action (Reference)

- Be sure to replace oil filter at every 1000 hours. (Replace oil filter at 100 hours only at the first time.)

(6) Replacement of cooling water



(A) Precaution for service

1) Loosen radiator cap (cooling water injection port) and air purge valve.
2) Loosen cooling water drain cock at the lower part of the unit and drain cooling water.
3) After draining, close cooling water drain cock and inject specified amount of cooling water from the injection port. Inject cooling water at the higher place than the sub-engine by pulling the cooling water hose to this side after removing hose fixing bolt.
4) Close air purge valve and inject cooling water until it comes to “MAX” position of the reserve tank. (See page 109 for specified type of cooling water.)
5) Purge air by operating sub-engine.
6) Close radiator cap after purging and operate the engine until the thermostat opens.
7) Stop the engine after the thermostat opens and cool it down to the ambient temperature.
8) After cooling down, replenish cooling water again until it comes to “MAX” position of the reserve tank.

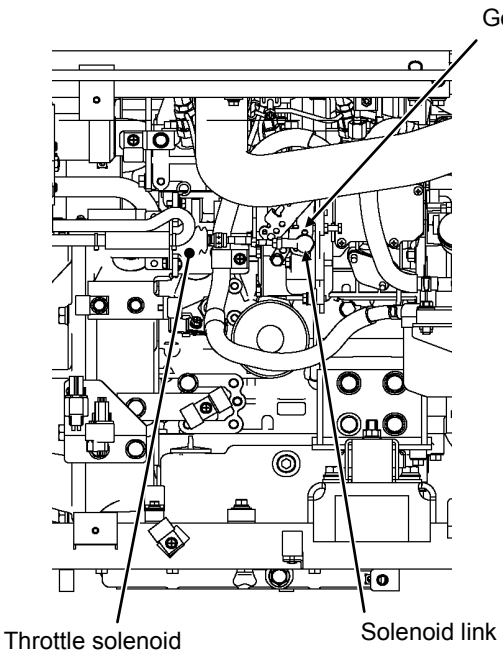
(B) Possible failure

- Over heat.
- Decrease of rotation speed
- Decrease of power
- Bad color of exhaust gas
- Poor start up
- Shortening of engine life

(C) Corrective action (Reference)

- Purge air completely
- Be sure to close cooling water drain cock, air purge valve and radiator cap.

(7) Inspection of sub-engine governor lever, solenoid link, etc.



(A) Precaution for service

1) Inspect if the link mechanism from solenoid to governor lever operates smoothly.

(B) Possible failure

- Poor stopping of sub-engine.
- Decrease of rotation speed or insufficient rotation speed.
- Burning of solenoid.

(C) Corrective action (Reference)

- Periodically inspect link mechanism and pivot of lever and execute cleaning and apply lubricant.

(8) Fuel tank drainage

(A) Precaution for service

1) Remove drain plug from fuel tank and drain contaminants (such as water, waste, etc.) from the bottom of the tank.
2) Keep draining until pure fuel comes out.
3) Install drain plug and check if any fuel leakage exists.

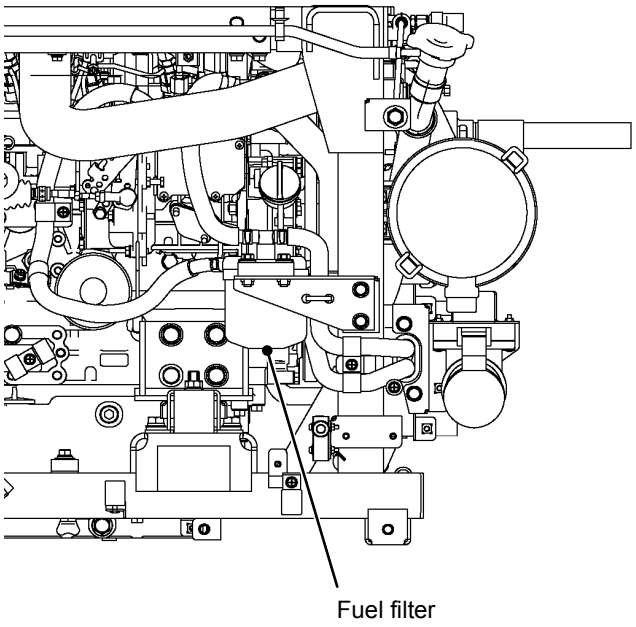
(B) Possible failure

- Decrease of rotation speed
- Decrease of power
- Bad color of exhaust gas
- Poor start up
- Poor operation of fuel injection pump
- Clogging of fuel injection nozzle

(C) Corrective action (Reference)

- Prepare a vessel for draining fuel before the work.

(9) Replacement of fuel filter



(A) Precaution for service

1) Remove fuel filter by using filter wrench.
2) When replacing the filter, install new filter filled with full of fuel.

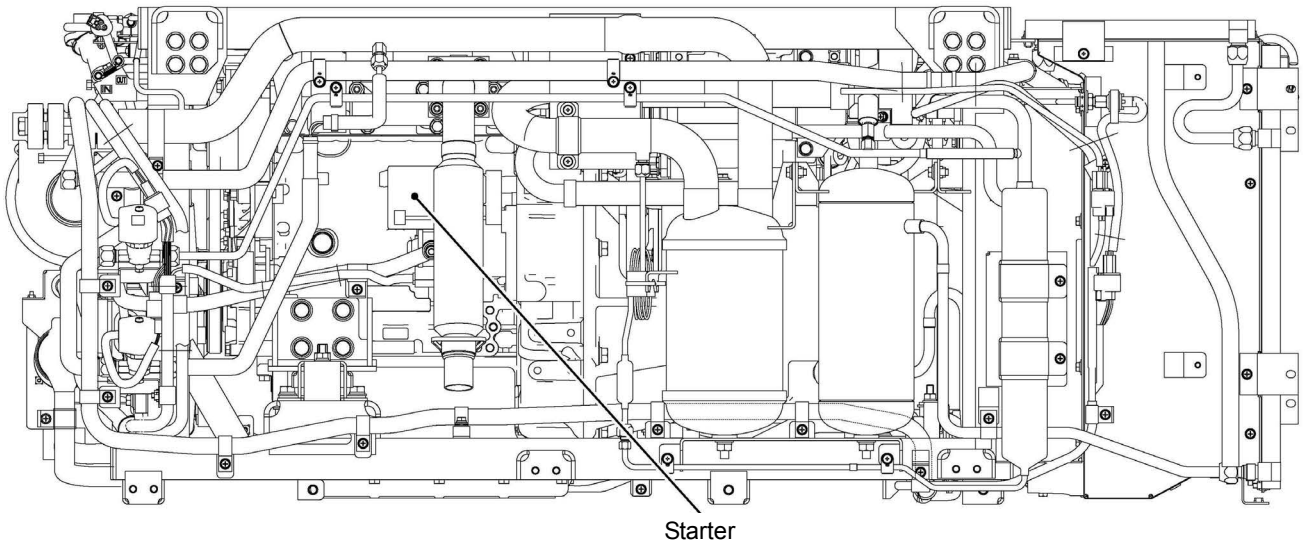
(B) Possible failure

- Bad condition of sub-engine due to crude fuel
- Poor start up

(C) Corrective action (Reference)

- Replace fuel filter at every 1000 hours of operation.
  When the dirt is severe, replace the filter even if it is less than 1000 hours. (Confirm with oil separator)
- Execute air purge until the bubbles disappear completely.

(10) Inspection (operation, noise, vibration) and replacement of starter



(A) Precaution for service

1) If abnormal sound or abnormal heating is observed, it indicates malfunction so that replace the starter. Always try to remember normal conditions and pay attention when inspect.

(B) Possible failure

- Poor start up
- Broken wires
- Poor contacts
- Dead battery
- Engine seizure

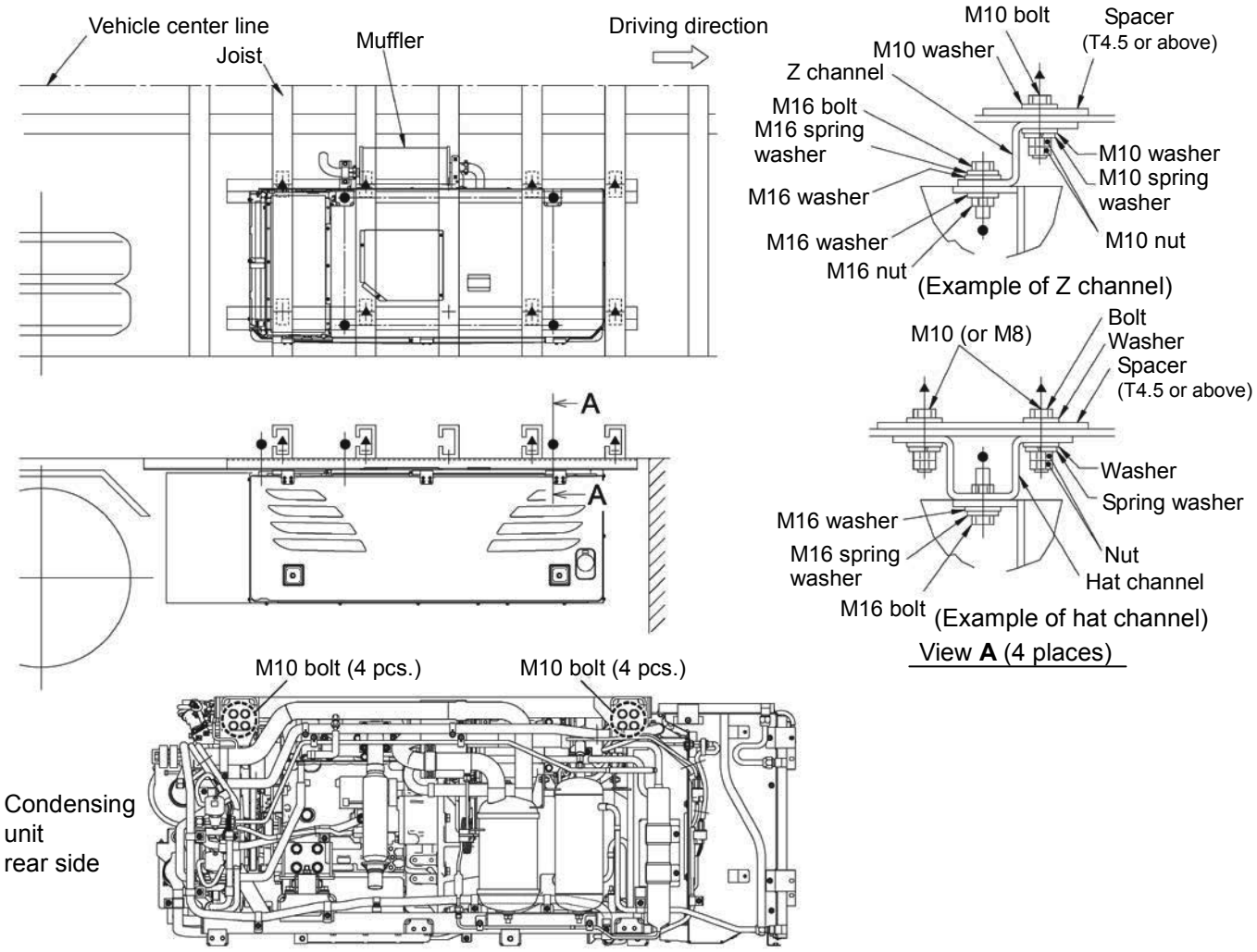
(C) Corrective action (Reference)

- Replace starter. Normal replacement interval is 30,000 times of start and stop.

<Replacement method of starter>

1) Remove minus terminal of the battery. When leaving battery unconnected for more than 3 hours, the built-in clock of the controller starts to delay. Reset the calendar after servicing.
2) Remove the rear panel of the unit.
3) Remove the wiring for the starter. Pay attention that the connector is fixed with a split pin.
4) Replace the starter by removing the fixing bolt.
5) Be sure to fix the connector with a split pin when connecting after replacement.

(11) Condensing unit installation bolt retightening



<Tightening torque of condensing unit fixing bolt>

Thread diameter	Tightening torque N·m (kgf/m)
M8	25 ~ 29.5 (2.55 ~ 3)
M10	50.5 ~ 58.9 (5.15 ~ 6)
M16	218.7 ~ 246.2 (22.3 ~ 25.1)

(A) Precaution for service

・ Tighten by referring above table for tightening torque.

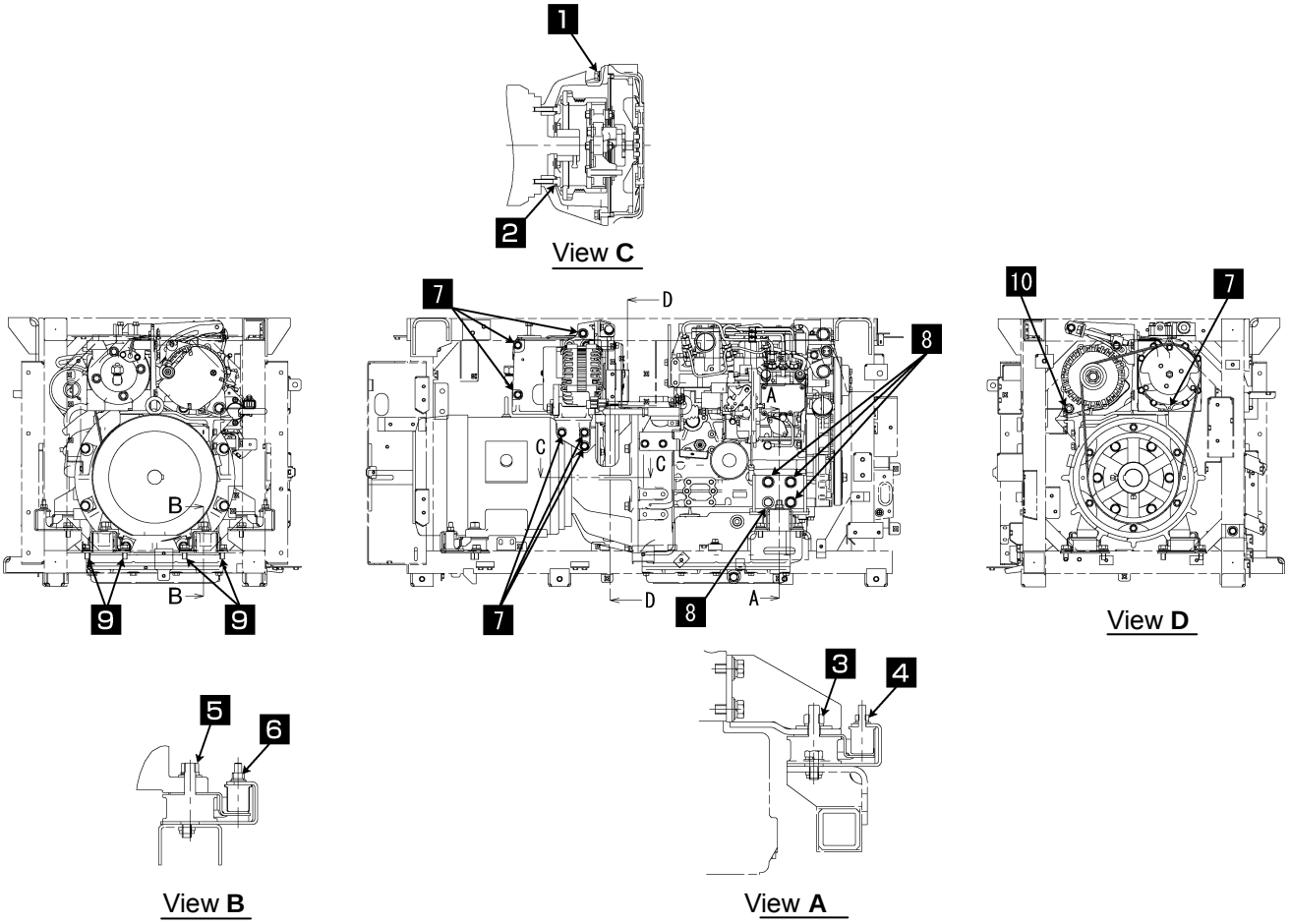
(B) Possible failure

・ Over tightening of bolts and nuts may result in break due to stretch of bolt and insufficient tightening may cause trouble or accident due to loosening.

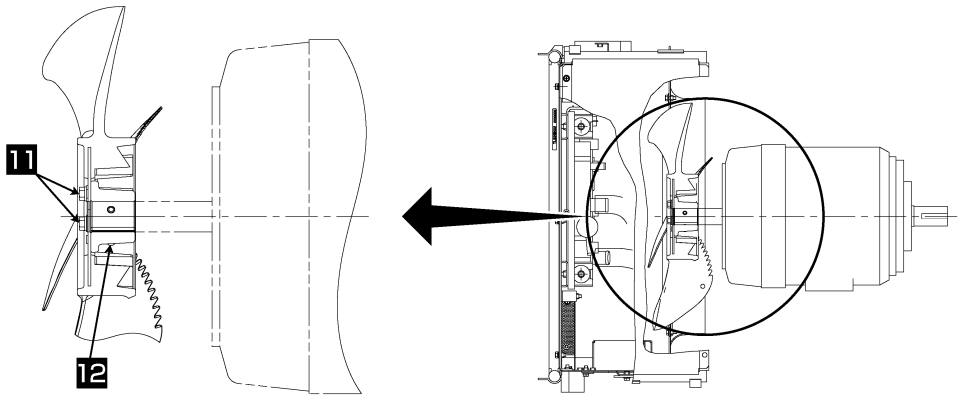
(C) Corrective action (Reference)

・ Periodically inspect bolts and nuts or similar if they are tightened at specified torque.

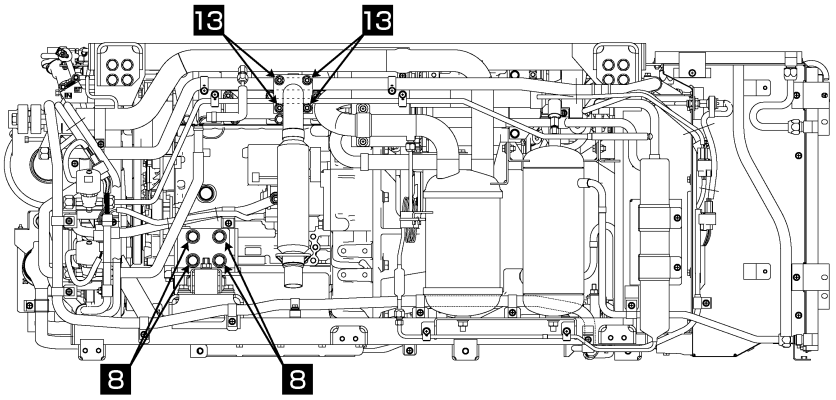
(12) Major part installation bolt inspection and retightening



Condenser and radiator



Condensing unit rear side



<Tightening torque of major parts>

No.	Name	Thread diameter	Tightening torque N·m (kgf/m)
1	Engine housing fixing bolt	M10	44.1 ± 1.6 (450 ± 14)
2	Motor housing fixing bolt	M10	44.1 ± 1.6 (450 ± 14)
3	Engine fixing nut (anti-vibration)	M12	68.6 ± 2.0 (700 ± 21)
4	Engine stopper fixing nut	M8	23.5 ± 0.7 (240 ± 7)
5	Motor fixing nut (anti-vibration)	M12	68.6 ± 2.0 (700 ± 21)
6	Motor stopper fixing nut	M8	23.5 ± 0.7 (240 ± 7)
7	Compressor bracket fixing bolt	M8	23.5 ± 0.7 (240 ± 7)
8	Engine bracket fixing bolt	M10	44.1 ± 1.6 (450 ± 14)
9	Motor bracket fixing bolt	M10	44.1 ± 1.6 (450 ± 14)
10	Alternator fixing nut	M10	44.1 ± 1.6 (450 ± 14)
11	Condenser fan fixing bolt	M8	23.5 ± 0.7 (240 ± 7)
12	Condenser fan fixing setting screw	M8	23.5 ± 0.7 (240 ± 7)
13	Exhaust pipe fixing nut	M8	17.6 ± 0.6 (180 ± 6)

(A) Precaution for service

・ Tighten by referring above table for tightening torque.

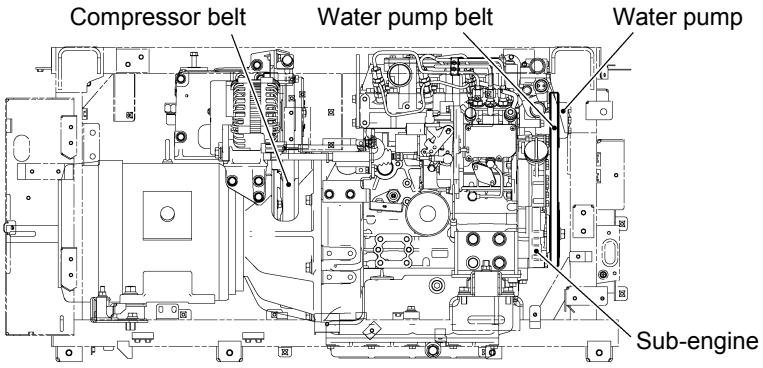
(B) Possible failure

・ Over tightening of bolts and nuts may result in break due to stretch of bolt and insufficient tightening may cause trouble or accident due to loosening.

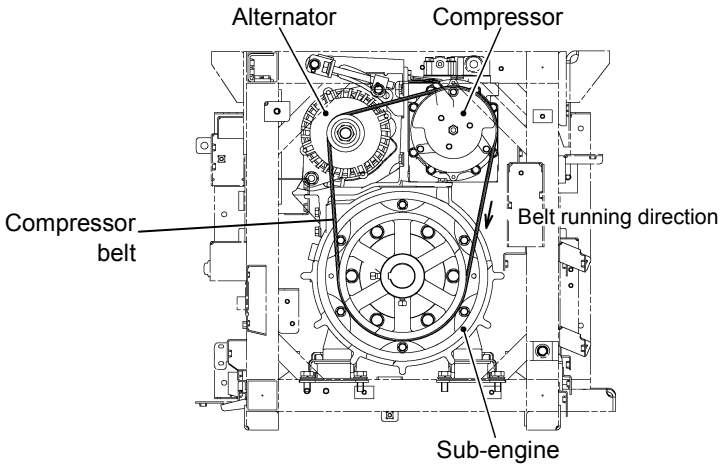
(C) Corrective action (Reference)

・ Periodically inspect bolts and nuts or similar if they are tightened at specified torque.

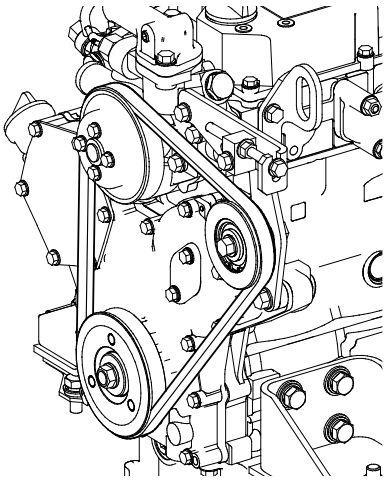
(13) Inspection of belt and groove of pulley and replacement of belt



●Detail of compressor belt



●Detail of water pump belt



(A) Precaution for service

<Inspection of slackened belt, damage on belt>

1) Inspect if compressor belt and water pump belt are not slackened. (See page 101 for tension.)
2) Visually inspect if there is any crack or one-sided wear.
3) Retighten the belt since initial elongation happens in case of new belt.

<Inspection of pulley belt groove>

1) Be sure to inspect if belt groove of pulley is not rusted if the unit is not used for long time.

(B) Possible failure

<Slackened belt, damage on belt>

- Abnormal sound
- Poor cooling due to broken belt, dead battery, and engine over heat

<Rust or wear on pulley belt groove>

- Abnormal sound due to slipping of belt, poor cooling.
- Unusual wear of belt

(C) Corrective action (Reference)

1) Be sure to turn off the main switch before working for inspection.

<Slackened belt, damage on belt>

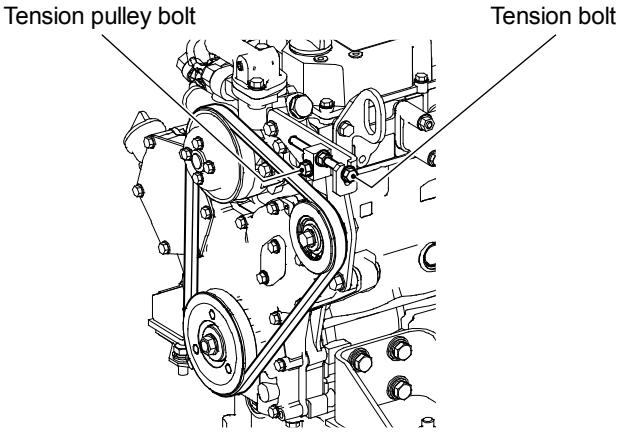
- Retighten the belt if it is slackened.
- Replace the belt if damage or crack is found.

<Rust or wear on pulley>

- Remove the rust by wire blush or the like if there is rust on the pulley.
- Replace the pulley if it is worn significantly.

<Belt tension inspection and belt replacement procedure>

1) Water pump belt

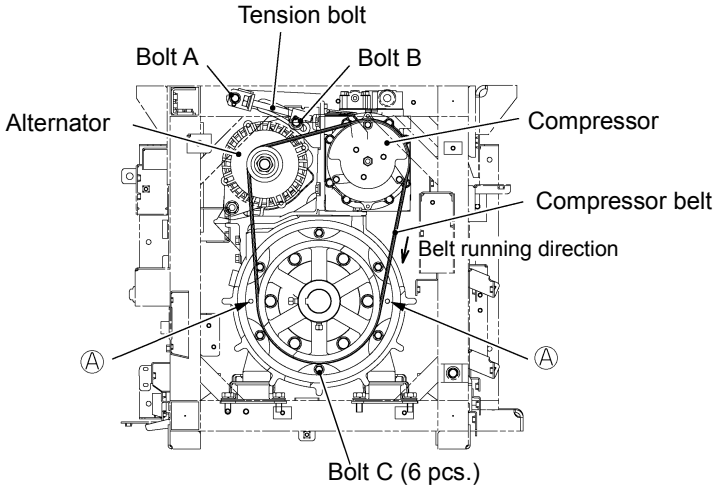


a) Remove side panel and check the tension of the belt by tension gauge.
For new belt: 500 ± 100 N, for retighten: 350 ± 50 N

b) If the tension is not correct, loosen the tension pulley bolt, and adjust the tension to the above specified value by turning the tension bolt.

c) When replacing the belt, loosen the tension pulley bolt and the tension bolt, and adjust the tension according to the procedure b) above after replacing the belt.

2) Compressor belt

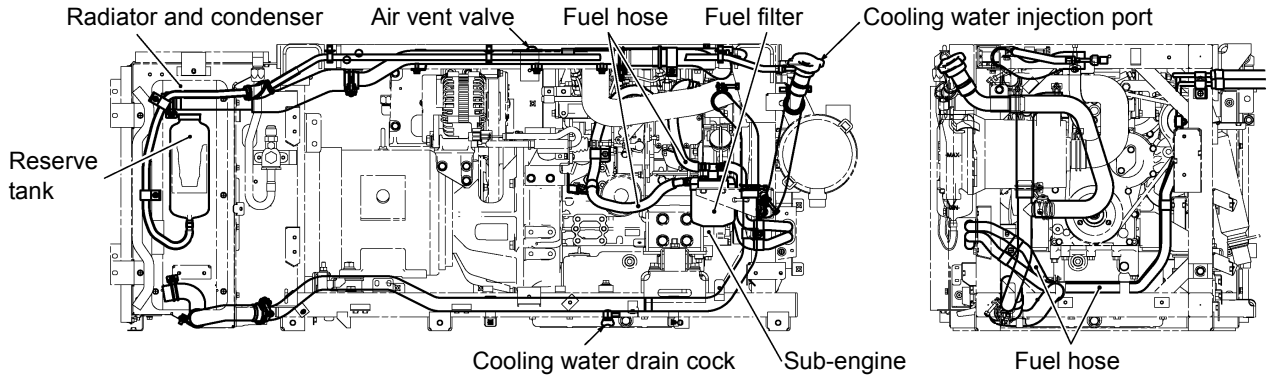


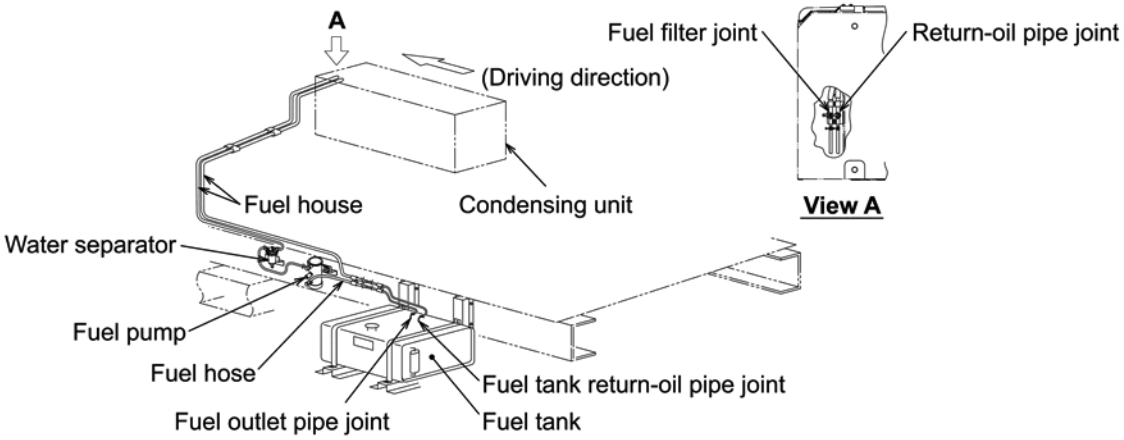
a) Check the tension of the belt by tension gauge.
For new belt: 800 ± 100 N, for retighten: 560 ± 50 N

b) If the tension is not correct, loosen bolts A and B (M8 bolt) and adjust tension using tension bolt.

c) When replacing the belt, loosen bolts A and B (M8 bolt), remove 6 pieces of bolt C (M8), separate the pulley by turning push bolts (M8) into 2 places at (A), and replace the belt through the gap of pulleys.
Adjust the tension according to the procedure b) above after replacing the belt.

(14) Inspection of fuel leakage and cooling water leakage





(A) Precaution for service

<Fuel leakage>

1) Try early detection of fuel leakage by checking entire sub-engine at inspection since fuel leakage could happen at the connection of fuel hose, fuel filter and fuel pump, etc.

<Cooling water leakage>

1) Check if there is no leakage of cooling water from the tank, water hoses, pipes or connecting parts.

(B) Possible failure

<Fuel leakage>

- Increase of fuel consumption
- Abnormal engine stop due to air injection into fuel
- Fire by fuel ・ environmental destruction

<Cooling water leakage>

- Over heat (Decrease of rotation speed and output power)
- Seizure of sliding portion such as crank shaft, piston, etc.
- Abnormal stop of refrigeration unit

(C) Corrective action (Reference)

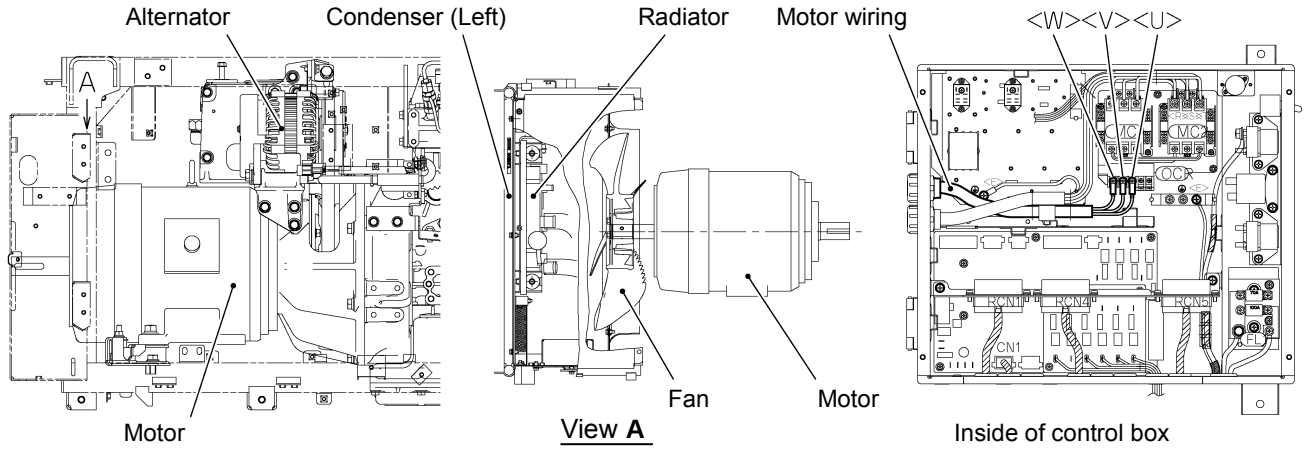
<Fuel leakage>

- Repair the place where fuel leaks.
- Retighten when hose band is loosened.
- Replace fuel hose at every 9000 hours of operation.

<Cooling water leakage>

- Inspect and replenish cooling water.
- Repair where cooling water leaks. Retighten when hose cramp is loosened.
- Replace water hose at every 9000 hours of operation.

(15) Confirmation of motor drive operation and replacement of motor



(A) Precaution for service

1) Connect power plug to the power source and operate the unit with motor drive mode.
2) Confirm that the motor stops when the temperature reaches to the set temperature at automatic start/stop operation. (Thermo OFF)
3) Confirm that the motor restarts when the inside container temperature goes up or down. (Thermo ON)

(B) Possible failure

- Poor operation of motor
- Breaking of wire
- Poor contact of wire

(C) Corrective action (Reference)

- Inspect conditions of power supply such as on or off of the power breaker in the building.
- Correct if there is breaking of wire or poor contact of wire.
- Replace if there is any faulty relays and so on.
- Replace motor if it is faulty.

<Motor replacing method>

a) Uninstall the condensing unit from the vehicle body.
(Be sure to uninstall after refrigerant recovery. See page 122.)
b) Remove the compressor and the alternator.
c) Remove the condenser (left) and the radiator. Remove the fan from the condenser.
d) Remove the wiring connecting the motor and separate motor from the engine. Pull out the motor to the left and replace.
Support the engine and the motor by pieces of timber or the like when separating.

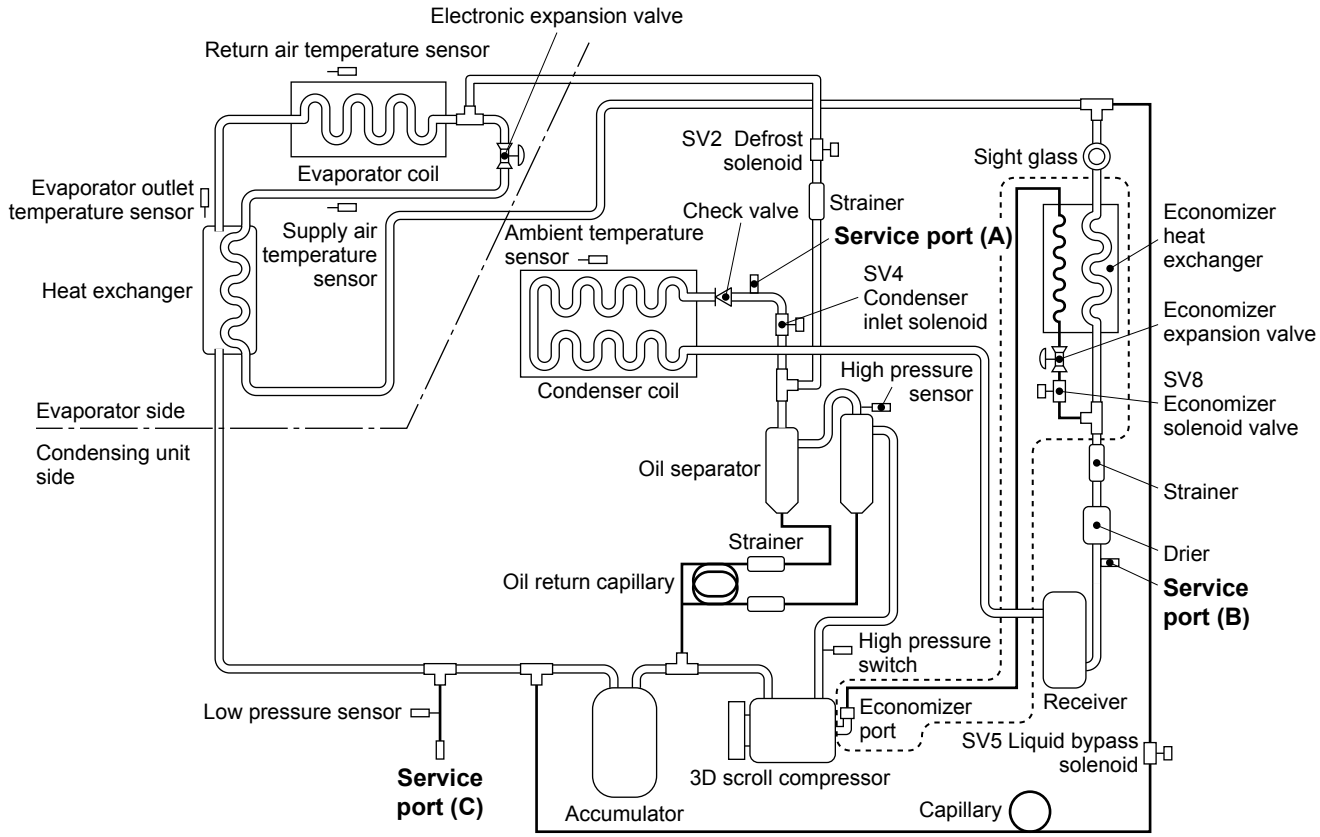
⚠ CAUTION

⚠ Confirm the arrangement of U, V and W when connecting the motor wiring.
※ Otherwise, it may cause damage of the compressor by a reversal.

(16) Cooling inspection (Temperature indication on the display, inspection of high/ low pressure, inspection of thermostat operation)

(A) Precaution for service

1) Install gauge manifold on the service valves (at service ports (A) and (C)) and compare the gauge pressure with the pressure indicated on the cabin controller (See page 57).



Note: - - - - shows economizer cycle for TU1250SAE.

2) Confirm if the pressure is normal by referring to the standard operating pressure. (See page 123.)
3) Investigate the temperature and resistance value of the temperature sensor. (See pages 31 and 32.)
4) Investigate temperature change by starting the engine.
5) Change the operation mode to auto start/stop and confirm if the engine stops when the setting temperature is achieved. (See page 49.)
6) After confirming the stop of the engine, change the setting temperature and confirm if the engine starts up again.

(B) Possible failure

- Abnormal temperature indication
- Abnormal pressure

(C) Corrective action (Reference)

- Replace the temperature sensor if it is faulty.
- Replace the pressure sensor if it is faulty.
- Clean the condenser coil if it is dirty.
- Replace the compressor if the compression is poor.

(17) Inspection of defrost operation

(A) Precaution for service

1) Lower inside container temperature to 0°C.
2) Turn on manual defrost switch.
3) Confirm that "**Defrost**" turns on in the cabin controller display screen.
4) Confirm that the evaporator outlet temperature increases. (It is abnormal if it decreases significantly.)
5) Confirm the draining of water from the drain hose.
6) Confirm that the evaporator outlet temperature at the end of defrost is normal, and that the temperature decreases after the end of defrost. (Normal temperature at the end of defrost: 25 ± 1.5°C)

(B) Possible failure

- Defrost function does not operate due to defective evaporator outlet temperature sensor (EVT).
- Defrost function does not operate due to defective defrost timer counting.
- Defrost operation is terminated compulsory at 30 minutes (maximum defrosting time) before the evaporator outlet temperature reaches to 25°C due to shortage of refrigerant circulation caused by defective solenoid valve.

(C) Corrective action (Reference)

- Replace the evaporator outlet temperature sensor (EVT) if it is faulty.
- Replace the main circuit board if it is faulty.
- Replace the defrost solenoid valve (SV2) if it is faulty.

(18) Inspection of battery

(A) Precaution for service

1) Check if there is any crack or leakage of liquid from battery body and inspect mounting condition.
2) Confirm that the liquid level is between the upper and lower lines.
3) Confirm that the battery voltage is over 12.6 V.
4) Measure the specific gravity of the liquid and confirm it is over 1.25. Compensate the specific gravity by the following equation since it varies by liquid temperature.
   Specific gravity = measured specific gravity + 0.0007 * (liquid temperature – 20°C)

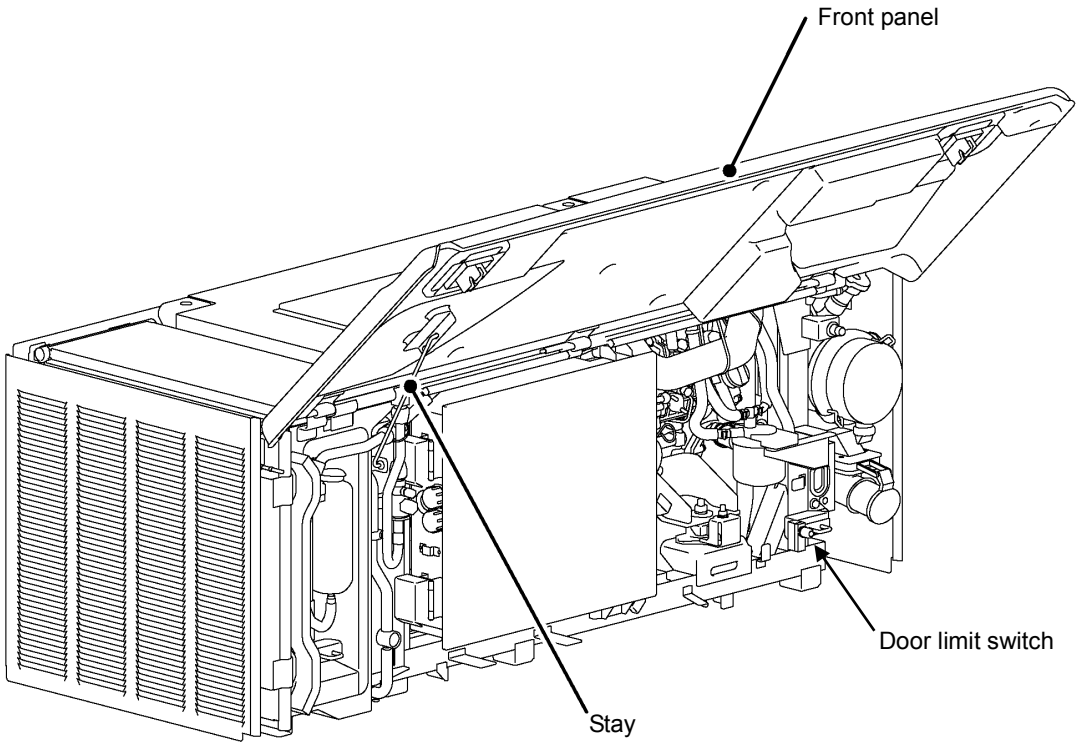
(B) Possible failure

- Dead battery
- Poor start up

(C) Corrective action (Reference)

- Replenish battery liquid if it is short.
- Replace the battery if it is faulty.

(19) Inspection of front panel opening switch (door limit switch) operation



(A) Precaution for service

・ Confirm that the abnormal display ⚠ flickers, and that the alarm code "E030" (Unit panel not close) is displayed, and that the unit will not start if it is operated with the front panel opened.

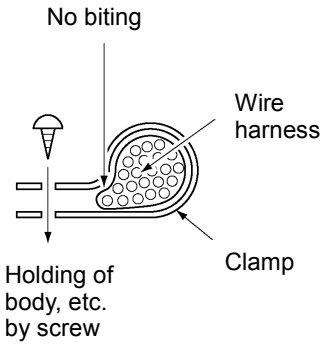
(B) Possible failure

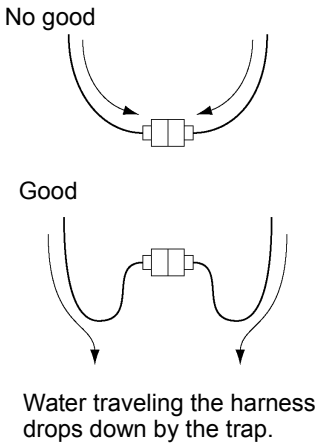
・ There is a danger of injury with rotating objects.

(C) Corrective action (Reference)

・ Repair or replace the switch if the unit does not stop with emergency.

(20) Inspection of loosening electric wiring terminal, sheath and damage





(A) Precaution for service

1) When starting the inspection or servicing of the electric wiring, disconnect the battery (-) terminal.
2) Check the electric wiring for interference with any vibratory object on the way. Also, make sure that the wiring should not be slid or pulled out when pulled lightly.
3) Make sure that the connector is inserted securely until it makes “click” sound.
4) Make sure that the tip of the clamp does not bite the wire harness or crush it. Also, check if the cables are clamped at the appropriate intervals.

Harness diameter	Interval of clamp
Less than ø 5	Less than 300 mm
ø 5 ~ ø 10	Approximately 400 mm
ø 10 ~ ø 20	Approximately 500 mm

5) Make sure that a trap is set up at the connector where rain water is expected to splash such as at under the floor so as to prevent water drop from entering.
6) Be sure to inspect starter harness and battery harness without fail.

(B) Possible failure

- Cable sheath may be subjected to damage or fire.
- Interference with other equipment.
- Broken wire and poor contact.
- Defective contact or broken wire due to generation of rust.
- Unit may be subjected to fire owing to heating and firing caused by increase of the contact resistance.
- The connector may be removed by vibration.

(C) Corrective action (Reference)

- Verify that the battery terminal is certainly disconnected.
- Replace the cables if damaged.
- Avoid placing the wiring near the engine exhaust pipe and high pressure piping.
- Clamp cable securely.

(21) Inspection of motor insulation resistance

(A) Precaution for service

1) Disconnect power supply plug and remove the motor cables from the breaker.
2) Measure the resistance by megohmmeter.

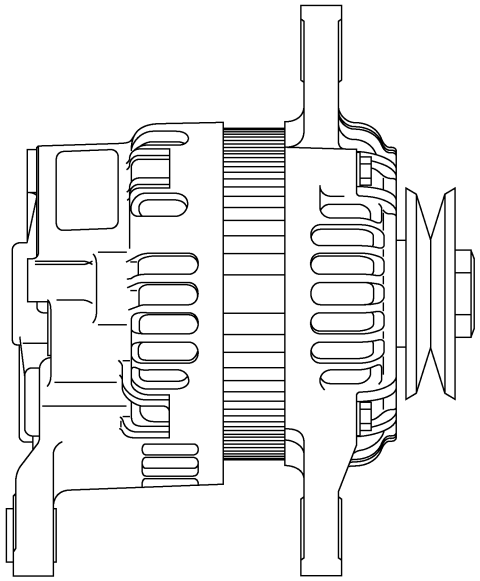
(B) Possible failure

・ The electric motor does not rotate.

(C) Corrective action (Reference)

・ Replace the motor if it is faulty. (See page 103 for replacing method.)

(22) Inspection and replacement of alternator



(A) Precaution for service

1) Measure the charging current by using a clamp meter.
2) Replace the alternator if abnormal sound or abnormal heating is observed.

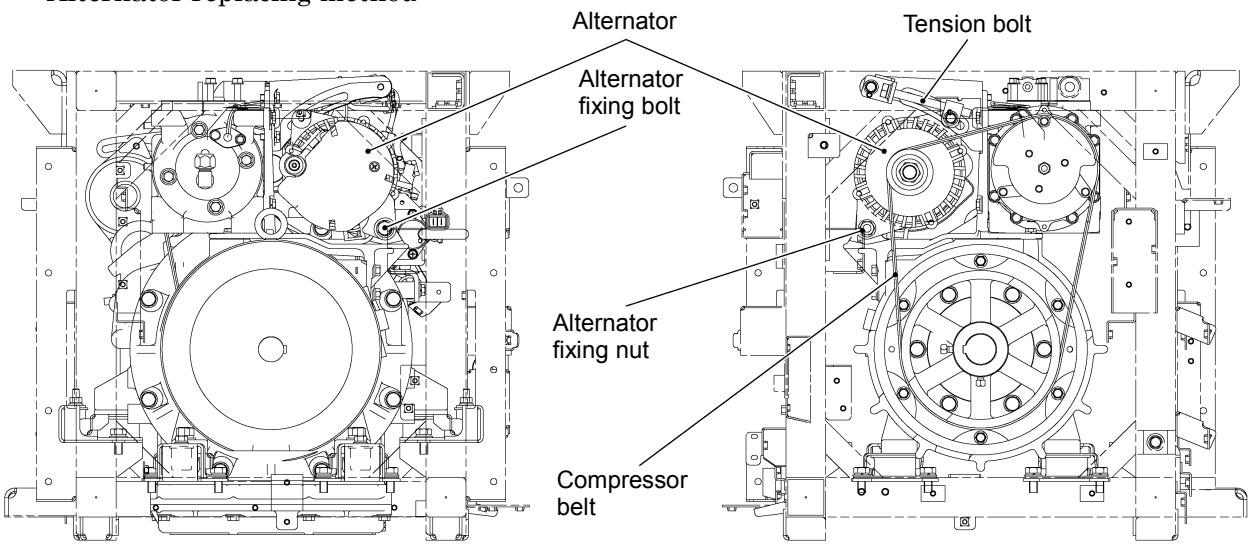
(B) Possible failure

・ Slipping sound of belt.
・ Poor charging.

(C) Corrective action (Reference)

・ Repair if broken wire or poor contact is found.
・ Replace the alternator if it is defective.

<Alternator replacing method>



(A) Precaution for service

1) Be sure to disconnect the battery terminal. (When leaving battery unconnected for more than 3 hours, the built-in clock of the controller starts to delay. Reset the calendar after servicing.)
2) Remove the alternator cable.
3) Loosen tension bolt, remove the alternator fixing bolts and replace the alternator.
4) Check the tension of the compressor belt after replacement. (See page 101.) Confirm that the alternator fixing nut is tightened with specified torque, and check the charging current and output voltage.

(B) Possible failure

- Dead battery.
- Poor start up.

(23) Cleaning of condenser coil, radiator coil, evaporator coil and drain port

(A) Precaution for service

1) The coils should be washed with tapped water by using brush or cleaned with air by blowing dust, because the fins of the coils will be possibly deformed by pressurized water poured directly.
2) Check if the water gushes out from the drain hose.

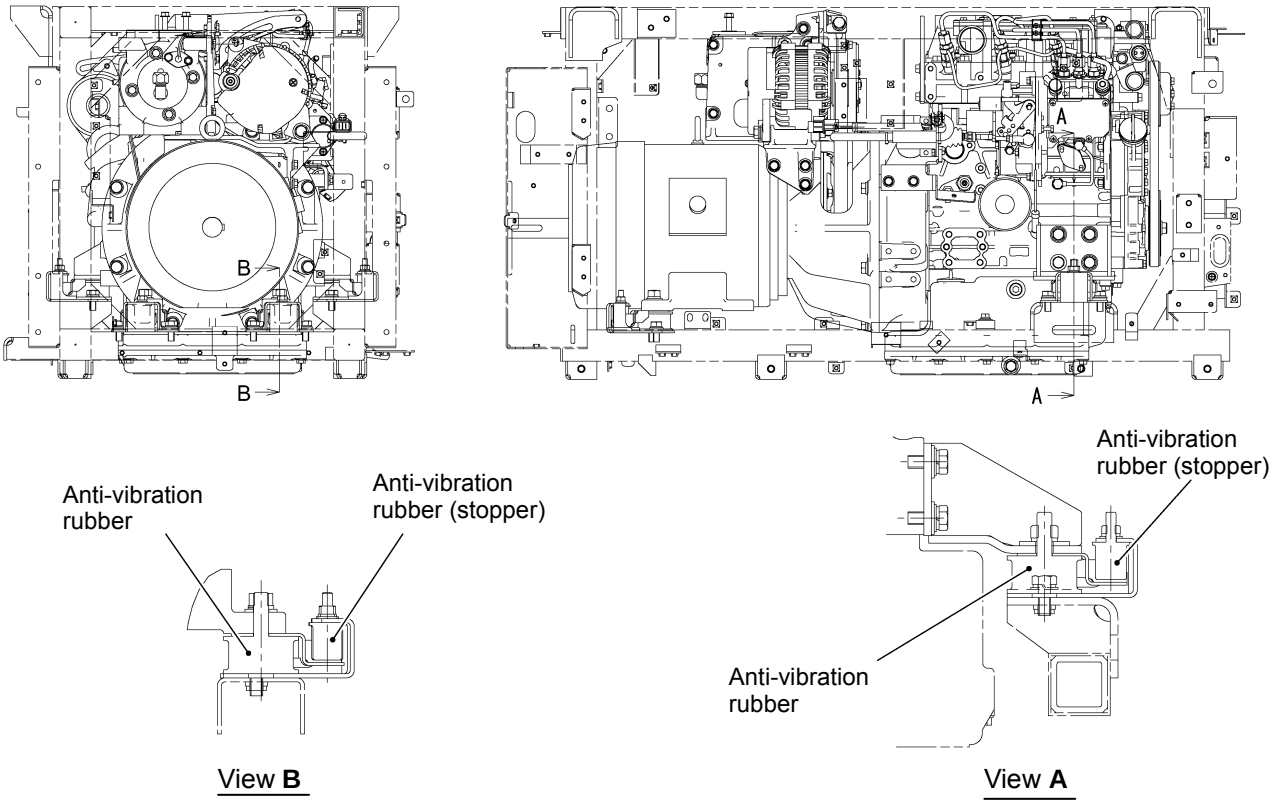
(B) Possible failure

- High pressure abnormal or drop of refrigeration capacity due to dirty condenser coil.
- Engine overheat due to dirty radiator coil.
- Drop of refrigeration capacity due to dirty evaporator coil.
- Flowing in of drain water into the container due to clogging of drain hose.

(C) Corrective action (Reference)

- Execute priority cleaning at every 3000 hours.

(24) Inspection of damage on cushion rubber (crack, break), removal of engine



(A) Precaution for service

1) Check if there is any crack, deformation or break on the anti-vibration rubber.

(B) Possible failure

- Abnormal sound
- Drop off of engine
- Unusual vibration
- Crack of piping
- Short circuit due to contact of wiring

(C) Corrective action (Reference)

- Replace the anti-vibration rubber if damaged. (See page 103 for motor replacing method.)

<Engine installation method>

a) Uninstall the condensing unit from the vehicle body.
(Be sure to uninstall after refrigerant recovery. See page 122.)

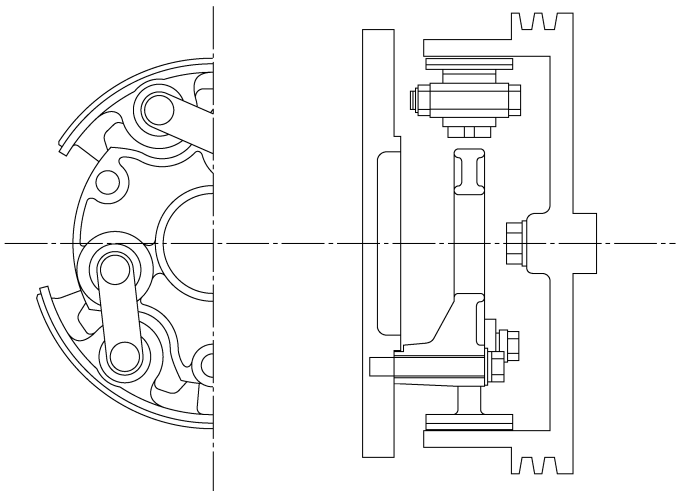
b) Remove the compressor and the alternator.

c) Remove the fan from the condenser and separate the motor from the engine, shift the motor to the left.
Support the engine and the motor by pieces of timber or the like when separating.

d) Remove the exhaust pipe, fuel hose, cooling water hose and wiring connecting the engine.

e) Remove the frame on the upper part of the unit and take down the engine from the unit by using a sling.

(25) Replacement of centrifugal clutch shoe



(A) Precaution for service

1) Uninstall the condensing unit from the vehicle body.
   (Be sure to uninstall after refrigerant recovery. See page 122.)
2) Remove the compressor and the alternator.
3) Remove the fan from the condenser and separate the motor from the engine, shift the motor to the left.
   Support the engine and the motor by pieces of timber or the like when separating.
4) Replace the shoe of the centrifugal clutch.

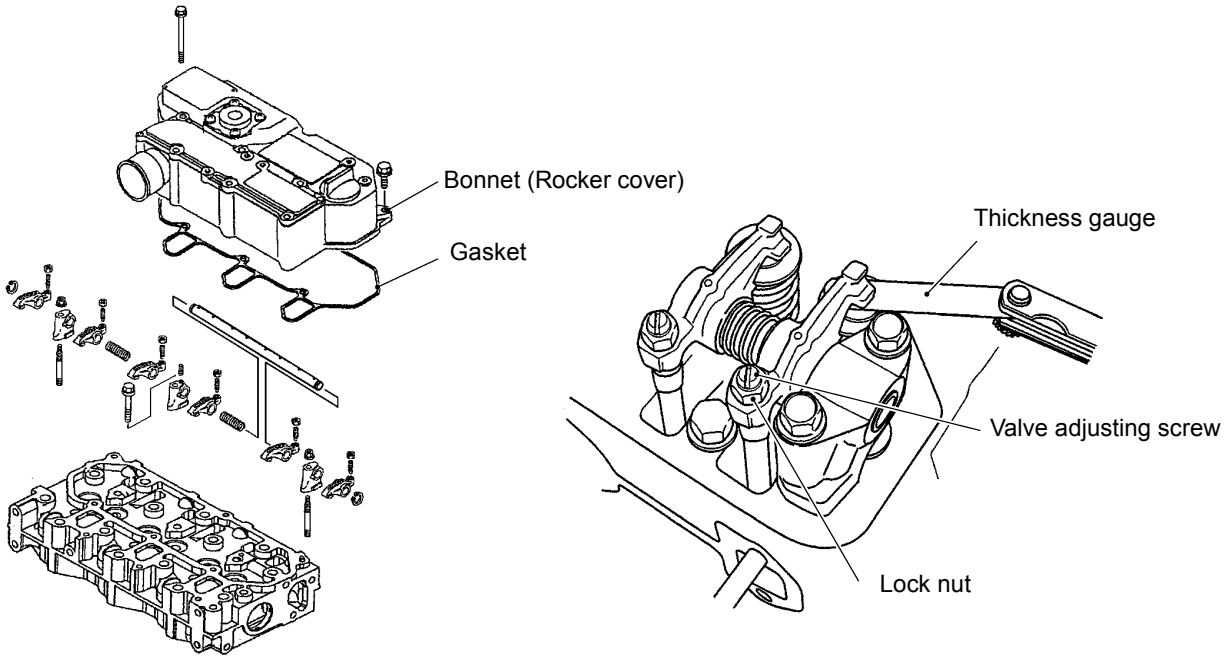
(B) Possible failure

- Slipping of clutch
- Belt burning
- Abnormal sound

(C) Corrective action (Reference)

- Replace at every 9000 hours.

(26) Inspection of valve clearance



(A) Precaution for service

1) Uninstall the condensing unit from the vehicle body.
   (Be sure to uninstall after refrigerant recovery. See page 122.)
2) Remove the upper cover of the unit and remove the bonnet (rocker cover) of the engine.
3) Insert a thickness gauge into the gap between the rocker arm and the valve cap of each cylinder at the point of top dead center and confirm that the valve clearance is in the specified value.
   Specified valve clearance: 0.15 ~ 0.25 mm
4) If it is out of specified value and in case the adjustment is necessary, adjust the clearance with the valve adjusting screw of the rocker arm and the lock nut.
5) Replace the gasket with new one after adjustment.

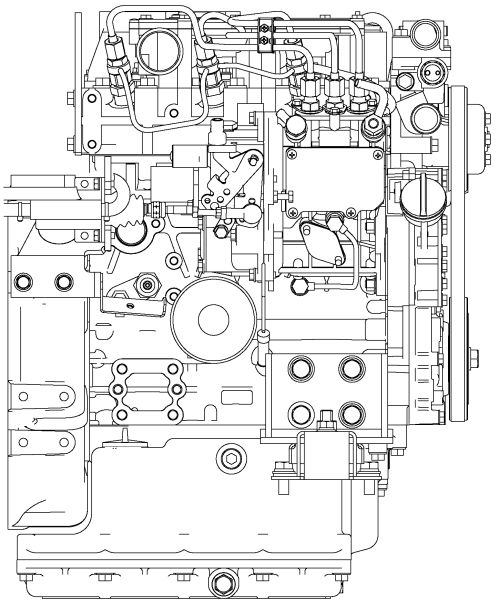
(B) Possible failure

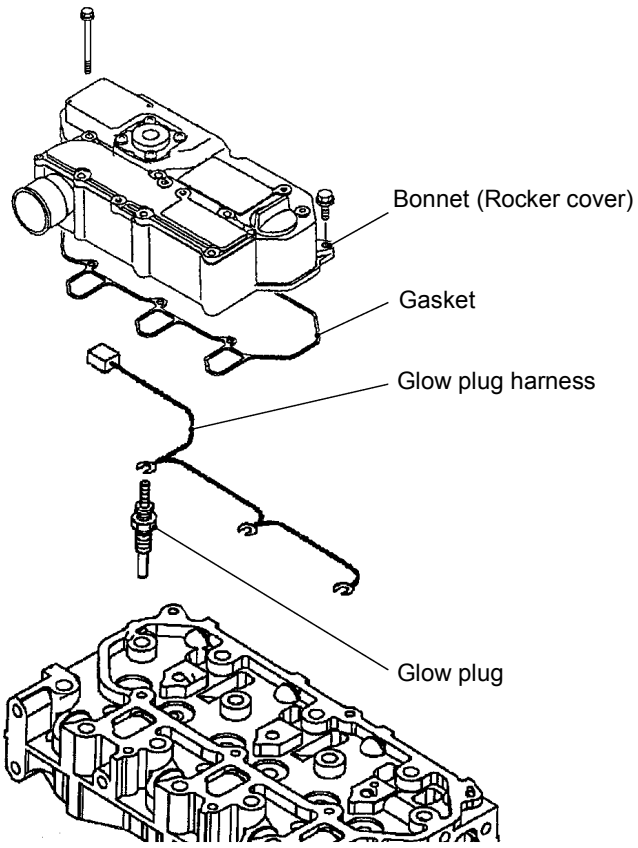
- Poor engine start up
- Insufficient engine output power
- Abnormal sound

(C) Corrective action (Reference)

- Work by referring the engine service manual OBTNV-J00201.
- Inspect at every 9000 hours.

(27) Replacement of glow plug





(A) Precaution for service

1) Uninstall the condensing unit from the vehicle body.
   (Be sure to uninstall after refrigerant recovery. See page 122.)
2) Remove the upper cover of the unit and remove the bonnet (rocker cover) of the engine.
3) Remove the glow plug harness and the glow plug from the cylinder head and replace the glow plug.
   Also, discard the old gasket and replace with new one.
4) After replacement, check if the glow plug is working with a clamp meter.

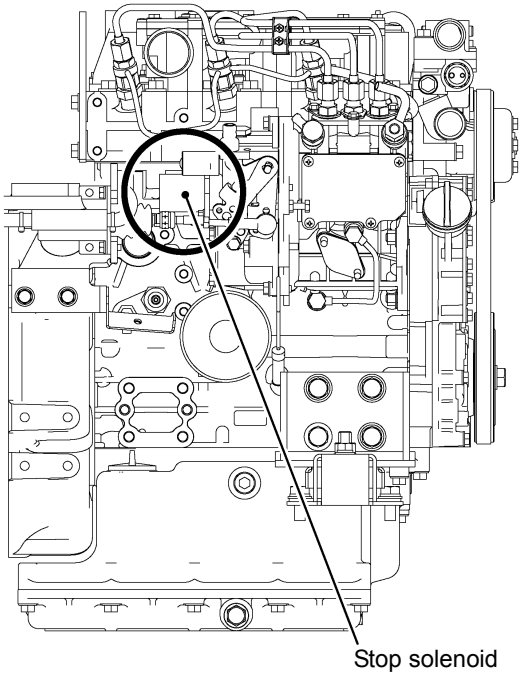
(B) Possible failure

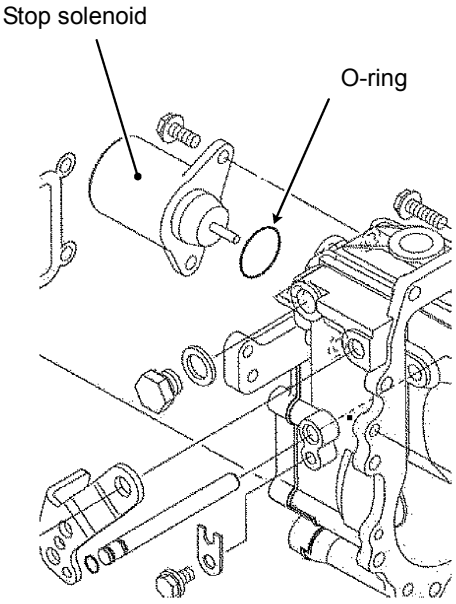
・ Poor engine start up at the cold region.

(C) Corrective action (Reference)

・ Replace at every 9000 hours (or 30000 times).

(28) Replacement of engine stop solenoid





(A) Precaution for service

1) Loosen the stop solenoid fixing bolt and remove the wiring.
2) Replace the stop solenoid and the O-ring.
3) Fix the stop solenoid with bolts and restore the wiring.
   Be careful not to bite the O-ring when installing.
   Also, install the stop solenoid firmly to avoid causing oil leakage.
4) After starting the engine, confirm that the engine stops.

(B) Possible failure

- Poor engine start up
- Poor engine stop

(C) Corrective action (Reference)

- Replace at every 9000 hours (or 30000 times).

(29) Sub-engine overhaul

(A) Precaution for service

1) Uninstall the engine by referring the engine installation procedure. (See page 111.)
2) Execute overhaul of the injection pump, injection nozzle, etc. by referring the engine service manual OBTNV-J00201.
3) After the overhaul, check the amount of engine oil and cooling water before starting the engine. Also, after the reinstallation of the engine, confirm the tightening of bolts, nuts and the like and adjust the belt tension.

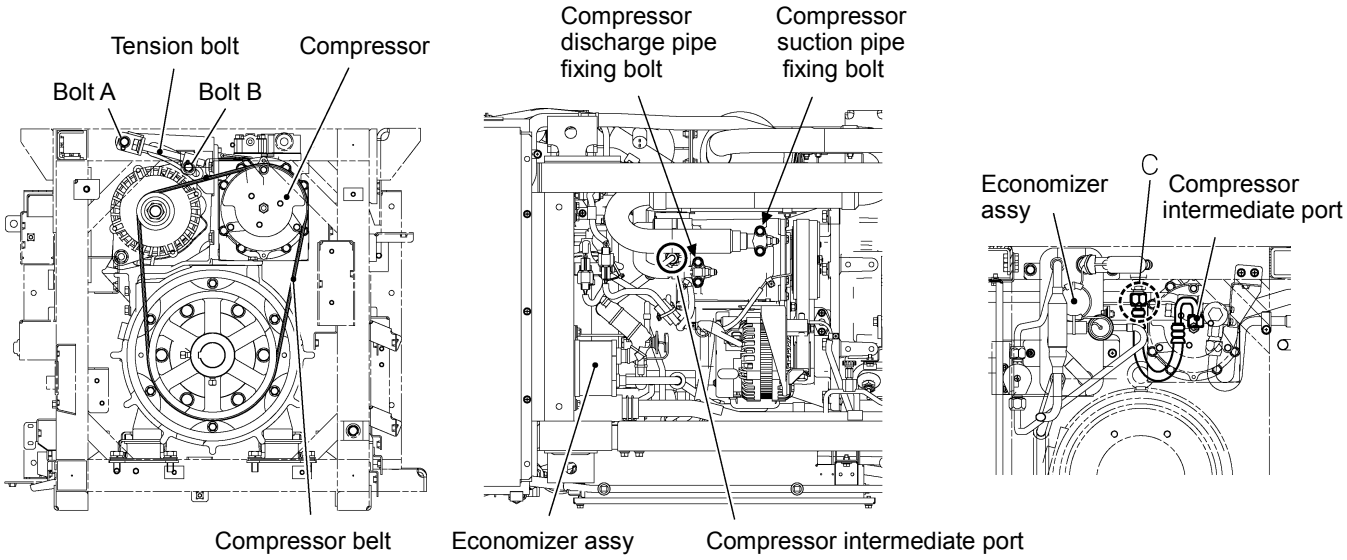
(B) Possible failure

- Poor engine start up
- Excessive consumption of engine oil
- Abnormal drop of engine revolution
- Lot of black smoke or white smoke

(C) Corrective action (Reference)

- Execute the overhaul of sub-engine at every 9000 hours.

(30) Replacement of compressor



(A) Precaution for service

1) Loosen the bolts A, B and the tension bolt, and remove the compressor belt from the alternator and the compressor.
2) Remove the fixing bolts for compressor discharge and suction pipes at the fitting, and remove the economizer piping at the place C between the compressor intermediate port and the economizer assy.
3) Remove the harnesses for Td sensor, compressor magnet clutch and alternator.
4) Remove the alternator, remove the compressor bracket fixing bolts, and uninstall the compressor along with its bracket.
5) After the replacement of the compressor, replace the gasket at the fitting with the new one.

(B) Possible failure

- Poor cooling
- Poor compression
- Compressor lock

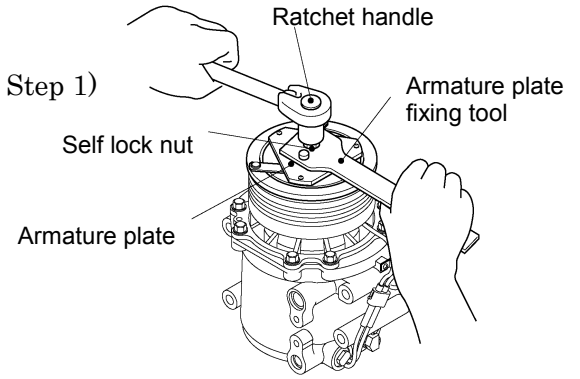
(C) Corrective action (Reference)

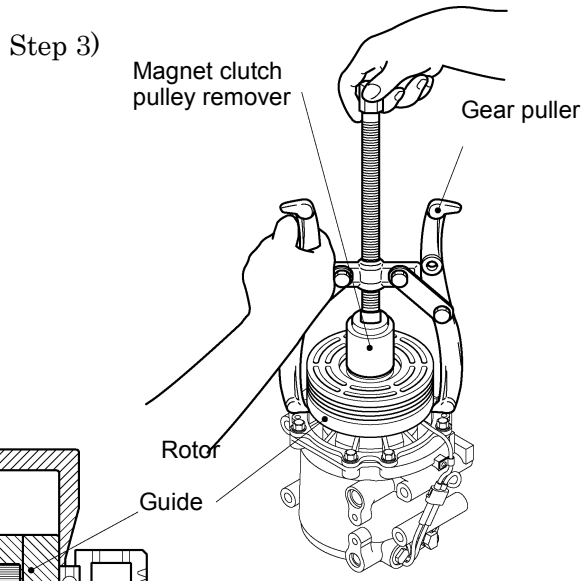
- While replacing the compressor, measure the weight of the removed compressor and the new compressor and adjust the oil in the new compressor so that the oil amount inside the refrigeration cycle will not be excessive.
- After the replacement of the compressor, adjust the tension of the compressor belt.

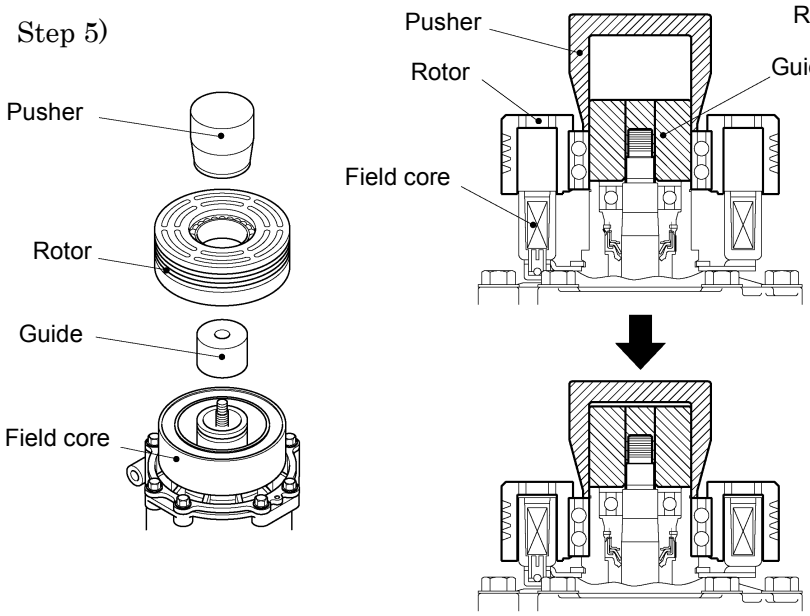
(31) Replacement of compressor magnet clutch

(A) Precaution for service

1) After un-installation of the compressor, remove the self lock nut by using the armature plate fixing tool.
2) Remove the armature plate, and remove the shim and the snap ring.
3) Remove the rotor by using the magnet clutch remover and the gear puller.
   Note: Be sure to use the clutch remover so as to avoid possibility of damaging the compressor by placing the push rod of the gear puller directly to the compressor shaft.
4) Remove the field core fixing clamp and the snap ring, and remove the field core.
5) Reassemble the clutch with the reverse order. However, use the pusher and the guide while assembling the rotor.
   Note: Insert the rotor vertically to the nose.
   Also, push the inner race of the rotor bearing slowly in case of using the pusher.







6) After fixing the armature plate by the self lock nut, confirm that the air gap between the armature and the rotor is 0.3 ~ 0.5 mm. If it is not, adjust the gap by using shim(s).

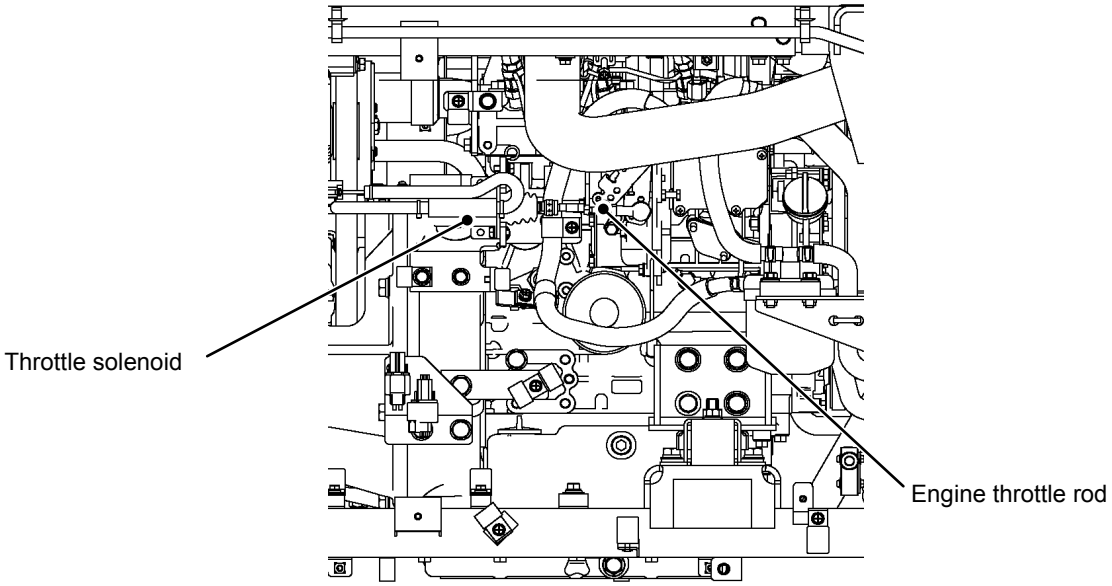
(B) Possible failure

- Clutch lock
- Abnormal sound

(C) Corrective action (Reference)

- Prepare the special tool for magnet clutch described in Section 14 for servicing.

(32) Replacement of throttle solenoid



(A) Precaution for service

1) Remove the engine throttle rod (adjusting rod) and remove the wiring and fixing bolts.
2) Replace the throttle solenoid.
3) Fix the bolts and restore the wiring.
4) Fix the engine throttle rod.
5) Start the engine and adjust the rotation speed. (See page 86.)

(B) Possible failure

- Poor cooling
- Rotation speed down
- Rotation speed up

(C) Corrective action (Reference)

- Be sure to adjust the rotation speed after replacement.
- Replace at every 9000 hours.

9.6 List of flare nut and bolt tightening torque

(1) Flare nut standard tightening torque

Copper Tube	Tightening Torque N·m (kgf·m)
ø6.35	16 ± 2 (1.6 ± 0.2)
ø9.52	38 ± 4 (3.8 ± 0.4)
ø12.7	55 ± 6 (5.5 ± 0.6)
ø15.88	75 ± 7 (7.5 ± 0.7)
ø19.05	110 ± 10 (11.0 ± 1.0)

(2) General bolts tightening torque

N·m (kgf·m)

Material / Thread Diameter / Head Mark	SS400 None or 4	S45C △ or 7	SUS304 None
M3	0.8 ± 0.2 (0.08 ± 0.02)	1.15 ± 0.35 (0.12 ± 0.04)	0.9 ± 0.1 (0.09 ± 0.01)
M4	1.25 ± 0.25 (0.13 ± 0.03)	2.0 ± 0.5 (0.20 ± 0.05)	2.16 ± 0.25 (0.22 ± 0.03)
M5	2.16 ± 0.25 (0.22 ± 0.03)	3.9 ± 0.5 (0.40 ± 0.05)	3.9 ± 0.5 (0.40 ± 0.05)
M6	3.95 ± 0.45 (0.40 ± 0.05)	7.1 ± 0.7 (0.72 ± 0.07)	7.1 ± 0.7 (0.72 ± 0.07)
M8	9.1 ± 0.7 (0.93 ± 0.07)	17.2 ± 1.5 (1.76 ± 0.15)	17.7 ± 1.5 (1.81 ± 0.15)
M10	18.3 ± 1.3 (1.87 ± 0.13)	34.4 ± 3.0 (3.51 ± 0.31)	35.6 ± 2.7 (3.63 ± 0.28)
M12	31.3 ± 2.1 (3.19 ± 0.21)	58.8 ±4.9 (6.00 ± 0.50)	61.1 ± 4.7 (6.23 ± 0.48)
M14	50.0 ± 3.4 (5.10 ± 0.35)	94.7 ± 7.4 (9.66 ± 0.76)	98.1 ± 7.4 (10.01 ± 0.76)
M16	78.9 ± 5.4 (8.05 ± 0.55)	149.1 ± 11.8 (15.21 ± 1.20)	154.2 ± 11.5 (15.73 ± 1.17)

9.7 Grease and oils

		Oil, Antifreeze coolant	Capacity
Sub-engine fuel		Light oil (Diesel fuel) (Intense cold season: Cold weather fuel)	—
Sub-engine oil		API CE or higher 10W-30 (Intense cold season: SAE 10W)	9.5 liter
Refrigeration machine oil		JXTG Nippon Oil & Energy Corporation Diamond Freeze MA32R	2-tier oil separator specification: 1.25 liter
Cooling water	* Antifreeze coolant	Fuso Diesel Long Life Coolant	4.6 liter (including reserve tank)
	Water	Soft water with fewer impurities	

* Use the antifreeze coolant with the following concentration according to the lowest outdoor temperature.

Antifreeze coolant concentration (%wt)	30	35	40	45	50	55	60
Mixed antifreeze coolant amount (L)	1.4	1.6	1.8	2.1	2.3	2.5	2.8
Lowest outdoor temperature (°C)	-10	-15	-20	-25	-30	-35	-40

At shipping from the factory: Antifreeze coolant concentration is 50%wt.

Notice

- Adjust the concentration of the antifreeze coolant according to the lowest outdoor temperature. The radiator and the engine will be damaged due to frozen cooling water if the concentration is not sufficient.
- Cooling water is the industrial waste. When disposing, observe and follow the regulations in each country regarding the disposal of industrial waste.

9.8 Power supply facility

(50Hz)

Specification of power supply (for motor drive)					
Power supply capacity (kVA)	Rated capacity (A)		Voltage fluctuation	Voltage drop at start up	Inter phase unbalance
	Hand switch	Over current breaker			
20	50	50	± 10% of rated voltage	± 15% of rated voltage	Within 3%

9.9 Method of refrigerant recovery, evacuation and refrigerant charging

(1) Refrigerant recovery･evacuation

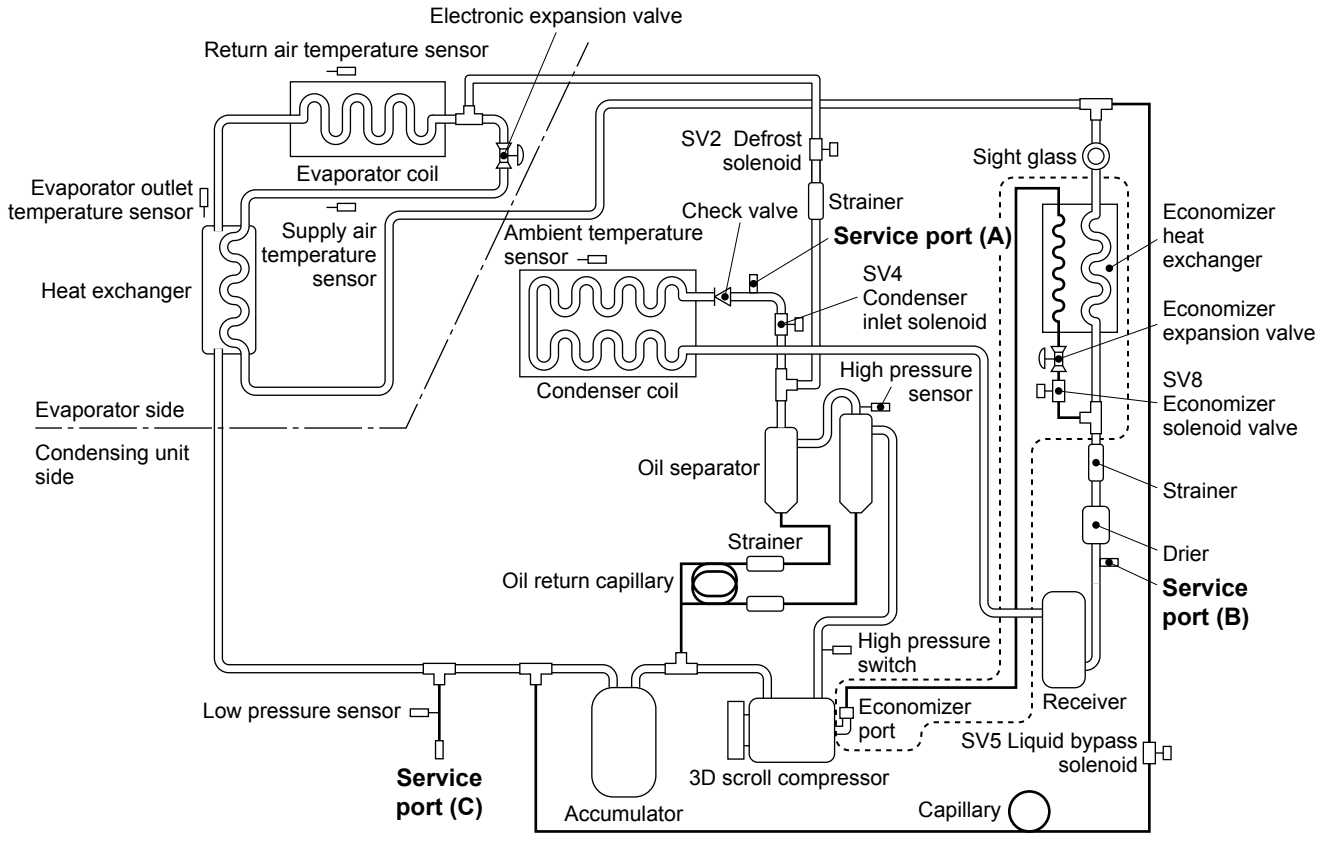
Connect high pressure side of gauge manifold to service ports (A) and (B) by using a tee, and connect low pressure side to service port (C). Recover the refrigerant and evacuate system simultaneously from the 3 places.

(2) Refrigerant charge

Measure the specified quantity of liquid refrigerant and charge from service ports (A) and (B).
When the specified quantity of refrigerant cannot be charged, run the unit and charge the remaining refrigerant gradually from service port (C).

⚠ CAUTION

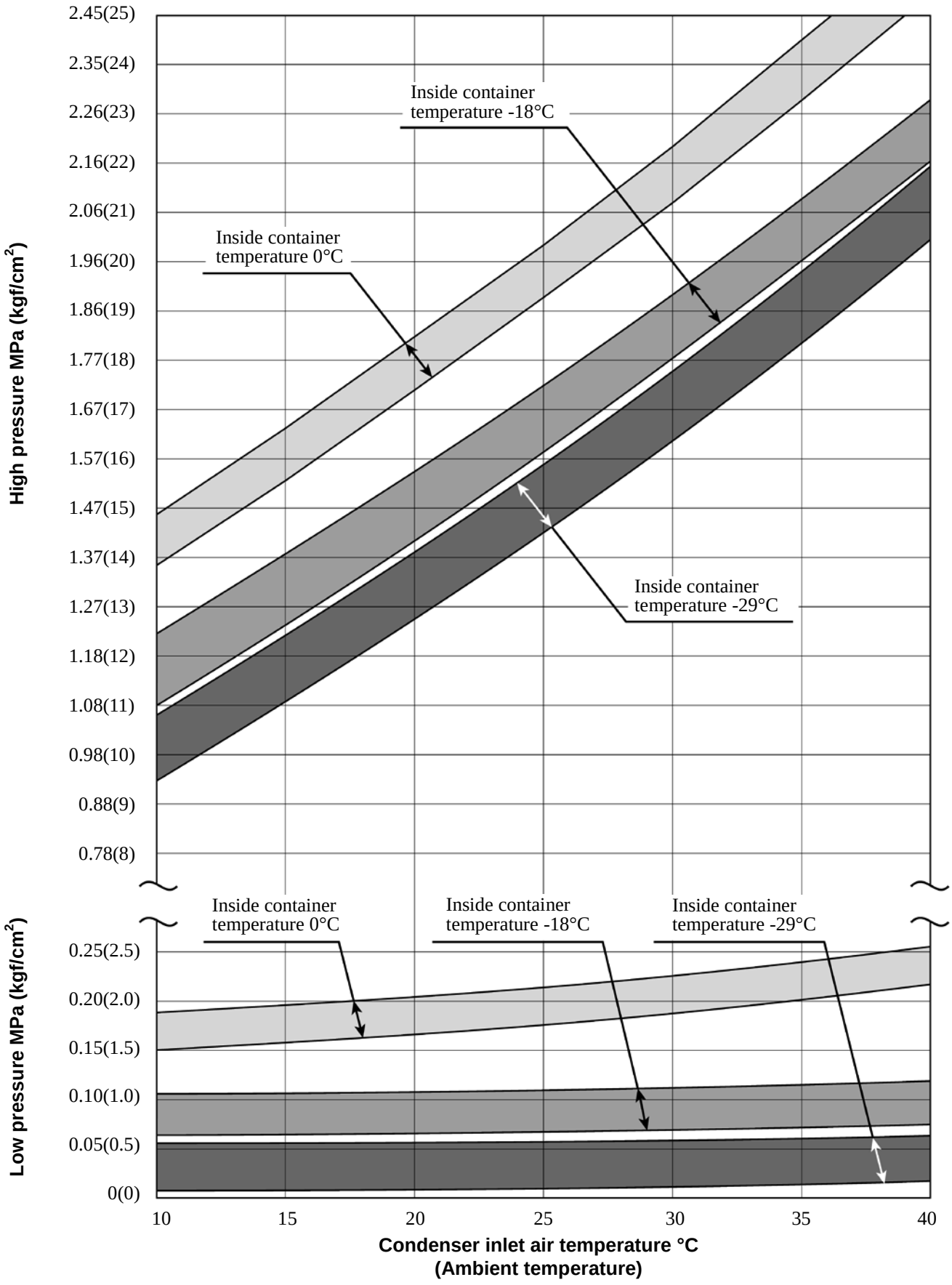
⚠ Connect the refrigerant hose firmly to avoid leaking when charging.
※ Otherwise, it may cause frostbite or refrigerant leakage.



Note: - - - - shows economizer cycle for TU1250SAE.

9.10 Standard operating pressure

At engine high speed



10.1 TROUBLSHOOTING

10.1 Troubleshooting of refrigerant system

(1) Abnormality and its cause of refrigerant system

Cause \ Abnormality	Defrosting is not possible.	Refrigerating capacity is not observed.	Compressor generates noise.	Compressor does not maintain the suction pressure.	Compressor does not suck.	Pump down is not possible.	Suction pipe is frosted.	Sight glass is flushing.	Low pressure is high.	Low pressure is low.	High pressure is high.	High pressure is low.
Refrigerant is overcharged.							○		○		○	
Refrigerant is insufficient, leaking	○	○						○		○		○
Temperature of inlet air of the condenser is excessively high.									○		○	
Condenser is clogged.											○	
Temperature of inlet air of the condenser is excessively low.								○		○		○
Air is mixed in the refrigerating cycle.		○	○								○	
Condenser fan stops.											○	
Evaporator coil is clogged.		○					○			○		
Evaporator coil is frosted.		○					○			○		
An excessive amount of refrigeration oil circulates.		○										
Compressor is defective (bearing, scroll lap, etc.).		○	○	○	○	○			○			○
Improper mounting of evaporator outlet temperature sensor EVT		○					○		○			
Expansion valve is excessively opened.		○					○		○		○	
Expansion valve is excessively closed.		○								○		○
Expansion valve is clogged.		○								○		○
The low-pressure side is clogged.		○								○		○
The high-pressure side is clogged. (Defective of condenser inlet solenoid valve and check valve, etc.)										○	○	
Evaporator fan is stopped. (During cooling operation)		○					○			○		
Defective defrost solenoid valve SV	○	○							○			

(2) Insufficient cooling capacity

Trouble cause	Countermeasure
(1) Airflow is insufficient. (a) The evaporator coil is frosted. (b) Defective evaporator fan motor	 (a) Reset the time on the defrost timer. (b) Check the short circuit･breaking of wire and the motor.
(2) Since an opening exists on the refrigeration van, air enters from outdoors through the opening.	Check for opening, and repair to eliminate the opening.
(3) The sight glass is flushing.	Inspect for gas leakage and replenish refrigerant after repair.
(4) Condenser coil is dirty.	Wash with water. Take care of the fins which may be deformed if rubbed with hard-haired brush. **WARNING** • If the high-pressure washer is used, the condenser fins will be deformed. Be sure to prevent using the high-pressure washer. • Avoid using the steam washer because the pressure in the equipment will abnormally rise and it is very dangerous.
(5) When Items (1) ~ (4) are normal. (a) The electronic expansion valve or the drier is clogged.	(a) Connect a gauge manifold, and start engine. Check that the engine is rotating with high-speed (2100min^{-1}). The electronic expansion valve or drier may be clogged if a slightly lower value is indicated as the pressure on the high-pressure side and the pressure indicated on the lower side is lower than the standard operating pressure. 1) Electronic expansion valve may be clogged if moisture freezes at and blocks the hole of electronic expansion valve outlet. Check the aperture with the controller. See page 60. The normal aperture of the electronic expansion valve is less than 200 pulses. 2) Recover the refrigerant if moisture is mixed. Then replace the drier. After completely removing the moisture with the "repeated evacuating method", replace the refrigerant. Furthermore when the drier is clogged, the low-pressure gauge may also show the lower value than the normal operating condition. In this case, the drier and subsequent tubing will be covered by frost. If it is slightly clogged, the temperature difference is observed between before and after the drier. Replace the drier in such cases.
(b) The electronic expansion valve is excessively opened.	(b) When the pressure on the low-pressure side is high together with the low-pressure piping up to the compressor frosted, the electronic expansion valve is excessively opened and refrigerant enters into the compressor in liquid state. Check whether the EVT is not afloat or the electronic expansion valve is not seized.
(c) Defective evaporator outlet temperature sensor EVT, low-pressure sensor LPT	(c) To judge whether LPT is good or not, remove LPT at the connection to open it to the atmosphere, and then check if the low pressure on controller is within the range of 0±10 kPa. If it is out of the range it is defective. (See page 58 for the usage of the controller.) To judge whether EVT is good or not, measure the temperature on the pipe located near EVT and compare the result with the value shown on the control display, or check the resistance value at the connector. (See page 58 for the usage of the controller, see pages 33 and 34 for the comparison of resistance value.) When checking the pipe temperature, closely contact the temperature sensor to the pipe and cover them with insulation material to avoid sensing ambient temperature.

Trouble cause	Countermeasure
(d) Excessive refrigerant	(d) If the high pressure and the low pressure are higher than the standard operating pressure, refrigerant is overcharged. Recover refrigerant once and then re-charge the specified quantity.
(e) Much air is mixed in the equipment.	(e) If the high-pressure gauge shows a fairly high value, a lot of bubbles are seen in the sight glass and cooling is poor, air is mixed. It is necessary to recover refrigerant and evacuate system.

(3) Abnormal sound is heard.

Trouble cause	Countermeasure
(1) Loosened bolt and nut due to improper mounting work	Check, repair or retighten.
(2) Compressor (a) Metallic noise is heard from the internal. (b) Oil is excessively filled.	 (a) Disassemble for internal check. Repair or replace if necessary. (b) Drain oil to the specified amount.
(3) Belt is loose.	Retighten to the specified tension.
(4) Sub-engine muffler is clogged.	Replace the muffler.
(5) Fan interference	Inspect and repair if necessary.
(6) Liquid compression in the compressor	Check electronic expansion valve and quantity of refrigerant.

(4) High pressure is too high during cooling operation.

Trouble cause	Countermeasure
(1) Mixing of air in the equipment	Recover refrigerant, and evacuate the equipment.
(2) Dirty condenser coil	Clean the condenser coil.
(3) Excessive refrigerant amount	Recover refrigerant once and re-charge the proper quantity.
(4) Defective condenser fan	Inspect.
(5) Condenser inlet solenoid valve (SV4) does not open.	Repair or replace if necessary.
(6) Clogged pipe on the high-pressure side	Repair or replace if necessary.
(7) Condenser coil fin is damaged.	Repair.
(8) Ambient temperature is high.	Move the unit into the shade or to a cool airy place.
(9) Belt slip	Adjust the tension.
(10) Service valve tends to be closed. (TU100SAE-CN)	Fully open the valve.
(11) Discharge strainer is clogged. [TU100SAE-CN (Improved)]	Replace the discharge strainer.

(5) High pressure is too low during cooling operation.

Trouble cause	Countermeasure
(1) Refrigerant quantity is insufficient.	Repair the leakage area and recharge the refrigerant.
(2) Defective compressor	Replace.
(3) Clogged drier	Replace.
(4) Defrost solenoid valve (SV2) is open.	Repair or replace if necessary.
(5) Ambient temperature is low.	Not abnormal.
(6) Frosted evaporator coil	Inspect and conduct the defrosting operation.

(6) Low pressure is too high during cooling operation.

Trouble cause	Countermeasure
(1) Defective compressor	Replace.
(2) Refrigerant quantity is excessive.	Recover refrigerant once and then re-charge the proper quantity.
(3) Defrost solenoid valve (SV2) is open.	Repair or replace if necessary.
(4) Ambient temperature is high.	Move the unit into the shade or to a cool airy place.
(5) Electronic expansion valve is open excessively. (Defective operation)	Inspect evaporator outlet temperature sensor and low pressure sensor. Replace if expansion valve is seized.

(7) Low pressure is too low during cooling operation.

Trouble cause	Countermeasure
(1) Refrigerant quantity is insufficient.	Inspect and repair the leakage area and recharge the refrigerant.
(2) Frosted evaporator coil	Inspect and conduct the defrosting operation.
(3) Clogged drier	Replace
(4) Ambient temperature is low.	Not abnormal.
(5) Clogged pipe on the low pressure side	Inspect and repair.
(6) Electronic expansion valve is clogged or closed excessively. (Defective operation)	Recover refrigerant and evacuate system if moisture freezes. Replace if expansion valve is seized.
(7) Defective evaporator fan	Inspect, and repair or replace if necessary.
(8) Service valve tends to be clogged.	Fully open the valve.

10.2 Troubleshooting of sub-engine

(1) Sub-engine troubles and their causes

Cause \ Abnormality	Sub-engine does not start.	Unstable rotation, hunting	Black or white exhaust smoke during start-up	Excessive vibration, abnormal noise	Excessive engine oil consumption	Contamination of engine oil by foreign object	Improper oil pressure (OPS trips, E70)	Overheat (abnormal stop)	Black or white exhaust smoke after start-up	Excessive fuel consumption, contamination	Battery charging is insufficient.	Starter does not start to rotate.
Improper clearance of suction･discharge valve.	○			○								
Seizure of suction･discharge valve.	○	○	B	○					B			
Pressure leakage from cylinder head gasket.						○		○				
Wear of piston ring or cylinder.	○		W		○				W			
Seizure of crank pin or shaft bearing.	○	○		○								
Wear of crank metal and journal metal.		○		○								
Wear of suction･discharge valve guide.			W		○							
Pressure leakage from valve seat.			B	○					B	○		
Shortage of cooling water in radiator.			B					○				
Crack in cooling water jacket.						○		○				
Faulty thermostat function.			B					○	W			
Usage of inadequate engine oil.	○				○							
Leakage from engine lubrication system.					○							
Insufficient engine oil quantity.							○					
Excessive engine oil quantity.					○				W			
Injection timing is too early at fuel injection pump.				○					B			
Injection timing is too late at fuel injection pump.			W						W	○		
Usage of inadequate fuel.			B･W						B･W			
Insufficient fuel supply to fuel injection pump.	○											
Irregular injection volume from fuel injection pump.		○	B･W	○					B･W			
Excessive fuel injection.					○			○	B	○		
Clogging of fuel filter.	○											
Clogging of air filter.			B						B			
Trouble of wiring.	○						○	○			○	
Defective alternator.											○	
Defective battery. (Flat battery)	○										○	○
Defective starter.	○											○

Note. B: Black, W: White

(2) Shortage of output

Trouble cause	Countermeasure
(1) Insufficient compression	
a) Improper valve clearance	a) Adjust the valve clearance.
b) Pressure leakage from valve seat	b) Removing the cylinder head, grind out the valve.
c) Seized valve stem	c) Repair or replace.
d) Deteriorated or broken valve spring	d) Replace the valve spring.
e) Pressure leakage from cylinder head gasket	e) Replace the gasket.
f) Stuck or broken piston ring	f) Replace the piston ring.
g) Worn piston ring, cylinder	g) Overhaul the engine.
(2) Defective fuel injection system	
a) Improper injection timing	a) Adjust the injection timing.
b) Defective nozzle	b) Adjust or replace the nozzle.
c) Cylinder head, nozzle hole are clogged with carbon.	c) Remove carbon.
(3) Defective fuel system	
a) Clogged fuel filter element	a) Replace the fuel filter element.
b) Mixing of air in fuel system	b) Bleed air from each pipeline.
c) Contaminated fuel tank	c) Clean the fuel tank.
d) Deteriorated fuel pump function	d) Disassemble or replace the fuel pump.
e) Improper injection amount from injection pump	e) Adjust by referring the Engine Service Manual.
f) Insufficient injection amount due to improper governor adjustment	f) Adjust by referring the Engine Service Manual.
(4) Insufficient intake air volume	
a) Clogged air cleaner	a) Replace the element.
b) Larger valve clearance	b) Adjust the valve clearance.
(5) Overheat	
a) Inadequate engine oil	a) Replace with the specified oil.
b) Shortage of cooling water	b) Replenish cooling water.
c) Worn or broken water pump belt	c) Adjust or replace.
d) Faulty thermostat function	d) Replace the thermostat.
e) Faulty water pump function	e) Repair or replace the water pump.
f) Clogging of or water leakage from radiator	f) Clean, repair or replace in case of water leakage
g) Defective nozzle	g) Adjust or replace.

(3) Excessive engine oil consumption

Trouble cause	Countermeasure
(1) Loose oil pan drain plug	Tighten the drain plug or replace the gasket.
(2) Loose oil pan set bolt	Tighten the set bolt.
(3) Loose timing gear cover	Tighten the set bolt or replace the gasket.
(4) Defective cylinder head cover gasket	Replace the gasket.
(5) Broken oil filter O-ring	Replace the O-ring.
(6) Worn valve, stem guide or broken oil seal	Replace the oil seal.
(7) Improper piston ring abutment position	Adjust the piston ring position.
(8) Worn piston ring	Replace the piston ring.
(9) Worn piston and cylinder	Replace the piston and cylinder liner.
(10) Excessive lubricant spray over bore, piston	Oil is over charged. Reduce to the specified quantity.

(4) Faulty startup

Trouble cause	Countermeasure
(1) Startup speed is slow. a) Engine oil is too dense. b) Discharge or deteriorated capacity of battery c) Poor contact of starter cable and grounding band d) Defective starter	 a) Replace with the specified oil. b) Charge or replace the battery. c) Clean, re-tighten terminals, or replace the cable. d) Repair or replace.
(2) Defective injection system a) Fuel leakage from injection pipe b) Defective nozzle c) Mixed air d) Delayed injection timing e) Defective governor link	 a) Tighten or replace the pipe. b) Repair or replace the nozzle. c) Bleed air. d) Adjust the injection timing. e) Adjust or replace.

(5) Engine knock

Trouble cause	Countermeasure
(1) Diesel knock a) Faulty nozzle spray or improper spray pressure b) Inadequate fuel c) Insufficient compression pressure d) Inadequate injection timing e) Super cooled or overheated engine f) Irregular injection volume g) Improper valve clearance	 a) Clean, adjust or replace. b) Use the specified fuel. c) Overhaul the engine. d) Adjust the injection timing. e) Warm up the engine or replace cooling water. f) Adjust the injection volume on the injection pump of each cylinder. g) Adjust the valve clearance.

(6) Faulty idling revolution

Trouble cause	Countermeasure
(1) Injection pump and related matters	In case of irregular injection volume from injection pump, adjust the injection volume from injection pump.
(2) Nozzle	In case of irregular injection volume or irregular injection pressure from each nozzle, adjust or replace the nozzle.
(3) Engine main body 1) Improper valve clearance 2) Poor adhesion of valve seat 3) Too slow engine speed 4) Seizure of crank metal or shaft bearing	 1) Adjust the valve clearance. 2) Grind the valve. 3) Adjust the idling speed. 4) Overhaul the engine.

Notice

- In many cases, engine noise is considered to generate as a result of combined effects related to respective revolving sections, sliding sections, combustion noise, and so forth. It is necessary therefore to identify the cause of noise resulting from each factor. Check them after stopping the injection by such measures as disconnecting wiring of stop solenoid and so on.

(7) Others

Trouble cause	Countermeasure
(1) Crankshaft and bearing metal a) Excessive oil clearance due to wear on metal b) Eccentric wear on crankshaft journal c) Burning, peeling of crankshaft metal	 a) Replace the metal. b) Repair or replace the journal. c) Replace the metal.
(2) Connecting rod and bearing metal a) Wear on connecting rod metal b) Bent connecting rod c) Burning, peeling of connecting rod metal	 a) Replace the metal. b) Repair or replace the rod. c) Replace the metal.
(3) Piston, piston pin and piston ring a) Excessive clearance due to wear on cylinder b) Worn piston or piston pin c) Seized piston d) Broken piston ring	 a) Overhaul the engine. b) Replace the piston or piston pin. c) Replace the piston and piston ring, and inspect respective sections of the engine. d) Replace the piston ring, inspect and clean respective sections of the engine.
(4) Others a) Wear on timing gears such as idler gear and camshaft gear b) Wear on rocker arm c) Excessive valve clearance	 a) Replace the gear. b) Replace the rocker arm. c) Adjust the valve clearance

(8) Starter does not start to rotate

Trouble cause	Countermeasure
(1) Defective battery (Flat battery)	a) Charge the battery. b) Replace the battery if the specific gravity does not increase over 1.3 after charging.
(2) Blown fuse “FL1”	Replace the fuse.
(3) Trouble of wiring (poor contact) (removal, disconnection)	a) Check plus (+) terminal of battery, S terminal (8D line) and B terminal (2 line) of starter. Fix if any slack is found. b) Check if battery voltage is detected on B terminal (2 line) of starter. Disconnection of 2 line is suspected if no voltage is found. c) Check if 12V is detected on S terminal (8D line) at 20 seconds after operation switch is on. Trouble on starter relay (AR_{SR}) is suspected if 12 V is not detected. d) Check if 12V is detected at the contact side of AR_{SR} relay (2D line). Disconnection between FL1 ~ AR_{SR} is suspected if 12V is not detected.
(4) Defective starter relay (AR_{SR})	a) Check if 12V is detected on 7A7 line of AR_{SR} relay at 20 seconds after operation switch is on. b) Check if AR_{SR} relay is grounded. c) Defect of AR_{SR} relay is suspected if 12V is not detected on 2D line after the check of a) and b). Replace the AR_{SR} relay.
(5) Defective starter	Defective starter is suspected if no problem is found after investigation of (1) through (4). Replace the starter.

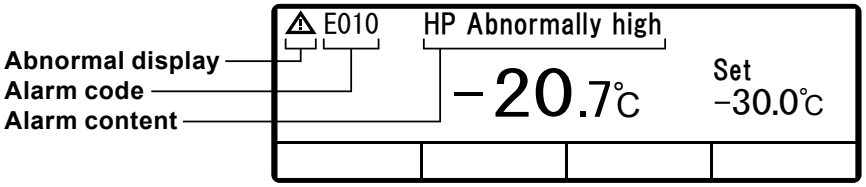
(9) Defective charging

Trouble cause	Countermeasure
(1) Broken, removed or slackened belt	Adjust the belt to the proper tension if slackened. Replace the belt if broken or removed.
(2) Trouble of wiring (removal, disconnection)	a) Check if battery voltage is detected on alternator wiring on B terminal (2D line) and S terminal (2D line). Disconnection of wiring is suspected if no voltage is found. b) Check if 12V is detected on alternator coupler L line after engine starts up. Disconnection of wiring between main board and L line or defective main board is suspected if no voltage is found.
(3) Defective alternator	Defective alternator is suspected if no problem is found after investigation of (1) and (2). Replace the alternator.

10.3 Troubleshooting of electrical system

(1) Type of abnormal

Counter measures and recovery actions are different depending on the effect that is caused by the abnormal of the refrigeration unit to its operation. There are 6 types of abnormal as shown below.



Type of abnormal	Unit Operation	Recovery action	Abnormal display	Alarm code	Alarm contents	LCD back light	Buzzer sound∗
Permanent Stop abnormal	Stops.	Operation cannot be resumed without special manipulation because fatal accident could happen if the operation resumes without recovery of the cause of abnormal.	On	Display	Display	Flicker	Yes
Manual recovery abnormal	Stops.	Operation resumes by OFF/ON of cabin controller					
Automatic recovery abnormal A	Stops.	Operation resumes automatically when satisfying recovery condition.	Flicker			No	No
Automatic recovery abnormal B	Only ventilation and engine/ generator is ON	Operation resumes automatically when satisfying recovery condition.	No Display	No Display	Nothing displayed		
Emergency operation abnormal	Continues. (Emergency operation)	- (Normal operation resumes when abnormal detection condition becomes unsatisfied)	Flicker	Display	No Display (Normal display such as cooling)		
Warning abnormal	Continues.	- (Normal operation resumes when abnormal detection condition becomes unsatisfied)					

∗ As per setting

(2) Alarm code list

Alarm code	Alarm content	Type of abnormal	Countermeasures
E003	Magnet clutch fuse break	Manual recovery	Fuse F3 has blown. Replace fuse F3 (10A) in the control box. Inspect magnet clutch and harness if trouble persists after replacement.
E004	Throttle solenoid fuse has break	Emergency operation	Fuse F9 has blown. Replace fuse F9 (30A) in the control box. Inspect throttle solenoid and harness if trouble persists after replacement. Engine continues emergency operation with low speed during abnormal.
E006	Load drive circuit fuse break	Manual recovery	Fuse F2 has blown. Replace fuse F2 (15A) in the control box.
E009	Commercial power supply defective	Emergency operation	Emergency operation continues by switching to engine drive if the “Automatic drive selection backup setting mode” of the cabin controller is ON.
		Automatic recovery A	Commercial power is in failure or disconnected. Check the commercial power supply.
E010	HP abnormally high	Automatic recovery B	High-pressure switch has tripped. (1) Check installation condition of fan and bell-mouth. (2) Inspect if condenser coil is too dirty. If so, clean up with water. (Prevent from high pressure cleaning.) (3) Check refrigerant is not over charged or high pressure circuit is not clogged.
		Manual recovery	High pressure switch had been activated 10 times. Inspect above conditions.
E013	Td abnormally high	Automatic recovery B	Compressor discharge gas temperature has reached to 145°C. (1) Check if high pressure and low pressure are normal. (2) Check if refrigerant is short.
		Automatic recovery A	Abnormal discharge gas temperature alarm had been activated 4 times with following conditions. High pressure is high and EEV opening ratio is small.
		Manual recovery	Abnormal discharge gas temperature alarm had been activated 4 times with high pressure is low.
E016	LPT failure	Emergency operation	Low pressure sensor is disconnected or shorted. Replace low pressure sensor.
		Automatic recovery B	Refrigerant pressure at compressor suction side has dropped. Inspect if gas is leaking or if the low pressure circuit part is clogging or defective.
		Manual recovery	Abnormal low pressure alarm had been activated 5 times. Inspect above conditions.
E017	HPT failure	Emergency operation	High-pressure sensor is disconnected or shorted. Replace high pressure sensor.
E021	Engine coolant temperature high	Manual recovery	Sub-engine cooling water temperature switch has tripped. (1) Inspect water quantity in the reservoir tank and replenish if short. (2) Check and clean the dirt on the radiator. (3) Check if cooling water is leaking.
E023	Engine speed abnormally low	Automatic recovery B	Sub-engine speed has dropped below 1000 rpm. (1) Inspect fuel quantity, fuel leakage and supply of air. (2) Inspect the governor lever, etc.
		Automatic recovery A	Abnormal low engine speed alarm had tripped 3 times. Inspect above conditions.
		Manual recovery	Abnormal low engine speed alarm had tripped 10 times. Inspect above conditions.
E024	Engine start failure	Manual recovery	Sub-engine start has failed 5 consecutive times. (1) Inspect the fuel tank to see if fuel is reserved. (2) Inspect the battery, starter and grounding if fuel is reserved.

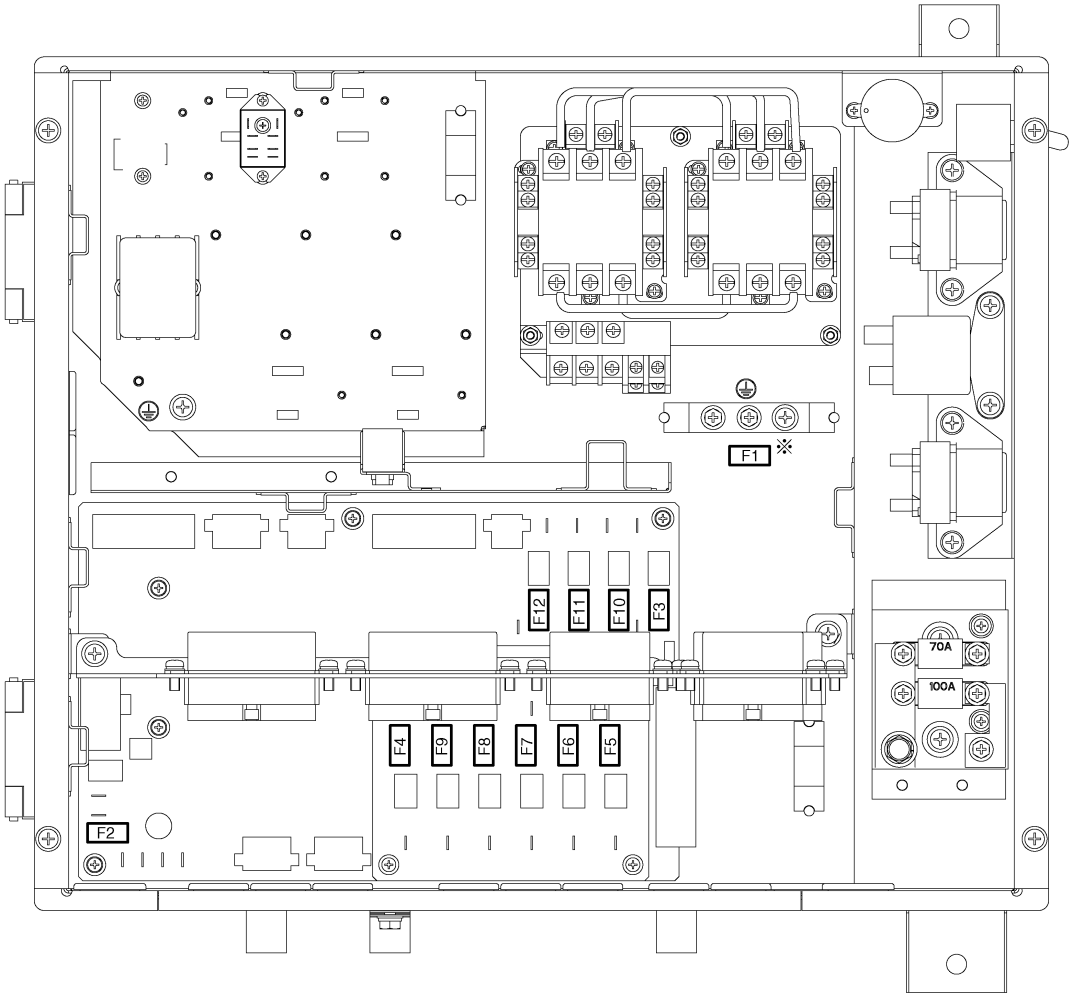
Alarm code	Alarm content	Type of abnormal	Countermeasures
E027	Engine speed abnormally high	Manual recovery	Sub-engine speed has increased over 3000 rpm. Inspect engine throttle rod (adjusting rod).
E030	Unit panel not close	Automatic recovery A	Condensing unit front panel is open or door limit switch is defective. (1) Close the front panel completely and check if E30 disappears. (2) Inspect door limit switch.
E031	OCR tripped	Emergency operation	Emergency operation continues by switching to engine drive if the "Automatic drive selection backup setting mode" of the cabin controller is ON.
		Automatic recovery A	Over current protection device of motor has tripped. Inspect motor harness.
		Manual recovery	Over current protection device of motor had tripped 2 times. Inspect above conditions.
E032	Alternator generation not enough	Warning abnormal	Generation voltage from alternator dropped. Inspect compressor belt tension and alternator.
		Manual recovery	Generation voltage from alternator and battery voltage dropped. Inspect above conditions and battery.
E033	HTS tripped (Option)	Automatic recovery A	Evaporator electric heater protection device has tripped. Inspect electric heater and protection device.
E036	ECS abnormally high	Permanent stop	Sub-engine clutch has overheated. Inspect sub-engine clutch and engine clutch temperature sensor (ECS).
E050	TH sensor failure	Emergency operation	Return air temperature sensor (TH) is disconnected or shorted. Inspect return air temperature sensor.
E054	Throttle solenoid failure	Emergency operation	Throttle solenoid is defective. Inspect throttle solenoid and harness. Sub-engine continues emergency operation with low speed during failure.
E060	HPS failure	Automatic recovery A	High-pressure switch (HPS) has failed. Inspect high-pressure switch.
E063	Td sensor failure	Emergency operation	Discharge gas temperature sensor (TDS) is disconnected or shorted. Inspect discharge gas temperature sensor.
E070	OPS failure	Warning abnormal	Sub-engine oil pressure switch (OPS) has failed. Inspect oil pressure switch.
		Manual recovery	Sub-engine oil pressure is low. Inspect oil quantity and oil pressure switch.
E081	OCR failure	Emergency operation	Emergency operation continues by switching to engine drive if the "Automatic drive selection backup setting mode" of the cabin controller is ON.
		Manual recovery	Over current protection device of motor has failed. Inspect over current relay (OCR) and contactor (MC).
E099	Controller communication failure	Automatic recovery A	Controller cannot communicate properly. Inspect connection of connectors. Further inspect cabin controller, main printed board and main harness.
		Manual recovery	Communication error alarm had tripped 10 times. Inspect above conditions.

Alarm code	Alarm content	Type of abnormal	Countermeasures
E202	R/L1 phase loss (Standby)	Warning abnormal	The R-phase of commercial three phase power is open-phased (no current). (Motor does not rotate if S-phase or T-phase is open-phased.) Inspect power supply facility, disconnection of R-phase harness in the unit and the state of power plug pin.
E204	DCS fuse break	Warning abnormal	Fuses F10, F11 and F12 have blown. Replace fuses F10, F11 and F12 (10A) in the control box. Inspect external equipment and harness if trouble persists after replacement.
E205	Drain hose heater fuse break	Warning abnormal	Fuse F4 has blown. Replace fuse F4 (10A) in the control box. Inspect drain hose heater and harness if trouble persists after replacement.
E210	Pump down failure	-	Pump down cannot be carried out during self diagnosis operation (PTI operation). Inspect SV2 and EEV.
E221	Engine low speed failure	Warning abnormal	Sub-engine low speed is extensively deviated from the rated speed. (lower than 1300rpm) Adjust engine speed.
E222	Engine high speed failure	Warning abnormal	Sub-engine high speed is extensively deviated from the rated speed. (exceeding 2100±200rpm) Adjust engine speed.
E223	Engine stall	Manual recovery	Sub-engine had stalled 5 times. (1) Inspect if fuel exists, fuel is leaking or air injection. (2) Inspect fuel pump.
E250	EVT sensor failure	Emergency operation	Evaporator outlet temperature sensor (EVT) is disconnected or shorted. Inspect evaporator outlet temperature sensor.
E252	THD sensor failure	Emergency operation	Supply air temperature sensor (THD) is disconnected or shorted. Inspect supply air temperature sensor.
E256	ATS sensor failure	Emergency operation	Ambient air temperature sensor (ATS) is disconnected or shorted. Inspect ambient air temperature sensor.
E260	Defrost SV failure	Manual recovery	Defrost solenoid valve (SV2) is shorted. Inspect defrost solenoid valve.
E264	Condenser inlet SV failure	Manual recovery	Condenser inlet solenoid valve (SV4) is shorted. Inspect condenser inlet solenoid valve.
E265	Liquid bypass SV failure	Emergency operation	Liquid bypass solenoid valve (SV5) is shorted. Inspect liquid bypass solenoid valve.
E266	EEV failure	Manual recovery	Electronic expansion valve (EEV) is shorted. Inspect electronic expansion valve.
E268	Buzzer failure	Emergency operation	Buzzer circuit is shorted. Inspect buzzer.
E269	Stop solenoid&relay failure	Manual recovery	Stop solenoid circuit is shorted. Inspect stop solenoid, stop solenoid relay and harness.
E270	Starter relay circuit failure	Manual recovery	Starter relay circuit is shorted. Inspect starter relay and harness.
E271	ARMO circuit failure	Emergency operation	Emergency operation continues by switching to engine drive if the “Automatic drive selection backup setting mode” of the cabin controller is ON.
		Manual recovery	Motor relay circuit is shorted. Inspect motor relay and harness.

Alarm code	Alarm content	Type of abnormal	Countermeasures
E272	Pre-heater relay circuit failure	Manual recovery	Pre-heater (glow plug) relay circuit is shorted. Inspect pre-heater, pre-heater relay and harness.
E273	Electic heater relay failure (Option)	Emergency operation	Evaporator electric heater relay is shorted. Inspect evaporator electric heater relay.
E274	Fuel pump failure	Manual recovery	Fuel pump has failed. Inspect fuel pump.
E275	ECS failure	Warning abnormal	Sub-engine clutch temperature sensor (ECS) is disconnected or shorted. Inspect sub-engine clutch temperature sensor.
E280	Battery voltage low	Warning abnormal	Battery voltage has dropped below 12V. Replace battery if aged.
E281	Evaporator fan motor fuse break	Warning abnormal	One or more of evaporator fan motor fuses F5, F6, F7 and F8 (15A) have blown. Inspect fuses in the control box and replace if blown. Inspect fan motor and harness if trouble persists after replacement.
E282	Economizer SV failure	Emergency operation	Economizer solenoid valve (SV8) is shorted. Inspect economizer solenoid valve.

10.4 Location of fuse

Fuses are located in the control box on the condensing unit.



F2 : 15A (Relay circuit)
F3 : 10A (Compressor magnet clutch)
F4 : 10A (Drain hose heater A)
F5 : 15A (Evaporator fan motor 1)
F6 : 15A (Evaporator fan motor 2)
F7 : 15A (Evaporator fan motor 3)
F8 : 15A (Evaporator fan motor 4)
F9 : 30A (Throttle solenoid)
F10 : 10A (External equipment power)
F11 : 10A (External equipment power)
F12 : 10A (External equipment power)

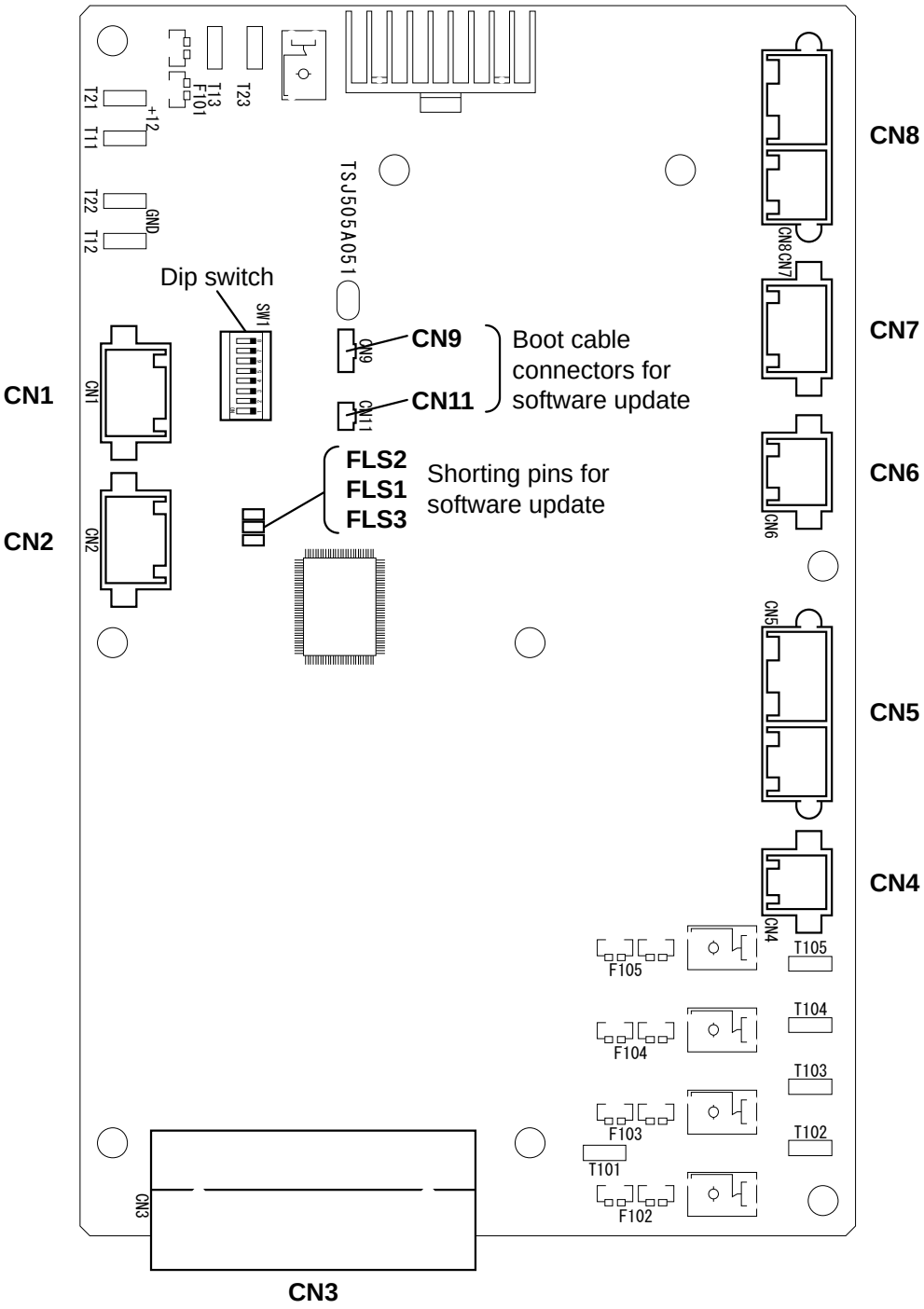
※ F1 : 20A (Control circuit) is fixed with a fuse holder.

10.5 Inspection of controller printed circuit board

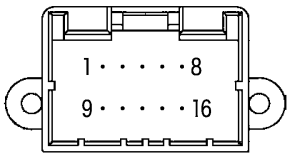
(1) Cautionary points for handling the printed circuit board

1) When taking the board, prevent touching any pattern or part with hand.
   To take the board, pinch it at both sides with hand.
2) Prevent touching the board with hand which oil or similar sticks to.
3) Prevent applying any load to the parts on the board with hand or similar.
4) Be sure to prevent any shock which is caused by drop or similar.
5) Prevent water from splashing on the board due to rain or similar.
6) Prevent handling the board at any area where static electricity generates (dry area, room laid with carpet or similar and so on).
7) To temporarily put the board, store it wrapping with the aluminum foil and or conductive bag, etc.

(2) Layout of main circuit board and connector terminal

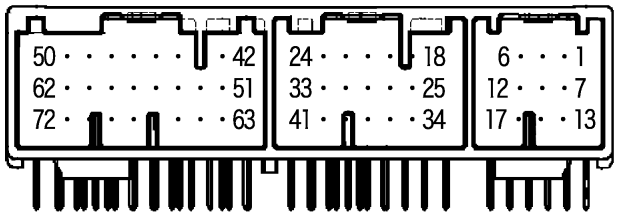


1) CN1 (Connector for cabin controller).



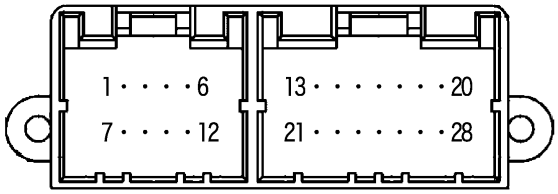
Pin No.	Purpose	Function
1	Communication	Cabin controller communication (RS485-A)
2	Communication	Cabin controller communication (Shield GND)
4	Digital input	ARM ON/OFF signal for main board
5	Digital input	Power ON/OFF signal for main board
6	GND	GND for cabin controller
7	Power	Power for cabin controller (DC12V)
9	Communication	Cabin controller communication (RS485-B)
12	Digital input	ARM ON/OFF signal for main board
13	Digital input	Power ON/OFF signal for main board
14	GND	GND for cabin controller
15	Power	Power for cabin controller (DC12V)

2) CN3 (Connector for analog sensor, speed sensor and contact connection)



Pin No.	Purpose	Function	Pin No.	Purpose	Function
1	Analog input	Ambient temp sensor (ATS)	32	GND	High-pressure sensor (HPT) GND
2	Analog input	Evaporator outlet temp sensor (EVT-A)	33	GND	Low-pressure sensor (LPT) GND
3	Analog input	Return air temp sensor (TH-A)	40	Power	High-pressure sensor (HPT) power
4	Analog input	Supply air temp sensor (THD-A)	41	Power	Low-pressure sensor (LPT) power
5	Analog input	Discharge gas temp sensor (TDS)	44	Digital input	Commercial power detection contact input (AR AC)
7	GND	Ambient temp sensor (ATS) GND	50	Speed input	Engine revolution speed sensor input (FWS)
8	GND	Evaporator outlet temp sensor (EVT-A) GND	51	Digital input	Limit switch contact input (LM)
9	GND	Return air temp sensor (TH-A) GND	52	Digital input	Contactor contact input (MC)
10	GND	Supply air temp sensor (THD-A) GND	53	Digital input	Over-current relay contact input (OCR)
11	GND	Discharge gas temp sensor (TDS) GND	54	Digital input	Oil pressure switch contact input (OPS)
16	GND	Engine clutch temp sensor (ECS) GND	58	Digital input	Water temp switch contact input (WTS)
17	Analog input	Engine clutch temp sensor (ECS)	62	GND	Engine revolution speed sensor (FWS) input GND
23	Analog input	High-pressure sensor (HPT)	64	Digital input	Box door switch contact input (BDS, option)
24	Analog input	Low-pressure sensor (LPT)	72	Digital input	High-pressure switch contact input (HPS)
31	Analog input	Alternator (GU_L)			

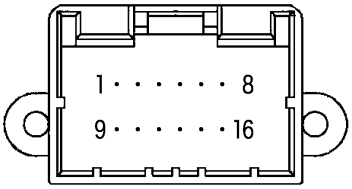
3) CN5 (Connector for relay board).



Pins 1 ~ 12 support multi-temperature unit.

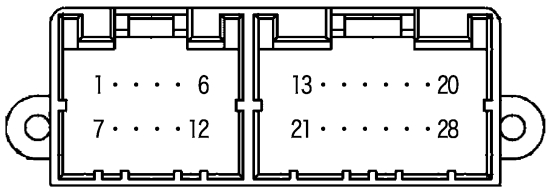
Pin No.	Purpose	Function
13	Digital output	Evaporator fan motor relay drive output (AR FM1)
14	Digital output	Evaporator fan motor relay drive output (AR FM2)
15	Digital output	Evaporator fan motor relay drive output (AR FM3)
16	Digital output	Evaporator fan motor relay drive output (AR FM4)
17	Digital output	Throttle solenoid relay drive output (AR HS)
18	Digital output	Drain hose heater relay drive output (AR DH-A)
21	Digital input	Evaporator fan motor FM1 fuse input (F5)
22	Digital input	Evaporator fan motor FM2 fuse input (F6)
23	Digital input	Evaporator fan motor FM3 fuse input (F7)
24	Digital input	Evaporator fan motor FM4 fuse input (F8)
25	Digital input	Throttle solenoid HS fuse input (F9)
26	Digital input	Drain hose heater DH-A fuse input (F4)

4) CN7 (Connector for EEV·engine actuator).



Pin No.	Purpose	Function
1	Digital output	EEV-A (1)
2	Digital output	EEV-A (2)
3	Power	Power for EEV-A (COM)
5	Digital output	Glow plug relay output (AR PH)
6	Digital output	Stop solenoid relay output (RS HOLD)
7	Digital output	Starter relay output (AR SR)
9	Digital output	EEV-A (3)
10	Digital output	EEV-A (4)

5) CN8 (Connector for solenoid valve etc.).



Pin No.	Purpose	Function
2	Digital output	Stand-by motor relay output (AR MO)
3	Digital output	Stop solenoid relay output (AR SOL)
9	Digital output	Buzzer relay output (BZ)
10	Digital output	Fuel pump relay output (FP)
13	Digital output	Defrost solenoid valve relay output (SV2)
22	Digital output	Economizer solenoid valve relay output (SV8)
24	Digital output	Condenser inlet solenoid valve relay output (SV4)
26	Digital output	Liquid bypass solenoid valve relay output (SV5)

(3) Dip switch setting

Change the setting of dip switch on the main PCB according to the type of unit, optional function, or other.

Unit type	Switch No.							
	8	7	6	5	4	3	2	1
Setting at the shipment of spare parts	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
TU1250SAE	OFF	OFF	**ON**	OFF	OFF	OFF	**ON**	OFF
TU1100/900SAE	OFF	OFF	**ON**	OFF	OFF	OFF	**ON**	**ON**

*R

Switch No.	Description of change
1	Change on TU1250SAE Series ⇔ TU1100/900SAE Series (ON: TU1100/900SAE)
2	Change on oil separator specification (ON: 2-tier oil separator specification)
3	—
4	—
5	[Optional function] Prevention control for supply air temperature drop *1 (ON: Control enabled)
6	Change on refrigerant control (ON: R452A, OFF: R404A*2)
7	—
8	—

*R

*1: Operation in which the priority is given to the prevention of drop in the supply air temperature, in order to protect cargoes from freezing. (Priority is given normally to the cooling capacity even under the cold storage condition (chilled zone). The supply air temperature is allowed to drop in this case.)

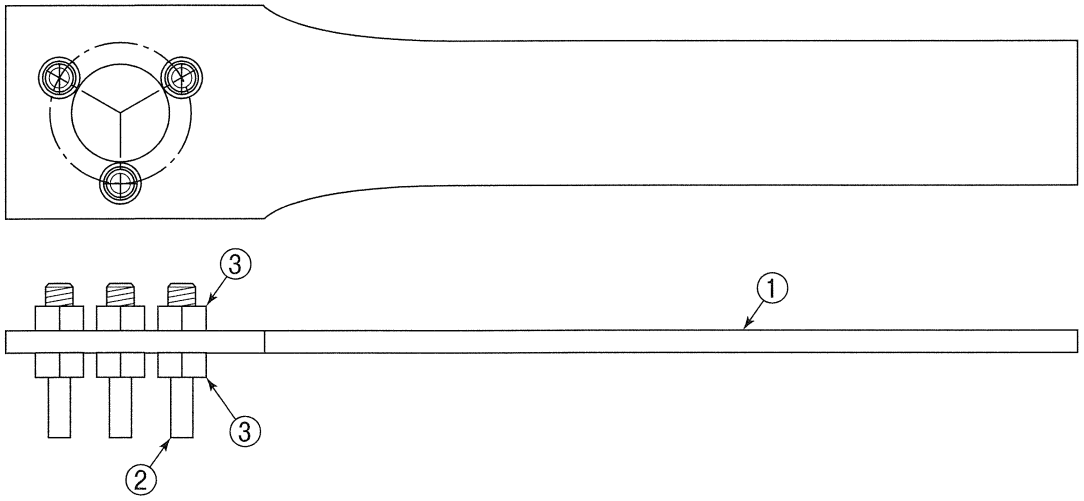
*2: Only R452A model is certified to ATP.

11. SATURATED TEMPERATURE PRESSURE TABLE (R452A)

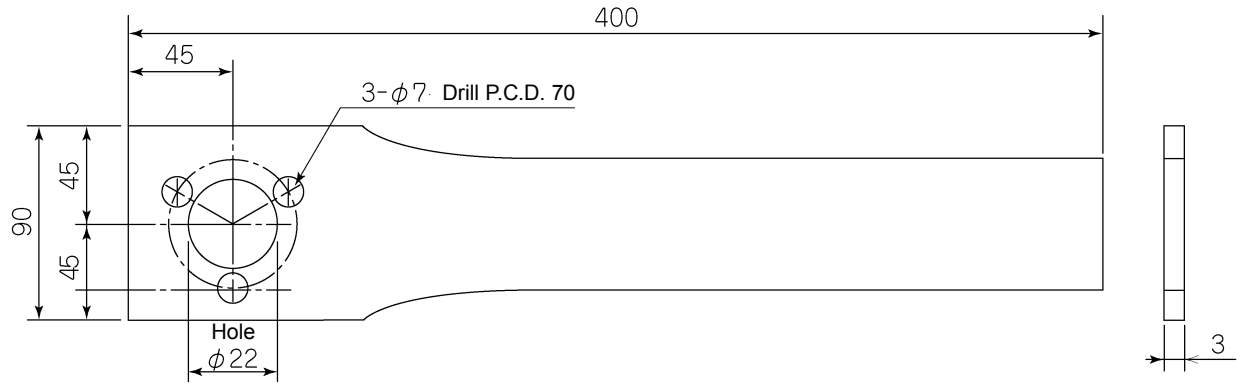
Tempera-ture (℃)	Saturated pressure (MPa)	Tempera-ture (℃)	Saturated pressure (MPa)	Tempera-ture (℃)	Saturated pressure (MPa)	Tempera-ture (℃)	Saturated pressure (MPa)	Tempera-ture (℃)	Saturated pressure (MPa)
− 50	− 0.033	− 26	0.105	− 2	0.400	22	0.944	46	1.851
− 48	− 0.026	− 24	0.122	0	0.435	24	1.004	48	1.948
− 46	− 0.018	− 22	0.141	2	0.471	26	1.067	50	2.048
− 44	− 0.009	− 20	0.161	4	0.509	28	1.132	52	2.152
− 42	− 0.000	− 18	0.182	6	0.549	30	1.200	54	2.260
− 40	0.010	− 16	0.204	8	0.591	32	1.271	56	2.372
− 38	0.021	− 14	0.228	10	0.635	34	1.344	58	2.489
− 36	0.033	− 12	0.253	12	0.681	36	1.421	60	2.610
− 34	0.045	− 10	0.279	14	0.729	38	1.500		
− 32	0.058	− 8	0.307	16	0.779	40	1.583		
− 30	0.073	− 6	0.336	18	0.832	42	1.669		
− 28	0.088	− 4	0.368	20	0.887	44	1.759		

12. SPECIAL TOOL FOR MAGNET CLUTCH

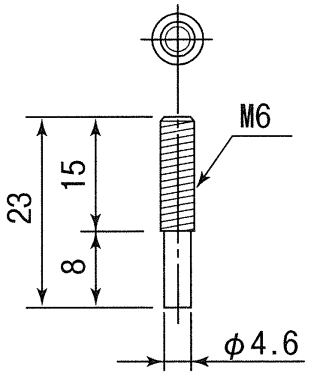
Armature plate fixing tool



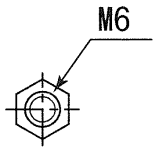
① Plate (Material: S45C)



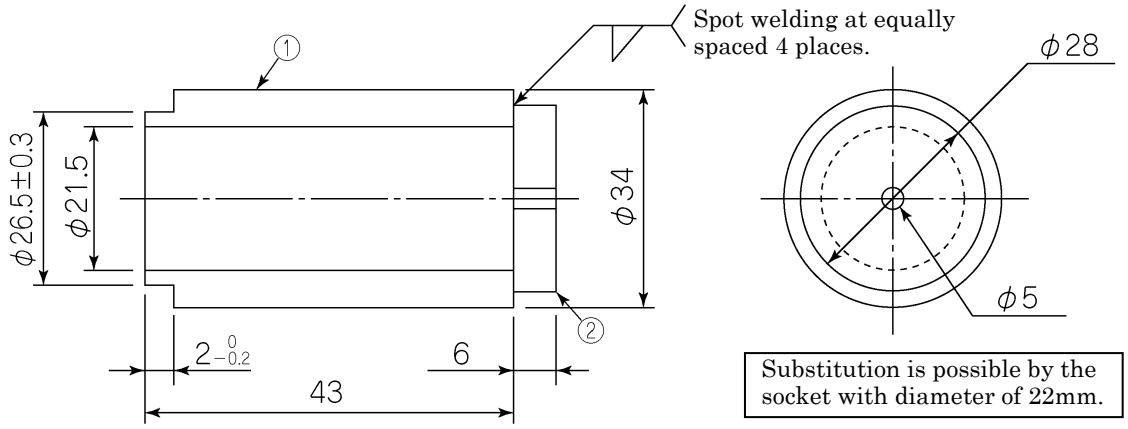
② Pin (3 pcs.) (Material: S45C)



③ JIS B 1181 Hexagonal nut M6 (6 pcs.) (Material: S45C)

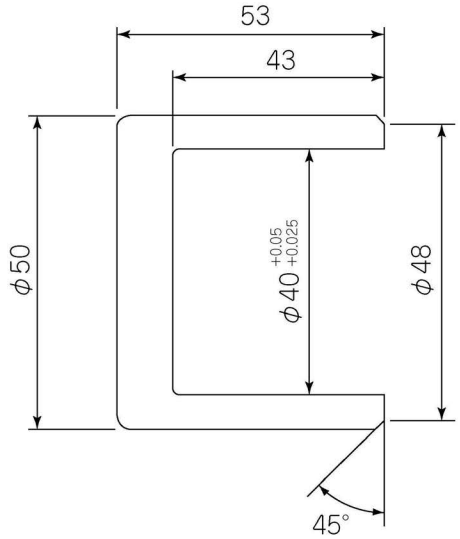


Magnet clutch pulley remover (Material: ①② S45C)

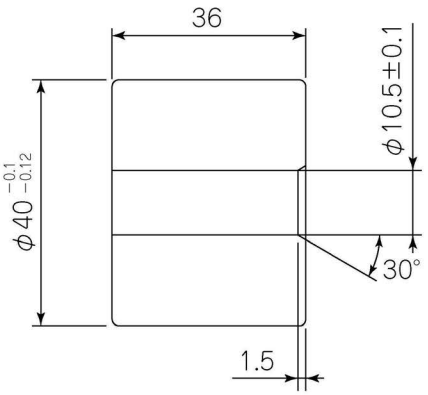


Magnet clutch rotor installer (for nose diameter ø40) (Material: ①② S45C)

① Pusher



② Guide



13. ABBREVIATIOS AND CODES

3D	Three dimensional	**HD**	Hot gas defrost
AC	Alternating current	**HPS**	High-pressure switch
AH	Ampere-hour	**HPT**	High-pressure sensor
AL	Alarm	**HS**	Throttle solenoid
API	American Petroleum Institute	**HTS**	High temperature thermo switch
APR	Anti-phase reversal relay	**IC**	Integrated circuit
AR AC	AC power supply detection relay	**I/F**	Terminal (operation management)
AR DCS	DCS (DC supply for external equipment) relay	**LCD**	Liquid crystal display
AR DH	Drain hose heater relay	**LIGHT**	Terminal (night illumination)
AR EH	Evaporator heater relay	**LM**	Limit switch
AR FM	Evaporator fan motor relay	**LPT**	Low-pressure sensor
AR HS	Engine throttle solenoid relay	**M**	Standby motor
AR M	Run switch relay	**MC**	Motor contactor
AR MCL	Compressor magnetic clutch relay	**MC EH**	Evaporator heater contactor
AR MO	Motor relay	**MCL**	Compressor magnetic clutch
AR PH	Pre-heater (glow plug) relay	**MIC**	Microwave integrated circuit
AR SOL	Engine stop solenoid relay	**OCR**	Over current relay
AR SR	Starter relay	**OPS**	Oil pressure switch
ASSY	Assembly	**PC**	Connector (personal computer)
AT	Ambient air temperature	**PCD**	Pitch circle diameter
ATS	Ambient air temperature sensor	**PH**	Pre-heater, Glow plug
BATT	Battery	**PR**	Connector (printer)
BZ	Buzzer	**PTI**	Pre-trip inspection
CN	Connector	**RCN**	Connector
CND	Connector	**RS**	Run solenoid (Engine stop solenoid)
CNS	Connector	**RT**	Return air temperature
CON	Power socket	**SAE**	Society of Automotive Engineers
DC	Direct current	**SDS**	Safety data sheet
DH	Drain hose heater	**SM**	Starter motor
DCS	DC power supply	**SOL**	Solenoid
E	Ground	**SOL HS**	Engine throttle solenoid
ECS	Engine clutch temperature sensor	**SOL RS**	Engine stop solenoid
EEV	Electronic expansion valve	**SR**	Starter relay
EH	Evaporator heater	**SV**	Solenoid valve
EVT	Evaporator outlet temperature sensor	**SV2**	Defrost solenoid valve
F1	Control circuit fuse	**SV4**	Condenser inlet solenoid valve
F2	Relay circuit fuse	**SV5**	Liquid bypass solenoid valve
F3	Compressor magnet clutch fuse	**SV8**	Economizer solenoid valve
F4	Drain hose heater fuse	**SW d-e**	Diesel-electric selection switch
F5-8	Evaporator fan motor fuse	**SW DEFROST**	Switch (defrost)
F9	Engine throttle solenoid fuse	**SW DOWN**	Switch (down)
F10-12	External equipment power supply fuse	**SW M**	Main switch
FET	Field effect transistor	**SW MODE**	Switch (mode)
FH	Fuse holder	**SW RUN/STOP**	Operation switch
FL1	Fusible link 1	**SW SET**	Switch (set)
FL2	Fusible link 2	**SW UP**	Switch (up)
FM	Evaporator fan motor	**SW WHISPER**	Switch (whisper)
FP	Fuel pump	**TB**	Terminal block
FPS	Centrifugal clutch temperature sensor	**TDS**	Discharge gas temperature sensor
FWS	Flywheel sensor	**TH**	Return air temperature sensor
G	Ground	**THD**	Supply air temperature sensor
GND	Ground	**Wp**	Cooling water pump
GU	Alternator	**WTS**	Water temperature switch

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