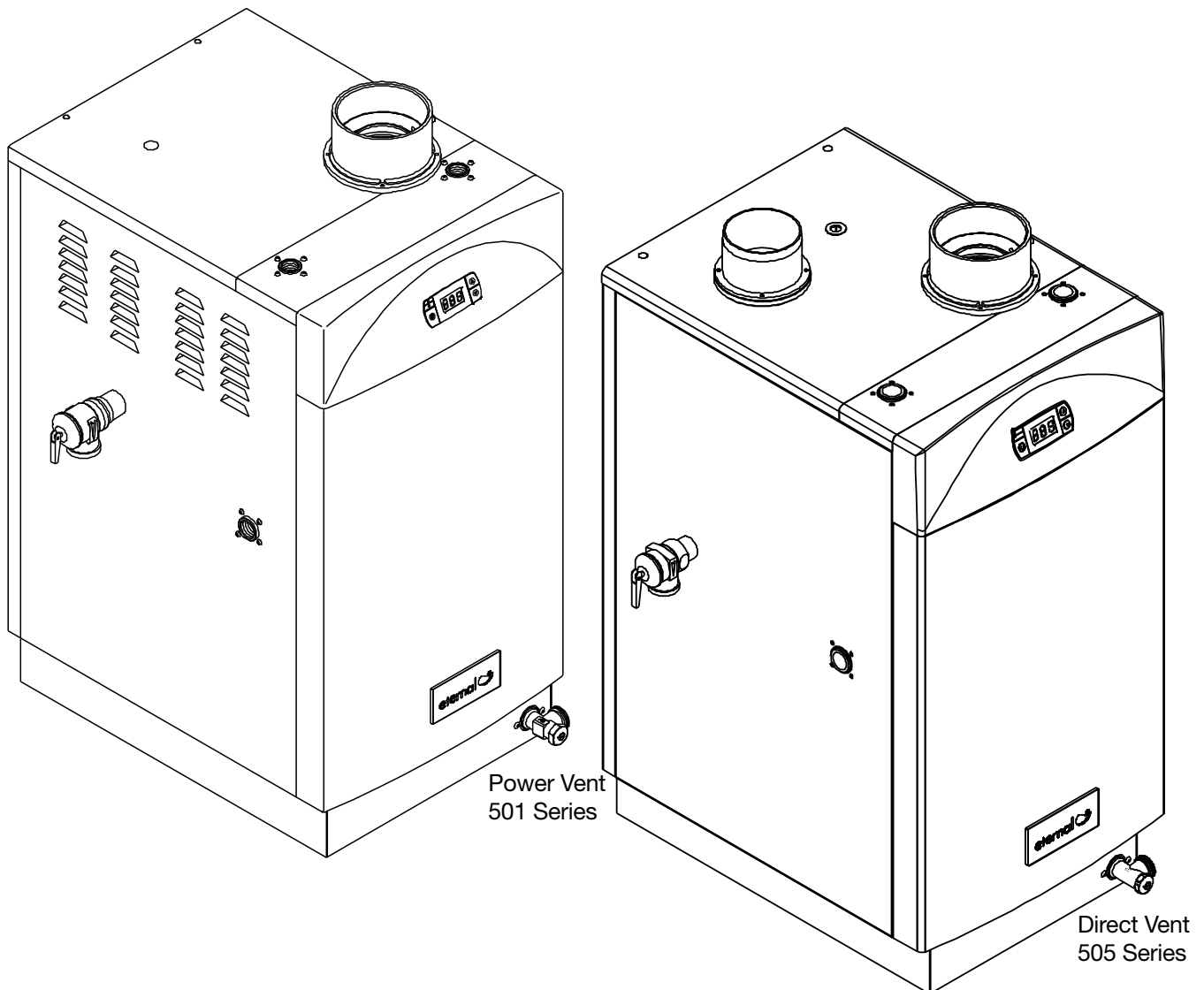


NATURAL GAS (NG) - FACTORY DEFAULT

Liquid Propane Gas (LPG) - Optional Conversion

501 Series, Models GU20/26/28/32

505 Series, Models GU20DV/28DV/26DV/32DV



[www.eternalwaterheater.com](http://www.eternalwaterheater.com)

Call Toll Free # 866-946-1096

US Patent No 6,945,197 / © 2008 Grand Hall  
Part Number: MASM01  
REV051809JM

# Glossary

This glossary is provided to help you understand some of the technical language used throughout this service manual.

DC	Direct Current
AC	Alternating Current
KW	KiloWatt, 1,000 Watts
IC	Integrated Circuit
Hz	Hertz
BTU/h	British Thermal Units per Hour
Kpa	KiloPascal, 1,000 Pascals
CPU	Central Processing Unit
PCB	Printed Circuit Board
POT	Potentiometer
RPM	Revolutions Per Minute
NOx	Nitrous Oxide
GPM	Gallons Per Minute
mA	milliamps
LED	Light Emitting Diode
H	Heat energy into water
M	Mass of water
$\Delta T$	Temperature rise
Q	Water heater hot water output
F	Flow rate of water through a pipe
A	Internal cross sectional area of the pipe in M <sup>2</sup>
V	Velocity of water in the pipe (m/second)
TE	Thermal Efficiency
T <sub>in</sub>	Temperature of incoming water
T <sub>out</sub>	Temperature of outgoing water
TH	Thermistor
WC	Inches of water column

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# INTRODUCTION

This Service Manual is designed to help you troubleshoot and repair Grand Hall's Eternal Hybrid Water Heaters. It is not intended as a replacement for the Installation and Operation Manual that comes with the unit.

The terms and component parts used in this manual are current manufactured items or vendor provided items used in Grand Hall water heaters. Make sure you have the right version of service manual corresponding to the unit being serviced.

Only licensed, trained professional technicians may perform procedures outlined in this manual.

## ABOUT ETERNAL HYBRID

Eternal is the first and only of its kind. By combining a small storage tank with the heat exchanger, the unit delivers endless hot water without pressure drop or temperature variation. Hybrid refers to the aspect of combining tank and tank-less features.

Grand Hall's patented counter-flow design enhances energy efficiency, as well as providing constant self cleaning.

Eternal requires no user maintenance over time.

The advanced heat exchanger tank is entirely made of stainless steel. Manufactured by precision robotic welding; the Eternal is designed to last.

# FEATURES AND BENEFITS

## FEATURES

- World's first Hybrid heat exchanger tank
- Stainless steel construction
- Intelligent computer monitoring system
- Easy troubleshooting with error code on front display
- Built-in power-vent with flexible venting options
- Preprogrammed for Natural Gas and Liquid Propane convertible
- Self-cleaning counter-flow design
- Energy and space saving
- Environmentally friendly

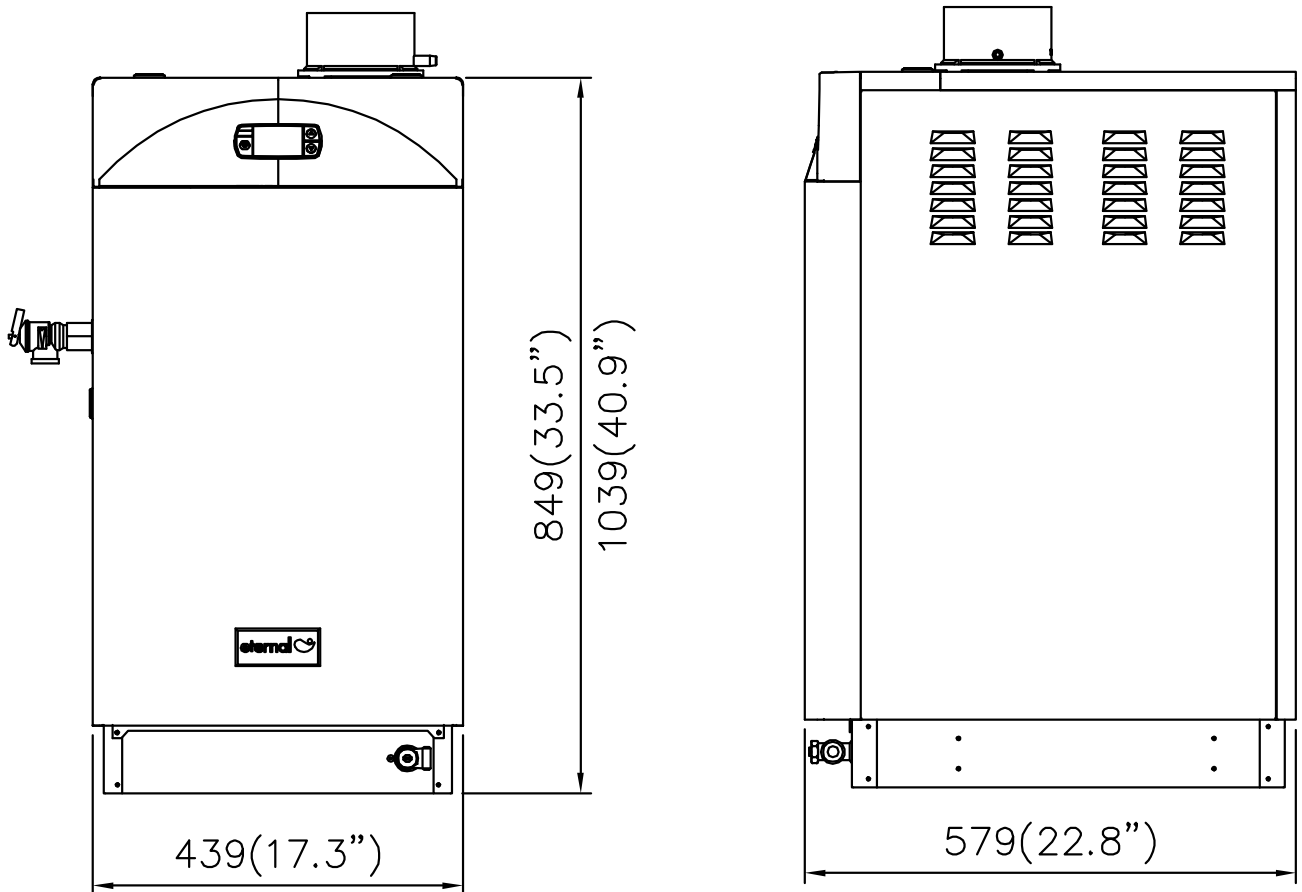
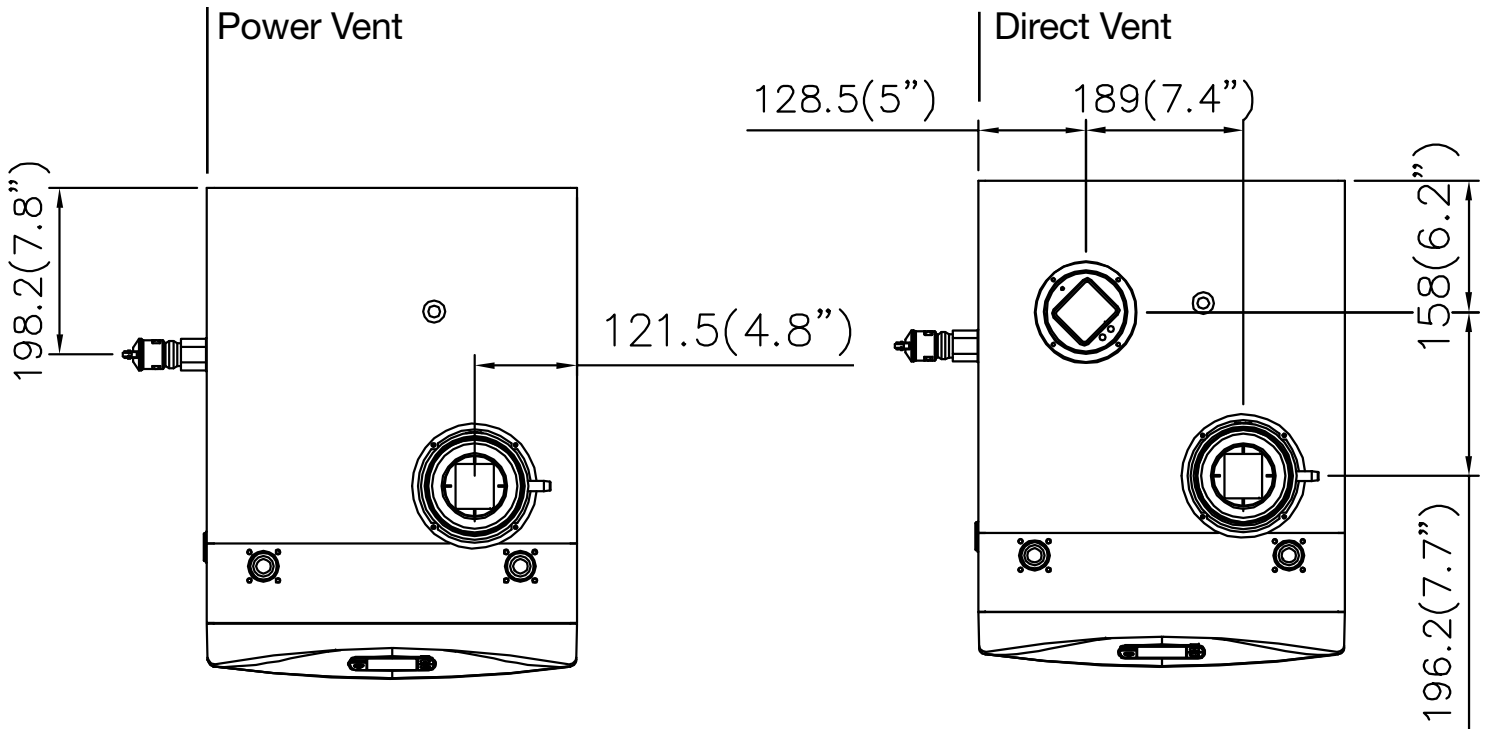
## BENEFITS

- Capable of replacing multiple tanks with a single unit
- Consistent temperature and pressure of hot water
- Endless hot water on demand for simultaneous applications
- Faster hot water delivery with built-in reserve tank
- Ideal for recirculation system with built-in reserve tank
- Durable stainless steel tank resists corrosion
- Low NOx and CO for green building
- Installer friendly with flexible installation options

## PRECISION

- Digital temperature setting from 100F to 167 F in multiple steps (factory preset max 140F)
- Electronic ignition by flow sensor or thermostat
- Modulating gas valve as low as 47,500 BTU
- Thermistor sensors monitor water temperature
- Computer controlled mixing valve

# DIMENSIONS



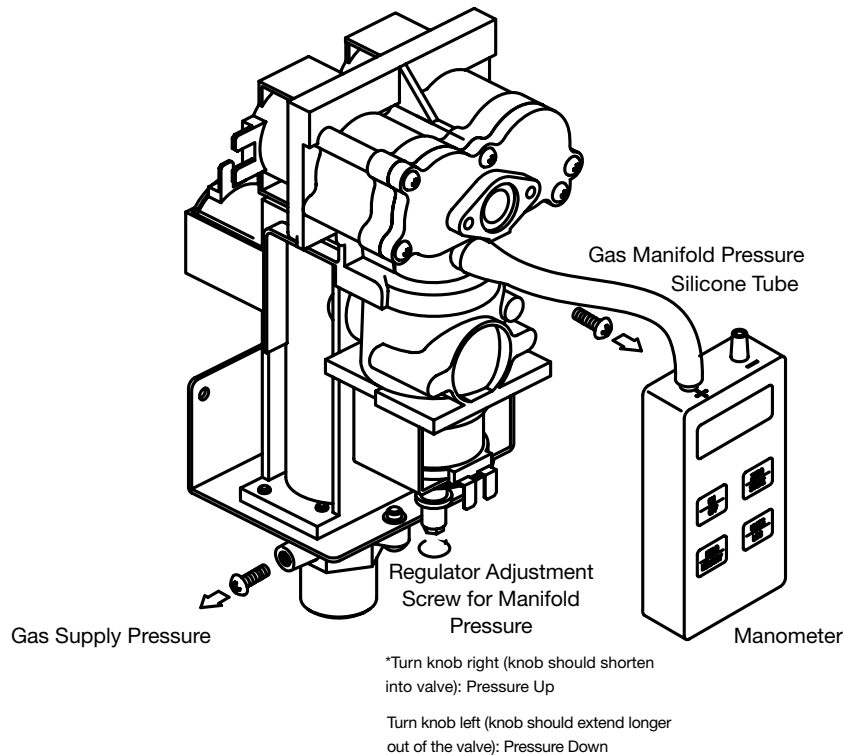
# SPECIFICATIONS

Model Name		GU20 (optional)	GU26	GU28 (optional)	GU32
Model Number (CSA)		501(11,12,21,22)1201	501(11,12,21,22)1261	501(11,12,21,22)1281	501(11,12,21,22)1321
Type	Installation	Indoor or Outdoor			
	Flue system	Forced Exhaust Power Vent			
	Operation	With or Without Remote Controls			
Ignition		Direct Electronic Ignition and Automatic Flame Sensing			
Gas Valve Type		Current Controlled Double Stage Negative Pressure Full Modulation Gas Valve			
Burner System		Single Orifice Fuel Injection Pre-Mixing Cylindrical Metal Fiber Infrared Burner w/Full Modulation			
Gas Input	Min	47,500 BTU	47,500 BTU	47,500 BTU	47,500 BTU
	Max	145,000 BTU	180,000 BTU	199,000 BTU	236,000 BTU
Orifice Size	NG	7.0mm	7.0mm	9.0mm	9.0mm
	LP	5.2mm	5.2mm	6.5mm	6.5mm
Gas Supply Pressure	NG	3.5 - 10.5 "WC			
	LP	8.0 - 14 "WC			
Manifold Pressure	Min	0.9 "WC	0.9 "WC	0.5 "WC	0.5 "WC
	Max	1.6" WC	2.4 "WC	1.8 "WC	2.5 "WC
Maximum Valve Current		105mA	131mA	107mA	126mA
Combustion Analysis	CO	Under 100PPM			
	NOx	Under 55PPM			
	Flue Temp	Under 185F			
Operating water pressure		15 to 150Psi			
Flow Capacity Range		0.1 - 12.8gpm	0.1 - 15.8gpm	0.1 - 17.5gpm	0.1 - 20.8gpm
Water Flow Sensing		Water Flow Sensor w/Built-in Display			
Water Temperature Sensing		Tank Thermistor, Inlet Thermistor, Outlet Thermistor, Burner Thermistor, Air Thermistor			
Water Temperature Control		Simulation Feedforward and Feedback w/Electronically Controlled Mixing Valve			
Water Holding Capacity		3.8 gal		6.4 gal	
Thermal Efficiency		86%			
Temperature Settings		100,102,104,106,108,110,112,114,116,122,131,140,149,158,167 (15 steps)			
Packaged Weight (lbs)		166.1		196.2	
Unit Weight (lbs)		145.6		172.9	
Maximum Noise Level		48db		60db	
Electrical Power Supply		120 Volts 60 Hz, 2A Circuit			
Electrical Consumption		Standby - 8 watts, Maximum - 84 watts		Standby - 8 watts, Maximum - 105 watts	
Package Dimensions (WxHxD)		20.5 x 38.3 x 24.8		20.5 x 45.7 x 24.8	
Unit Dimensions (WxHxD)		17.3 x 33.5 x 22.8		17.3 x 40.9 x 22.8	
Connections	Gas	3/4 inches NPT Female			
	Cold water	3/4 inches NPT Female			
	Hot water	3/4 inches NPT Female			
Safety Devices		T&P Valve, Flame Rod, Thermal Fuse (307F), Remaining Flame Detector, Fan RPM Detector, Freeze Protection (-4F), Vent Blockage Detection, Thermostat Switch (194F), Thermostat Switch (221F), Ignition Prevention, GFCI Leakage Breaker w/3A fuse, Mixing Valve, User Selectable Maximum Temperature Lock			

<b>GU20DV (optional)</b>	<b>GU26DV</b>	<b>GU28DV (optional)</b>	<b>GU32DV</b>
<b>505(11,12)1201</b>	<b>505(11,12)1261</b>	<b>505(11,12)1281</b>	<b>505(11,12)1321</b>
Indoor Only			
Sealed Combustion Direct Vent			
With or Without Remote Controls			
Direct Electronic Ignition and Automatic Flame Sensing			
Current Controlled Double Stage Negative Pressure Full Modulation Gas Valve			
Single Orifice Fuel Injection Pre-Mixing Cylindrical Metal Fiber Infrared Burner w/Full Modulation			
47,500 BTU	47,500 BTU	47,500 BTU	47,500 BTU
145,000 BTU	180,000 BTU	199,000 BTU	236,000 BTU
6.4mm	6.4mm	7.4mm	7.4mm
5.1mm	5.1mm	5.7mm	5.7mm
3.5 - 10.5 "WC			
8.0 - 14 "WC			
0.9 "WC	0.9 "WC	0.4 "WC	0.4 "WC
1.6 "WC	2.4 "WC	1.75 "WC	2.4 "WC
106mA	131mA	106mA	126mA
Under 100PPM			
Under 55PPM			
Under 185F			
15 to 150Psi			
0.1 - 12.8gpm	0.1 - 15.8gpm	0.1 - 17.5gpm	0.1 - 20.8gpm
Water Flow Sensor w/Built-in Display			
Tank Thermistor, Inlet Thermistor, Outlet Thermistor, Burner Thermistor, Air Thermistor			
Simulation Feedforward and Feedback w/Electronically Controlled Mixing Valve			
3.8 gal		6.4 gal	
86%			
100,102,104,106,108,110,112,114,116,122,131,140,149,158,167 (15 steps)			
175.1		204.4	
151.8		180.2	
48db		60db	
120 Volts 60 Hz, 2A Circuit			
Standby - 8 watts, Maximum - 84 watts		Standby - 8 watts, Maximum - 105 watts	
20.5 x 38.3 x 24.8		20.5 x 45.7 x 24.8	
17.3 x 33.5 x 22.8		17.3 x 40.9 x 22.8	
3/4 inches NPT Female			
3/4 inches NPT Female			
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T&P Valve, Flame Rod, Thermal Fuse (307F), Remaining Flame Detector, Fan RPM Detector, Freeze Protection (-4F), Vent Blockage Detection, Thermostat Switch (194F), Thermostat Switch (221F), Ignition Prevention, GFCI Leakage Breaker w/3A fuse, Mixing Valve, User Selectable Maximum Temperature Lock			

# CHECKING GAS COMBUSTION SPECIFICATIONS

Figure 1: The gas valve is designed with both test ports for gas supply pressure to the unit, and manifold pressure. Refer to Figure 1 for locations of the test ports on the gas valve.



## HOW TO CHECK GAS SUPPLY PRESSURE

1. Turn off power source and turn off gas supply to the unit
2. Remove the front cover from the unit
3. Remove the gas supply pressure test port screw and connect manometer to this port; turn on the gas to the water heater
4. Turn the water heater on and open multiple taps to force unit into high fire; check gas supply pressure at the test port with a manometer with unit in high fire

## HOW TO CHECK MANIFOLD GAS PRESSURE

1. While power and gas are off to the unit, open any hot tap to flush and fill the tank completely with cold water
2. Close the running tap and turn power and gas back on to the unit; set temperature to 131F
3. The unit should fire up to bring the internal storage up

to set temperature even without any tap open; this is standby mode

4. Wait for 10 seconds after the start of standby mode combustion and check manifold gas pressure at the test port with a manometer

Check manometer reading of low fire manifold pressure against unit combustion specifications on p. 6 & 7. If low fire manifold pressure needs to be adjusted, loosen the nut securing the adjustment knob on the bottom of the gas valve (*refer to Figure 1*) and adjust to correct setting:

**NOTE: Manifold Gas Pressure should only be adjusted on low Fire**

**NOTE: If gas supply pressure drops below 3.5" WC unit will not have enough gas volume for max fire!**

**NOTE: Recirculation pump must be off when checking Manifold Gas Pressure**

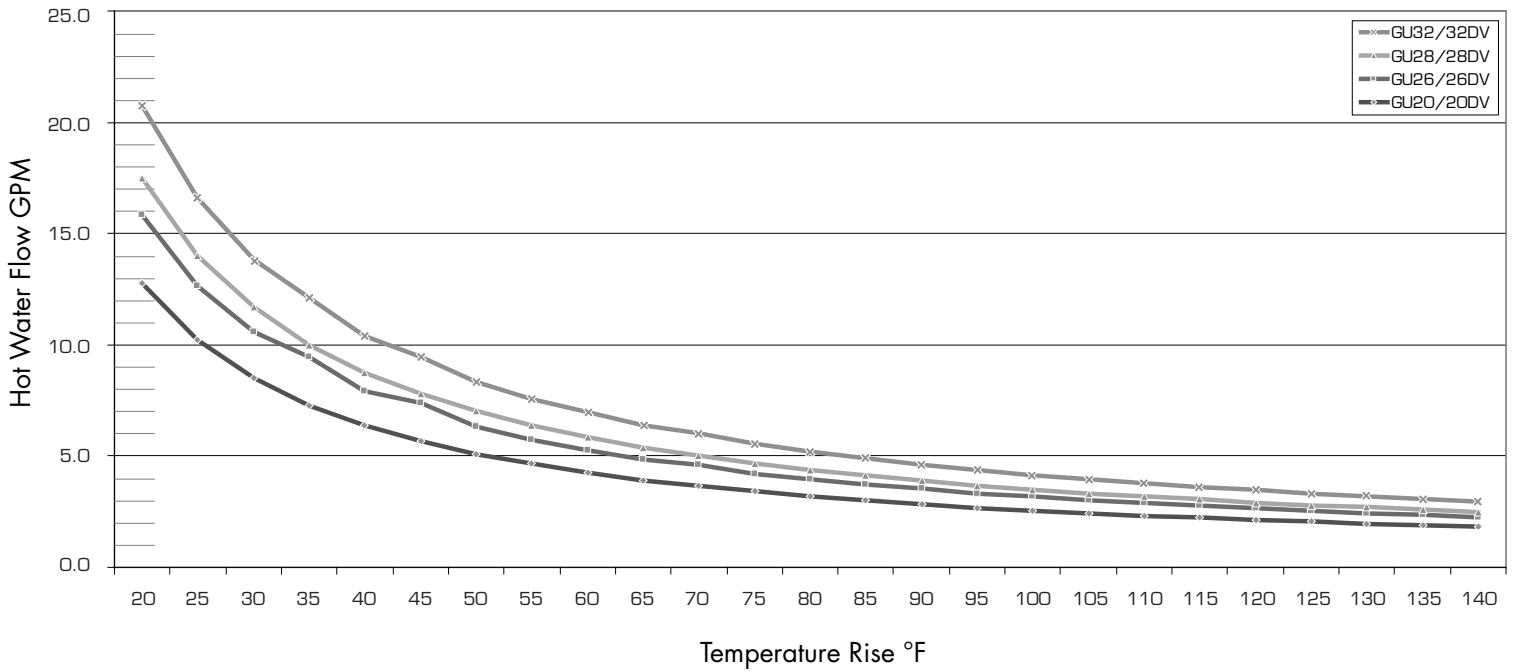


# WATER FLOW

## FLOW CALCULATION

Eternal comes with built-in GPM monitor on the display. To access GPM monitor, open any tap to trigger combustion. Once the combustion LED is lit and the front display shows current temperature, press either the up or down key and the display will switch to GPM mode.

This design helps you in diagnosing problems related to not getting enough hot water flow, whether due to undersized gas line or improper combustion.



## HOW TO READ FLOW CHART

Calculate the current degree rise by subtracting the inlet temperature from set outlet temperature.

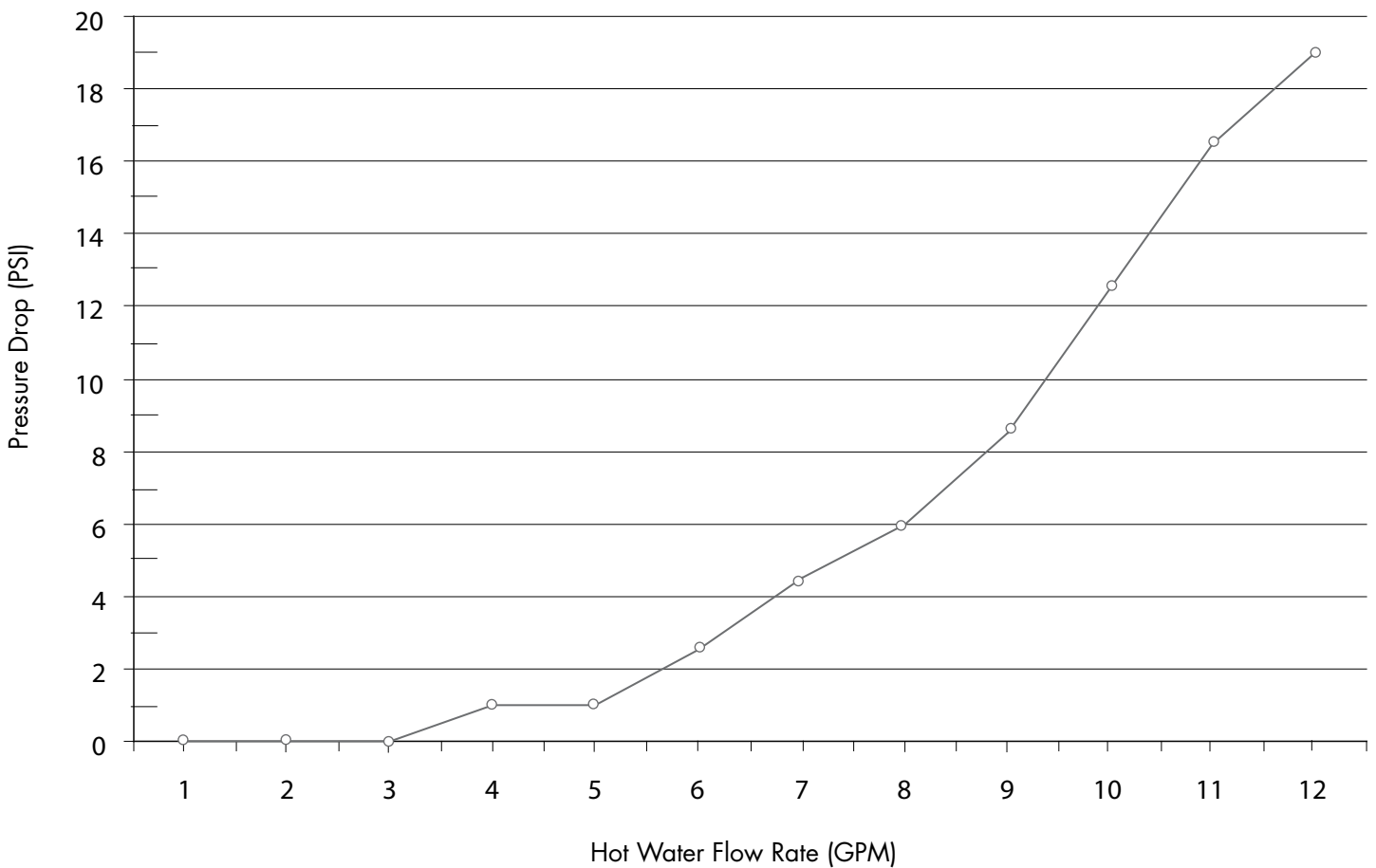
$$\Delta T = T_{out} - T_{in}, \text{ For example: } 122F - 77F = 45F \text{ Rise}$$

Match the degree rise on the chart above and see where the vertical line intersects the particular unit's flow rate. This indicates the unit's flow rate at your temperature rise. Because there is no flow restriction, the burner will not maintain temperature if flow exceeds specified heating capacity. For example, set at 122F with 77F ground inlet water, if GU32 is flowing at 20GPM it will not maintain 122F set temperature.

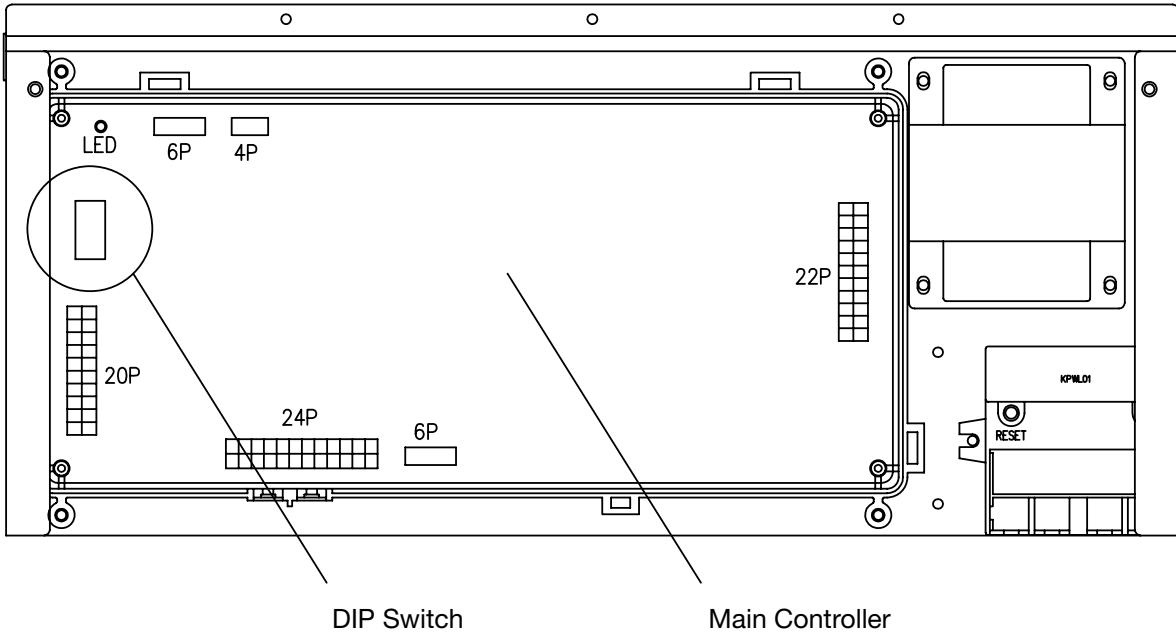
## NON-FLOW RESTRICTING DESIGN

Eternal is designed to heat water with minimal pressure drop across multiple applications. Unlike copper heat exchangers using coiled pipes, the hybrid heat exchanger comes with built-in reserve tank and does not use any coiled pipes to heat water.

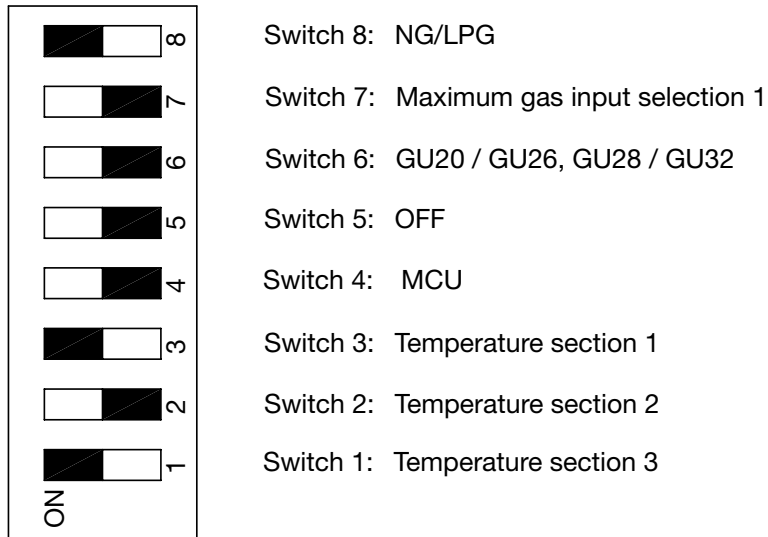
The following graph shows that Eternal can reach 7GPM with just 4.5Psi drop. The graph applies to all models and the laboratory test was conducted on 35Psi inlet supply pressure.



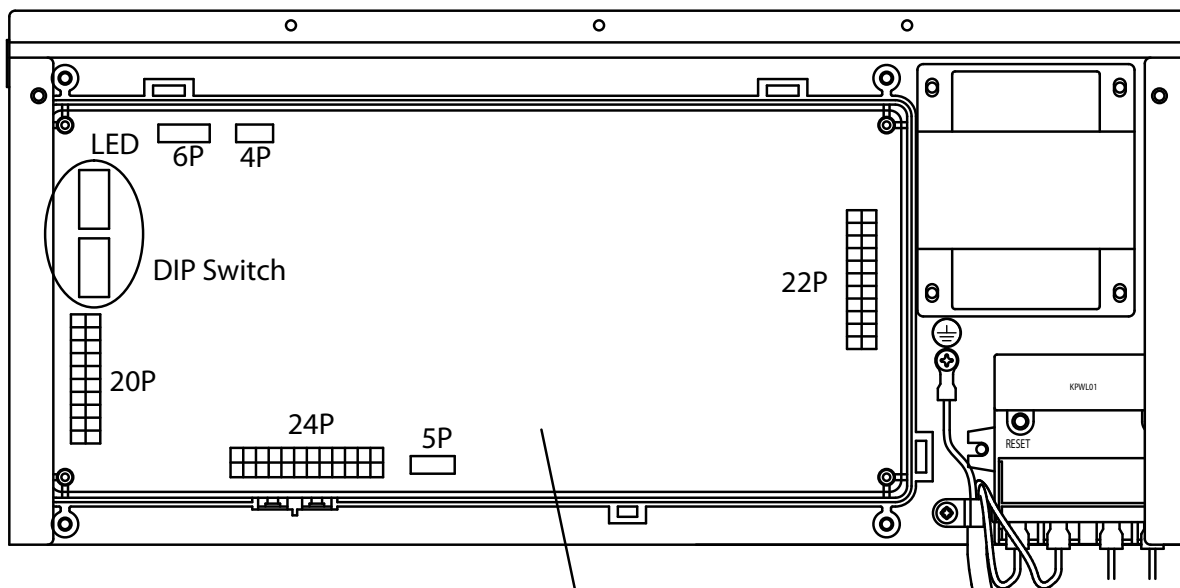
# CONTROLLER DIP SWITCH SETTINGS (POWER VENT)



Location of DIP Switch

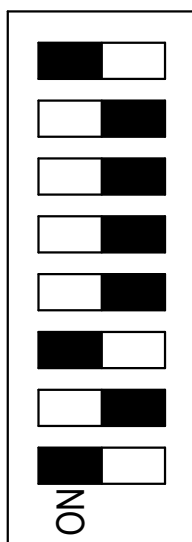


# CONTROLLER DIP SWITCH SETTINGS (DIRECT VENT)

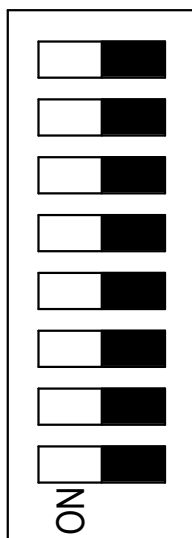


Main Controller

Default Setting Layout

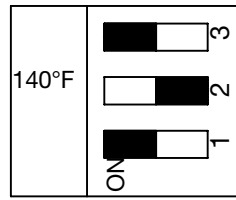
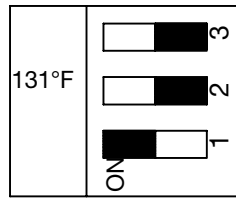
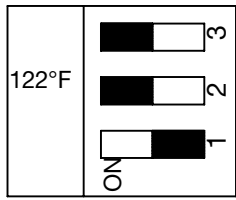
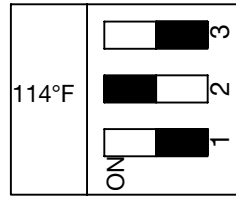
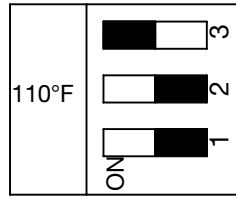
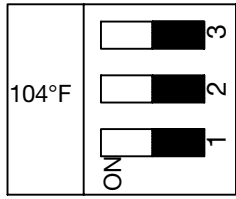


- 8 Switch 8: NG/LPG
- 7 Switch 7: Maximum gas input selection 1
- 6 Switch 6: GU20DV / GU26DV, GU28DV / GU32DV
- 5 Switch 5: OFF
- 4 Switch 4: MCU
- 3 Switch 3: Temperature section 1
- 2 Switch 2: Temperature section 2
- 1 Switch 1: Temperature section 3

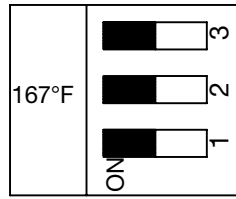
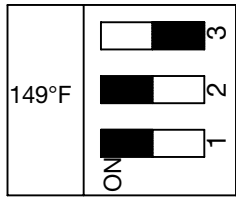


- 8 Switch 8: Reserved
- 7 Switch 7: Reserved
- 6 Switch 6: Reserved
- 5 Switch 5: Reserved
- 4 Switch 4: Reserved
- 3 Switch 3: Reserved
- 2 Switch 2: Reserved
- 1 Switch 1: Reserved

# LIMITATION OF MAXIMUM TEMPERATURE BY SELECTION SWITCH



Default Setting layout



# SAFETY DEVICES

## **DRY FIRE PROTECTION**

If no flow of water in the proper direction is detected by the flow sensor, the unit will refuse to fire in order to protect the heat exchanger.

## **FLAME FAILURE**

Located on the burner surface, the flame rod supervises combustion. If no flame is detected during the ignition sequence, the unit will shut down flow of gas at the gas valve to protect against excess gas buildup.

## **TEMPERATURE AND PRESSURE RELIEF VALVE**

The standard T&P valve will expel excess pressure or overheated water from the heat exchanger tank whenever the pressure exceeds 150psi or temperature exceeds 210F.

## **THERMAL FUSE**

Designed as a last resort safety device, the fuse is located above the combustion chamber. If heat exchanger overheats (exceeds 307F), the fuse will shut down the flow of gas at the gas valve and shut the unit down.

## **OVER HEAT PROTECTION DEVICE (THERMOSTAT)**

This re-settable switch is fitted at the hot outlet of the tank. Whenever water temperature exceeds 194F, the switch will pop and cut off gas supply at the gas valve. Push the switch to reset the unit.

## **FREEZE PROTECTION**

The unit's storage contains hot water that internally circulates to prevent the internal pipes from freezing. Freeze protection only works if the unit is supplied with gas and electricity. Freeze protection works as low as -4F ambient temperature.

## **FAN REVOLUTION CHECK**

The DC motor for the inducer and exhaust fans is monitored by the main controller board. Should the fans fail or spins at an improper speed, the main controller will make necessary adjustments to ensure optimal combustion.

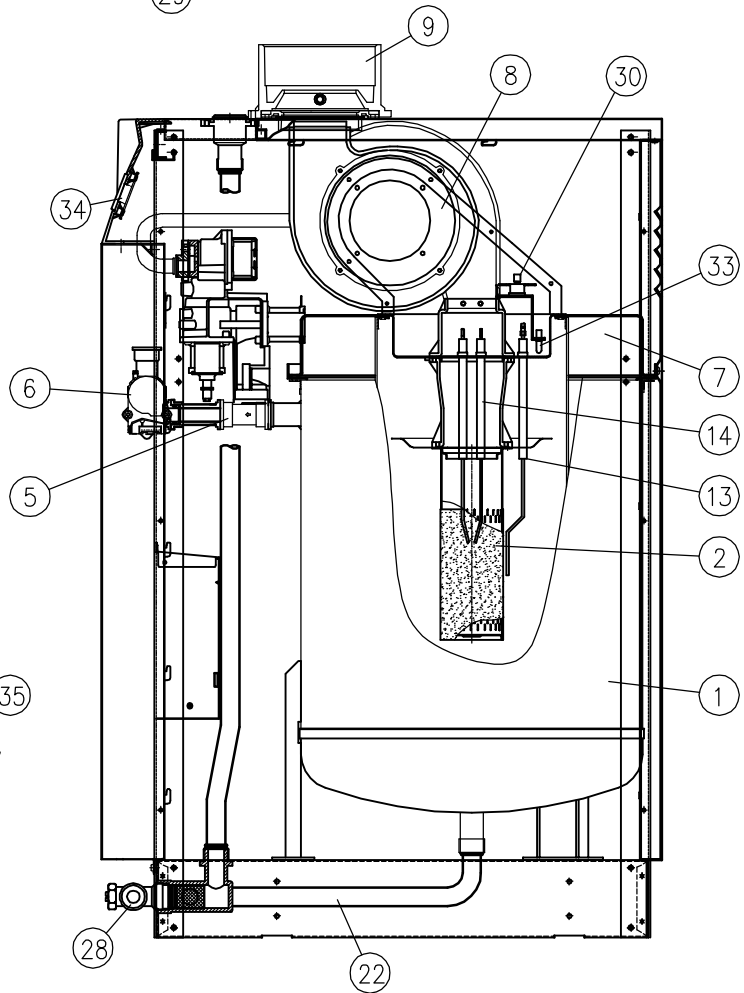
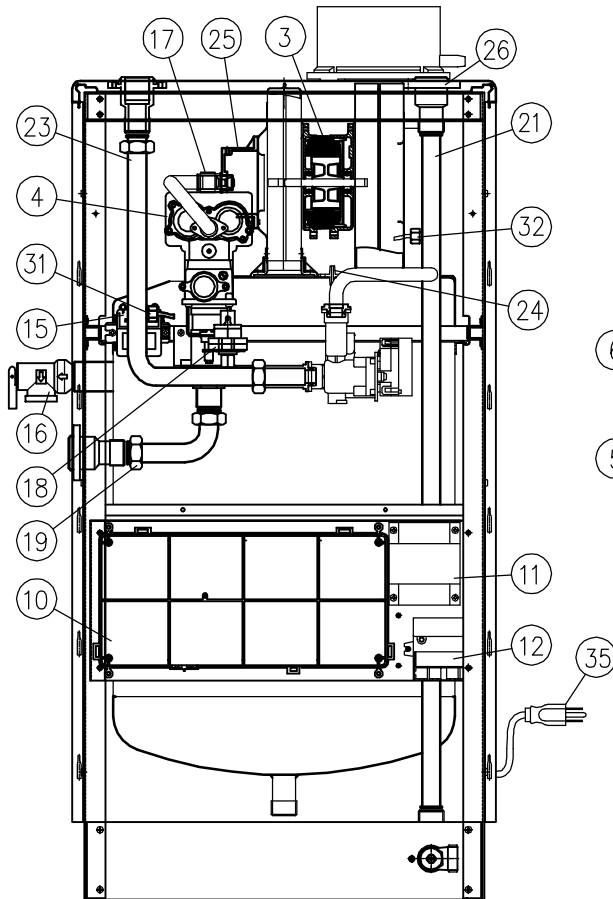
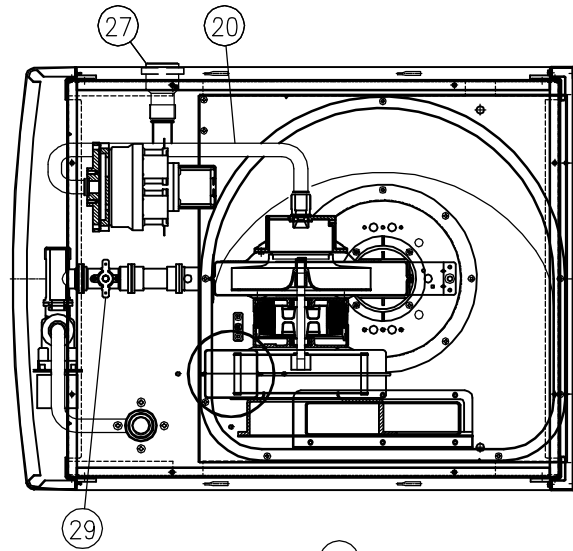
## **THERMAL SENSORS (THERMISTORS)**

These sensors are used in conjunction with the main controller to monitor the inlet and outlet temperatures, as well as combustion conditions of the unit. If heat exchanger outlet is hotter than specified setting, the system will open the mixing valve to temper the water.



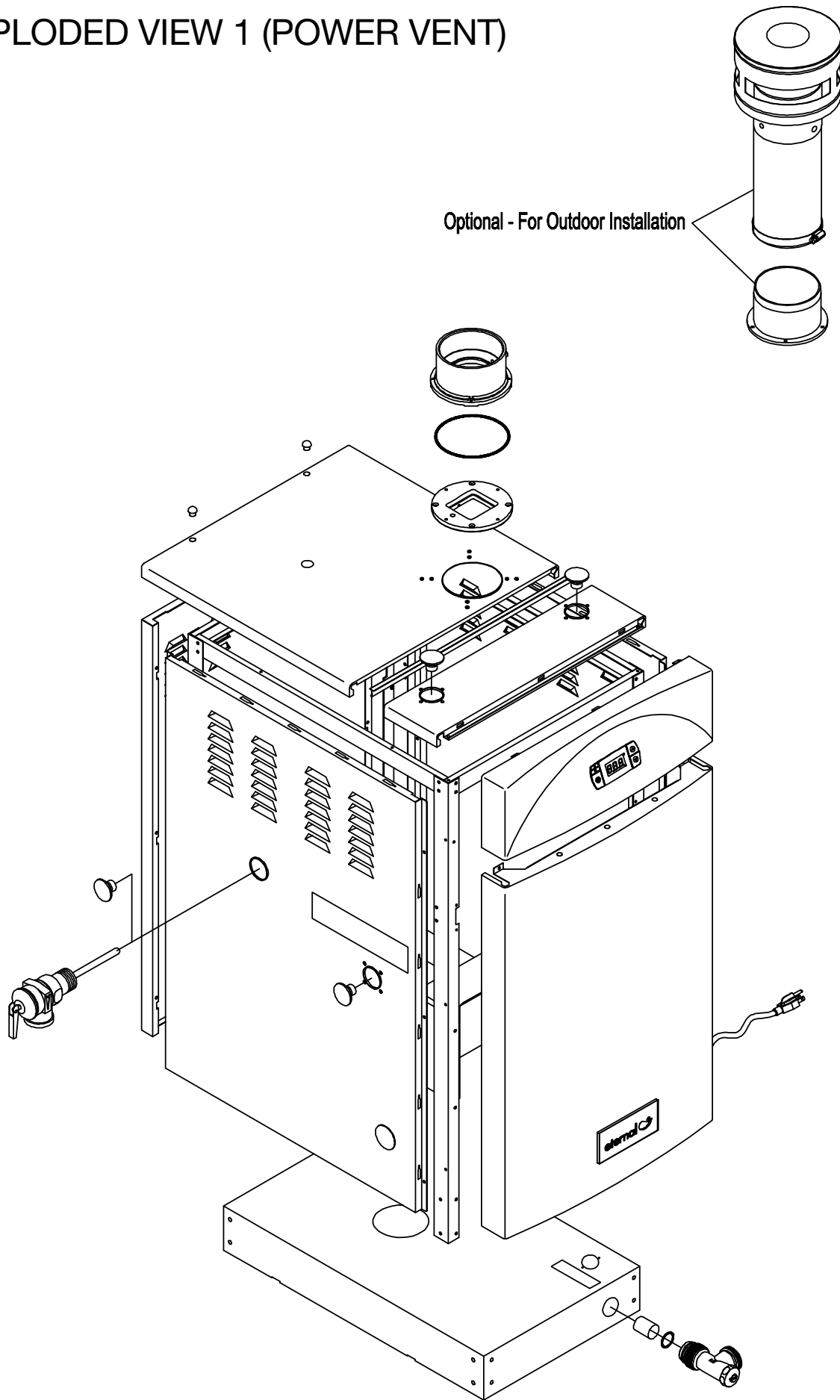
# SCHEMATIC VIEW (POWER VENT)

NO	DESCRIPTION	NO	DESCRIPTION
1	HEAT EXCHANGER	19	GAS TUBE-A
2	BURNER	20	GAS TUBE-B
3	DUAL FAN	21	COLD WATER TUBE-A
4	GAS VALVE	22	COLD WATER TUBE-B
5	WATER FLOW SENSOR	23	HOT WATER TUBE
6	MIXING VALVE	24	CONDENSATE NIPPLE
7	EXHAUST CHAMBER	25	NOZZLE HOLDER
8	EXHAUST DUCT	26	WATER FITTING
9	EXHAUST COLLAR	27	GAS ADAPTER
10	MAIN PCB BOX	28	DRAIN ASS'Y
11	TRANSFORMER	29	THERMOSTAT-HOT
12	LEAKAGE BREAKER	30	THERMOSTAT-FLAME
13	FLAME ROD PLUG	31	THERMISTOR(HOT)
14	IGNITOR PLUG	32	THERMISTOR(COLD)
15	IGNITOR	33	AIR THERMISTOR
16	T & P VALVE	34	FRONTAL CONTROLLER
17	NOZZLE	35	POWER CORD
18	WATER PRESSURE SWITCH		

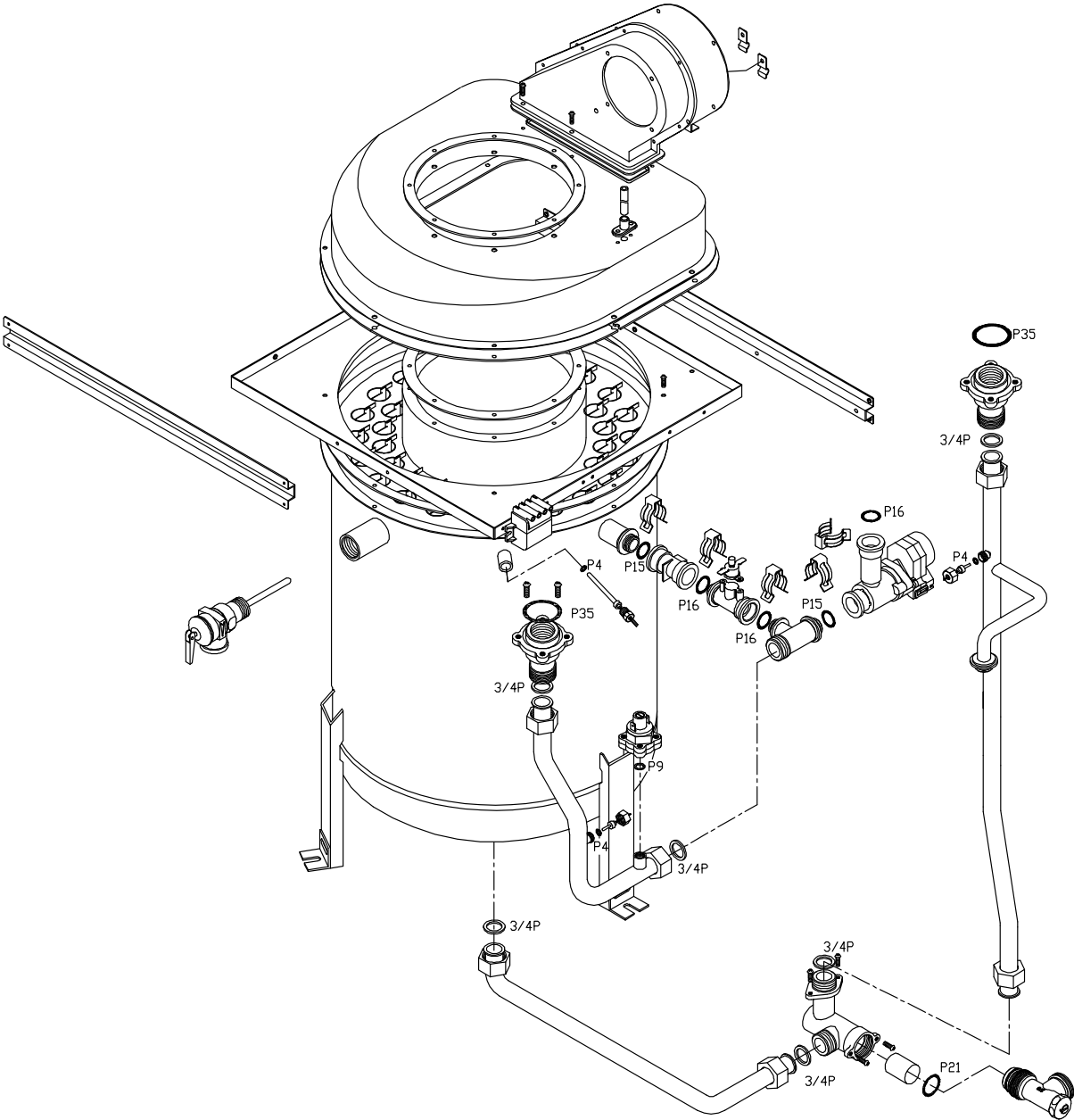




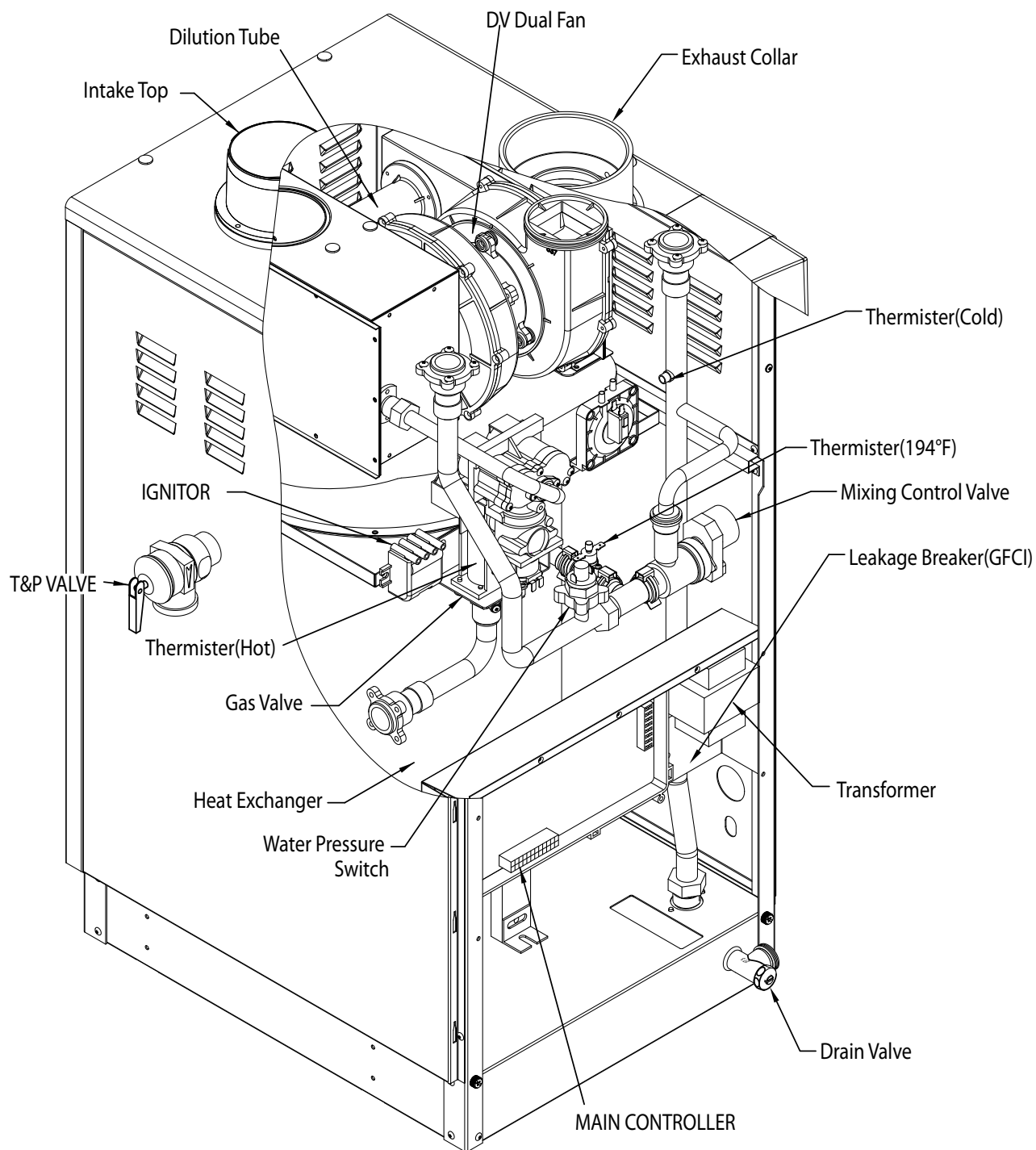
# EXPLODED VIEW 1 (POWER VENT)



# EXPLODED VIEW 2 (POWER VENT)

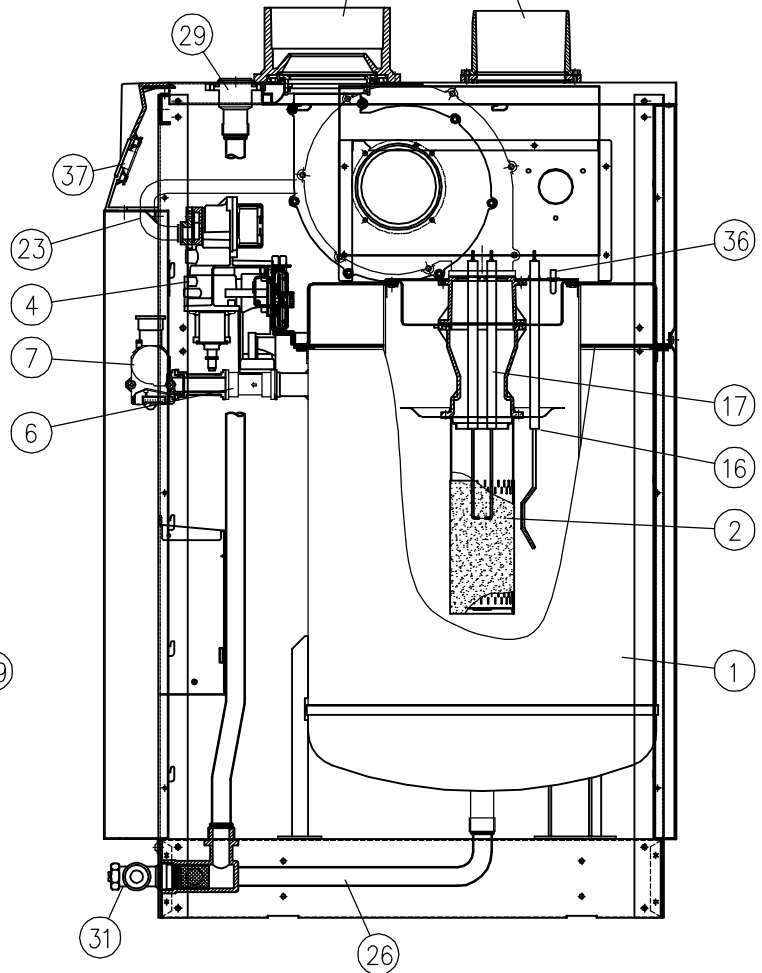
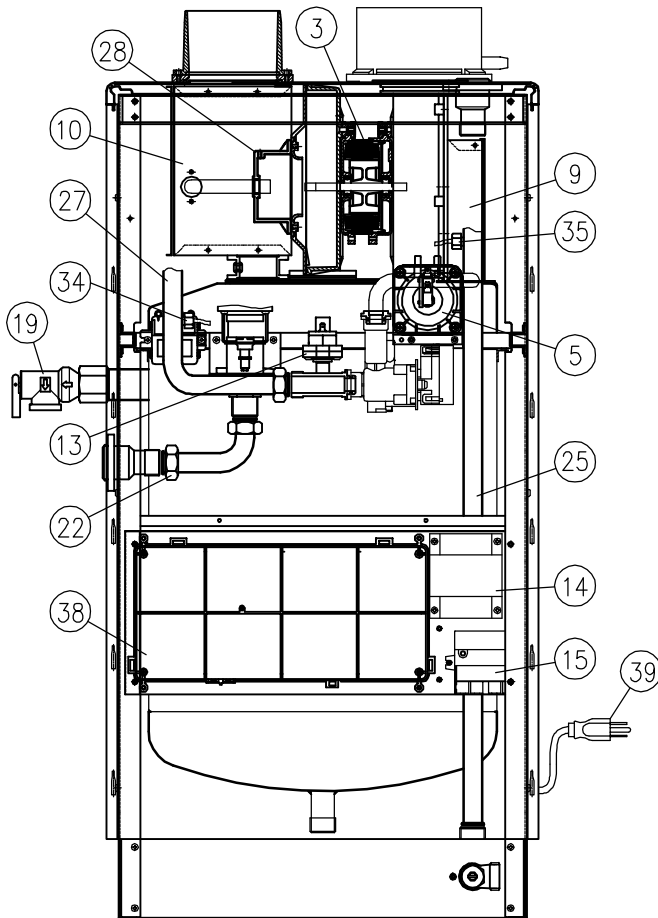
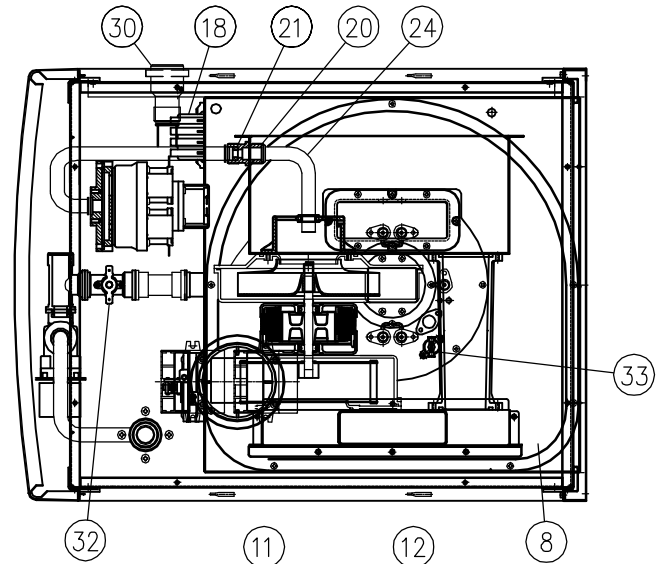


# CUT-AWAY VIEW (DIRECT VENT)

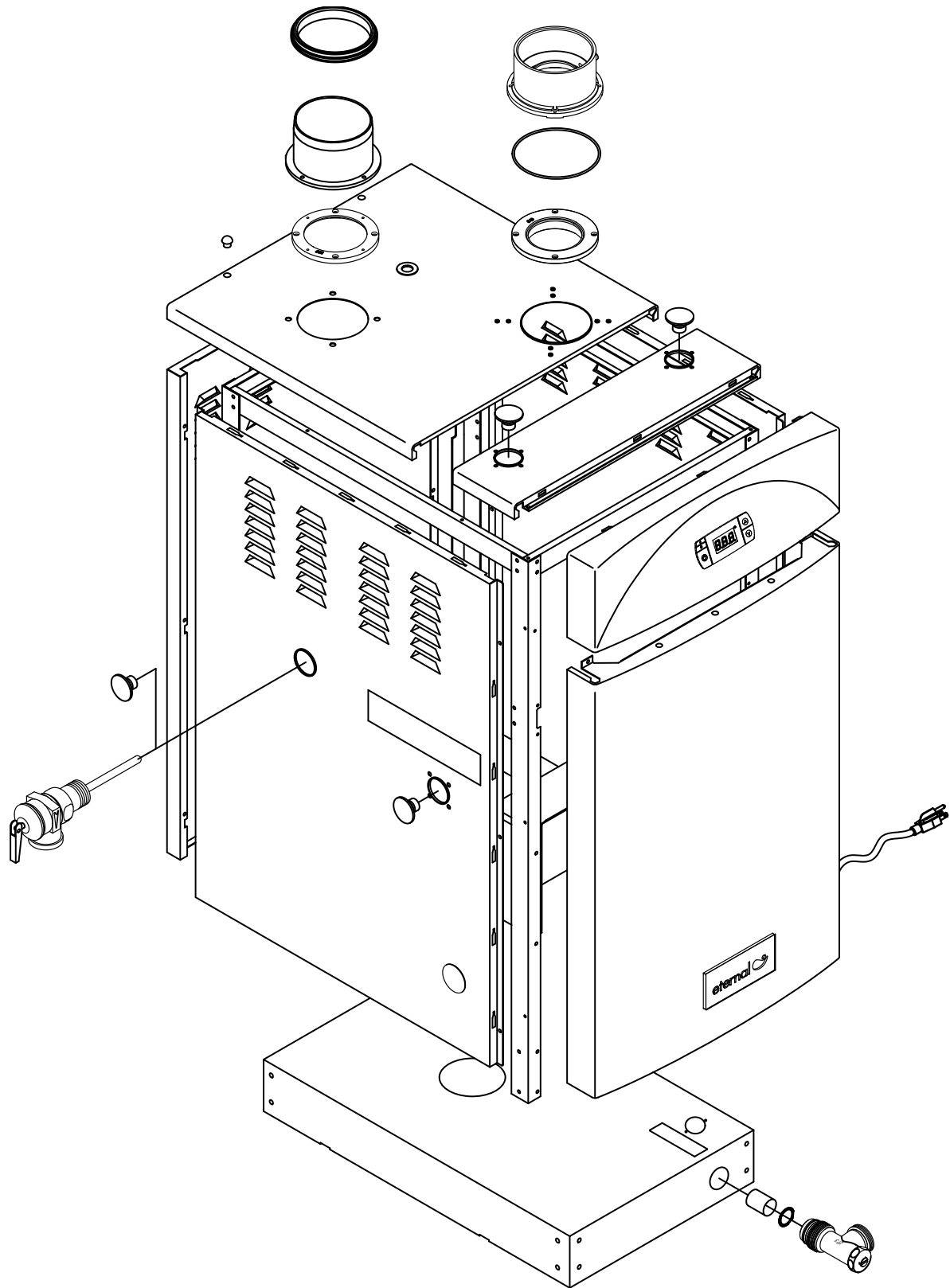


# SCHEMATIC VIEW (DIRECT VENT)

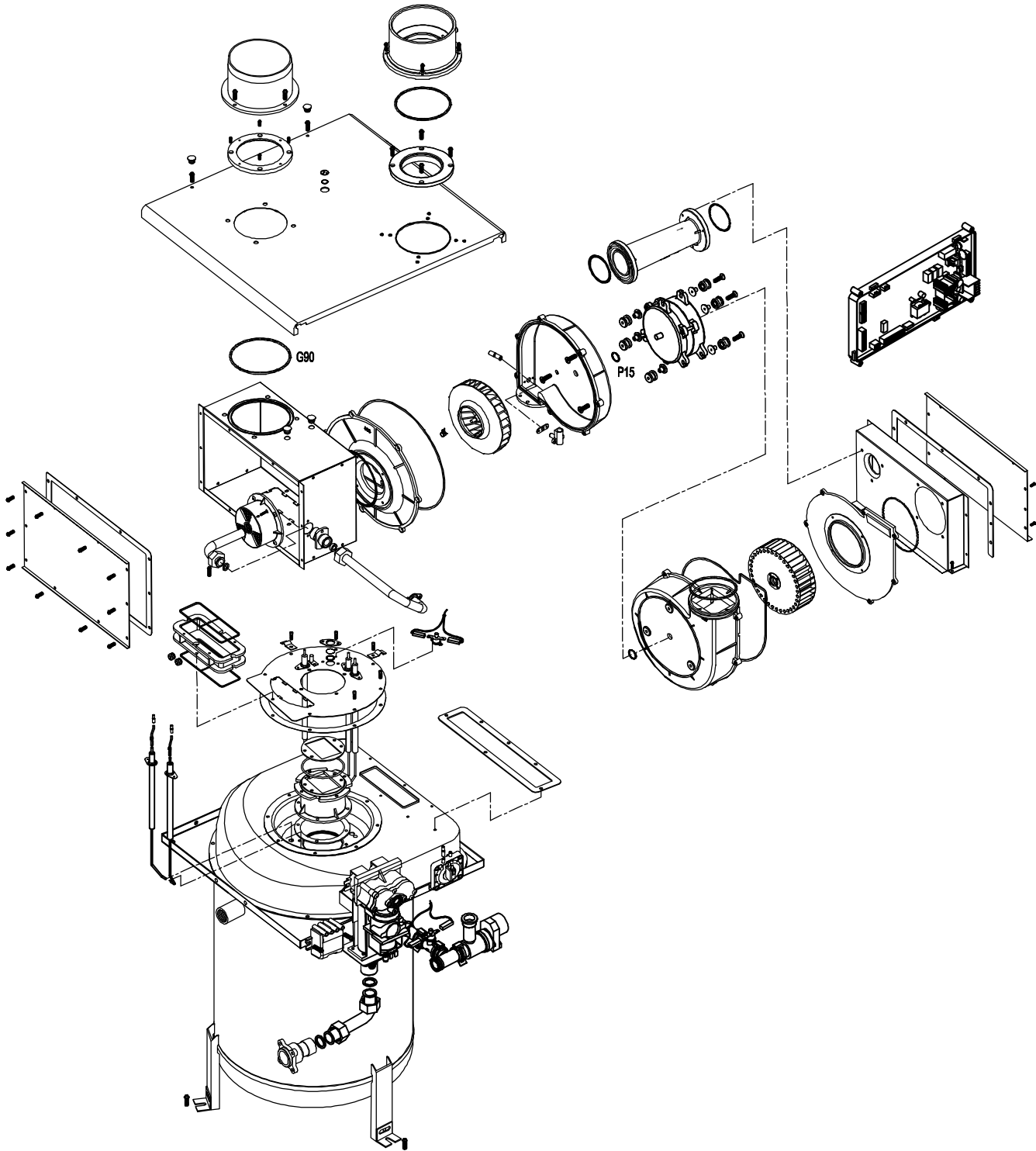
NO	DESCRIPTION	NO	DESCRIPTION
1	HEAT EXCHANGER	21	LPG ORIFICE
2	BURNER	22	GAS TUBE-A
3	DUAL FAN	23	GAS TUBE-BF
4	GAS VALVE	24	GAS TUBE-CF
5	AIR PRESSURE SWITCH	25	COLD WATER TUBE-A
6	WATER FLOW SENSOR	26	COLD WATER TUBE-B
7	MIXING VALVE	27	HOT WATER TUBE
8	EXHAUST CHAMBER	28	NOZZLE HOLDER
9	EXHAUST DUCT	29	WATER FITTING
10	AIR TIGHT BOX	30	GAS ADAPTER
11	EXHAUST COLLAR	31	DRAIN ASS'Y
12	INTAKE TOP	32	THERMOSTAT-HOT
13	WATER PRESSURE SWITCH	33	THERMOSTAT-FLAME
14	TRANSFORMER	34	THERMISTOR(HOT)
15	LEAKAGE BREAKER	35	THERMISTOR(COLD)
16	FLAME ROD PLUG-D	36	AIR THERMISTOR
17	IGNITOR PLUG-D	37	FRONTAL CONTROLLER
18	IGNITER	38	MAIN CONTROLLER
19	T & P VALVE	39	POWER CORD
20	NOZZLE		



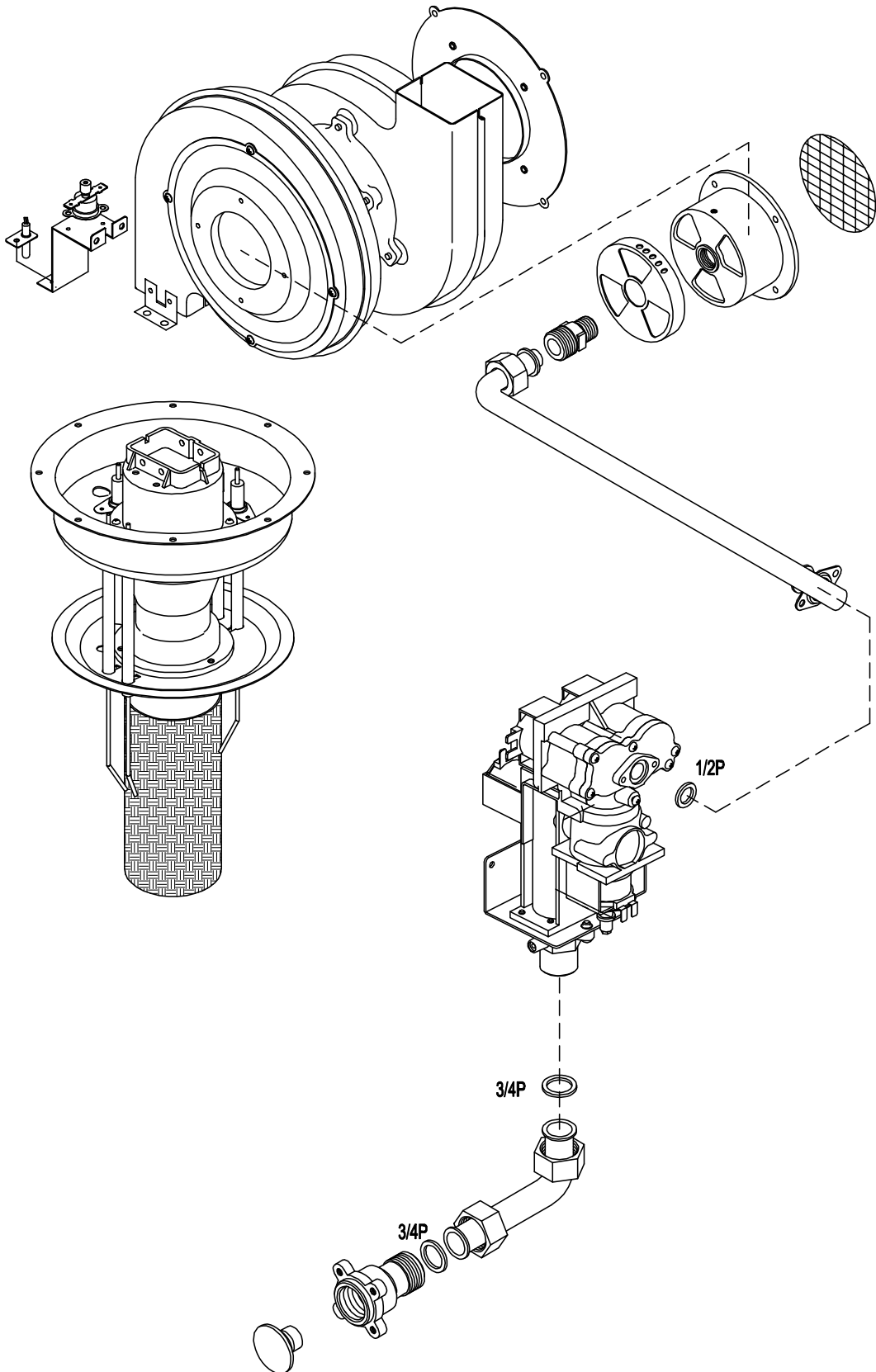
# EXPLODED VIEW 1 (DIRECT VENT)



# EXPLODED VIEW 2 (DIRECT VENT)



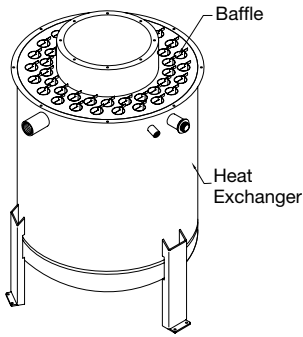
# BURNER EXPLODED VIEW







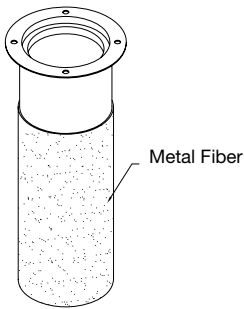
# MAIN COMPONENTS



## 1) Stainless Steel Heat Exchanger

Constructed by precision robots and made of durable stainless steel, the heat exchanger is designed to last. Features self-cleaning counter-flow design. Water enters from the bottom of the tank so there will be no sedimentation build-up. 44 Heat transfer pipes with baffles inside distributes heat evenly. Not one point of the heat exchanger is subject to more heat stress than other.

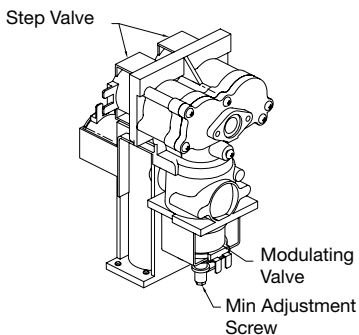
Built-in water reservoir allows for no lag hot water delivery, as well as easy recirculation.



## 2) Metal fiber burner

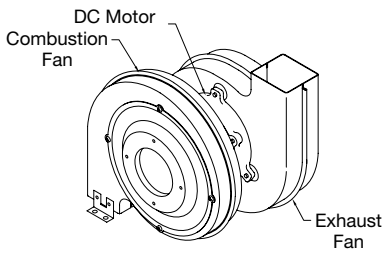
The Metal fiber burner is a highly advanced design utilizing infrared heat to improve efficiency and reduce pollution. This type of burner has 3 advantages: Uniform Surface Combustion, Corrosion Resistance, and low combustion by-products.

This unique burner also allows for pre-mix injection which has high modulation rates with just one injector. Other types of burner systems use multiple injectors which can cause big pressure drop from the gas supply. Eternal can be installed on as low as just 3.5" W.C.



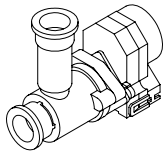
## 3) Dual Stage Current Controlled Solenoid Valve with Redundancy Shutoff

This two-step changeover solenoid increases safety and flexibility of Eternal's combustion process. Two stages linked in serial design allows for one stage to shut down incase another fails. The dual stage design also allows full modulation between minimum and maximum gas input rates.



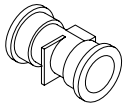
#### 4) Combustion & Exhaust Dual Fan

The dual fan allows for push-pull design in Eternal where the combustion fan mixes gas and air, then injects for combustion while exhaust fan simultaneously removes excess by-products from combustion chamber. The two fans are synchronized and modulated according to demand.



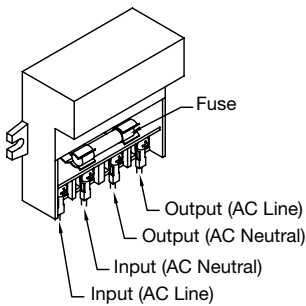
#### 5) Mixing Valve

The mixing valve is designed to temper the final outlet water should the heat exchanger output hotter water than preset. For instance, if set at 122F but heat exchanger is outputting 150F, the mixing valve will add cold water at the final outlet to ensure the final temperature is consistent with pre-set.



#### 6) Flow Sensor

The precision sensor signals the PCB based by how fast the turbine spins. The PCB then calculates the exact volume of water and matches the demand to proper gas supply, fan speed etc... to produce the amount of hot water desired using most efficient method possible.



#### 7) Leakage Breaker (GFCI)

This protective device is wired directly to the transformer. It provides built-in GFCI so that Eternal does not need to be plugged into a GFCI outlet. Make sure to check this device first if the unit stopped working as the breaker may have tripped or the fuse popped.

# OPERATION PRINCIPLES

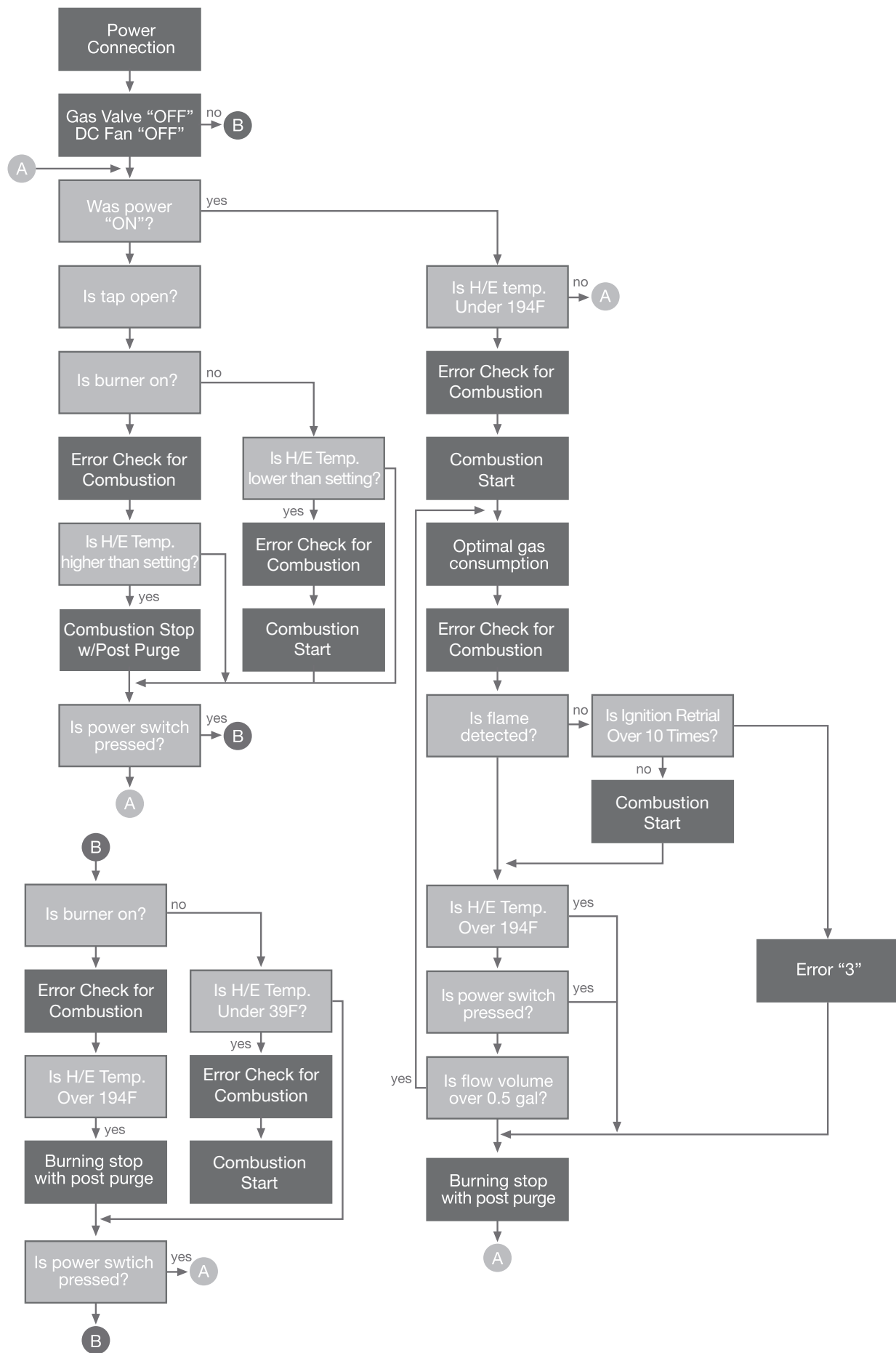
Eternal is a hybrid design, in which the unit can behave like a tank or tank-less under different conditions.

At less than 0.5GPM flow, Eternal is controlled by thermostat. If the water temperature in the holding tank drops below setting temperature, the unit will fire. Working under this condition, Eternal behaves very much like a traditional tank. The burner uses minimum input only with no modulation.

When the demand is greater than 0.5GPM, Eternal is controlled by flow. Gas supply and fan will modulate fully according to flow (over 500 steps!). The unit will produce endless hot water to meet high demand applications.

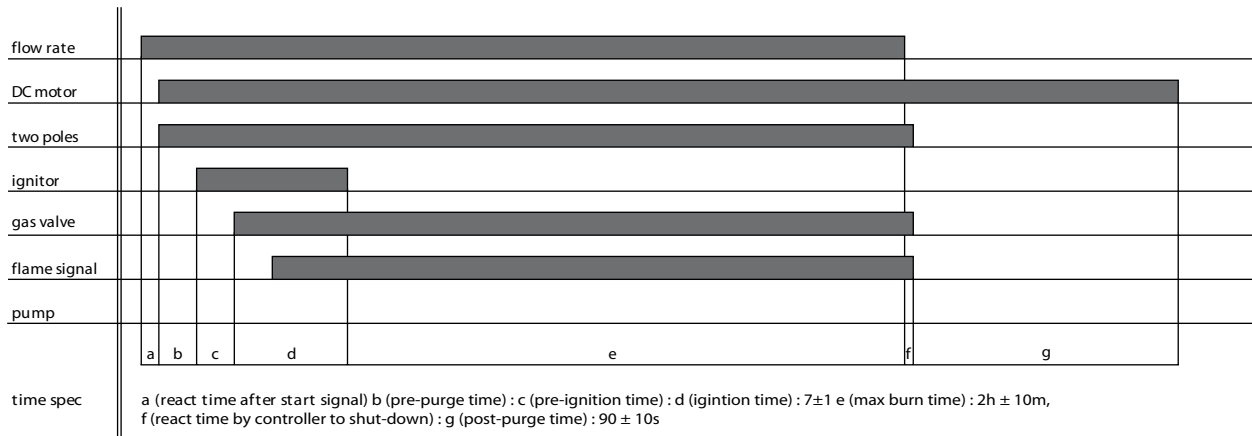
Eternal is easy to install because of the hybrid design. There is no need to worry about minimum flow to trigger combustion or cold water sandwiching. The holding tank can supply hot water as soon as the tap is opening. Unlike tank-less, which has to go through a proving cycle and flush out the cold water every time a tap is turned off from on. The home owner can enjoy steady hot water, and instantly with recirculation.

# OPERATIONAL SEQUENCE FLOW CHART

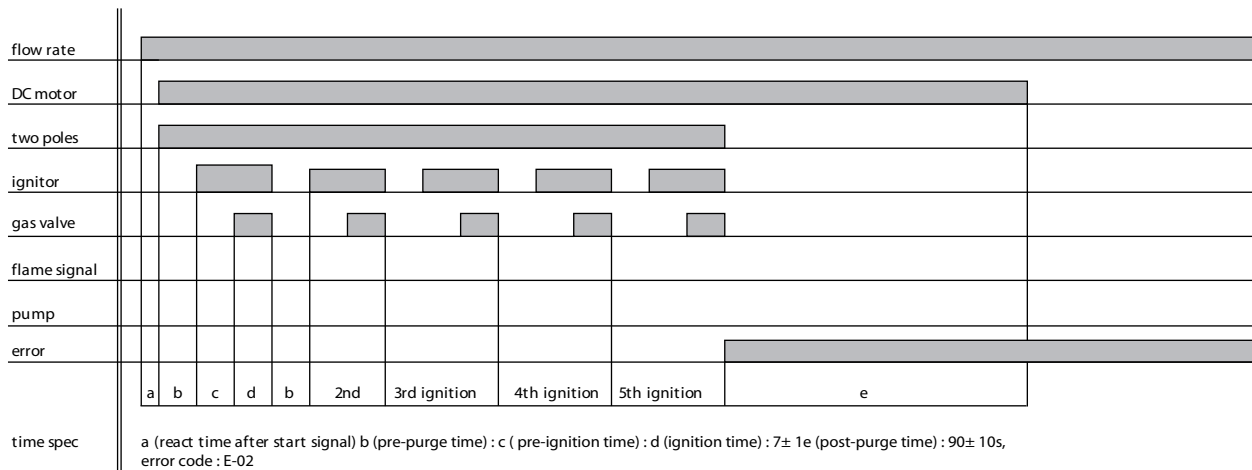


# TIME CHART

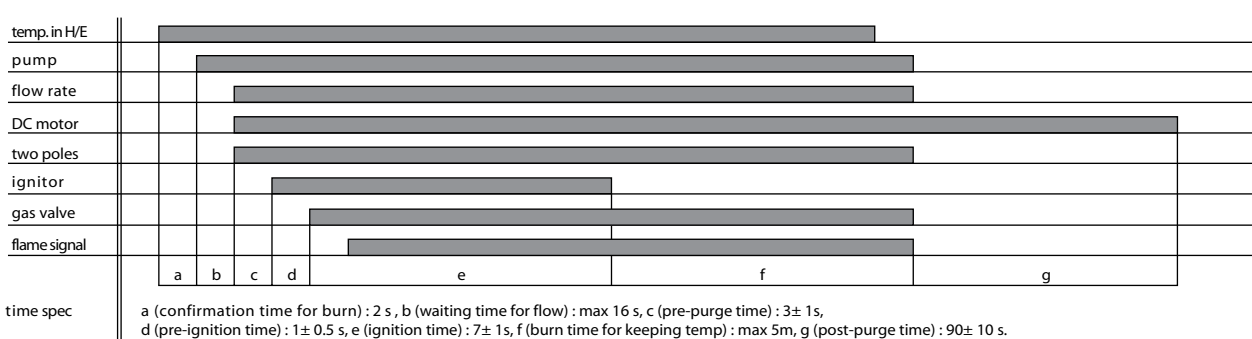
## Normal Ignition Sequence



## In No Gas Case Sequence



## Stand-By and Anti-Freezing Sequence



# SYMPTOMS AND REMEDIES

Symptom	Related Parts	Remedy
System doesn't display temperature on front controller	Power cord	The green LED in the leakage breaker isn't lit -> Check the power cord or the fuse (3A)
	Leakage Breaker (GFCI)	a) The red LED in the leakage breaker is lit -> Push reset button on the leakage breaker
		b) Output voltage of the leakage breaker is not normal -> Measure output voltage of the leakage breaker per Fault Diagnosis #16
	22p-main-wire	a) One of the pins connecting wire to the leakage breaker is out of the connector -> Check the state of connection visually and ensure all wires are properly connected
		b) One of the pins connecting wire to the transformer is out of the connector -> Check the state of connection visually and ensure all wires are properly connected
	Transformer	Output voltage of the transformer is not normal -> Measure output voltage of the transformer per Fault Diagnosis #1
	Main Controller	The main controller has a problem -> Check Lighting of LED on the main controller or listen to movement noise of the mixing valve
20p-main-wire	One of the pin connecting wire to the main controller is out of the connector -> Check the state of connecting visually	
System doesn't do temperature up function	Main Controller	DIP switches -> Change the DIP switch to allow maximum desired temperature per settings on p. 12
System doesn't operate when tap is open	Flow Sensor	No signal -> Measure signal from the flow sensor per Fault Diagnosis #17
System fails ignition (Error 2 on front controller)	22p-main-wire	One of the pins in the 22p connector plug is out of position -> Measure AC voltage during ignition procedure
	Ignitor	One of the pins connecting wire to the ignitor is out of the connector, or the ignitor has a problem -> Check the state of connection visually and ensure all wires are properly connected
	Ignition plugs	One of the ignition plugs is in contact with chassis -> Measure resistance between plug and chassis per Fault Diagnosis #18
	Discharge of high voltage	Destruction of insulation -> Check place of discharge visually

Symptom	Related Parts	Remedy
System doesn't detect flame signal (Error 2 on front of controller)	Flame signal plug	The green LED in the leakage breaker isn't lit -> Check the power cord or the fuse (3A)
	22p-main-wire	Pin is out of the connector -> Measure AC voltage between the flame signal plug and chassis per Fault Diagnosis #19
After detection of flame signal, system lose the signal (Error 3 on front controller)	Input gas	Input gas is not enough -> Measure gas supply pressure per instructions on p.8
	Gas valves	The change-over gas valve doesn't open for max fire -> Measure manifold gas pressure per instructions on p.8
Error 1	Flame Signal Plug	There is dirty substance between the plug and chassis -> Measure resistance between plug and chassis per Fault Diagnosis #19
	Main Controller	The main controller has a problem -> Replace main controller
Error 4 or 5	An outlet thermistor	The outlet thermistor has a problem -> Measure resistance of the outlet thermistor per Fault Diagnosis #2
	24p-main-wire	One of the pins connecting with the outlet thermistor to the main controller is out of the connector plug -> Check the state of connection visually and ensure all wires are properly connected
Error 6 or 7	H/E thermistor	The H/E thermistor has a problem -> Measure resistance of the H/E thermistor per Fault Diagnosis #2
	24p-main-wire	One of the pins connecting wire of the H/E thermistor to the main controller is out of the connector plug -> Check the state of connection visually and ensure all wires are properly connected
Error 8 or 9	Inlet Thermistor	The inlet thermistor has a problem -> Measure resistance of the inlet thermistor per Fault Diagnosis #2
	24p-main-wire	One of the pins connecting wire of the inlet thermistor to the main controller is out of the connector plug -> Check the state of connection visually and ensure all wires are properly connected
Error 11	DC motor	The DC motor has a problem -> Check rotation signal of the DC Motor per Fault Diagnosis #4
Error 12	H/E thermistor in thermistor assembly	The H/E thermistor has a problem -> Measure resistance of the H/E thermistor per Fault Diagnosis #2

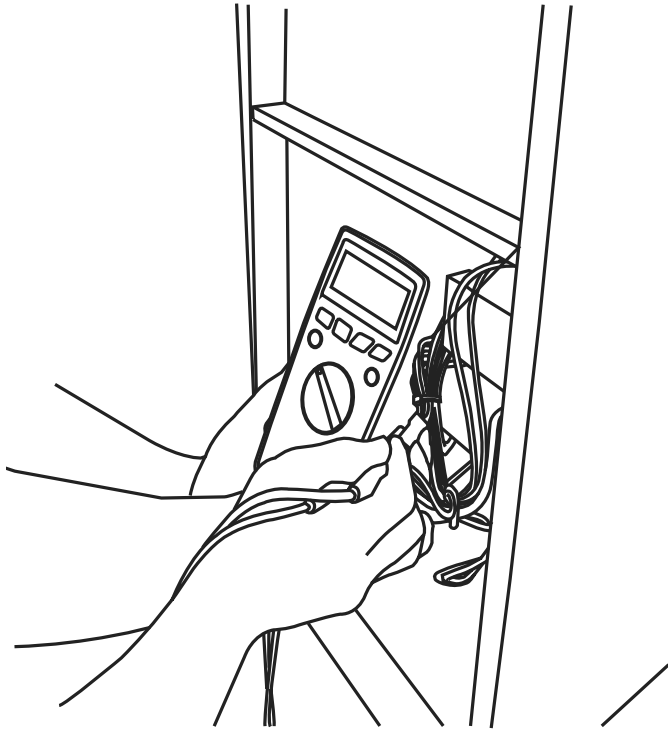
Symptom	Related Parts	Remedy
Error 13	No water	There is no water in the H/E ( Heat Exchanger ) -> Check if H/E is filled with water
	Pressure switch	The pressure switch has a problem -> Measure resistance of the pressure switch per Fault Diagnosis #5
Error 14,15,16	Main Controller	The main controller has a problem -> Replace the main controller
Error 17 or 18	Burner Thermistor	The burner thermistor has a problem -> Measure resistance of the burner thermistor per Fault Diagnosis #6
	24p-main-wire	One of the pins connecting wire of the air thermistor to the main controller is out of the connector plug, or is shorted due to contact with the chassis -> Check the state of connection visually and ensure all wires are properly connected
Error 19 or 20	Air Thermistor	The air thermistor has a problem -> Measure resistance of the air thermistor per Fault Diagnosis #2
	24p-main-wire	One of the pins connecting wire of the air thermistor to the main controller is out of the connector plug, or is shorted due to contact with the chassis -> Check the state of connection visually and ensure all wires are properly connected
Error 21	Air Thermistor	The air thermistor has a problem -> Measure resistance of the air hole thermistor per Fault Diagnosis #2
	Ventilation condition	Ventilation condition is not normal -> Check ventilation condition
Error 22	Burner thermistor	The burner thermistor has a problem -> Measure resistance of the burner thermistor per Fault Diagnosis #6
Error 24	Mixing Valve	The mixing valve has a problem -> Listen for abnormal movement noise of the mixing valve
	24p-main-wire	One of the pins connecting wire of the mixing valve to the main controller is out from out of the connector plug, or is shorted due to contact with chassis -> Check the state of connection visually and ensure all wires are properly connected
Error 27	Mixing Valve	The mixing control valve has a problem -> Listen to movement noise of the mixing valve
	24p-main-wire	One of the pins connecting wire of the mixing valve to the main controller is out of the connector plug, or is shorted due to contact with the chassis -> Check the state of connection visually and ensure all wires are properly connected



Symptom	Related Parts	Remedy
Error 28	Thermal Safety Device	a) The thermostat (194F) activated -> Measure resistance of the thermostat (194F) per Fault Diagnosis #7
		b) The thermostat (221F) activated -> Measure resistance of the thermostat (221F) per Fault Diagnosis #7
		c) The thermal fuse (307F) activated -> Measure resistance of the thermal fuse (307F) per Fault Diagnosis #7
	Main gas valves	The main gas valve solenoid's coil may be blown -> Measure resistance of main gas valve solenoid per Fault Diagnosis #11
Error 30	RPM signal of DC motor	The RPM signal is not normal -> Measure RPM of the DC motor per Fault Diagnosis #4
Error 31	RPM signal of DC motor	The RPM signal is not normal -> Measure RPM of the DC motor per Fault Diagnosis #4
Error 34	24p-main-wire	One of the pins connecting wire of the change-over gas valve to the main controller is out of the connector plug, or is shorted due to contact with the chassis -> Check the state of connection visually and ensure all wires are properly connected
	Change-over Gas Valve	The solenoid coil of the change-over gas valve is blown -> Measure resistance of coil per Fault Diagnosis #13
Error 35	24p-main-wire	One of the pins connecting wire of the modulating gas valve to the main controller is out of the connector plug, or is shorted due to contact with the chassis  -> Check the state of connection visually and ensure all wires are properly connected
	Modulating Gas Valve	The modulating gas valve solenoid's coil may be blown -> Measure resistance of modulating gas valve solenoid per Fault Diagnosis #15
Error 36 through 43	Main Controller	Main controller has a problem -> Replace the main controller
Error 45 (DV only)	Venting Condition	There is no positive pressure in the venting system when DC Motor is working -> Check venting system to ensure the DC Motor is generating positive pressure.
	Air pressure switch	-> Measure resistance of air pressure switch per Fault Diagnosis #20
	2P main wire	One of the pins connecting wire of the air pressure switch to the main controller is out of the connector plug, or is shorted due to contact with the chassis -> Check the state of connection visually and ensure all wires are properly connected
Error 46	Combustion Air	Insufficient combustion air supplied to the unit -> Check vents for blockage, and check that sufficient combustion air is supplied to the unit

# FAULT DIAGNOSIS

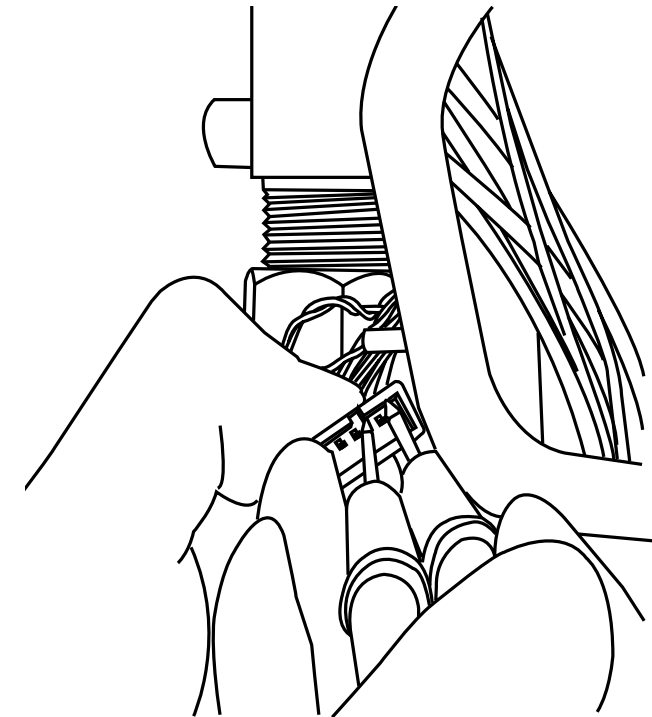
## Fault Diagnosis #1: How to check AC voltage supplied from transformer.



1. Set multi-meter to measure AC voltage range.
2. Push tester pins into connector according to chosen output pins.

pin no	color	AC voltage	remark
1,6	black	from 102V to 132V	input voltage
2,7	blue	over 150V	for flame rod
3,8	red	over 40V	for DC motor
4,9	white	over 18V	for gas valve
5,10	yellow	over 12V	

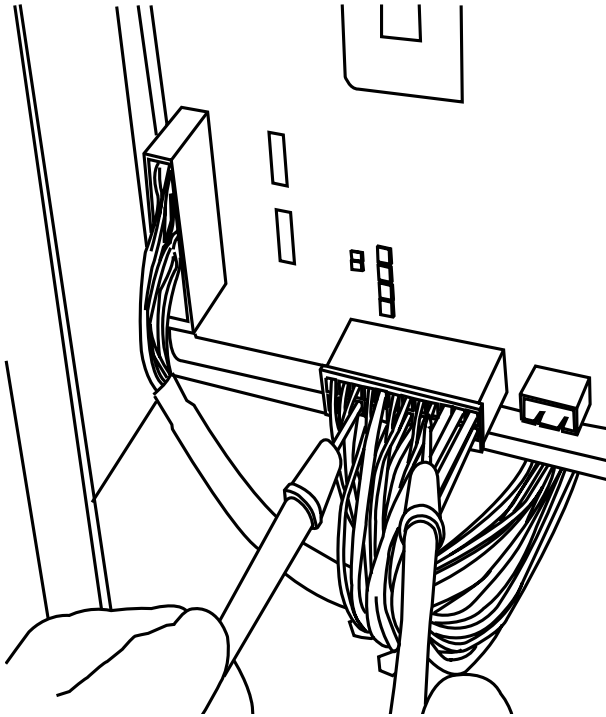
## Fault Diagnosis #2: How to check resistance of thermistor assembly.



1. Set multi-meter to measure resistance range.
2. Push tester pins into connector according to chosen thermistor.

pin no	color	remark
1,6	white	air hole thermistor
3,4	white	inlet thermistor
5,6	black	heat exchanger thermistor
7,8	red	outlet thermistor

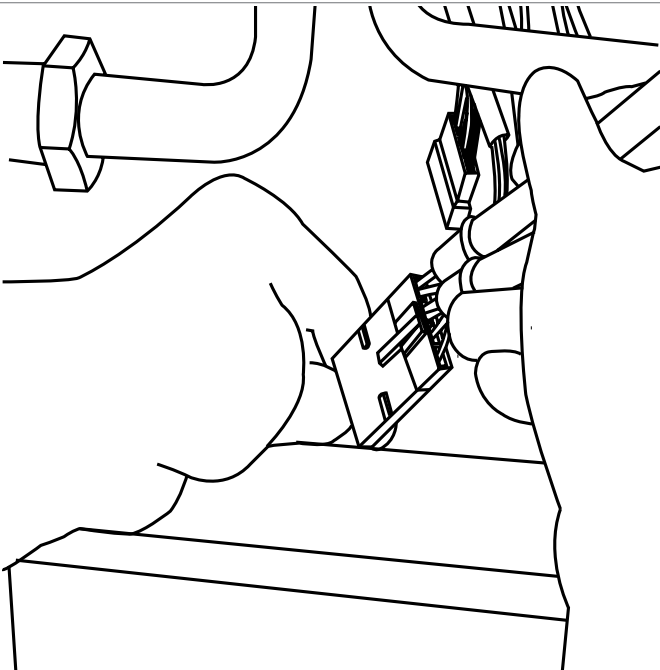
**Fault Diagnosis #3: How to check DC voltage on 24p connector in main controller .**



1. Set multi-meter to measure DC voltage range.
2. Push tester pin into connector according to chosen pins.

pin no	color	remark
1, 15	blue / black	inlet thermistor
2, 15	white / black	outlet thermistor
3, 15	red / black	heat exchanger thermistor
13, 15	green / black	air hole thermistor
14, 15	orange / black	burner thermistor
4, 17	red / black	flow rate
16, 17	blue / black	pressure sensor
12, 24	white / black	rotation signal of a DC motor
11, 24	red / black	drive voltage for a DC motor
23, 24	yellow / black	circuit voltage for a DC motor

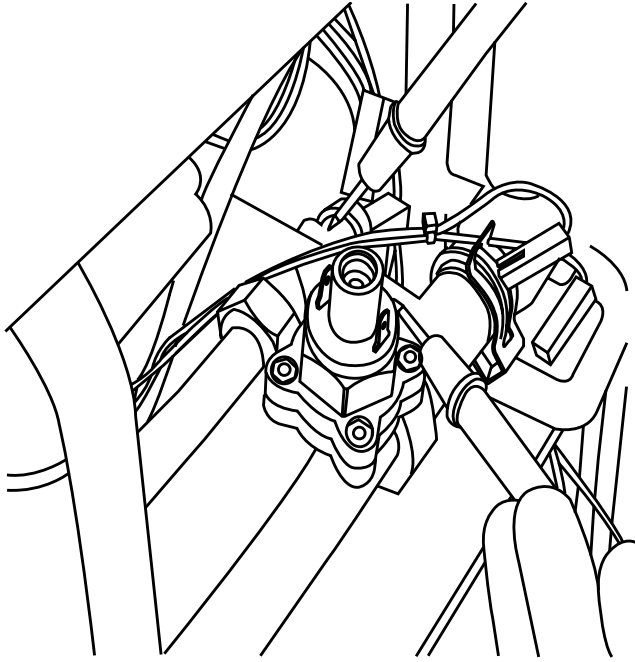
**Fault Diagnosis #4: How to check voltage of DC motor.**



1. Set multi-meter to measure DC voltage range.
2. Push tester pin into connector according to chosen pins.

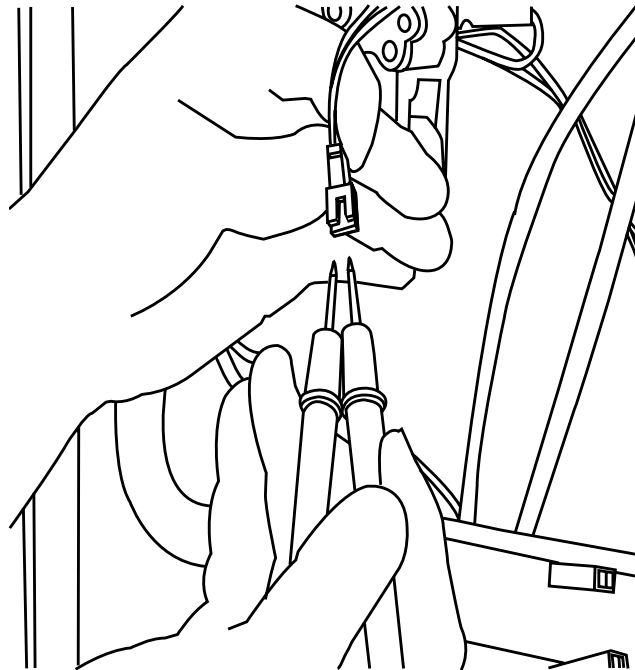
color	remark
white	rotation signal (From DC 3.5V to 4.5V)
red	drive voltage (From DC 8V to 45V)
yellow	circuit voltage (over than DC 4.5V)
black	ground for a DC motor

**Fault Diagnosis #5: How to check resistance of contacts of pressure switch.**



1. Set multi-meter to measure resistance range.
2. Touch tester pins to a pressure sensor like figure.
3. Normal resistance: less than 100Ω when water is supplied normally.

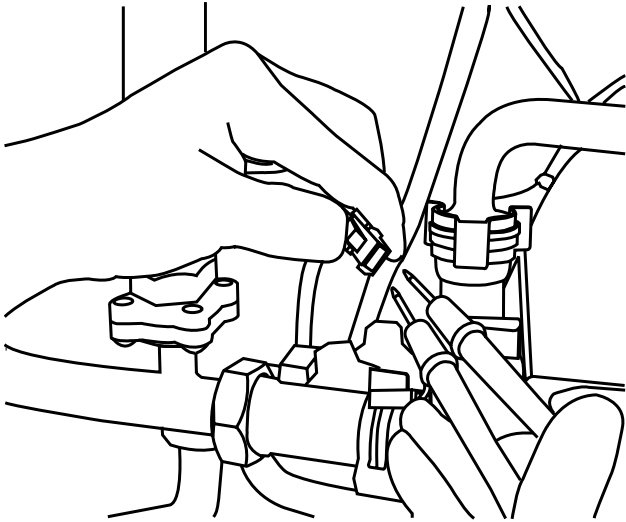
**Fault Diagnosis #6: How to check resistance of burner thermistor.**



1. Set multi-meter to measure resistance range.
2. Touch tester pins to a pressure sensor like figure.
3. Normal resistance:

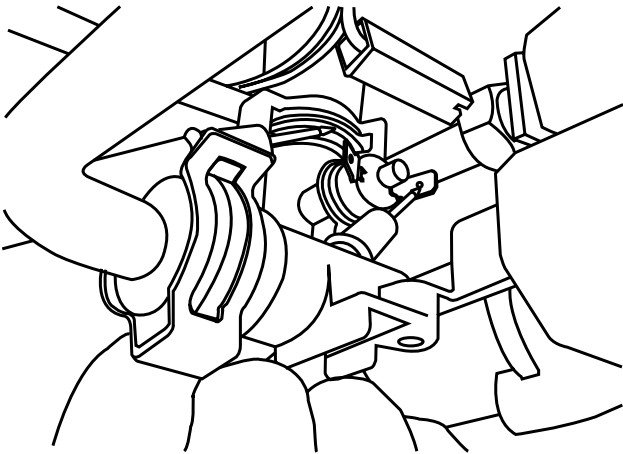
temperature	resistance
32°F ~ 68°F	233 kΩ ~ 1100 kΩ
69°F ~ 104°F	97 kΩ ~ 232 kΩ
105°F ~ 140°F	44 kΩ ~ 96 kΩ
141°F ~ 176°F	22 kΩ ~ 43 kΩ
177°F ~ 212°F	11 kΩ ~ 22 kΩ
213°F ~ 248°F	6.3 kΩ ~ 11 kΩ
249°F ~ 284°F	3.7 kΩ ~ 6.3 kΩ
285°F ~ 320°F	2.3 kΩ ~ 3.7 kΩ
321°F ~ 356°F	1.4 kΩ ~ 2.3 kΩ
357°F ~ 392°F	0.95 kΩ ~ 1.4 kΩ

**Fault Diagnosis #7: How to check resistance of safety devices.**



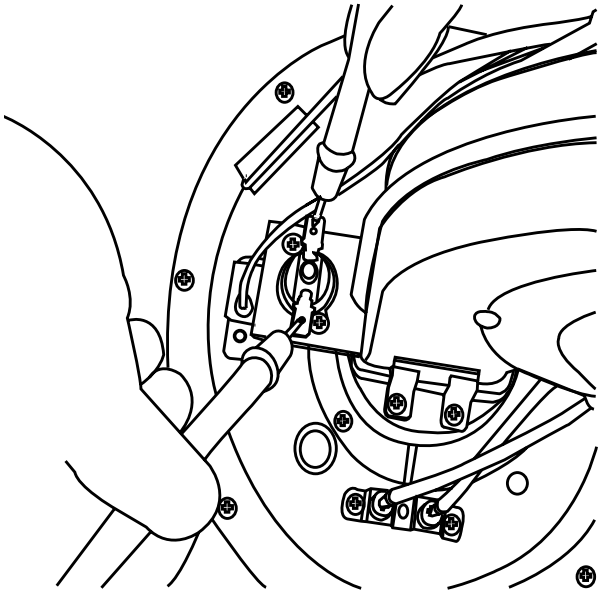
1. Set multi-meter to measure resistance range.
2. Push tester pins into a connector like figure.
3. Normal resistance: less than  $100\Omega$

**Fault Diagnosis #8: How to check resistance of a thermostat (194F).**



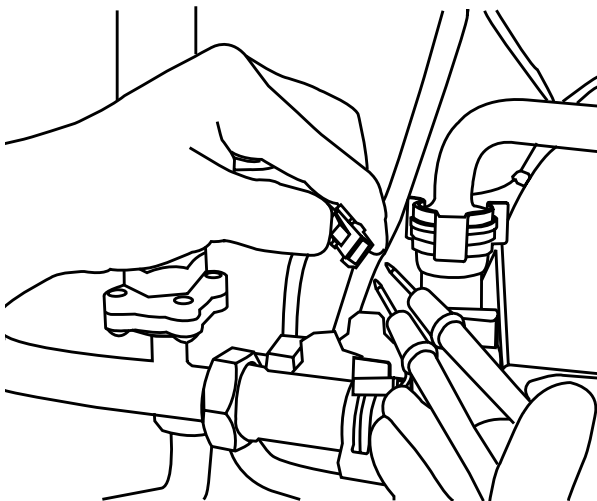
1. Set multi-meter to measure resistance range.
2. Touch tester pins to a thermostat like figure.
3. Normal resistance: less than  $100\Omega$

**Fault Diagnosis #9: How to check resistance of thermostat (221F) .**



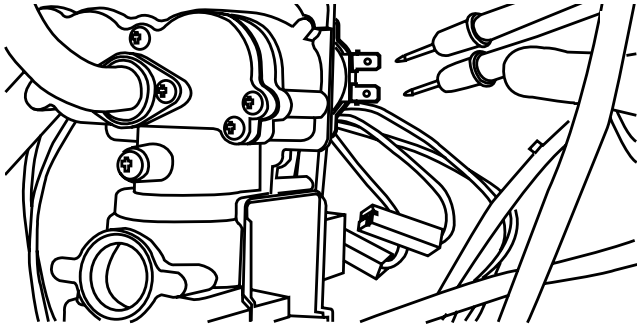
1. Set multi-meter to measure resistance range.
2. Touch tester pins to a thermostat like figure.
3. Normal resistance: less than  $100\Omega$

**Fault Diagnosis #10: How to check resistance of thermal fuse.**



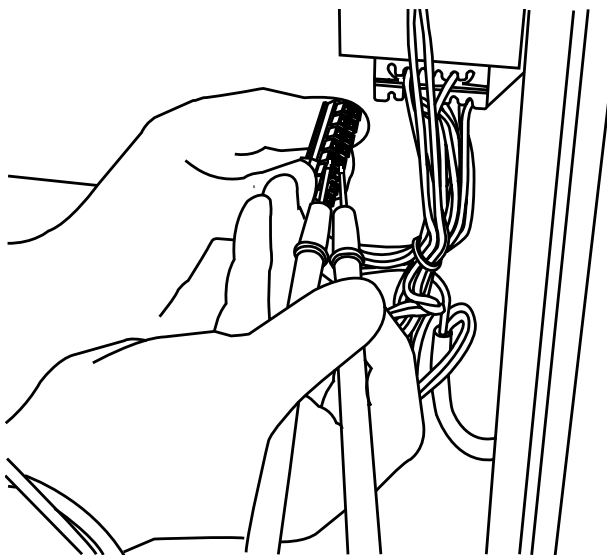
1. Set multi-meter to measure resistance range.
2. Push tester pins into connectors like figure.
3. Normal resistance: less than  $100\Omega$

**Fault Diagnosis #11 : How to check resistance of main gas valve solenoid.**



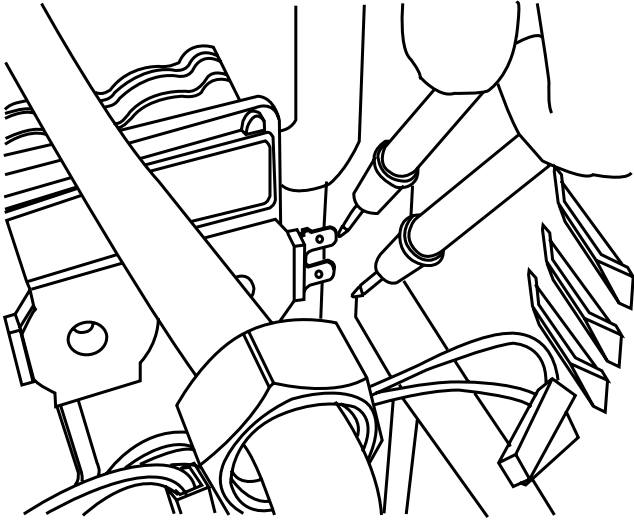
1. Set multi-meter to measure resistance range.
2. Touch tester pins to terminal like figure.
3. Normal resistance: less than  $2k\Omega$

**Fault Diagnosis #12: How to check resistance of wire connected to change-over solenoid on the gas valve.**



1. Set multi-meter to measure resistance range.
2. Push tester pins to a connector like figure.
3. Normal resistance: less than  $2k\Omega$

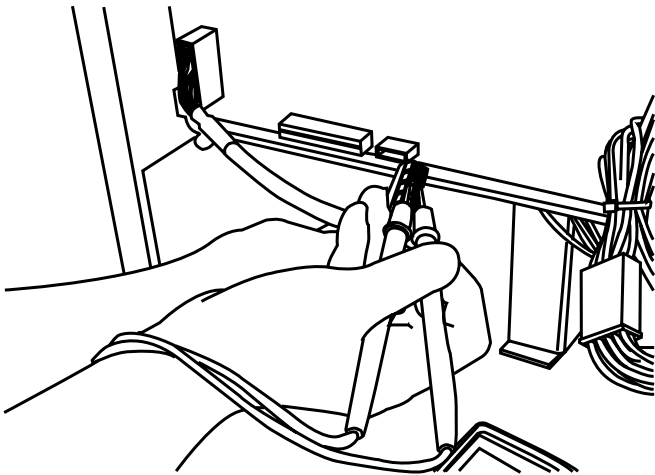
**Fault Diagnosis #13: How to check resistance of change-over solenoid.**



*figure shows position of change-over solenoid when looking from back of the unit towards the front*

1. Set multi-meter to measure resistance range.
2. Touch tester pins to terminal like figure.
3. Normal resistance: less than  $2k\Omega$

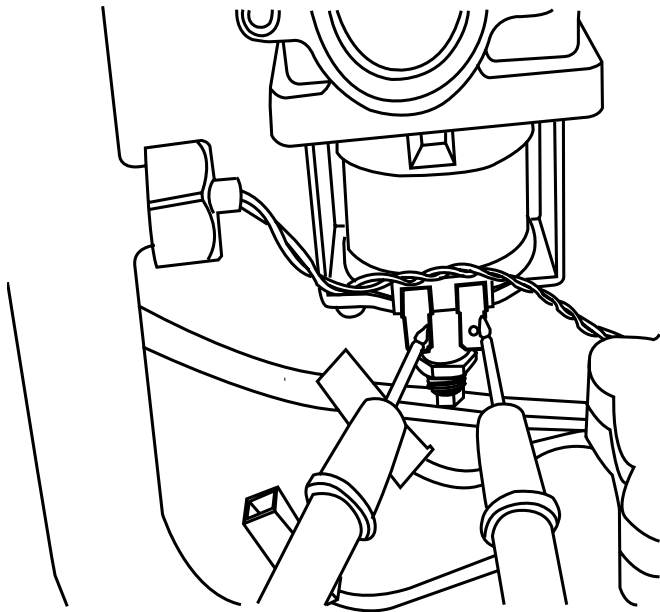
**Fault Diagnosis #14: How to check resistance of wire connected to modulating solenoid on the gas valve.**



1. Set multi-meter to measure resistance range.
2. Push tester pins to a connector like figure.
3. Normal resistance: less than  $1k\Omega$

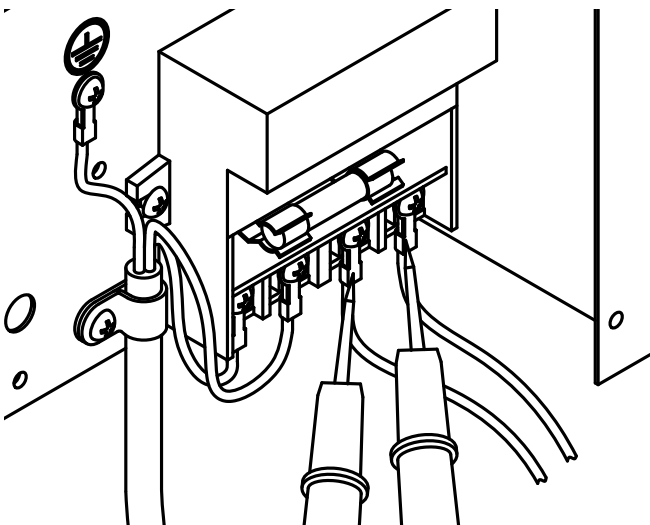


**Fault Diagnosis #15: How to check resistance of modulating solenoid on the gas valve.**



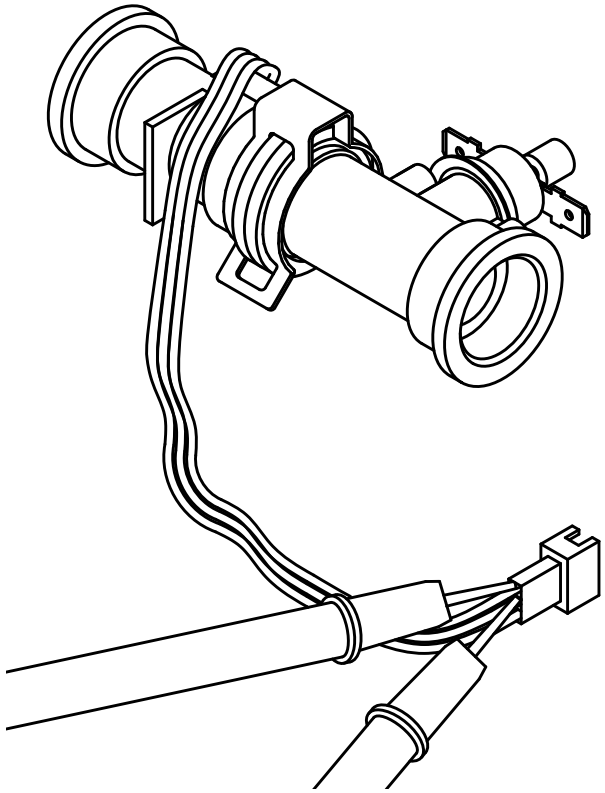
1. Set multi-meter to measure resistance range.
2. Touch tester pins to terminal like figure.
3. Normal resistance: less than  $1k\Omega$

**Fault Diagnosis #16 : How to measure output voltage of the leakage breaker.**



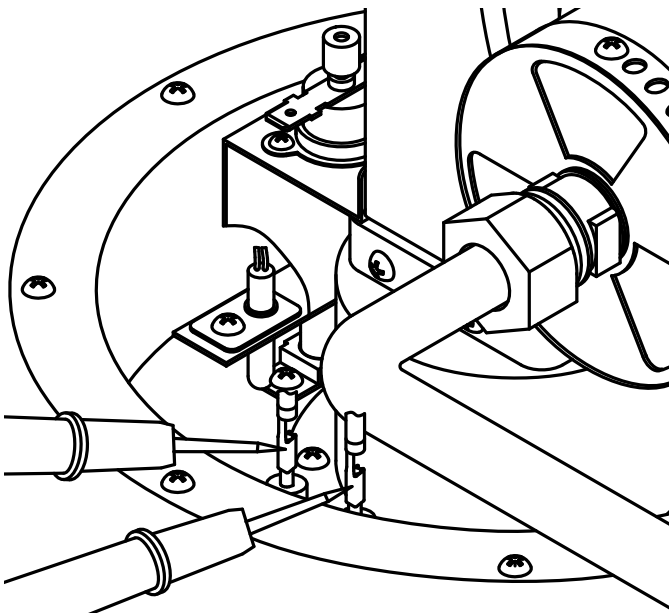
1. Set multi-meter to measure AC voltage.
2. Touch tester pins to terminal 1 and 2 ( Input Voltage)
3. Touch tester pins to terminal 3 and 4 ( Output Voltage)
4. Normal Voltage : AC 108 ~ 132V

**Fault Diagnosis #17 : How to measure signal from flow sensor.**



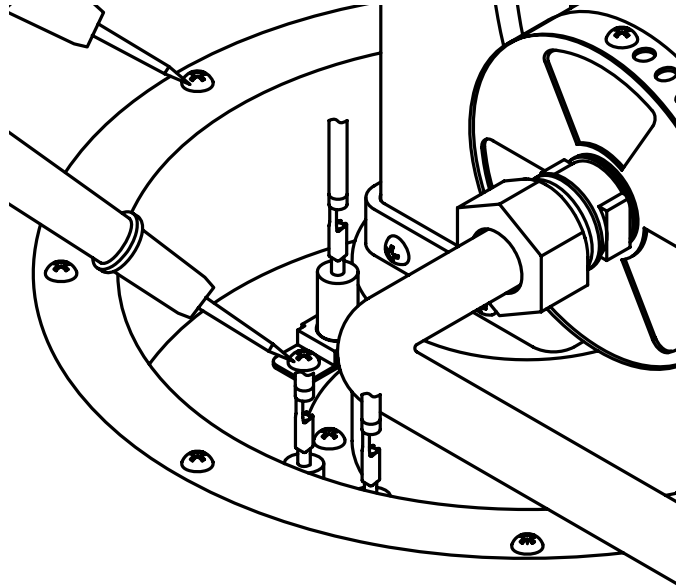
1. Set multi-meter to measure frequency of DC voltage.
2. Push tester pins to connector (black and orange) like figure.
3. Flow rate (GPM) = measured frequency  $\div$  26.5

**Fault Diagnosis #18 : How to measure resistance between ignition plugs.**



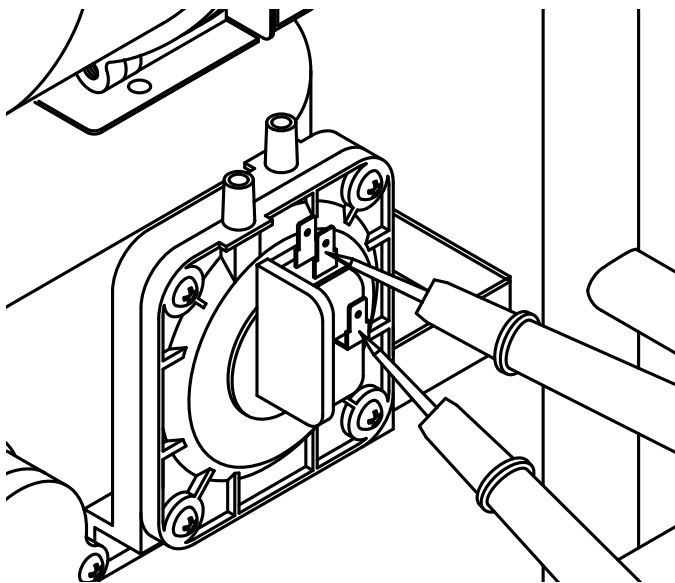
1. Set multi-meter to measure resistance.
2. Touch tester pins to plug and chassis like figure.
3. Normal resistance: mor than 1k $\Omega$

**Fault Diagnosis #19 : How to measure output voltage (or resistance) between flame signal plug and chasis.**



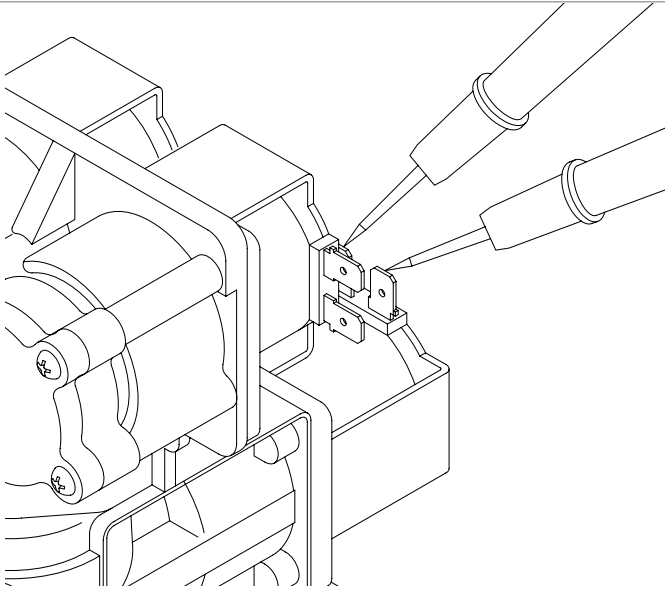
1. Set multi-meter AC voltage (or resistance).
2. Touch tester pins to terminal and chassis like figure
3. Normal Voltage: More than ACC100 V  
(Normal resistance: More than 100k $\Omega$ )

**Fault Diagnosis #20 : How to measure resistance of air pressure switch.**



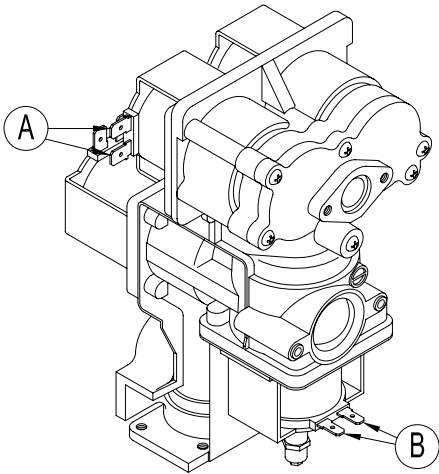
1. Set multi-meter to measure resistance.
2. Touch tester pins to air pressure switch like figure
3. Normal resistance: less than 100k $\Omega$

**Fault Diagnosis #21 : How to measure resistance of main gas valve solenoid (lower).**

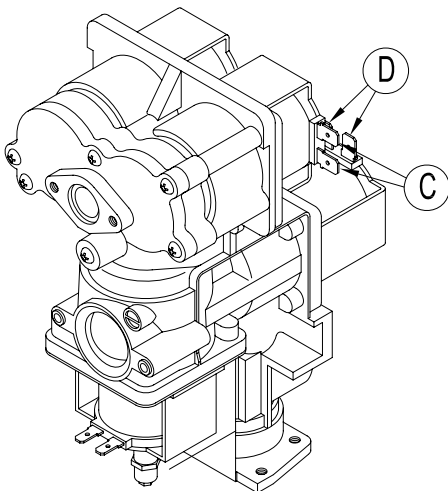


1. Set multi-meter to measure resistance.
2. Touch tester pins to terminal like figure.
3. Normal resistance: less than  $2k\Omega$

**Fault Diagnosis #22 : Description of gas valve.**



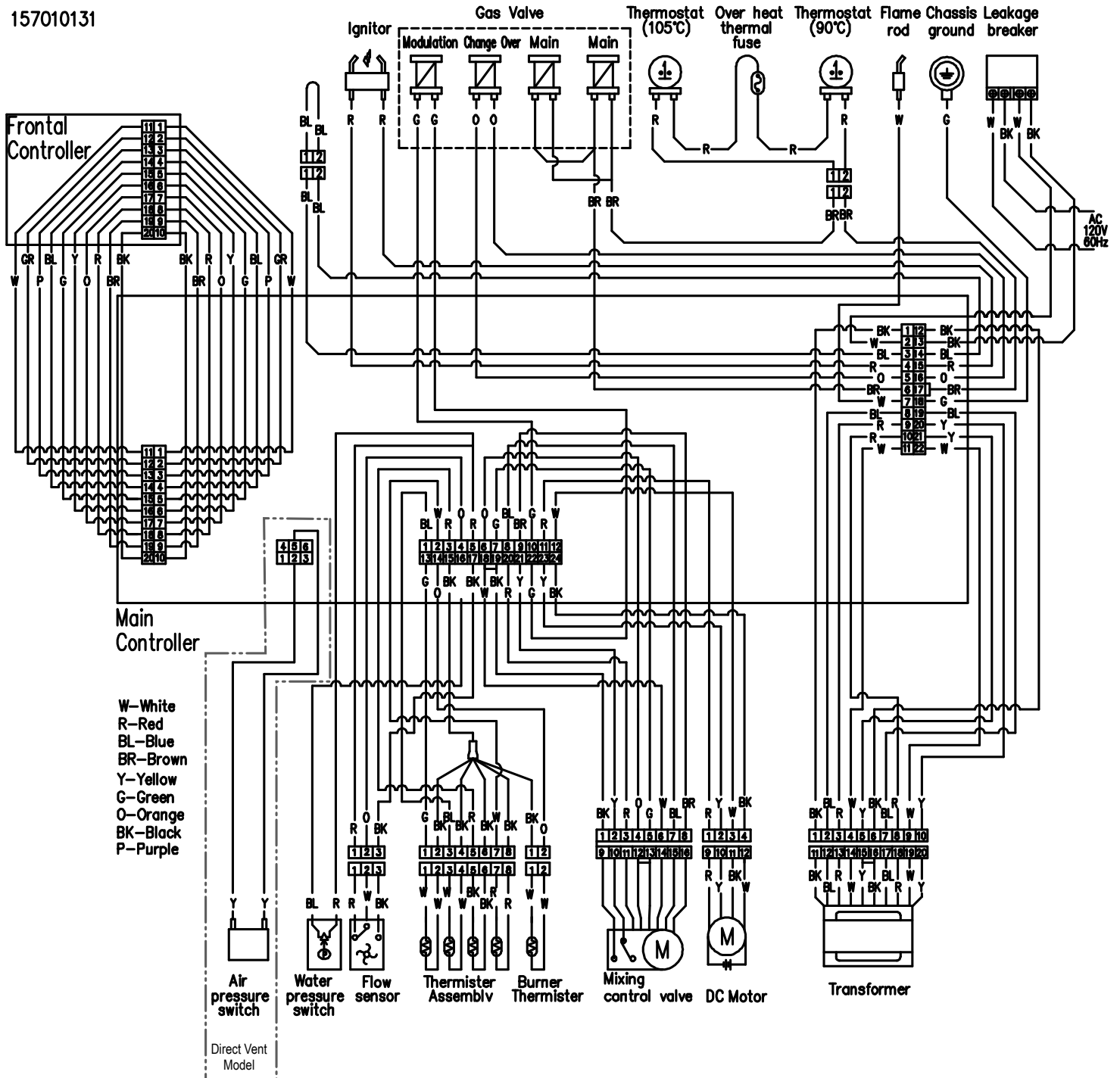
- A. Change over gas valve solenoid
- B. Modulation gas valve solenoid



- C. Main gas valve solenoid (upper)
- D. Main gas valve solenoid (lower)

# WIRING DIAGRAM (POWER & DIRECT VENT)

157010131



# ELECTRICAL COMPONENT ANALYSIS

Recheck wiring harness and ensure all connections are tight before performing component analysis. Power cord must be unplugged for items marked with \* before analysis.

Nature of Fault	Examination Point	Diagnostic Point	Values	Yes or No	Action
A. Front Display does not light up after pressing the ON button	1. Is the power cord plugged in?	Visual Inspection	Is it plugged in?	Yes	Go to A-2
				No	Plug cord in
	2. Is electricity supplied to the water heater?	Visual Inspection	Is green LED of a leakage breaker lit?	Yes	Go to A-4
				No	Go to A-3
	3. Check 3A fuse inside leakage breaker box	*Inspect fuse visually and measure the resistance of the fuse	Resistance is lower than 100Ω?	Yes	Go to A-4
				No	Replace the fuse
	4. Check leakage breaker	Visual Inspection	Is the red LED lit on the leakage breaker?	Yes	Reset the breaker
				No	Go to A-5
	5. Check wire (22p)	Visual Inspection	Did the LED on the main controller light, even for a second?	Yes	Go to A-8
				No	Go to A-6
	6. Check wire (22p)	Check #1, #2, #12, #13 of 20p-main-wire visually	Is there any escaped pin?	Yes	Secure wiring
				No	Go to A-7
	7. Check transformer	Measure voltage [per Fault Diagnosis #1]	Is Voltage higher than AC 12V?	Yes	Go to A-8
				No	Replace the transformer
	8. Check wire (20p)	Visual Inspection	Is it connected to the main controller?	Yes	Replace the main controller
				No	Secure wiring to the main controller

<b>B. Unit does not heat water in the tank</b>	1. Check DIP selection switch settings on main controller	Visual Inspection	Is switch #5 pushed to "ON" position?	Yes	Switch it to "OFF" position										
				No	Go to B-2										
	2. Check heat exchanger thermistor	Meaure resistance [per Fault Diagnosis #2] Table 1 <table border="1" data-bbox="613 407 932 743"> <thead> <tr> <th>Temperature (unit °F)</th> <th>Resistance (unit kΩ)</th> </tr> </thead> <tbody> <tr> <td>32 &lt; T &lt; 50</td> <td>15 &lt; R &lt; 25</td> </tr> <tr> <td>50 &lt; T &lt; 86</td> <td>7 &lt; R &lt; 15</td> </tr> <tr> <td>86 &lt; T &lt; 122</td> <td>3.4 &lt; R &lt; 7</td> </tr> <tr> <td>122 &lt; T &lt; 176</td> <td>1.3 &lt; R &lt; 3.4</td> </tr> </tbody> </table>	Temperature (unit °F)	Resistance (unit kΩ)	32 < T < 50	15 < R < 25	50 < T < 86	7 < R < 15	86 < T < 122	3.4 < R < 7	122 < T < 176	1.3 < R < 3.4	Is resistance value within specification per Table 1?	Yes	Go to B-3
			Temperature (unit °F)	Resistance (unit kΩ)											
32 < T < 50	15 < R < 25														
50 < T < 86	7 < R < 15														
86 < T < 122	3.4 < R < 7														
122 < T < 176	1.3 < R < 3.4														
		No	Replace the thermistor assembly												
3. Check inlet thermistor	Disconnect thermistor assembly connector from the bundle [and] measure resistance [per Fault Diagnosis #2]		Is resistance reasonable as per Table 1?	Yes	Go to B-4										
				No	Replace the thermistor assembly										
4. Check flow sensor	Measure voltage [per Fault Diagnosis #3]		Is water flowing more than 2 hours?	Yes	Close the tap										
				No	Replace the main controller										
<b>C. E4 or E5 on front display</b>	1. Check outlet thermistor	Disconnect thermistor assembly connector from the bundle and measure resistance [per Fault Diagnosis #2]	Is resistance reasonable as per Table 1?	Yes	Go to C-2										
				No	Replace the thermistor assembly										
	2. Check wire (24p)	Reconnect the thermistor assembly wire bundle and measure the voltage between pins 2 and 15 (white and black) on the 24P connector to the main controller [per Fault Diagnosis #3] Table 2 <table border="1" data-bbox="613 1646 932 1982"> <thead> <tr> <th>Temperature (unit °F)</th> <th>Resistance (unit V)</th> </tr> </thead> <tbody> <tr> <td>32 &lt; T &lt; 50</td> <td>2.3 &lt; R &lt; 3</td> </tr> <tr> <td>50 &lt; T &lt; 86</td> <td>1.8 &lt; R &lt; 2.3</td> </tr> <tr> <td>86 &lt; T &lt; 122</td> <td>1.2 &lt; R &lt; 1.8</td> </tr> <tr> <td>122 &lt; T &lt; 176</td> <td>0.7 &lt; R &lt; 1.2</td> </tr> </tbody> </table>	Temperature (unit °F)	Resistance (unit V)	32 < T < 50	2.3 < R < 3	50 < T < 86	1.8 < R < 2.3	86 < T < 122	1.2 < R < 1.8	122 < T < 176	0.7 < R < 1.2	Is voltage value within specification per Table 2?	Yes	Replace the main controller
			Temperature (unit °F)	Resistance (unit V)											
32 < T < 50	2.3 < R < 3														
50 < T < 86	1.8 < R < 2.3														
86 < T < 122	1.2 < R < 1.8														
122 < T < 176	0.7 < R < 1.2														
		No	Replace the 24p-main-wire												

<b>D. Error 6 or Error 7 on front controller</b>	1. Check thermistor in heat exchanger	(After disconnecting thermistor from wire) Measure resistance [per Fault Diagnosis #2]	Is resistance reasonable as per Table 1	Yes	Go to D-2
				No	Replace the thermistor assembly
	2. Check a wire (24p)	(After connecting thermistor with wire) Measure voltage between red and black on 24p connector in main controller [per Fault Diagnosis #3]	Is voltage reasonable as per Table 2	Yes	Replace the main controller
				No	Replace the 24p-main-wire
<b>E. Error 8 or Error 9 on front controller</b>	1. Check thermistor in inlet pipe	(After disconnecting thermistor from wire) Measure resistance [per Fault Diagnosis #2]	Is resistance reasonable as per Table 1?	Yes	Go to E-2
				No	Replace the thermistor assembly
	2. Check wire (24p)	(After connecting thermistor with wire) Measure voltage between blue and black on 24p connector in main controller [per Fault Diagnosis #3]	Is voltage reasonable as per Table 2?	Yes	Replace the main controller
				No	Replace the 24p-main-wire
<b>F. Error 11 on front controller</b>	1. Check DC motor	Inspection by listening	Does DC motor rotate?	Yes	Go to F-2
				No	Go to F-4
	2. Check rotation signal	Measure voltage between white and black in 4p connector [per Fault Diagnosis #4]	Is DC voltage between DC 3V and DC 4.5V?	Yes	Go to F-3
				No	Replace the DC motor
	3. Check wire (24p)	Measure voltage between white and black on 24p connector in main controller [per Fault Diagnosis #3]	Is DV voltage between DC 3V and DC 4.5V	Yes	replace the main controller
				No	Replace the 24p-main-wire
	4. Check transformer	Measure voltage [per Fault Diagnosis #1]	Is AC voltage higher than 40V	Yes	Go to F-5
				No	Replace the transformer
	5. Check Drive voltage for DC motor	Measure voltage between red and black on 24p connector in main controller [per Fault Diagnosis #3]	Is DC voltage over 30V during the purge	Yes	Go to F-6
				No	Replace the main controller
	6. Check wire (24p)	Measure voltage between red and black in 4p connector [per Fault Diagnosis #4]	Is DC voltage over 30V during the purge	Yes	Go to F-7
				No	Replace the 24p-main-wire
7. Check circuit voltage	Measure voltage between yellow and black on 24p connector [per Fault Diagnosis #3]	Is DC voltage over 5V?	Yes	Go to F-8	
			No	Replace the main controller	
8. Check wire (24p)	Measure voltage between yellow and black in 4p connector [per Fault Diagnosis #4]	Is DC voltage over 5V?	Yes	Replace the DC motor	
			No	Replace the main controller	



<b>G. Error 13 on front controller</b>	1. Check pressure switch	Disconnect the wires on the pressure switch and measure the resistance of the switch [per Fault Diagnosis #5]	Is resistance lower than $100\Omega$ as water is supplied?	Yes	Go to G-2
				No	Go to G-3
	2. Check wire (24p)	Reconnect the wires to the water pressure switch and measure the voltage between pins 16 and 17 (blue and black) on 24P connector to the main controller [per Fault Diagnosis #3]	Is voltage higher than DC 4.5V?	Yes	Replace the main controller
				No	Replace the 24p-main-wire
	3. Check main controller	Measure voltage between red and black on 24p connector in main controller [per Fault Diagnosis #3]	Is voltage higher than DC 4.5V?	Yes	Replace the 24p-main-wire
				No	Replace the main controller
<b>H. Error 17 (short) on front controller</b>	1. Check main controller	Disconnect the 2P wire connector on the burner thermistor and measure the voltage between pins 14 and 15 (orange and black) in 24P connector to the main controller [per Fault Diagnosis #3]	Is voltage higher than DC 4.5V?	Yes	Go to H-2
				No	Replace the main controller
	2. Check burner thermister	Measure resistance between pins on the 2P connector of the thermistor [per Fault Diagnosis #6]	Is resistance lower than $500\Omega$ ?	Yes	Replace the burner thermistor
				No	Go to H-3
	3. Check wire (24p)	Reconnect the 2P wire connector of the burner thermistor and measure voltage between pins 14 and 15 (orange and black) in 24P connector to the main controller [per Fault Diagnosis #3]	Is voltage lower than DC 0.3V?	Yes	Replace 24-main-wire
				No	Replace the main controller

<b>I. Error 18 (open) on front controller</b>	1. Check main controller	Disconnect the 2P wire connector of the burner thermistor on the wire bundle and measure voltage between pins 14 and 15 in the 24P connector to the main controller [per Fault Diagnosis #3]	Is voltage higher than DC 4.5V?	Yes	Go to I-2
				No	Replace the main controller
	2. Check burner thermister	Measure resistance between pins on the 2P connector of the thermistor [per Fault Diagnosis #6]	Is resistance higher than 1Ω?	Yes	Replace the burner thermistor
				No	Go to I-3
	3. Check wire (24p)	Reconnect the 2P wire connector of the burner thermistor and measure voltage between pins 14 and 15 (orange and black) in 24P connector to the main controller [per Fault Diagnosis #3]	Is voltage higher than DC 4.8V?	Yes	Replace 24p-main-wire
				No	Replace the main controller
<b>J. Error 19 (short) on front controller</b>	1. Check main controller	Disconnect 8P wire connector of the thermistor assembly and measure voltage between pins 13 and 15 (green and black) in 24P connector to the main controller [per Fault Diagnosis #3]	Is voltage higher than DC 4.5V?	Yes	Go to J-2
				No	Replace the main controller
	2. Check air thermistor	Measure resistance between pins 1 and 6 (white) of 8P thermistor connector [per Fault Diagnosis #2]	Is resistance lower than 500Ω?	Yes	Replace the thermister assembly
				No	Go to J-3
	3. Check wire (24p)	Reconnect the 8P wire connector of the thermistor assembly and measure voltage between pins 13 and 15 (green and black) in 24P connector to the main controller [per Fault Diagnosis #3]	Is voltage lower than DC 0.3V?	Yes	Replace 24p-main-wire
				No	Replace the main controller

<b>K. Error 20 (open) on front controller</b>	1. Check main controller	Disconnect 8P wire connector of the thermistor assembly and measure voltage between pins 13 and 15 (green and black) in 24P connector to the main controller [per Fault Diagnosis #3]	Is voltage higher than DC 4.5V	Yes	Go to K-2
				No	Replace the main controller
	2. Check air thermistor	Measure resistance between pins 1 and 6 (white) of 8P thermistor connector [per Fault Diagnosis #2]	Is resistance higher than 1M $\Omega$ ?	Yes	Replace the thermistor assembly
				No	Go to K-3
	3. Check wire (24p)	Reconnect the 8P wire connector of the thermistor assembly and measure voltage between pins 13 and 15 (green and black) in 24P connector to the main controller [per Fault Diagnosis #3]	Is voltage higher than DC 4.8V?	Yes	Replace 24p-main-wire
				No	Replace the main controller
<b>L. Error 28 on front controller</b>	1. Check thermal safety devices	Measure resistance between pins on the 2P connector (red wires) of thermal safety devices [per Fault Diagnosis #7]	Is resistance higher than 100 $\Omega$ ?	Yes	Go to L-2
				No	Go to L-5
	2. Check thermostat switch (194F) on the heat exchanger outlet	Measure resistance of thermostat switch (194F) [per Fault Diagnosis #8]	Is resistance higher than 100 $\Omega$ ?	Yes	reset the switch by pushing the button
				No	Go to L-3
	3. Check thermostat (221F) behind DC motor	Measure resistance of thermostat switch (221F) [per Fault Diagnosis #9]	Is resistance higher than 100 $\Omega$ ?	Yes	push its button to lock-off
				No	Go to L-4
	4. Check thermal fuse (307F) on the side of exhaust fan	Reconnect the 2P connector (red wires) of thermal safety devices and measure the resistance of main gas valve solenoids [per Fault Diagnosis #10]	Is resistance higher than 100 $\Omega$ ?	Yes	Replace the thermal-fuse-wire
				No	Go to L-1
	5. Check main gas valve's solenoid	Measure resistance [per Fault Diagnosis #11]	Is resistance higher than 2k $\Omega$ ?	Yes	Replace the gas valves
				No	Replace the main controller

<b>M. Error 34 on front controller</b>	1. Check connection quality between change-over gas valve and main controller	Measure pins 5 and 16 (orange) on the 22P wire connector to the main controller [per Fault Diagnosis #12]	Is resistance higher than 2k $\Omega$ ?	Yes	Go to M-2
				No	Replace the main controller
	2. Check change-over gas valve's solenoid	Measure the resistance of change-over gas valve solenoids [per Fault Diagnosis #13]	Is resistance higher than 2k $\Omega$ ?	Yes	Replace the gas valves
				No	Replace 22p-main wire
<b>N. Error 35 on front controller</b>	1. Check connection quality between modulation gas valve and main controller	Measure the resistance between pins 10 and 22 (green) on the 24P wire connector to the main controller [per Fault Diagnosis #14]	Is resistance higher than 1k $\Omega$ ?	Yes	Go to N-2
				No	Replace the main controller
	2. Check modulating gas valve's solenoid	Measure the resistance of modulation gas valve solenoids [per Fault Diagnosis #15]	Is resistance higher than 1k $\Omega$ ?	Yes	Replace the gas valves
				No	Replace 22p-main wire

# DISMANTLING FOR SERVICE

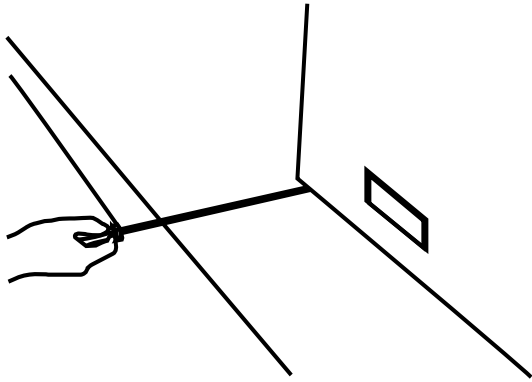
**CAUTION:** Before proceeding with dismantling, be sure to follow the CAUTION instructions before each step.

- Shut off and disconnect from gas supply
- Disconnect electrical supply from wall socket
- Shut off and disconnect the water supply
- Drain water from the appliance

## SEQUENCE

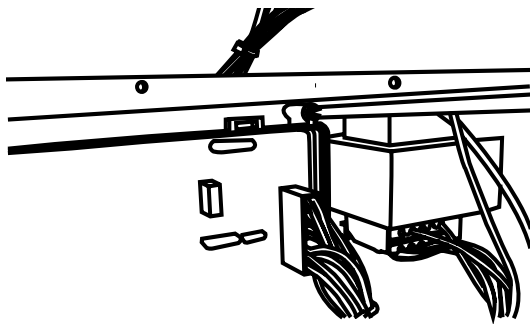
1. Removal of the front panel
2. Removal of the main controller
3. Removal of the front controller
4. Removal of the igniter
5. Removal of the mixing valve
6. Removal of the transformer
7. Removal of the pressure switch
8. Removal of the leakage breaker
9. Removal of the flow sensor
10. Removal of the gas valve
11. Removal of the motor, the thermal fuse, the burner and the burner thermistor
12. Removal of the thermistor assembly (hot outlet thermistor, cold inlet thermistor, and heat exchanger thermistor)

### 1) Removal of Front Panel



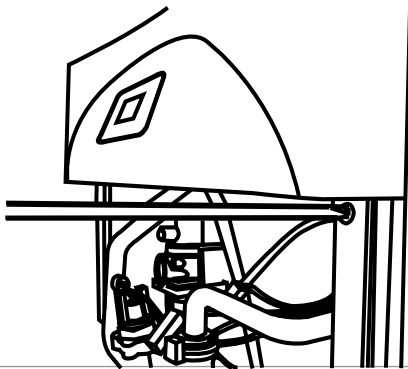
1. Loosen the two screws on the bottom of the front panel with Phillips head screw drivers.
2. Push the Front Panel downwards to release.

### 2) Removal of Main Controller



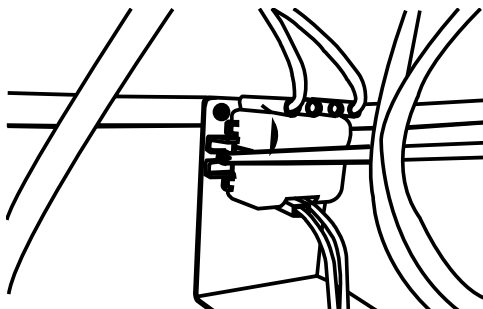
1. Loosen the four screws holding the Main Controller to the frame with Philips head screw driver

### 3) Removal of Front Controller



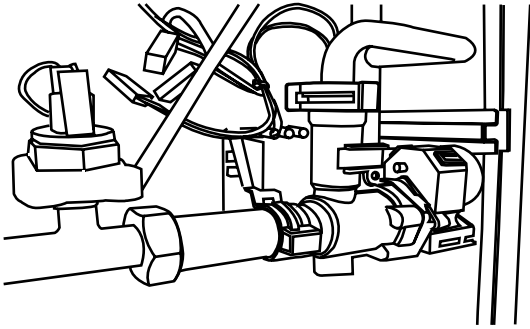
1. Loosen the two screws holding the Front Controller onto the frame with Philips head screw driver.
2. Pull the Front Controller towards yourself.

### 4) Removal of Ignitor

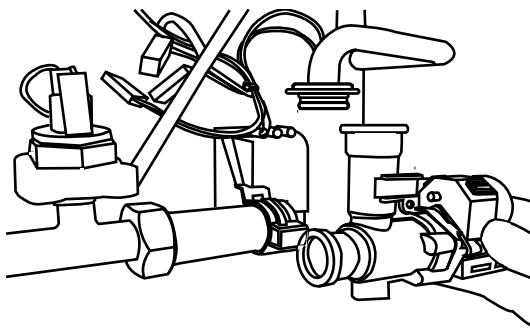


1. Loosen the two screws holding the ignitor box to the frame with Philips head screw driver.
2. Disconnect the wires on the bottom of the ignitor box. DO NOT try to disconnect the black wires on top of the ignitor box.

### 5) Removal of Mixing Valve



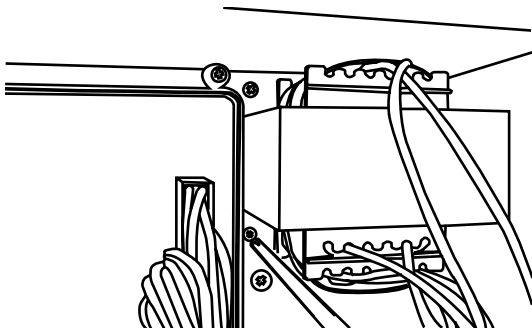
1. Disconnect the wire connector from the mixing valve. Pull out the two clamps holding the mixing valve in place with the water pipes to remove the mixing valve.



2. Gently wiggle the mixing valve rightwards and in a downwards direction to release.

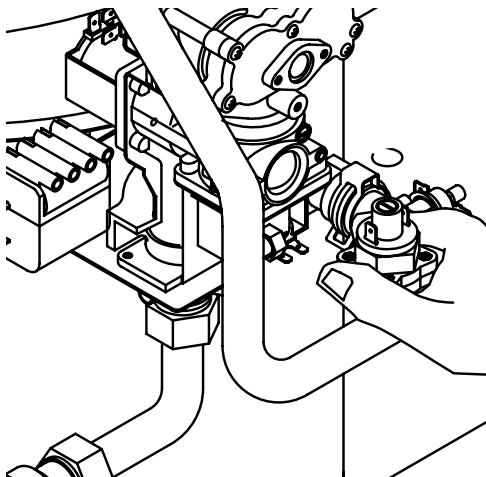
Be careful not to lose the O-Rings.

### 6) Removal of Transformer



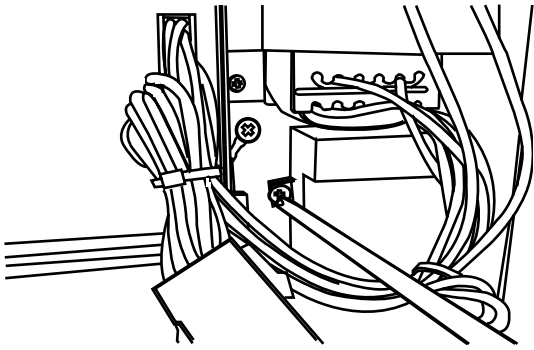
1. Loosen the four screws holding the transformer to the frame with Philips head screw driver

### 7) Removal of Pressure Switch

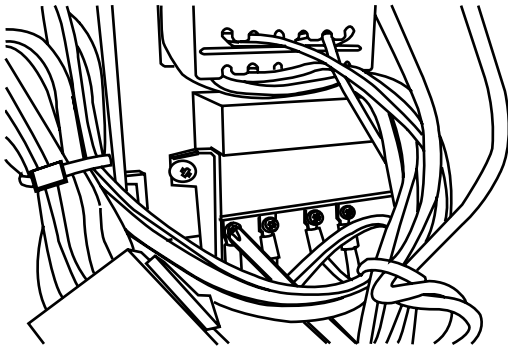


1. Turn the pressure switch by hand to loosen

### 8) Removal of Leakage Breaker

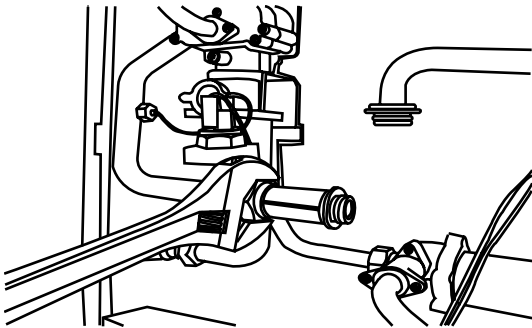


1. Loosen one screw to the left of the leakage breaker box holding the box to the frame with Philips head screw driver

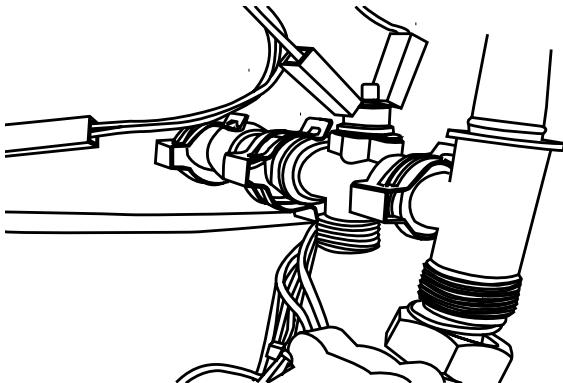


2. Loosen the four screws securing electrical wires to the leakage breaker board with Philips head screw driver

### 9) Removal of Flow Sensor

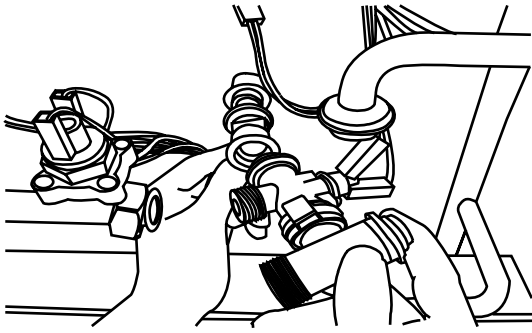


1. Remove the mixing valve first [per step. 5] and loosen the union on the T connector with a 10" crescent wrench



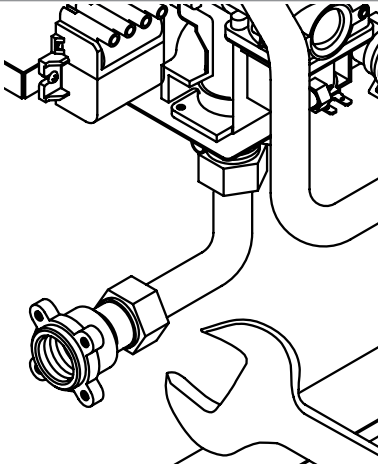
2. Disconnect the two wire connectors to the thermostat (194F) switch and remove the two clamps holding the brass fitting to the flow sensor and heat exchanger tank





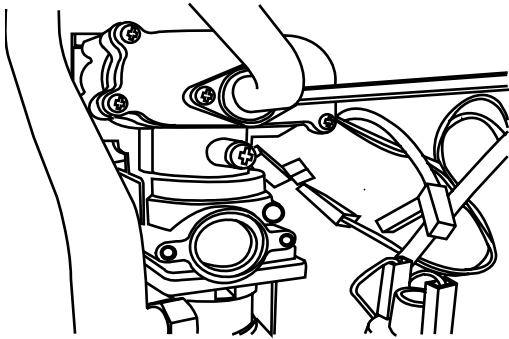
3. Pull the Flow sensor towards yourself to release

## 10) Removal of Gas Valve

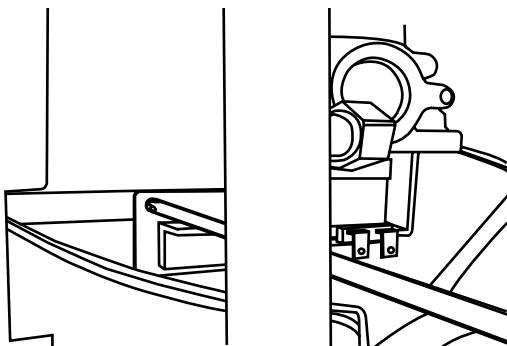


1. Loosen the union connecting gas tube to the bottom of the gas valve assembly with 10" crescent wrench and disconnect all the wire connectors.

Be careful not to lose the rubber O-Ring packing. Disconnect all the connectors.

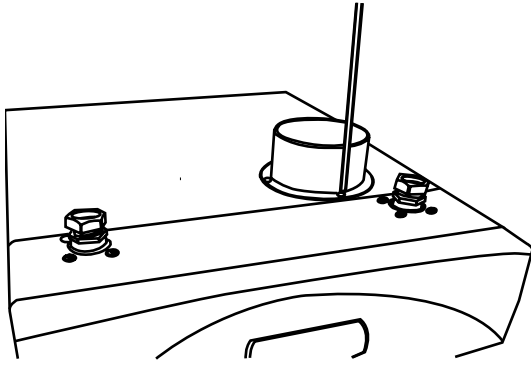


2. Loosen the two screws holding the gas tube to the upper part of the gas valve

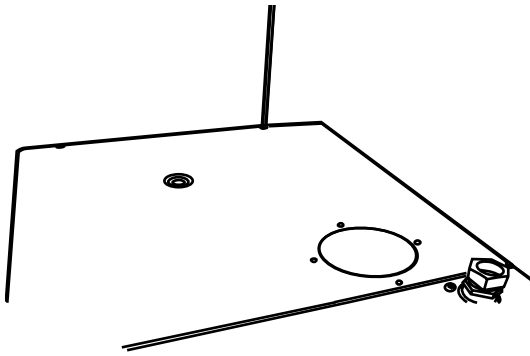


3. The gas valve assembly is secured to the frame by three screws. Loosen the screws with Philips head screw driver to remove the gas valve.

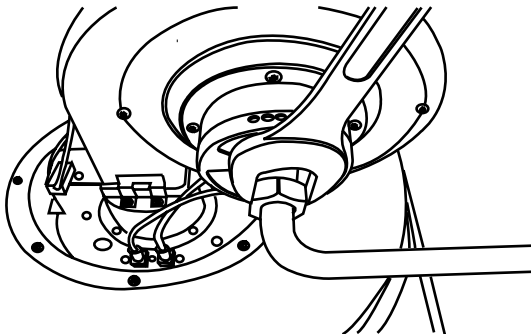
### 11) Removal of Motor, Thermal Fuse, Burner and Burner Thermistor



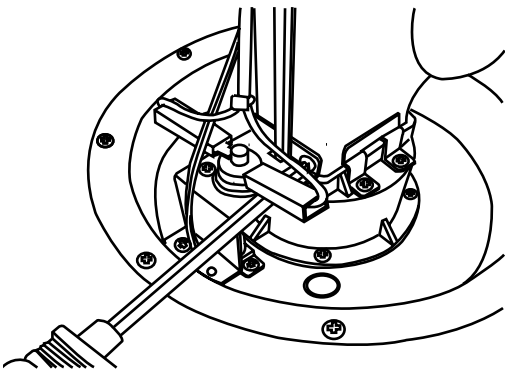
1. Loosen the four screws



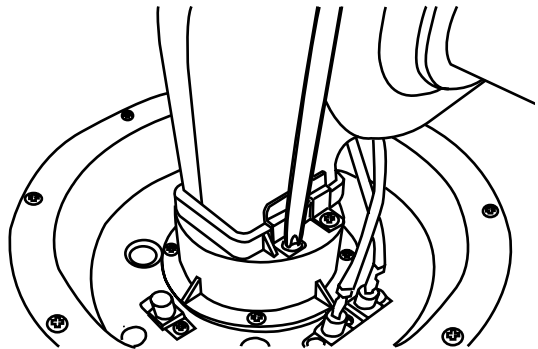
2. Loosen the two screws. Push the Top Panel backwards.



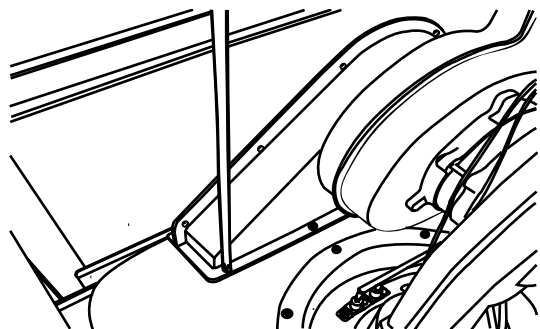
3. Loosen the union by 10" crescent wrench to release.



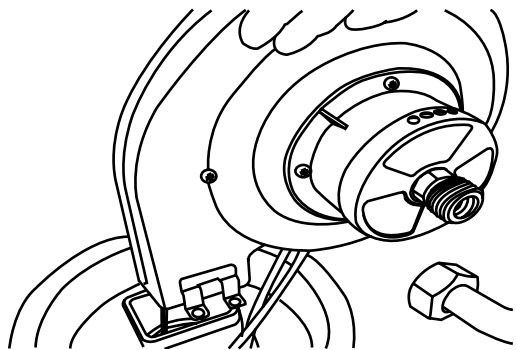
4. Loosen the two screws by 4" Phillips driver.



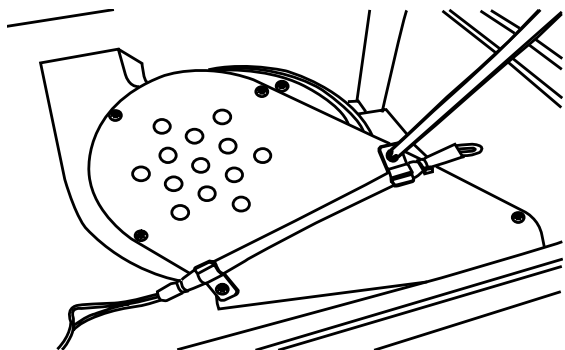
5. Loosen the four screws holding the injection fan to the burner with Philips head screw driver



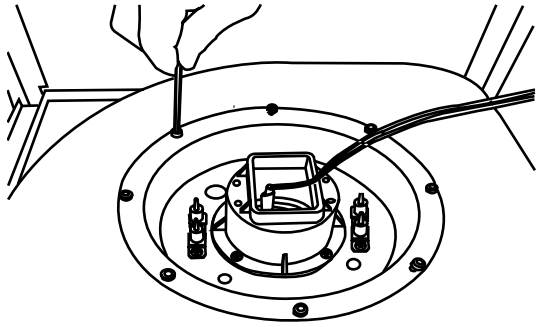
6. Loosen the five screws holding the exhaust fan flange to the top of the exhaust hood with Philips head screw driver. Disconnect the fan's power wire from the wiring harness



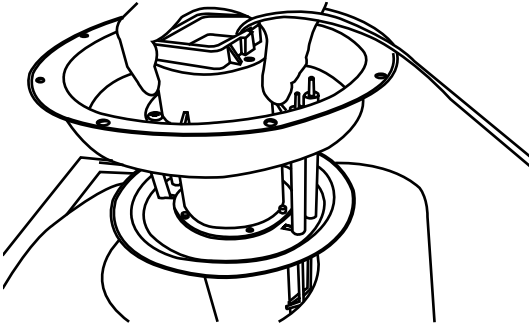
7. Gently rock the fan assembly loose from the burner and exhaust hood, and lift upward out of the unit to remove.



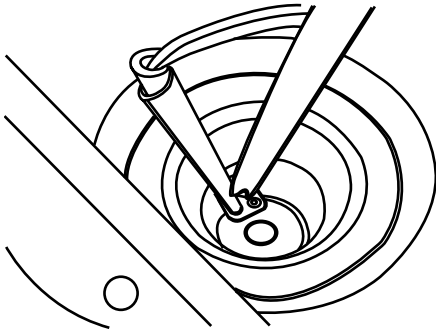
8. Loosen the two screws on the side of the exhaust fan to release the thermal fuse (307F).



9. Loosen the eight screws by 7/64" hexagon wrench driver



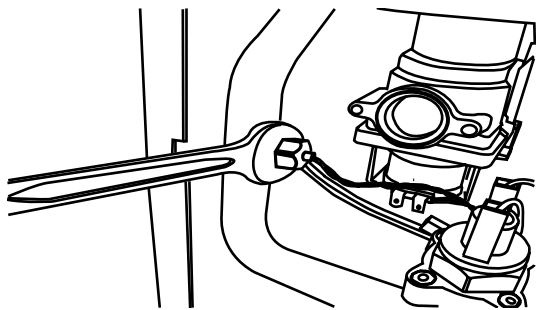
10. Pull out the burner assembly upwards



11. Loosen the one screw that fixes to the Burner thermistor.

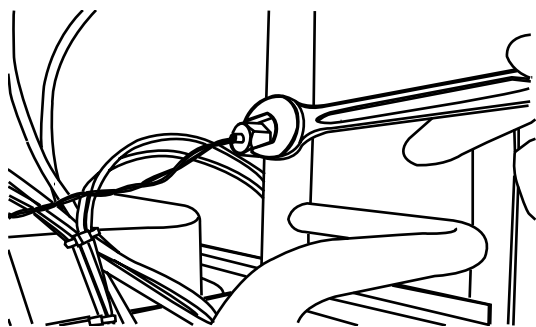
## 12) Removal of Thermistor Assembly

### Hot Outlet Thermistor



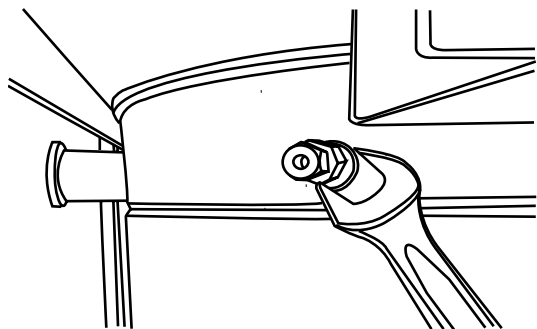
1. Loosen the nut holding the outlet thermistor to the hot water pipe by 6" crescent wrench, and be careful not to lose the rubber O-Ring. Gently pull out the thermistor by the metallic end with needle nose pliers. DO NOT pull by wire to remove.

### Cold Inlet Thermistor



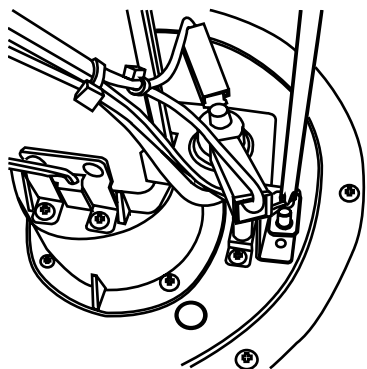
2. Loosen the nut holding the inlet thermistor to the cold water pipe by 6" crescent wrench, and be careful not to lose the rubber O-Ring. Gently pull out the thermistor by the metallic end with needle nose pliers. DO NOT pull by wire to remove.

## 13) Heat Exchanger Thermistor



1. Loosen the nut holding the H/E thermistor to the H/E tank by 6" crescent wrench, and be careful not to lose the rubber O-Ring. Gently pull out the thermistor by the metallic end with needle nose pliers. DO NOT pull by wire to remove.

## 14) Air Thermistor

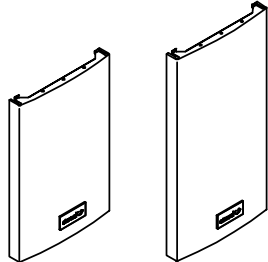
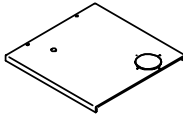
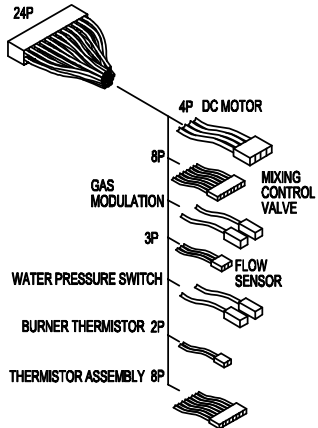
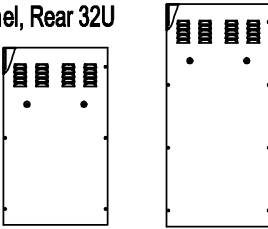
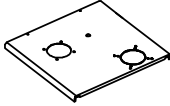
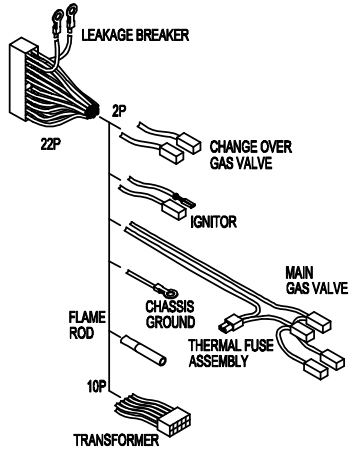
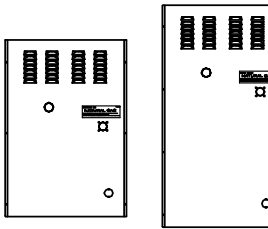
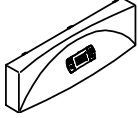
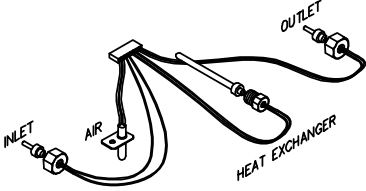
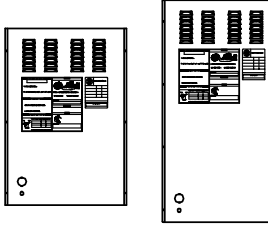
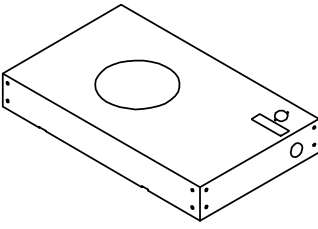
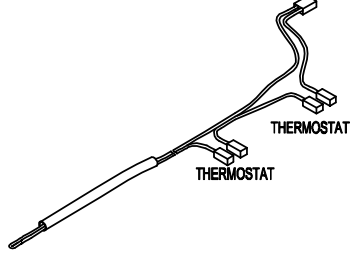
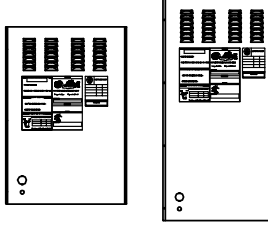
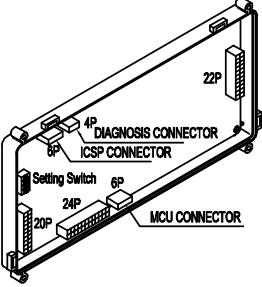
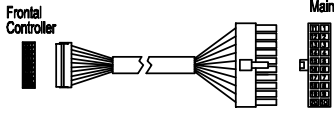
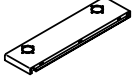
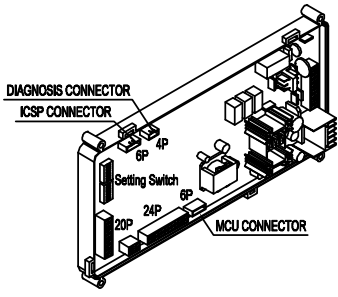


1. Loosen the one screw securing the air thermistor to the bracket to remove.

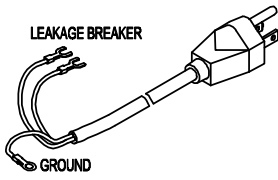
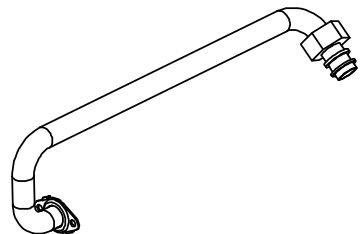
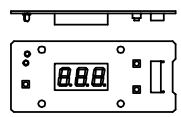
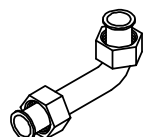
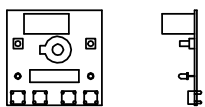
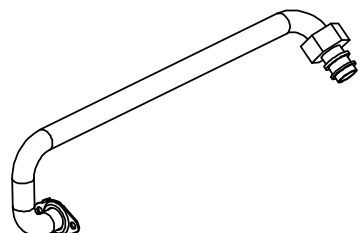
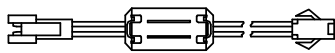
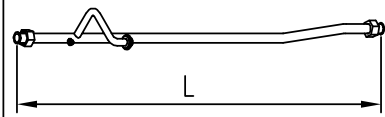
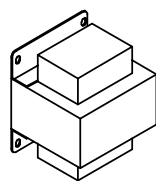
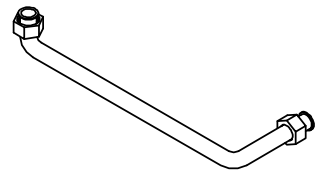
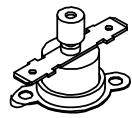
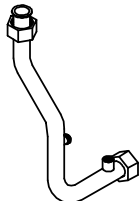
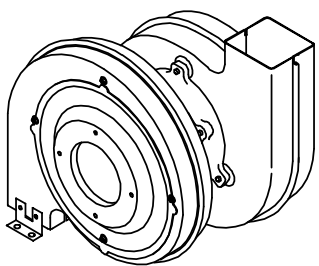
# MODULAR PARTS LIST AND DIAGRAMS FOR SERVICE AND REPAIR

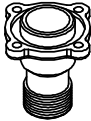
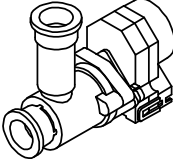
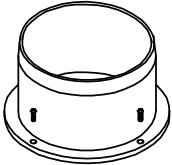
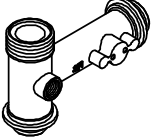
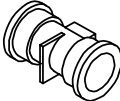


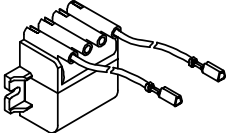

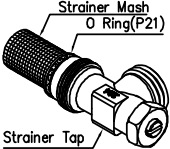
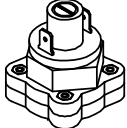

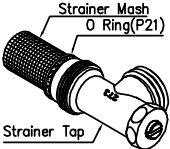
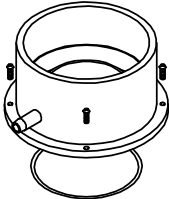
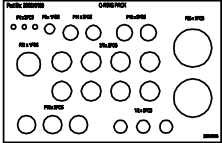
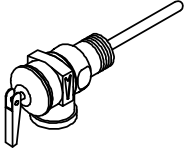
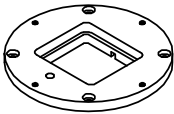

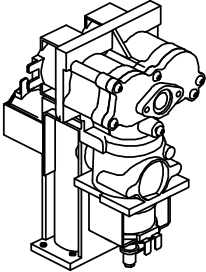
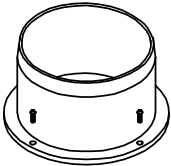


Diag. #	Model	Description	Part #
1	GU26/26DV	Panel, Front 26U Assembly	301070224
2	GU32/32DV	Panel, Front 32U Assembly	302070224
3	GU26/26DV	Panel, Rear 26U	301040002
4	GU32/32DV	Panel, Rear 32U	302040002
5	GU26/26DV	Panel, Left 26U Assembly	301070225
6	GU32/32DV	Panel, Left 32U Assembly	302070225
7	GU26	Panel, Right 26U Assembly	301070226
8	GU32	Panel, Right 32U Assembly	302070226
9	GU26DV	Panel, Right 26U (DV) Assembly	307070226
10	GU32DV	Panel, Right 32U (DV) Assembly	308070226
11	GU26/26DV, GU32/32DV	Panel, Top/Front Assembly	301070227
12	GU26/32	Panel, Top/Rear Assembly	301070228
13	GU26DV/32DV	Panel, Top/Rear (DV) Assembly	307070228
14	GU26/26DV, GU32/32DV	Front Control Panel Assembly	301080170
15	GU26/26DV, GU32/32DV	Panel, Bottom Assembly	301070229
16	GU26	Main Controller 26U Gen.1	301060218
17	GU26	Main Controller 26U Gen.2	3010602182
18	GU32	Main Controller 32U Gen.1-6.0B	302060218N
19	GU32	Main Controller 32U Gen.1-7.2B	302060218O
20	GU32	Main Controller 32U Gen.2	3020602182
21	GU26DV	Main Controller 26U (DV)	307070218
22	GU32DV	Main Controller 32U (DV)	308070218
23	GU26/26DV, GU32/32DV	24P-Main Wire	193010102
24	GU26/26DV, GU32/32DV	22P-Main Wire	193010103
25	GU26/26DV, GU32/32DV	Thermistor Assembly	193010090
26	GU26/26DV, GU32/32DV	Thermal Fuse Assembly	193010101
27	GU26/26DV, GU32/32DV	20P-Frontal Wire	193010100
28	GU26/26DV, GU32/32DV	Power Wire Assembly	192010143
29	GU26/26DV, GU32/32DV	Controller/Front	193010095
30	GU26/26DV, GU32/32DV	Leakage Breaker 120	193010096
31	GU26/26DV, GU32/32DV	EMI Filter Assembly	193010236
32	GU26/26DV	Transformer 26U	192010078
33	GU32/32DV	Transformer 32U	192020078
34	GU26/26DV, GU32/32DV	Thermostat-Hot	193010092
35	GU26/26DV, GU32/32DV	Thermostat-Flame	193010093
36	GU26	Dual Blower 26U Assembly	301070080
37	GU32	Dual Blower 32U Assembly	302070080
38	GU26DV	Dual Blower 26U (DV) Assembly	307070080
39	GU32DV	Dual Blower 32U (DV) Assembly	308070080
40	GU26/32	Burner Assembly	301070088A
41	GU26DV/32DV	Burner (DV) Assembly	307070088
42	GU26/32	Gas Tube A	150010071
43	GU26/32	Gas Tube B	150010072
44	GU26DV/32DV	Gas Tube DV-A	150070501


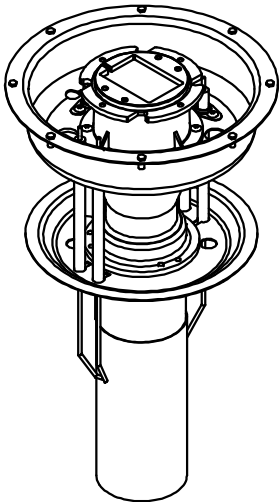

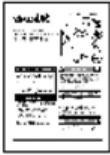

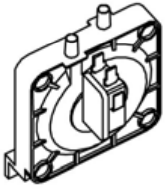
<b>Diag. #</b>	<b>Model</b>	<b>Description</b>	<b>Part #</b>
46	GU26/26DV	Cold Water Tube A 26U	150010073
47	GU32/32DV	Cold Water Tube A 32U	150020073
48	GU26/26DV, GU32/32DV	Cold Water Tube B	150010074
49	GU26/26DV, GU32/32DV	Hot Water Tube	150010075
50	GU26/26DV, GU32/32DV	Water Fitting(SUS304)	159050270
51	GU26/26DV, GU32/32DV	T Connector(SUS304)	159050271
52	GU26/26DV, GU32/32DV	Strainer Body(SUS304)	159050272
53	GU26/32	Drain Valve Assembly P1.0	301070231O
54	GU26/26DV, GU32/32DV	Drain Valve Assembly P1.5(SUS304)	305070273
55	GU26/26DV, GU32/32DV	T&P Relief Valve (Cash Acme)	194010281
56	GU26/26DV, GU32/32DV	Gas Valve	194010085
57	GU26/26DV, GU32/32DV	Mixing Valve	194010086
58	GU26/26DV, GU32/32DV	Water Flow Sensor	192010081
59	GU26/26DV, GU32/32DV	Igniter 120	193010089
60	GU26/26DV, GU32/32DV	Pressure Switch	192010167
61	GU26/26DV, GU32/32DV	Exhaust Collar Assembly	301070230
62	GU26/26DV, GU32/32DV	Exhaust Flange	153010226
63	GU26DV/32DV	Intake Top Assembly	307070517
64	GU26/32	Exhaust Top	153010049
65	GU26/32	Exhaust Top Packing	151010200
66	GU26/26DV, GU32/32DV	Air Tube D11	601010015
67	GU26/26DV, GU32/32DV	Air Tube D7	155010062
68	GU26/26DV, GU32/32DV	O-Ring Pack	301070169
69	GU26/26DV, GU32/32DV	Plug	601020001
70	GU26/32	Clamp 4"	151010193
71	GU26/26DV, GU32/32DV	Clamp	151010032
72	GU26/26DV, GU32/32DV	Mesh Screen	151010212
73	GU26/26DV, GU32/32DV	Cord Band	155010060
74	GU26/32	Operator's Manual package	157020132
75	GU26DV/32DV	Operator's Manual Package (DV)	157070132
76	GU26DV	Air Pressure Switch 5"	192070553
77	GU32DV	Air Pressure Switch 8"	192070513

<p>1 2</p>	<p>Panel, Front 26U Assembly Panel, Front 32U Assembly</p> 	<p>12 Panel, Top/Rear</p> 	<p>23 24P-Main Wire</p> 
<p>3 4</p>	<p>Panel, Rear 26U Panel, Rear 32U</p> 	<p>13 Panel, Top/Rear (DV) Assembly</p> 	<p>24 22P-Main Wire</p> 
<p>5 6</p>	<p>Panel, Left 26U Assembly Panel, Left 32U Assembly</p> 	<p>14 Front Control Panel Assembly</p> 	<p>25 Thermistor Assembly</p> 
<p>7 8</p>	<p>Panel, Right 26U Assembly Panel, Right 32U Assembly</p> 	<p>15 Panel, Bottom</p> 	<p>26 Thermal Fuse Assembly</p> 
<p>9 10</p>	<p>Panel, Right 26U Assembly Panel, Right 32U Assembly</p> 	<p>16 Main Controller 26U - 1st gen 17 Main Controller 26U - 2nd gen 18 Main Controller 32U - 1st gen 6.0B 19 Main Controller 32U - 1st gen 7.2B 20 Main Controller 32U - 2nd gen</p> 	<p>27 20P-Frontal Wire</p> 
<p>11</p>	<p>Panel, Top/Front</p> 	<p>21 Main Controller 26U (DV) 22 Main Controller 32U (DV)</p> 	



28	<b>Power Wire Assembly</b> 	38 39	43	<b>Gas Tube B</b> 
29	<b>Controller/Front</b> 	40	44	<b>Gas Tube DV A</b> 
30	<b>Leakage Breaker 120</b> 	41	45	<b>Gas Tube DV BF</b> 
31	<b>EMI Filter</b> 	41	46 47	<b>Cold Water Tube A 26U(L=27.64")</b> <b>Cold Water Tube A 32U(L=35.13")</b> 
32 33	<b>Transformer 26U</b> <b>Transformer 32U</b> 	42	48	<b>Cold Water Tube B</b> 
34 35	<b>Thermostat Hot (194°F)</b> <b>Thermostat Flame (221°F)</b> 	42	49	<b>Hot Water Tube</b> 
36 37	<b>Dual Blower 26U Assembly</b> <b>Dual Blower 32U Assembly</b> 	38 39		

<p>50 Water Fitting(SUS304)</p> 	<p>57 Mixing Valve</p> 	<p>64 Exhaust Top</p> 
<p>51 T Connector(SUS304)</p> 	<p>58 Water Flow Sensor</p> 	<p>65 Exhaust Top Packing</p> 
<p>52 Strainer Body(SUS304)</p> 	<p>59 Ignitor 120</p> 	<p>66 Air Tube(D11) : Ø8x240</p> 
<p>53 Drain Valve Assembly P1.0</p> 	<p>60 Pressure Switch</p> 	<p>67 Air Tube(D7) : Ø8x240</p> 
<p>54 Drain Valve Assembly P1.5(SUS304)</p> 	<p>61 Exhaust Collar Assembly</p> 	<p>68 O-Ring Pack</p> 
<p>55 T &amp; P Relief Valve</p> 	<p>62 Exhaust Flange</p> 	<p>69 Plug</p> 
<p>56 Gas Valve</p> 	<p>63 Intake Top Assembly</p> 	<p>70 Clamp 4"</p> 
		<p>71 Clamp</p> 

72	<b>Mesh Screen</b> 	<b>79 Burner Assembly(Aluminum)</b> 						
73	<b>Cord Band</b> 							
74	<b>Operator's Manual Package</b> 							
75	<b>Operator's Manual Package (DV)</b> 							
76 77	<b>Air Pressure Switch 5"</b> <b>Air Pressure Switch 8"</b> 							
78	<b>Dual Blower 32U Assembly (Aluminum)</b> 