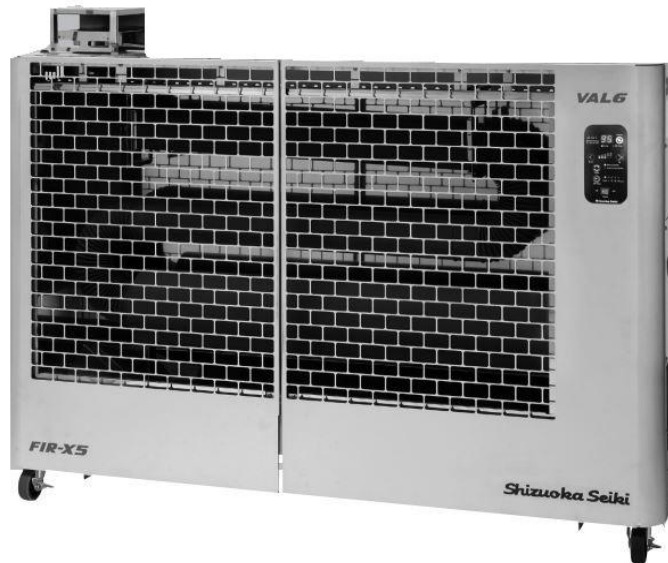


FAR INFRARED OIL HEATER
VAL6 FIR-X5
Maintenance Manual

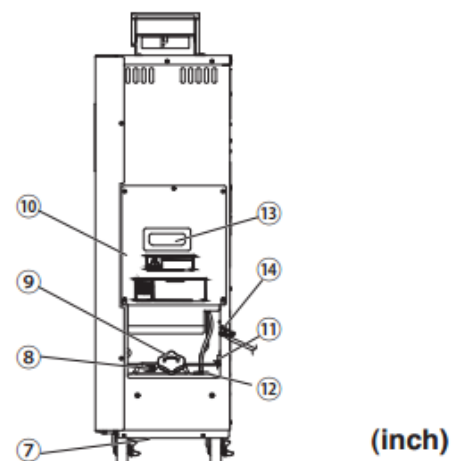
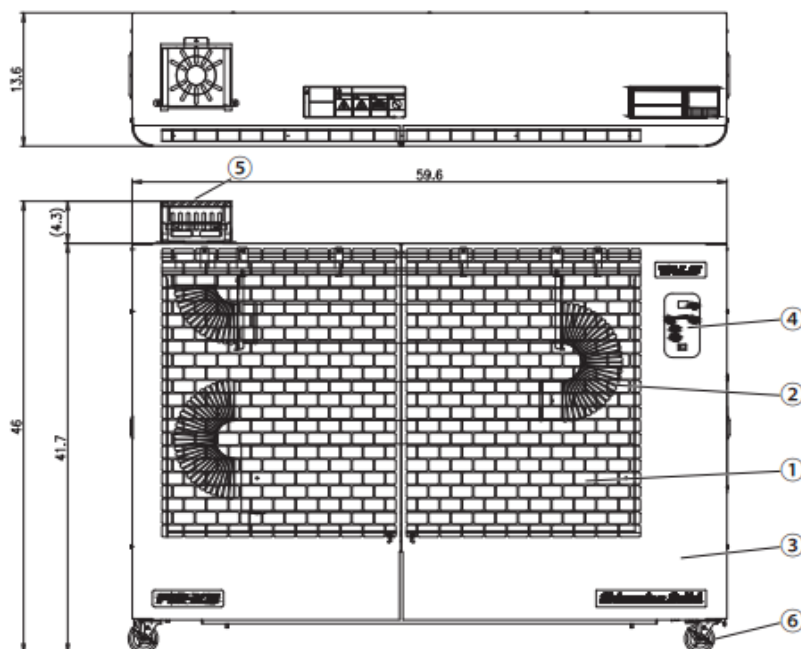


Contents

1. Names of Components	2
2. Safety Devices	3
3. Error Code	3
4. Sequence Time Chart	4
5. Wiring Diagram	4
6. Specifications	5
7. Troubleshooting	6
8. Standard resistance & Voltage	14
9. Check & Repair	15

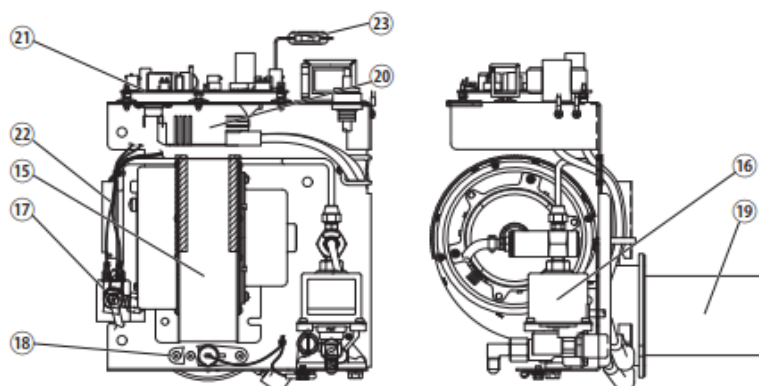
ED2 2021.08

1 【Names of Components】

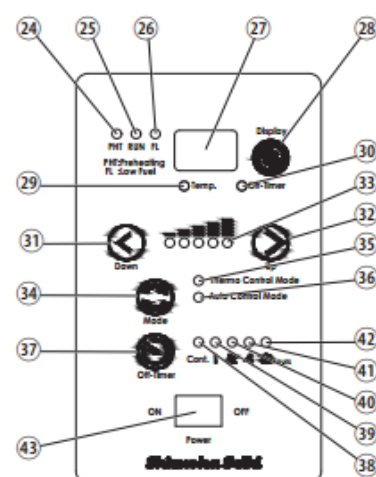


(inch)

< Burner section >



< Operation panel >



- 1 Combustion chamber
- 2 Radiation tube
- 3 Guard
- 4 Operation panel
- 5 Exhaust port
- 6 Wheel
- 7 Fuel tank
- 8 Fuel gauge
- 9 Fuel tank cap
- 10 Burner cover (Burner inside)
- 11 Tip-over switch
- 12 Fuel sensor
- 13 Overheat protection
(The backside of the burner)
- 14 External thermostat cord
- 15 Combustion fan

- 16 Solenoid valve
- 17 Solenoid valve
- 18 Flame monitor
- 19 Draft tube
- 20 igniter
- 21 Control board
- 22 Fuel preheater
- 23 Fuse
- 24 Preheating lamp
- 25 Run lamp
- 26 Low fuel lamp
- 27 Display
- 28 Display switching button
- 29 Temperature display lamp

- 30 Off-timer display lamp
- 31 Down button
- 32 Up button
- 33 Combustion level lamp
- 34 Mode switching button
- 35 Thermo control mode lamp
- 36 Auto control mode lamp
- 37 Off-timer setting button
- 38 Continuous Combustion lamp
- 39 1hour lamp
- 40 2hours lamp
- 41 4hours lamp
- 42 8hours lamp
- 43 Operation switch

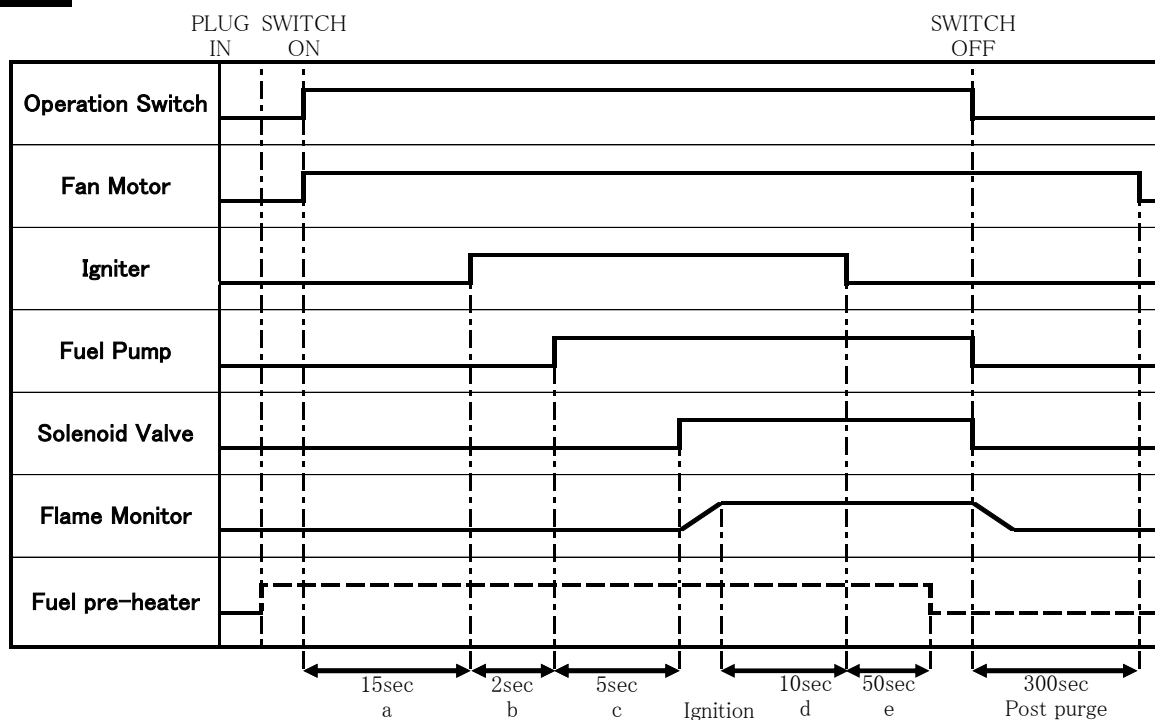
2 【Safety Devices】

Safety Devices	Detecting condition	Working condition after detecting
Flame detection (Misfire)	When the heater cannot detect a ignition during operation.	The error code 「A1」 is displayed and the fan cools down the heater for about 5 minutes (hereafter referred to as Post-purge) .
Low fuel	When the heater detects a out of fuel at the beginning of operation.	The error code 「A2」 is displayed .
	When it pased 60 minutes after the heater detects a out of fuel.	The error code 「A2」 is displayed and Post-purge sequence runs for 5 minutes.
Overheat protection	When the heater overheats.	The error code 「A3」 is displayed and if the heater is operating , Post-purge sequence will run for 5 minutes.
Tip-over	When the heater detects a vibration or an impacts.	The error code 「A4」 is displayed and if the heater is operating, Post-purge sequence will run for 5 minutes.
Abnormal fan speed	When the heater detects an abnormal fan speed.	The error code 「A5」 is displayed and if the heater is operating, Post-purge sequence will run for 5 minutes.
High voltage	When the heater detects a high voltage (about 145V) at the beginning of the operation.	The error code 「HV」 is displayed and the operation is prohibited.
Low voltage stop	When the heater detects a low voltage (about 70V) at the during of the operation.	The error code 「A6」 is displayed and if the heater is operating, Post-purge sequence will run for 5 minutes.
3 consecutive misfire	When there are three consecutive misfire.	There error code 「A7」 is displayed and the heater runs for 5 minutes.After that the operation is pobihited.
Circuitboard communication abnormality	When a communication between the control board and the operation board fails.	The error code 「A8」 is displayed and if the heater is operating, Post-purge sequence will run for 5 minutes.
Low voltage detection	When the heater detects low voltage (about 90V) during the operation.	The error code 「LV」 is displayed and the operation is continued.
Power outage safety device	When the power supply is restored after it shuts down during operation because of blackout or other reason.	The error code 「--」 is displayed and the operation is prohibited.

3 【Error Code】

Display	Safety device	Explanation
A1	Flame detection	When misfire occurs or flame goes out during the operation, the heater shuts down automatically.
A2	Low fuel	No fuel in the fuel tank.
A3	Overheat	When overheating is detected, the heater shuts down automatically.
A4	Tip-over	When the heater receives a large vibration or shock, it shuts down automatically.
A5	Abnormal fan speed	When an abnormality of the combustion fan is detected during combustion, the heater shuts down automatically.
A6	Low voltage stop	When the supply voltage is about 70V or less, the heater shuts down automatically.
A7	3 consecutive misfire	When there are 3 consecutive misfire, the operation is prohibited automatically.
A8	Circuitboard communication abnormality	When communication between the control board and the operation board fails, the operation is prohibited automatically.
HV	High voltage	When the heater is connected to an abnormal high voltage, the operation is prohibited automatically.
LV	Low voltage detection	When the power supply volatage drops below appoximately 90volts during operation, 「LV 」 is displayed and the operation is continued.
※Refer to 「7.Troubleshooting (P.6)」 for countermeasure.		

4 【Sequence Time Chart】



a: Ignition delay timer

b: Pump delay timer

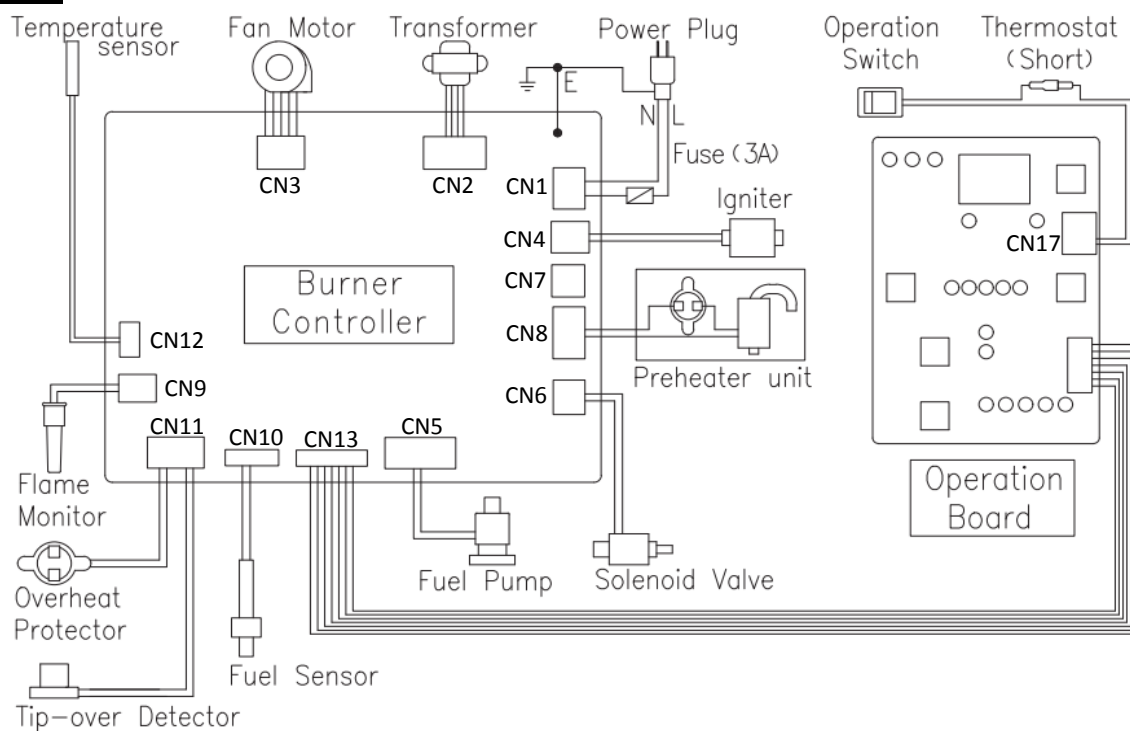
c: Solenoid valve delay timer

d: Post ignition

e: Stable time

※Fuel pre-heater : When the power cord is connected, the heater preheats for 3 minutes if the outside temperature is less than 41°F.

5 【Wiring Diagram】



6 【Specifications】

Specifications

Model Type	VAL6 FIR-X5
Type	Radiated / Direct-fired
Ignition System	High intensity discharge
Fuel	Kerosene or Fuel-Oil no heavier than No.2 (Diesel)
Fuel Consumption (Heat Output)	Level 5 : 0.53 GAL/h, 1.72 kg/h (75,100 BTU, 22.0 kW) Level 4 : 0.50 GAL/h, 1.63 kg/h (71,300 BTU, 20.9 kW) Level 3 : 0.48 GAL/h, 1.55 kg/h (67,600 BTU, 19.8 kW) Level 2 : 0.45 GAL/h, 1.46 kg/h (63,800 BTU, 18.7 kW) Level 1 : 0.42 GAL/h, 1.38 kg/h (60,100 BTU, 17.6 kW)
Tank Capacity	7.9 gallons (29.9 L)
Continuous Operating Time	Level 5 : 14 hours (Stopped by fuel sensor)
Dimensions (inch)	46.0 H x 59.6 W x 13.6 D
Weight (w/empty tank)	172 Lbs, 78kg
Power Supply	AC 120V (60Hz)
Power Consumption	Igniting : 65W, Burning : 45W (Lv.5), 41W (Lv.4), 37W (Lv.3), 34W (Lv.2), 31W (Lv.1) +44W When Preheater is operating
Electric Fuse	3A 250V
Operating Noise Level	56 dBA (Lv.5), 55dBA (Lv.4), 54dBA (Lv.3), 53dBA (Lv.2), 52dBA (Lv.1)
Safety Systems	Tip-over Switch Flame Monitor Electrical System Protection (High Voltage, Low Voltage, Prevention of automatic ignition after black-out) Overheat Protection Anomaly detection system for fan motor
Other Systems	Preheater for fuel supply Solenoid valve for remaining fuel Valve for draining air
Functions	Combustion mode Thermo control mode (The combustion level is manually maintained.) Auto control mode (The combustion level is automatically adapted to programed temperature setting) OFF-timer (1, 2, 4, 8 hours) Display (7seg) switching (Temperature [F], OFF-timer remaining time)

7 【Troubleshooting】

Contents

No.	Phenomenon	Page
1	Fuse blows out	7
2	The heater does not start	8
3	The heater does not ignition	9
4	Misfire within 40 seconds after ignition	11
5	Combustion stop during the operation	11
6	Smell of fuel comes out	12
7	Smoke comes out	12
8	Fuel leaks	13
9	Display 「LV」	13
10	Noise occurs	13
11	Combustion is not stable	13

Phenomenon	How to check	Result	Cause	Remedy
1 Fuse blows out. A. When the plug is put into an outlet.	Disconnect all connectors from the burner controller, then plug the power cable into an outlet	Fuse blows out	Failure of burner controller	Replace burner controller
	Unplug transformer connector (CN 2) from burner controller, then measure coil resistance values Standard: white-white : about 110 Ω $\Rightarrow$ Figure 3 (P.17) red-red : about 3 Ω yellow-yellow : about 20 Ω	0 Ω	Failure of transformer	Replace transformer
	Measure resistance at surge absorber (SA1) Standard: other than 0 Ω $\Rightarrow$ Figure 5 (P.18)	0 Ω	Surge absorber is short-circuited.	Replace burner controller
	Unplug pre-heater connector, then measure coil resistance values Standard: white-blue : about 400 Ω $\Rightarrow$ Figure 3 (P.17)	0 Ω	Failure of pre-heater	Replace pre-heater
B. When the switch is turned on. ※When fan motor is operated.	Unplug fan motor connector (CN 3) from burner controller, then turn on	Fuse does not blow out	Failure of fan motor	Replace fan motor
	Unplug fan motor connector (CN 3) from burner controller, then measure resistance values Standard: red-blue : about 520k Ω $\Rightarrow$ Figure 3 (P.17)	0 Ω		
C. When fuse blows out about 15 seconds after turning on. ※When igniter is operated.	Unplug igniter connector (CN 4) from burner controller, then turn on	Fuse does not blow out	Failure of igniter	Replace of igniter
	Unplug igniter connector (CN 4) from electrode, then measure coil resistance values of the high voltage side Standard: black-black (thick) : about 4k Ω $\Rightarrow$ Figure 3 (P.17)	0 Ω		
D. When fuse blows out about 17 seconds after turning on. ※When fuel pump is operated.	Unplug fuel pump connector (CN 5) from burner controller, then turn on	Fuse does not blow out	Failure of fuel pump	Replace of fuel pump
	Unplug fuel pump connector (CN 5) from burner controller, then measure resistance values standard: blue-blue : about 88 Ω $\Rightarrow$ Figure 3 (P.17)	0 Ω		
E. When fuse blows out about 22 seconds after turning on. ※When solenoid valve is operated.	Unplug solenoid valve connector (CN 6) from burner controller, then turn on	Fuse does not blow out	Failure of solenoid valve	Replace of solenoid valve
	Unplug solenoid valve connector (CN 6) from burner controller, then measure resistance values standard red-red : about 1.8k Ω $\Rightarrow$ Figure 3 (P.17)	0 Ω		

Phenomenon	How to check	Result	Cause	Remedy
2 The heater does not start. A. The lamp does not light on.	Replug power cable (CN1) , and then turn on	It works normally (Lamps is lit)	Disconnection of power cable	Plug connector (CN1) firmly
	Measure voltage at (CN1) terminal burner controller standard: AC 120V ⇒ Figure 4 (P.17)	AC 0V	No power source is supplied	Operate with appropriate power source
			Fuse blows out	Replace fuse
			Disconnection of power cable	Replace power cord
	Replug in transformer connector (CN 2) , and then turn on	It works normally (Lamps is lit)	Disconnection of transformer	Plug connector (CN2) firmly
	Measure voltage at input side of transformer connector standard: white-white : AC 120V ⇒ Figure4 (P.17)	AC 0V	Failure of burner controller	Replace burner controller
	Measure voltage at output side of transformer connector standard: yellow-yellow : AC 16V red-red : AC 12.5V ⇒ Figure4 (P.17)	AC 0V	Failure of transformer	Failure of transformer.
	Unplug transformer connector (CN 2) from burner controller, then measure coil resistance values Standard: white-white : about 110Ω ⇒ Figure3 (P.17) red-red : about 3Ω yellow-yellow : about 20Ω	∞Ω	Disconnection of transformer	Replace transformer
	Replug operation switch connector (CN17) , and then turn on	It works normally (Lamps is lit)	Disconnection of operation switch connector	Plug connector (CN17) firmly
	Unplug operation switch connector (CN17) , and then check conduction with multimeter Standard: red-red : Conducting (0Ω) when turned on	It does not conduct when operation switch is turned on (∞Ω)	Failure of operating switch	Replace operation switch
Disconnection of operation switch cord			Replace operation switch cord	
※When it does not correspond to the above content			Failure of burner controller	Replace burner controller
B. Display 「--」 ※When power outage safety device is operated	Turn off the operating switch, and then turn on	It works normally. (A ambient temperature is displayed)	Power source is restored after blackout when operating	—
			Power cord is connected with switching on	
	※When it does not correspond to the above content			Failure of burner controller
C. Display 「A2」	Refuel the fuel tank and operate the heater	It works normally.	No fuel in the fuel tank.	Refuel
	Pour the fuel in the fuel tank about a one-third and, unplug fuel sensor connector (CN10) , and then check conduction with multimeter Standard: black-black : Conducting (0Ω) with fuel	If the multimeter reads ∞Ω.	Failure of fuel sensor	Replace fuel sensor
			Disconnection of fuel sensor cord	Replace fuel sensor cord
	※When it does not correspond to the above content			Failure of burner controller

Phenomenon	How to check	Result	Cause	Remedy
2 The heater does not start. D. Display 「A3」 ※When overheat protection is operated	Replug overheat protection connector (CN 11) , and then turn on	「A3」 is not displayed (A ambient temperature is displayed)	Disconnection of overheat protection connector.	Plug connector (CN11) firmly
	Unplug overheat protection connector (CN 11) , and then check conduction with multimeter Standard: red-red : Conduction (0Ω) ⇒ Figure3 (P.17) Confirmation of burner packing ⇒ Figure15 (P.23)	It does not conduct when operation switch is turned on (∞Ω) (Overheat protection is not detected)	Failure of overheat protection	Replace overheat protection
			Disconnection of overheat protection cord.	Replace overheat protection cord
		It does not conduct when operation switch is turned on (∞Ω) (Overheat protection is detected)	Lack of burner packing	Add burner packing
			Deterioration of burner packing	Replace burner packing
※When it does not correspond to the above content.			Failure of burner controller.	Replace burner controller
E. Display 「A4」 ※Tip-over detector operation.	Replug in tip-over detector connector (CN 11) , and then turn on	「A3」 is not displayed (A ambient temperature is displayed)	Disconnection of tip-over connector	Plug connector (CN11) firmly
	Unplug tip-over detector connector (CN 11) , and then check lead with multimeter Standard: black-black : Conduction in horizontal (0Ω) ⇒ Figure3 (P.17)	It does not conduct in horizontal	Failure of tip-over switch	Replace tip-over switch
			Failure of tip-over switch cord	Replace tip-over switch cord
	※When it does not correspond to the above content			Failure of burner controller
F. Display 「A5」 Combustion fan abnormality detection .	Replug in combustion fan connector (CN 3) and then turn on	「A5」 is not displayed (A ambient temperature is displayed)	Disconnection of combustion fan connector.	Plug connector (CN3) firmly
	Turn the combustion fan by hand	Does not rotate or it move slowly	Combustion fan is locked	Cancel the lock or replace combustion fan
	Measure the voltage at CN3 terminal on burner controller standard: DC 170V ⇒ Figure4 (P.17)	DC 170V	Failure of combustion fan	Replace combustion fan
		DC 0V	Failure of burner controller	Replace burner controller
G. Display 「A6」 ※Low voltage stop.	Replug in power cable (CN1) , and then turn on	「A6」 is not displayed (A ambient temperature is displayed)	Disconnection of power source connector	Plug connector (CN1) firmly
	Measure the voltage of AC outlet standard: AC 120V ⇒ Figure 4 (P.17)	Lower than AC70V	Supplied voltage is too low	Operate with appropriate power source
	※When it does not correspond to the above content			Failure of burner controller
H. Display 「HV」 ※High voltage detection.	Measure the voltage of AC outlet standard: AC 120V ⇒ Figure4 (P.17)	More than AC 145V	Supplied voltage is too high	Operate with appropriate power source
	※When it does not correspond to the above content			Failure of burner controller.
I. Display 「A7」 ※3 consecutive misfire.	Turn off the operation switch, and then plug the power cable again	「A7」 is not displayed (A ambient temperature is displayed)	Normal indication after 3 consecutive misfire	—
	※When it does not correspond to the above content			Failure of burner controller.
3 The heater does not ignite. Display 「A1」 A. Fuel pump does not operate at all.	Replug in the fuel pump connector (CN 5) , and then turn on	「A1」 is not displayed (A ambient temperature is displayed)	Disconnection of fuel pump connector	Plug connector (CN5) firmly
	Unplug the fuel pump (CN 5) from burner controller, then measure resistance values standard: blue-blue : about 88Ω ⇒ Figure3 (P.17)	∞Ω	Failure of fuel pump.	Replace pump
			Disconnection of fuel pump connector	

Phenomenon	How to check	Result	Cause	Remedy
Display 「A1」	Check if there is a hole in the combustion section part	There is a hole	Stop of operation due to light leakage detection	Replace combustion chamber
A. Fuel pump does not operate at all.	Voltage of flame monitor standard: dark : DC 5V or higher ⇒ Figure4 (P.17) light : DC 5V or lower	The valves does not change or it is much different from the standard	Failure of flame monitor	Replace flame monitor
B. Fuel pump works but no fuel supply or low supply.	Check if the pipe is clogged	Fuel line is clogged	Flow rate is lower by clogged	Clean fuel line
	Check if filter element is dirty ⇒ Figure7 (P.19)	Filter element is dirty	Filter element is clogged	Replace filter element
	Check looseness of each joints	The connection has become loose	Air is coming	Fasten joints more tightly
	Check if the fuel pump is clogged	Pipe is clogged	Flow rate is lower by clogged	Replace pump
	Check if the nozzle is clogged	Nozzle is clogged	Flow rate is lower by clogged	Replace nozzle
	Replug in solenoid valve connector (CN 6) , and then turn on	「A1」 is not displayed (A ambient temperature is displayed)	Disconnection of solenoid valve connector	Plug connector (CN6) firmly
	Measure voltage at CN6 terminal on burner controller standard: black-black : about DC110V ⇒ Figure4 (P.17)	About DC 110V (For reference)	Failure of solenoid valve	Replace solenoid valve
		0V	Failure of burner controller	Replace burner controller
	Unplug the solenoid valve connector (CN 6) from the burner controller, then measure the resistance values standard: red-red : 1.8kΩ ⇒ Figure3 (P.17)	∞Ω	Failure of solenoid valve	Replace solenoid valve
C. Igniter does not spark.	Replug in igniter connector (CN 4) , and then turn on	Igniter does spark.	Disconnection of Igniter connector.	Plug connector (CN4) firmly
	Measure voltage at the CN4 terminal burner controller standard: AC 120V ⇒ Figure4 (P.17)	AC 120 V	Failure of igniter	Replace igniter
			Disconnection of Igniter connector	
		AC 0 V	Failure of burner controller	Replace burner controller
	Unplug the igniter connector (CN 4) from the electrode, then measure the coil resistance values Standard: black-black (Thick) : about 4kΩ ⇒ Figure3 (P.17)	∞Ω	Failure of igniter.	Replace igniter
D. Igniter does spark.	Check the fuel ⇒ Figure 8 (P.19)	Use fuel other than diesel and kerosene	Low quality fuel	Operate with appropriate fuel
		Be mixed with water		
		Diesel and kerosene goes bad		
	Measure the alignment of electrode. Standard: ⇒ Figure10 (P.20)	Part is out of standard position.	Alignment of electrode is out of standard	Replace electrode
	Check air inlet opening of fan moter. standard: 3.0 ⇒ Figure 13 (P.22)	Air inlet opening is unusual.	Improper quantity of combustion air	Operate with appropriate air inlet opening

Phenomenon	How to check	Result	Cause	Remedy	
4 Misfire within 40 seconds after ignition. Display 「A1」 ※ Ignition not detected during operation	Check dirty of flame monitor lens ⇒ Figure11 (P.21)	lens of flame monitor is dirty	Lock of light quantity to flame monitor	Clean flame monitor lens	
	Replug in the flame monitor connector (CN 9) , and then turn on	「A1」 is not displayed (A ambient temperature is displayed)	Disconnection of flame monitor connector	Plug connector (CN 9) firmly	
	Check voltage of flame monitor standard: dark : DC 5V or higher ⇒ Figure4 (P.17) light : DC 5V or lower	The valves does not change or it is much different from the standard.	Failure of flame monitor	Replace flame monitor	
		The value is higher than DC 5V	Failure of burner controller	Replace burner controller	
	Check if the nozzle is clogged	Nozzle is clogged	Flow rate is lower by clogged	Replace nozzle	
	Make sure that the filter element is dirty ⇒ Figure7 (P.22)	Filter element is dirty	Filter element is clogged	Replace filter element	
	Check air inlet opening of fan moter standard: 3.0 ⇒ Figure 13 (P.22)	Air inlet opening is unusual	Improper quantity of combustion air	Operate with appropriate air inlet opening	
	※When it does not correspond to the above content		Failure of burner controller.	Replace burner controller	
5 Combustion stop during the operation. A. Display 「A1」 ※Ignition not detected during operation.	Check the fuel ⇒ Figure 8 (P.19)	Use fuel except diesel and kerosene	Low quality fuel	Operate with appropriate fuel	
		Be mixed with water			
		Diesel and kerosene goes bad			
	Check air inlet opening of fan moter standard: 3.0 ⇒ Figure 13 (P.22)	Air inlet opening is unusual.	Improper quantity of combustion air	Operate with appropriate air inlet opening	
	Check dirty of flame monitor lens ⇒ Figure11 (P.21)	lens of flame monitor is dirty.	Lock of light quantity to flame monitor	Clean flame monitor lens	
	Check looseness of each joints	The connection has become loose.	Air is coming	Fasten joints more tightly	
	B. Display 「A2」	Refuel and operate the heater	It works normally.	No fuel in the fuel tank.	Refuel
		Pour the fuel in the fuel tank about a one-third and, unplug fuel sensor connector (CN10) , and then check conduction with multimeter Standard: black-black : Conducting (0Ω) with fuel	If the multimeter reads ∞ Ω ,	Failure of fuel sensor	Replace fuel sensor
Disconnection of operation fuel sensor cord				Replace fuel sensor cord	
※When it does not correspond to the above content		Failure of burner controller	Replace burner controller		
C. Display 「A3」 ※Overheat protector operation.	Check the ambient temperature Standard: Lower than 30℃ (86° F)	More than 30℃ (86° F)	Ambient temperature is too high	Operate in lower than 30℃ (86° F)	
	Replug overheat protection connector (CN 11) , and then turn on	「A3」 is not displayed (A ambient temperature is displayed)	Disconnection of overheat protection connector.	Plug connector (CN11) firmly	
	Unplug overheat protection connector (CN 11) , and then check conduction with multimeter Standard: red-red : Conduction (0Ω) ⇒ Figure3 (P.17) Confirmation of burner packing ⇒ Figure15 (P.23)	It does not conduct when operation switch is turned on (∞Ω) (Overheat protection is not detected)	Failure of overheat protection	Replace overheat protection	
			Disconnection of overheat protection cord.	Replace overheat protection cord	
		It does not conduct when operation switch is turned on (∞Ω) (Overheat protection is detected)	Lack of burner packing	Add burner packing	
D. Display 「A4」 ※Tip-over detector operation	Replug tip-over detector connector (CN 11) , and then check conduction with multimeter Standard: black-black : Conduction (0Ω) when turned on.	It does not conduct in horizontal (∞Ω)	Failure of tip-over detector	Replace tip-over switch	
			Disconnection of tip-over detector connector	Replace tip-over switch cord	
			Disconnection of tip-over connector	Plug connector (CN11) firmly	

Phenomenon	How to check	Result	Cause	Remedy
6 Smell of fuel comes out.	Check air inlet opening of fan moter. standard: 3.0 ⇒ Figure 13 (P.22)	Air inlet opening is unusual	Improper quantity of combustion air	Operate with appropriate air inlet opening
	Check if the pipe is clogged	Fuel line is clogged	Flow rate is lower by clogged	Clean fuel line
	Check if filter element is dirty ⇒ Figure7 (P.19)	Filter element is dirty	Filter element is clogged	Replace filter element
	Check looseness of each joints	The connection has become loose	Air is coming	Fasten joints more tightly
	Check if the nozzle is clogged	Nozzle is clogged	Flow rate is lower by clogged	Replace nozzle
	Check the marking of the nozzle mark: 0.40 G 80° AJ (DELAVAN)	Marking is incorrect	Incorrect nozzle.	Use correct nozzle
	Check the fuel ⇒ Figure 8 (P.19)	Use fuel except diesel and kerosene Be mixed with water Diesel and kerosene goes bad	Low quality fuel	Operate with appropriate fuel
7 Smoke comes out.	Check air inlet opening of fan moter. standard: 3.0 ⇒ Figure 13 (P.22)	Air inlet opening is unusual.	Improper quantity of combustion air	Operate with appropriate air inlet opening
	Check the dust of combustion fan	Fan is dusty.	Supplied air is reduced	Clean combustion fan
	Check the power supply voltage standard : AC 108~132V ⇒ Figure7 (P.19)	Less than standard	The rotation number of combustion fan is reduced	Operate with appropriate power source
	Check the marking of the nozzle mark: 0.40 G 80° AJ (DELAVAN)	Marking is incorrect.	Incorrect nozzle.	Use correct nozzle
	Check the altitude where heater is used	It is being used at higher than the altitude of 1000m (3000ft)	An oxygen concentration is low	Extend combustion air inlet opening standard : 3
	Check the fuel ⇒ Figure 8 (P.19)	Use fuel except diesel and kerosene Be mixed with water Diesel and kerosene goes bad	Low quality fuel	Operate with appropriate fuel
8 Fuel leaks	Check looseness of each joints	The connection has become loose	Air is coming	Fasten joints more tightly
	Check the condition of each part of drain packing	Be damaged and cracked	Failure of drain packing	Replace drain packing
9 Display 「LV」 Low voltage detection. (continue ignition)	Check the power supply voltage standard : AC 108~132V	Less than AC 90V	Supplied voltage is low	Operate with appropriate power source
	※When it does not correspond to the above content		Failure of burner controller	Replace burner controller

Phenomenon	How to check	Result	Cause	Remedy
10 Noise occurs. Noise occurs.	Check air inlet opening of fan moter. standard: 3.0 ⇒ Figure 13 (P.22)	Air inlet opening is unusual	Improper quantity of combustion air	Operate with appropriate air inlet opening
	Check the marking of the nozzle mark: 0.40 G 80° AJ (DELAVAN)	Marking is incorrect	Incorrect nozzle.	Use correct nozzle
	Check the altitude where heater is used	It is being used at higher than the altitude of 1000m (3000ft)	An oxygen concentration is low	Extend combustion air inlet opening standard : 3
	Check the fuel ⇒ Figure 8 (P.19)	Use fuel except diesel and kerosene	Low quality fuel	Operate with appropriate fuel
		Be mixed with water		
		Diesel and kerosene goes bad		
11 Combustion is not stable.	Check looseness of each joints	The connection has become loose	Air is coming	Fasten joints more tightly

8 【Standard resistance & Voltage】

<Standard resistance of functional parts>

Parts	Connector N o	Lead	Condition	Resistance	Memo
Operating Switch	CN17 1-2PIN	Red-Red	On	0 Ω	
			Off	∞ Ω	
Tip-over Switch	CN11 1-2PIN	Black-Black	not in working	0 Ω	
			in working	∞ Ω	
Overheat Protection	CN11 3-4PIN	Red-Red	not in working	0 Ω	
			in working	∞ Ω	
Igniter	CN4 1-2PIN	black-Black (Thick)	Output (Electrode side)	about 4k Ω	
Fuel Pump	CN5 1-3PIN	Blue-Blue	---	about 88 Ω	
Solenoid valve	CN6 2-4PIN	Red-Red	---	about 1.8k Ω	
Fan Motor	CN3	Red-Blue	---	about 520k Ω	Normal scale : 3.0
Temperature sensor	CN12 1-3PIN	Black-Black	Disconnection	∞ Ω	
			20 °C	13.0k Ω	
			Short	0 Ω	
Fuel pre-heater	CN8 1-3PIN	White-Blue	---	400 Ω	
Transformer	4-8PIN	White-White	Input side	110 Ω	
	CN2 1-2PIN	Red-Red	Output1	3 Ω	
	5-6PIN	Yellow-Yellow	Output2	20 Ω	
Fuel sensor	CN10 1-2PIN	Black-Black	enough fuel	0 Ω	
			out of fuel	∞ Ω	

<Input &Output of each component>

Parts	Connector N o	Lead	Condition	Voltage	Memo
Power Cable	CN1	Black-White	—	A C 120 V	
Igniter	CN4	Black-Black	Input side	A C 120 V	
Fan Motor	CN3	Red-Blue	—	DC 170V	
Fuel Pump	CN5	Blue-Blue	—	about DC 50V	
Transformer	4-8PIN	White-White	Input side	A C 120 V	
	CN2 1-2PIN	Red-Red	Output1	about 12.5V	
	5-6PIN	Yellow-Yellow	Output2	about 16V	
Solenoid valve	CN6 2-4PIN	Blue-Blue	—	about D C 110 V	
Fuel pre-heater	CN8 1-3PIN	White-Blue	—	A C 120 V	68±9° F → OFF 41±9° F → ON

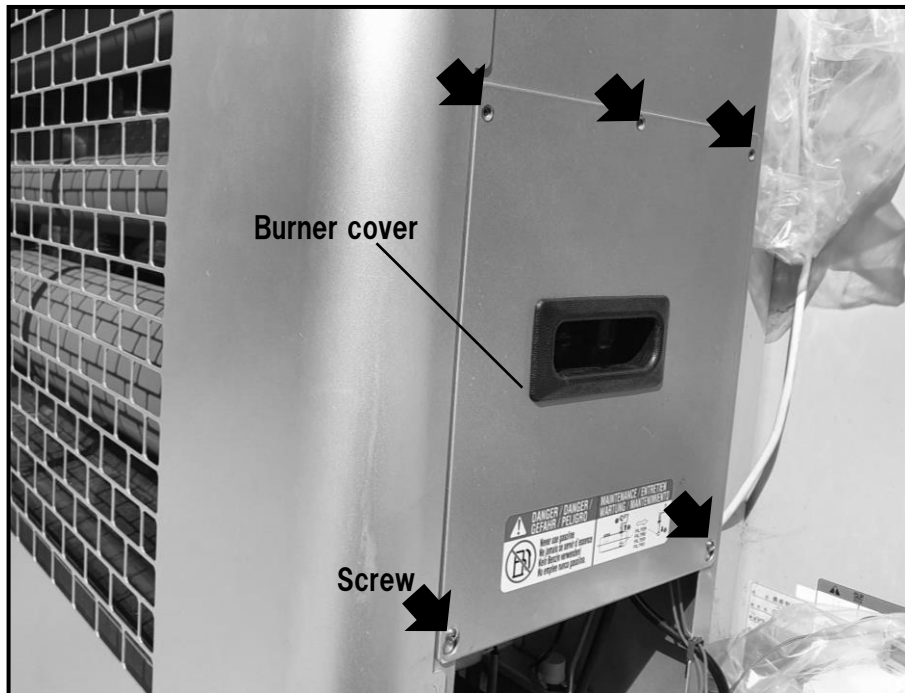
9

【Check & Repair】

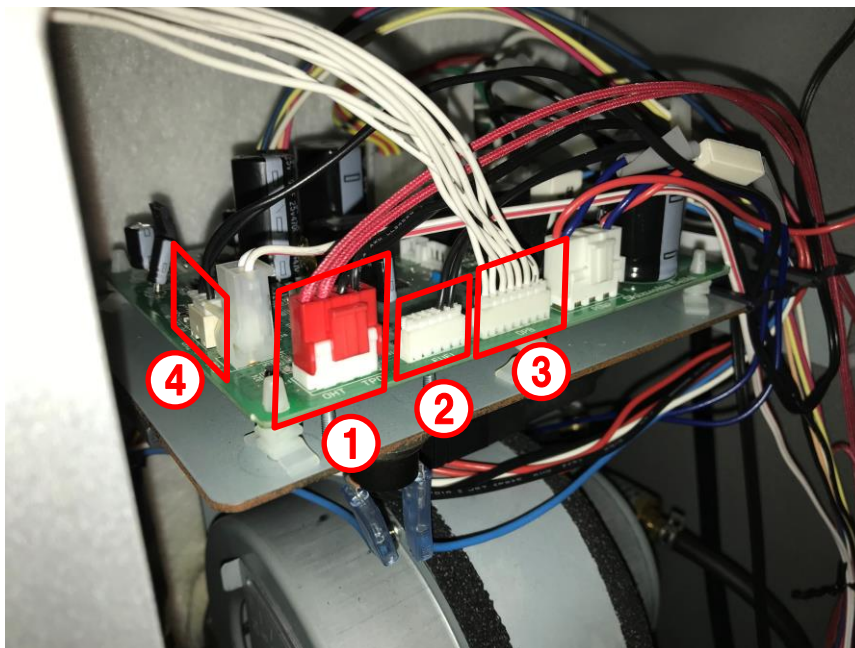
Figure1	Removing a burner cover	P.16
Figure2	Removing a burner unit	P.16
Figure3	Mesuring resistance	P.17
Figure4	Mesuring voltage	P.17
Figure5	Checking a surge absorber (SA1)	P.18
Figure6	Replacing a fuse	P.18
Figure7	Checking a filter element	P.19
Figure8	Checking a fuel tank	P.19
Figure9	Checking a fuel pump	P.20
Figure10	Positioning a electrode	P.20
Figure11	Cleaning a flame monitor	P.21
Figure12	Checking a burner cone • Whirl vane • Stabilizer	P.21
Figure13	Adjusting an air inlet opening of fan motor	P.22
Figure14	Overheat protection system	P.22
Figure15	Burner packing	P.23

Removing a burner cover

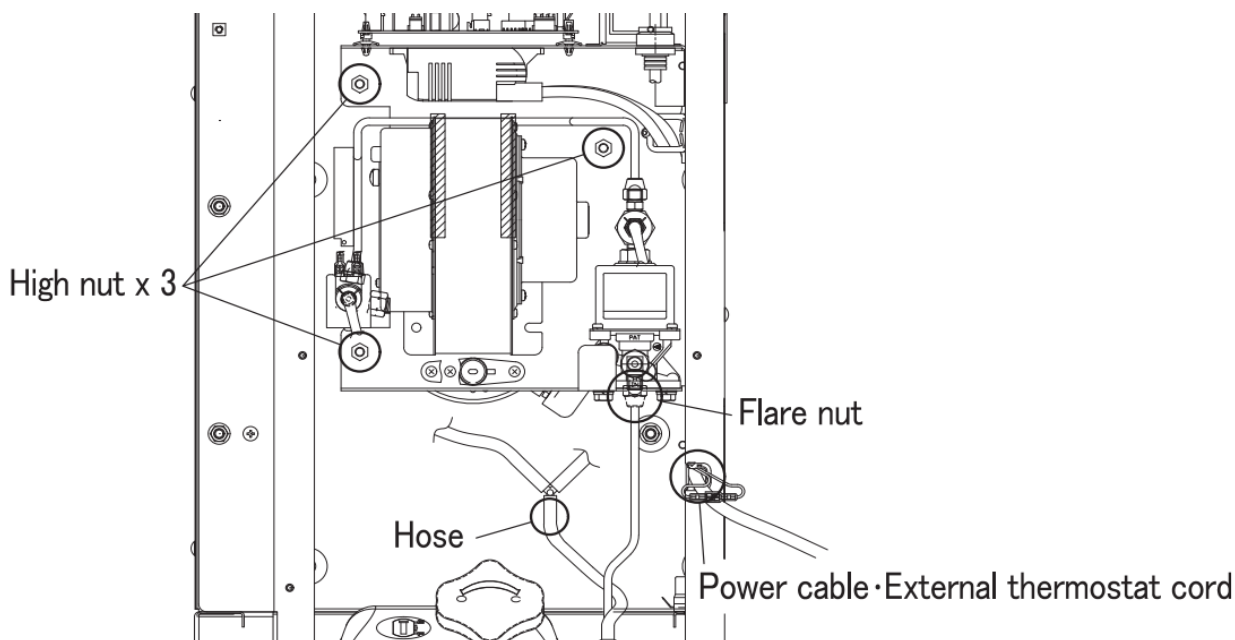
Loosen five screws and take the burner cover off.



Removing a burner unit



- ① Disconnect the 4 connectors from the burner controller.
(① Overheat prevention & Tip-over switch, ② Fuel sensor, ③ Operation board connector, ④ Temperature sensor : refer to Wiring diagram (P.4))



② Remove the flare nut, high nut, hose, external thermostast cord and power code.

Figure 3 Mesuring resistance

- ① Make sure the power cord is disconnected.
- ② Unplug an intended connector from burner controller.
- ③ Turn on the multimeter and set multimeter range.
- ④ Insert the lead head of multimeter to connector [lead wire side] and measure resistance.

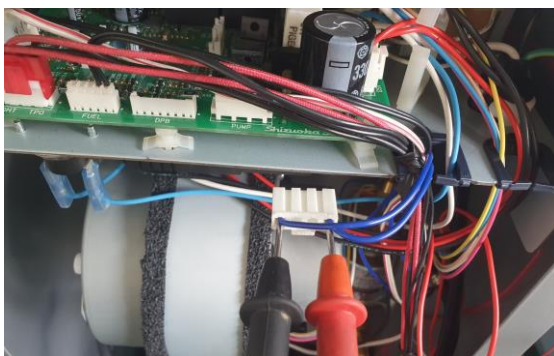
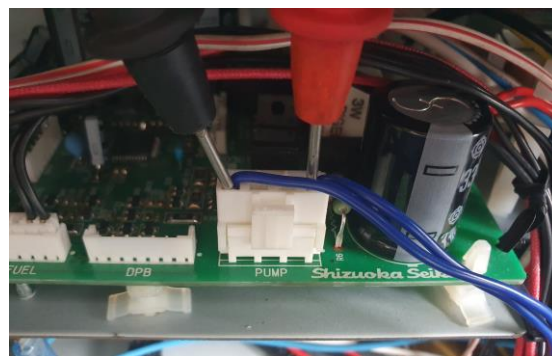


Figure 4 Mesuring voltage

- ① Operate the heater.
- ② Turn on the multimeter and set AC voltage range (partially direct current range).
- ③ Insert the lead head of multimeter to connector and measure voltage.



CAUTION

- ※ Make sure the power cord is disconnected. (when measuring resistance)
- ※ Measurement value refer to 「Standard resistance & Voltage」 . (P.14)
- ※ Be careful not to insert the lead head of resistor strongly since damage in connector may occur.

Figure 5 Checking a surge absorber (SA1)

Take out the operation board, and then point the lead head at solder part of SA1

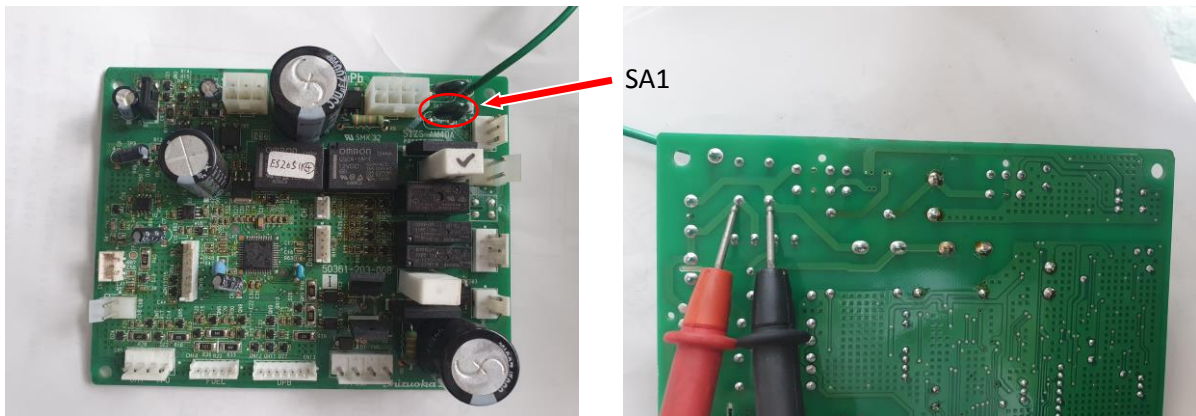


Figure 6 Replacing a fuse

1. Loosen five screws of burner cover and then take the cover off.
2. Take out the fuse from the fuse holder.
3. Replace with a new one.
4. Close the fuse holder.
5. Put the burner cover back and then tighten screws.

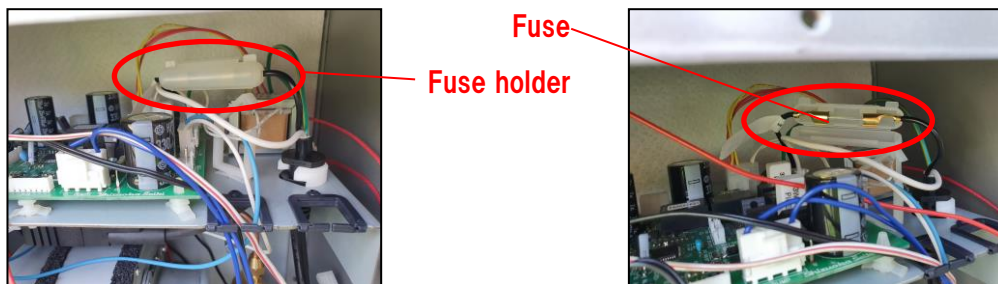


Figure7 Checking a filter element

1. Remove the suction pipe from the fuel tank.
2. If the filter is dirty, replace it with a new one.
3. Return the suction pipe to the fuel and firmly secure.

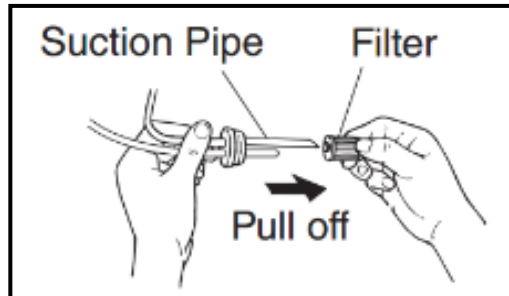
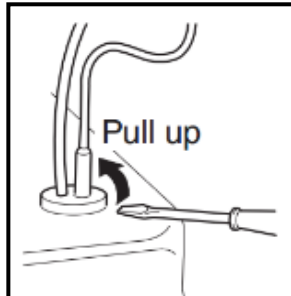


Figure8 Checking a fuel tank

- ① Remove the fuel cap and insert a suction pump into the tank.
- ② Remove as much fuel as possible (with the suction pump). Be sure that the fuel being removed is put only into a can or other container approved in your area for holding flammable liquids such as kerosene and Fuel-Oil no heavier than No.2 (Diesel).
- ③ Tighten the fuel cap firmly.
- ④ Prepare an empty container of about 4 liters (1.1 gallons) capacity: to hold kerosene and water remaining in the fuel tank, place the container under the drain bolt (of the fuel tank).
- ⑤ Next, use a 24mm wrench to remove the drain bolt and tilt the fuel tank until the fuel is completely drained out of the tank. (At the same time, be careful not to lose the drain bolt packing.)
- ⑥ Restore the drain bolt packing and tighten the drain bolt firmly so that fuel can not leak out (of the fuel tank).
- ⑦ Wipe off kerosene or water spilled over the tank and the surrounding area.

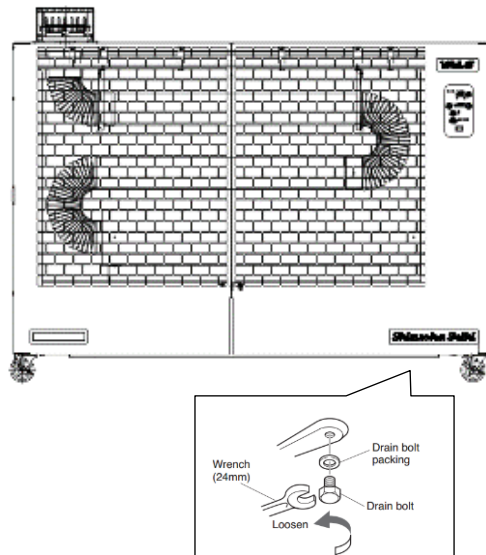


Figure9 Checking a fuel pump

Take out a fuel outlet line then check whether or not fuel comes out.

Please be careful because the fuel strongly comes out.

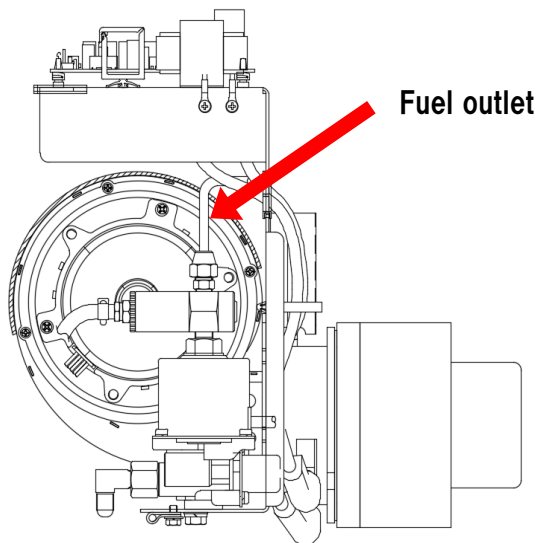


Figure10 Positioning a electrode

- Take out a burner and check each clearance as below.

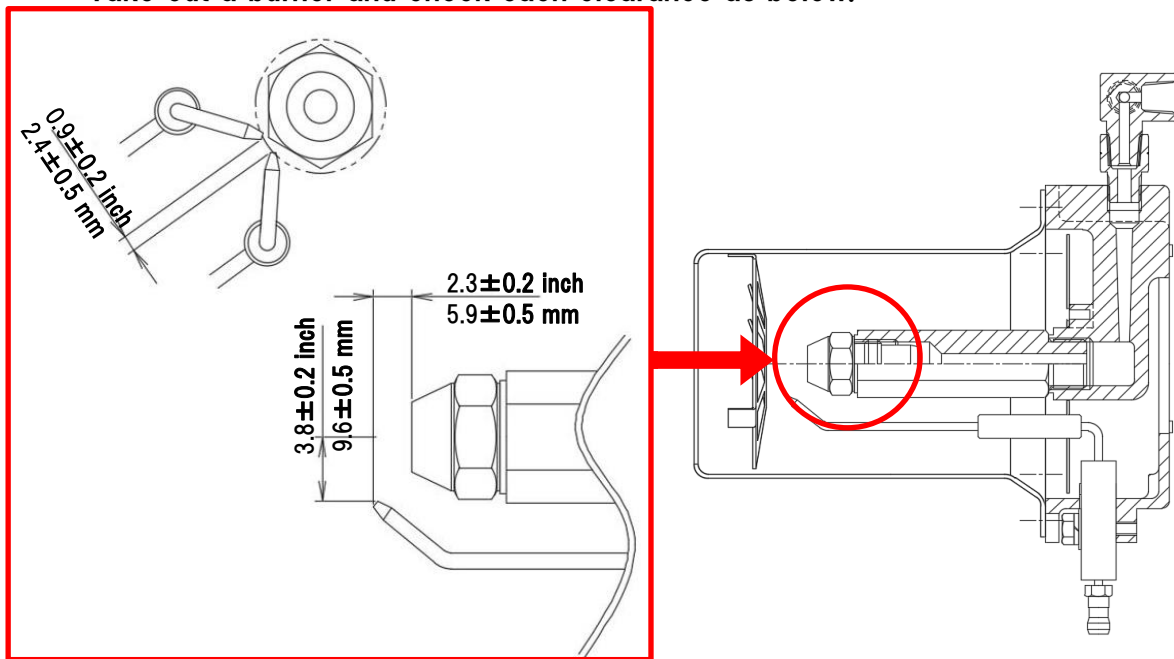
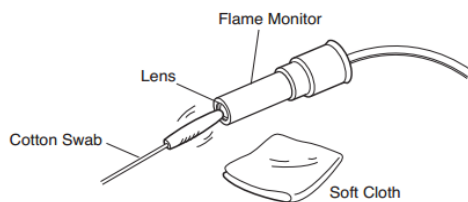


Figure11 Cleaning a flame monitor

- ① Unscrew five screws of burner cover and take the burner cover off. Pull out the flame monitor and check whether or not its lens is dirty/foul
- ② If the lens is dirty/foul, clean the surface of the lens with a soft cotton swab or cloth until it is clear.
- ③ Replace the flame monitor. Then securely replace the burner cover using the provided screws.



Flame monitor

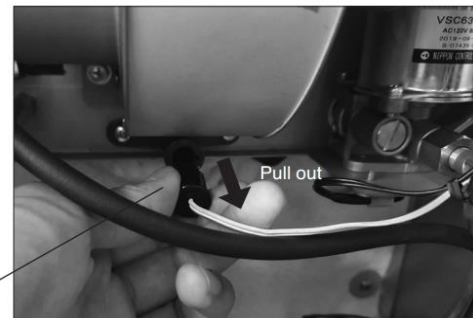


Figure12 Checking a burner cone • Whirl vane • Stabilizer

Take out a burner and check whether or not burner cone and whirl vane are dirt or not.
In case the burner cone and/or whirl vane is dirty, clean it (them) with cloth or brush.

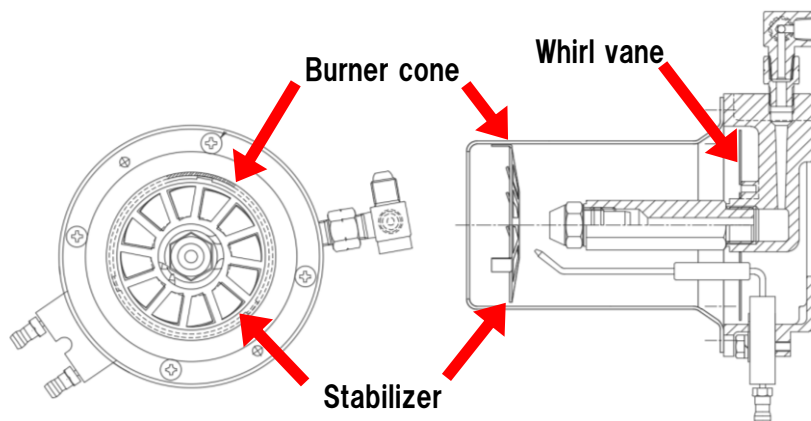


Figure13 Adjusting an air inlet opening of fan motor standard : 3

Loosen a screw and then extend/narrow an air inlet opening.
Also trial operation is required after each adjustment.
Be sure to repeat adjustment until following symptoms are identified.

- Black smoke is not coming out.
- White smoke extinguishes within a few seconds after ignition.
- Smell of fuel clear within ten seconds after ignition.

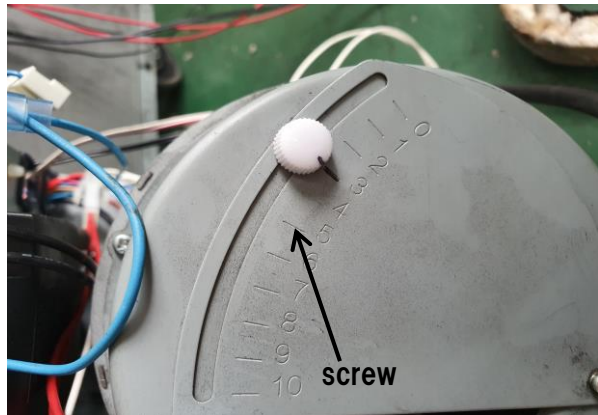
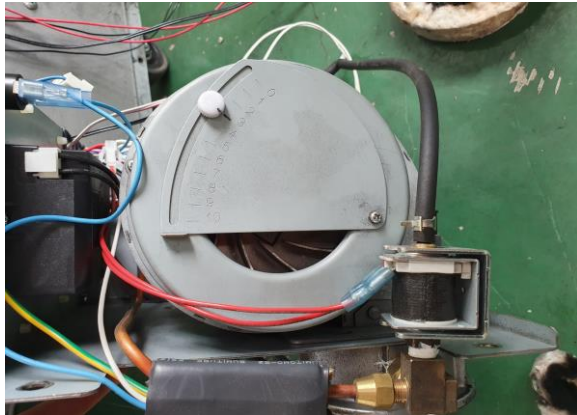


Figure14 Overheat protection system

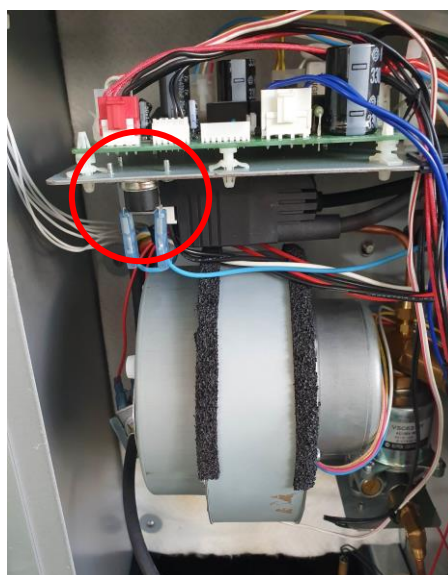
Take out the burner cover and unit from main body, as detailed in Figure 1 and 2.

When the burner uni

Burner section



Pre-heater section



Overheat protection system (Burner section)

293±7° F off (Display 「A3」)

212±18° F on (Recovery from the error)

Overheat protection system (Pre-heater section)

68±9° F off (Display 「A3」)

41±9° F on (Recovery from the error)

Figure15 Checking a burner packing

Take out the burner cover and unit from main body, as detailed in Figure 1 and 2 .

Check if there are 「Burner packing 1」 and 「Burner packing 2」 .

Check if 「Burner packing 1」 and 「Burner packing 2」 are not damaged.

