



Tankless Gas Water Heater

SERVICE **MANUAL**

Troubleshooting Guide and Instruction for Service

(To be performed ONLY by qualified service providers)



For the Bradford White EverHot® Exterior Tankless Gas Water Heater Models:

IGE-199R-10(N,X)

IGE-199C-5(N,X)

Key to Warning Symbols



Failure to comply with the following instructions may results in serious personal injury or damage to the appliance.



Be careful of possible electric shock. Wiring inside this appliance may potentially be at 120 volts.



Disconnect power supply to unit when carrying out the following service repairs.



Read Fault Diagnosis and Wiring Diagram carefully to avoid incorrect wiring.



Do not disassemble. Parts within can not be exchanged or diagnosed faulty.

Please follow the instructions in the following chapters to ensure safe and appropriate service.

After completing the service and confirming that there are no water or gas leaks or incorrect wiring, test operation of the appliance.

TABLE OF CONTENTS

<u>Section</u>	<u>Description</u>	<u>Page</u>
---	Glossary of Terms and Symbols.....	4
I	General Information.....	5
	a. How to Use This Manual.	6
	b. Cut Away illustration.	7
	c. Schematic illustration.	8
II	Specifications. (General).....	9
	a. Combustion Specifications.....	11
	b. Default Dip Switch Settings.....	12
III	Main Components.	13
IV	Safety Device Function.	15
V	Sequence of Operation.....	17
	a. Operation Sequence Flow Chart.	19
	b. Sequence Timing Chart.	21
VI	Troubleshooting (error messages).	23
	a. Quick Reference Diagnostic Points.	25
	b. Wiring Diagram.....	27
	c. Troubleshooting Flow Chart.	29
	d. Trouble Shooting Procedure.	34
VII	Gas Pressure Setting Procedure.	44
VIII	Service Procedures.	46
IX	Flushing Procedure for Lime Scale Removal	52
X	Parts Breakdown	53

Refer to installation and operation manual for the following reference information:

- General Dimensions.
- Piping Recommendations.
- Remote Control Features.
- Water Flow Rates vs Temperature.

GLOSSARY OF TERMS AND SYMBOLS

This glossary of terms and symbols is provided to assist you in understanding some of the language used throughout this manual.

dB(A)	-	sound pressure level in decibels, "A" range
DC	-	direct current
AC	-	alternating current
WFCD	-	water flow control device
FB	-	feedback information
Hz	-	hertz
IC	-	integrated circuit
BTU/H	-	British thermal units per hour
PSI	-	Pounds per square inch
LED	-	light emitting diode
GPM	-	gallons per minute
mA	-	milliamps
W.C.	-	inches of water column
mm	-	millimeters
NO _x	-	oxides of nitrogen NO & NO ₂
OHS	-	overheat switch
PCB	-	printed circuit board
CPU	-	central processing unit
POT	-	potentiometer
rpm	-	revolutions per minute
SV	-	solenoid valve
Ø	-	diameter
Δ°F	-	delta T or temperature rise above ambient
POV	-	modulating valve
TE	-	thermal efficiency
TH	-	thermistor
T _{IN}	-	temperature of incoming water
T _{out}	-	temperature of outgoing water

I - GENERAL INFORMATION

This tankless water heater is a high output, high efficiency appliance, which heats the water continuously as hot water is being drawn for use. Unlike tank type storage water heaters, this water heater does not store hot water. The burner operates whenever there is a demand for hot water and is off when the water flow stops. Hot water is continuously supplied for any length of time required, as long as the specified flow rates are not exceeded. There is no need to set the temperature higher than required for sufficient capacity. The water heater has sufficient capacity to supply several hot water faucets simultaneously. The hot water flow capability will be dependent upon the temperature of the outlet water selected. Operational features of this water heater include:

- This water heaters is designed to be installed outdoors on an outside wall using the supplied wall bracket. No indoor space is needed and the water heater can be mounted at a height convenient for servicing.
- The burners ignite by direct spark ignition within 3 seconds of detecting minimum operational water flow. There is no standing pilot.
- A variable speed combustion air blower forces the combustion air supply into the burner compartment.
- No venting system required. For outdoor installation only.
- An optional recess box is available which allows the water heater to be recessed into an outside wall and conceal the piping behind a cover for a more attractive installation. The box enclosure dimensions are: 40 ½" H x 14 ¾" W x 9 ½" D. Contact your supplier to order this optional accessory.
- The burner flame is continuously monitored and modulated to match the heating requirements of the water flow. Temperature and flow sensors continually monitor the water flow and outlet water temperature and adjust the burner and combustion air blower to maintain temperature.
- The included, remote mount Main Control may be conveniently located near the point of use and is adjustable from 96-160°F for residential models or 96-180°F for commercial models. In addition to the Main Control, up to two optional bathroom controls are available on the residential models for setting the temperature in the bathroom fixtures up to 120°F.
- The Remote Main Control also displays fault codes if the water heater malfunctions to assist with servicing the water heater.
- The heat exchanger coil is provided with anti-freeze heaters for cold climate conditions for protection as low as -30°F (-34°C). Drain solenoids should be installed to drain the water heater in the event of a power failure. (See installation instructions)

Tools Required for Troubleshooting

Multifunction Digital Test Meter with needle point test leads.
Long reach (12") Magnetic Phillips screw driver (#2 Tip).
3/16 Allen wrench.
Small (pocket size) blade screw driver.
Monometer or Magnehelic inches water column gage.

HOW TO USE THIS MANUAL

It is intended for this manual to be used by qualified service personnel for the primary purpose of troubleshooting analysis and repair of this tankless gas fired water heater. Understanding the basic operation of the "Main Components" and the "Sequence of Operation" sections of this manual will contribute greatly to your success in the troubleshooting analysis of this product.

Sections of this manual reference general information and specifications. The primary focus is trouble shooting analysis and repair. The trouble shooting section consists of the following:

- **Error Message Table**

Table showing Error Message as displayed on remote control indicating likely fault and remedy.

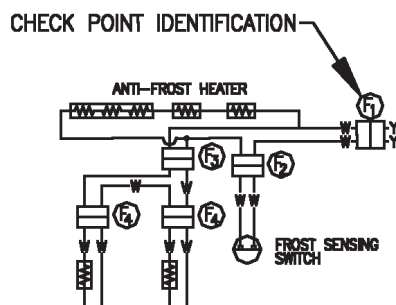
- **Quick Reference Diagnostics Points Table**

This guide will identify the specific diagnostic point for each component as well as the correct electrical value for each component.

- **Troubleshooting Flow Chart**

The "Trouble Shooting Flow Chart" identifies fault potentials and directs service to the appropriate diagnostic check points. The check points are identified in the troubleshooting procedure and are shown on the wiring diagram by means of an encircled letter with a subscript number.

Example:



This chart will also refer to a page number to reference a pictorial version of the component analysis as outlined in the "Trouble Shooting Procedure" section of this manual.

- **Trouble Shooting Procedure**

Pictorial procedure including diagnostic points, electrical values and referral to "Service Procedure" for replacement of faulty components.

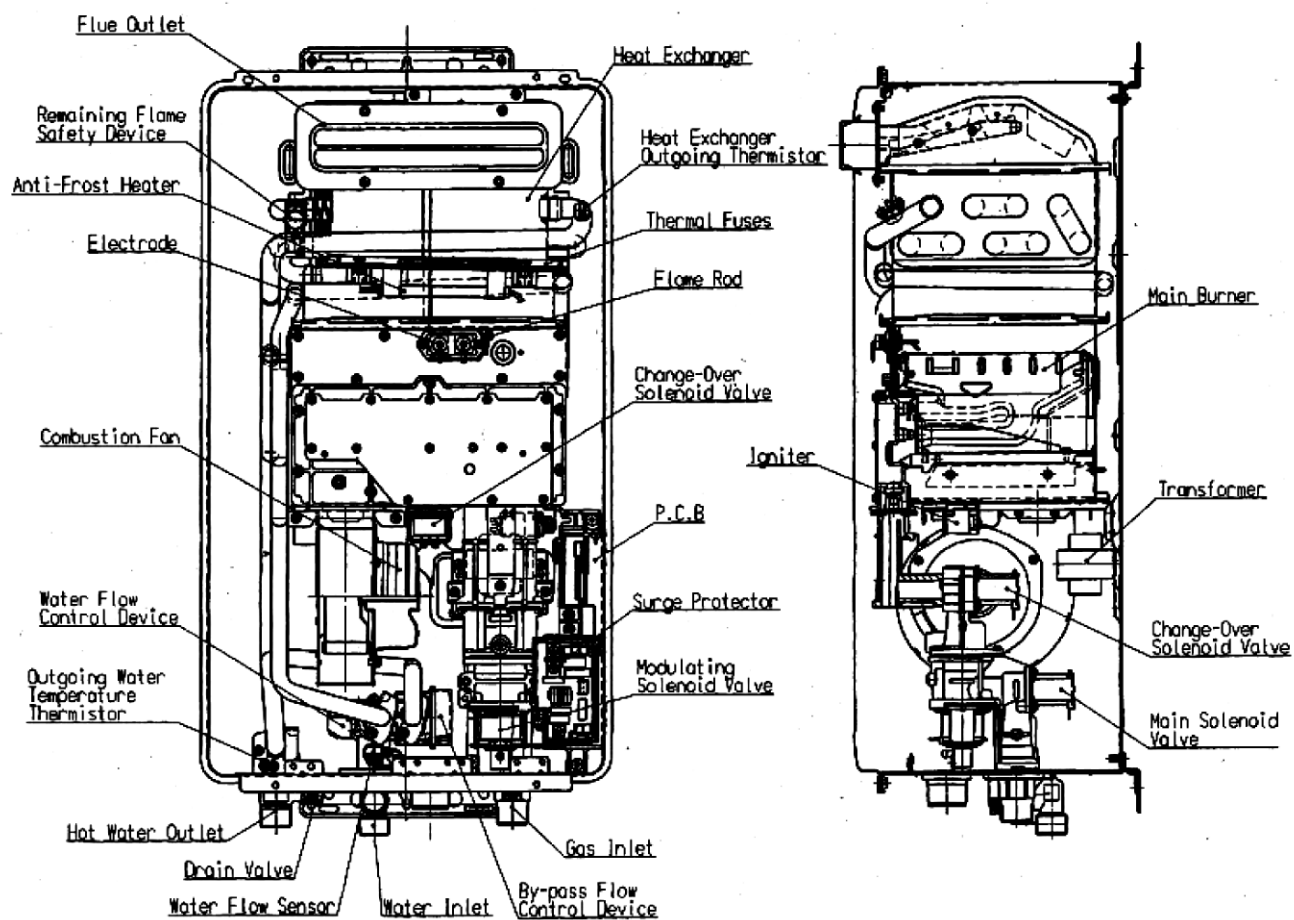
- **Quick Reference Diagnostics Points Table**

Quick reference guide for all diagnostic points.

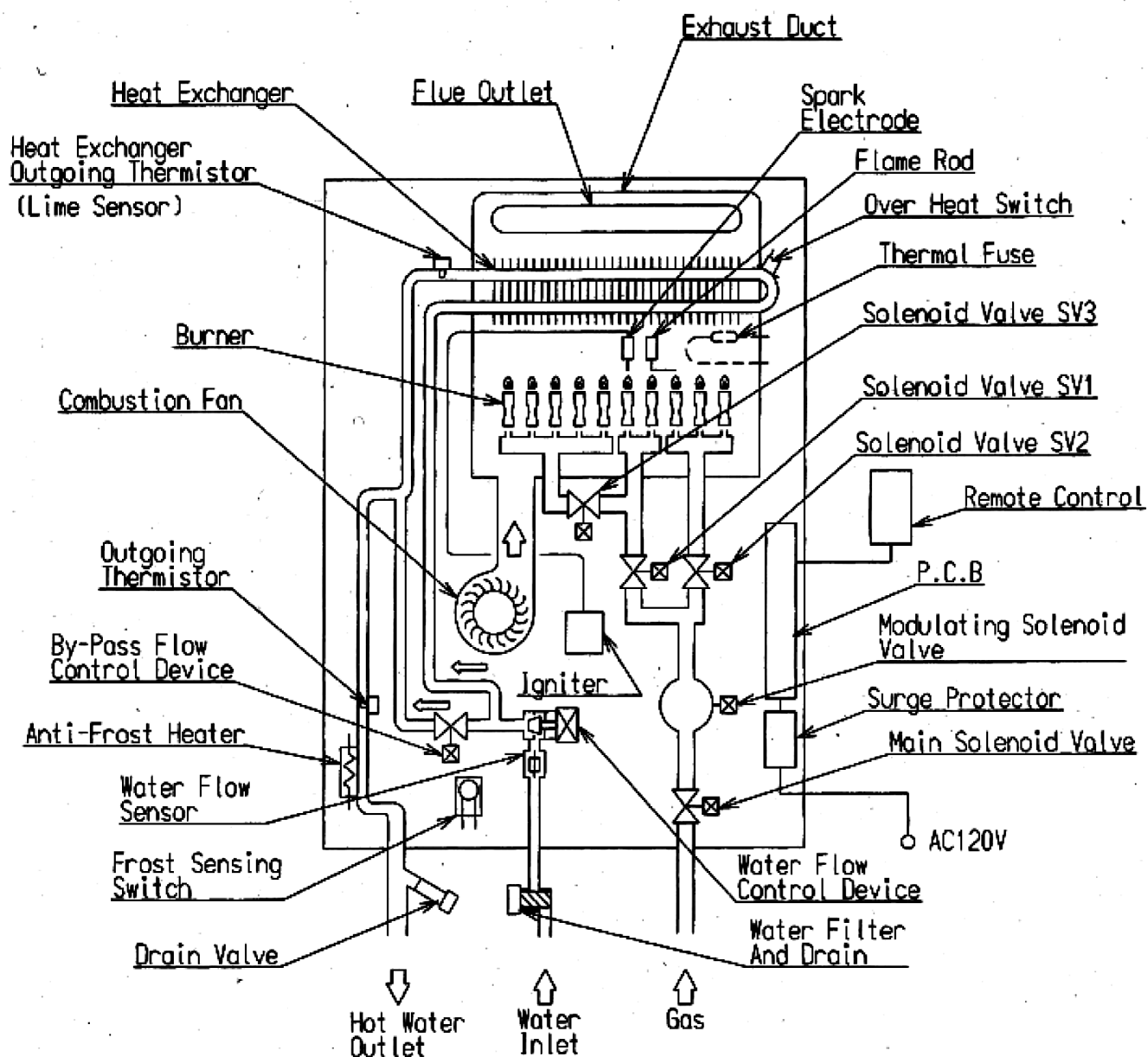
- **Service Procedure**

Pictorial procedure for removal and replacement of components.

CUT-AWAY ILLUSTRATION



SCHEMATIC ILLUSTRATION



II - SPECIFICATIONS – GENERAL

Type of appliance	Temperature controlled continuous flow gas hot water system	
Operation	With/without remote controls	
Exhaust system	Direct Vent - Forced combustion	
Model Type	Residential	Commercial
Maximum/Minimum gas rate (Input Btu's)	199,000 Btu's – 15,000 Btu's Natural gas 199,000 Btu's – 15,000 Btu's Propane Gas	
Thermal Efficiency	Natural Gas 84%	Propane Gas 85%
Energy Factor (EF)	Natural Gas 0.82	Propane Gas 0.84
Capacity (Gallons 1st Hour @ 90°F rise)	Natural Gas 218	Propane Gas 227
NO _x Emissions (at 3% O ₂)	Less than 40 ppm	
Hot water capacity (50°F rise)	0.5 to 6.5 GPM's	
Setpoint Temperature (without remote)	Factory setting - 120°F	
Temperature range with remote keypads connected	BC-45-4US 96 - 120°F BSC-45-4US 96 - 120°F MC-45-4US 96 - 180°F	MCC-45-4US 96 - 160°F
Approved gas type	Natural or Propane – Ensure unit matches gas supply type.	
Installation	Outdoor installation ONLY	
Dimensions	Height 23 ⁵ / ₈ " Width 13 ³ / ₄ " Depth 8 ⁷ / ₈ "	
Weight	46 Lbs.	
Noise levels	49 dB's	
Connections	Gas supply ¾" MNPT Cold water inlet ¾" MNPT Hot water outlet ¾" MNPT	
Ignition system	Direct electronic ignition	
Electrical consumption	Operating 63 watts Standby 5.5 watts Anti-frost protection 84 watts	
Water temperature control	Simulation feedforward and feedback	
Water flow control	Water flow sensor and automatic electro-mechanical water control device	
Recommended Minimum water supply pressure	20 PSI (recommend 50-80 PSI for maximum performance)	
Maximum water supply pressure	150 PSI	

II - SPECIFICATIONS – GENERAL (cont.)

Power Supply	Appliance – 120 Volts A.C. – 60 Hz. Remote control 12 volt D.C. (Digital)
Safety Devices	Flame failure - Flame rod
	Boiling protection - 203 °F
	Remaining flame (OHS) 194 °F bi-metal switch
	Fusible link
	Automatic frost protection - Bimetal sensor & anti-frost heaters
	Combustion fan rpm check - integrated circuit
	Over current - Glass fuse (3 amp)
Remote control cable	Non-polarized two core cable
Clearances from combustibles	Top of heater 12"
	Front of heater 24"
	Sides of heater 6"
	Back of heater 0"
	Ground 12"
	Installations within RGB-25 Recess Box: Clearances from combustibles to recess box top, bottom, back and sides = 0"
Clearances from Eaves, Porches, Overhangs	Top of heater 36"

II - SPECIFICATIONS (cont.)

COMBUSTION SPECIFICATIONS

Item	Gas Type	Natural	Propane
Gas consumption	Minimum Btu's	15,000	15,000
	Maximum Btu's	199,000	199,000
Injector Diameter Inches (mm)	Upper	ø.045 (1.15mm)	ø.029 (.75mm)
	Lower	ø.070 (1.8mm)	ø.045 (1.15mm)
Main Burner	B3A7-1 (Lean and Rich Bunsen Burner)		
Main Damper	H73-115 (Upper: ø6, Lower: Not Used)		
Gas Pressure Supply/Manifold	Minimum Supply	6" W.C.	10" W.C.
	Maximum Supply	10.5" W.C.	13.5" W.C.
	Low Fire Manifold	0.56" W.C.	0.88" W.C.
	High Fire Manifold	3.4" W.C.	5.1" W.C.

DIP SWITCH SETTINGS

DANGER

Do not attempt to adjust dip switch settings from there factory default settings.
Doing so will result in damage to unit, property damage, personal injury or death.
Contact Technical Support for information pertaining to dip switch function.

FACTORY DEFAULT SETTING, RESIDENTIAL UNITS

Natural Gas Model

Dip Switch Settings:

(SW1)	(SW2)
#1 = Off	#1 = On
#2 = On	#2 = Off
#3 = Off	#3 = Off
#4 = Off	#4 = Off
#5 = Off	
#6 = Off	
#7 = Off	
#8 = Off	

Propane Gas Models

Dip Switch Settings:

(SW1)	(SW2)
#1 = Off	#1 = Off
#2 = On	#2 = Off
#3 = Off	#3 = Off
#4 = Off	#4 = Off
#5 = Off	
#6 = Off	
#7 = Off	
#8 = Off	

FACTORY DEFAULT SETTING, COMMERCIAL UNITS

Natural Gas Models

Dip Switch Settings:

(SW1)	(SW2)
#1 = Off	#1 = On
#2 = On	#2 = Off
#3 = Off	#3 = Off
#4 = Off	#4 = On
#5 = Off	
#6 = Off	
#7 = Off	
#8 = Off	

Propane Gas Models

Dip Switch Settings:

(SW1)	(SW2)
#1 = Off	#1 = Off
#2 = On	#2 = Off
#3 = Off	#3 = Off
#4 = Off	#4 = On
#5 = Off	
#6 = Off	
#7 = Off	
#8 = Off	

III - MAIN COMPONENTS

1. Mechanical Water Regulator

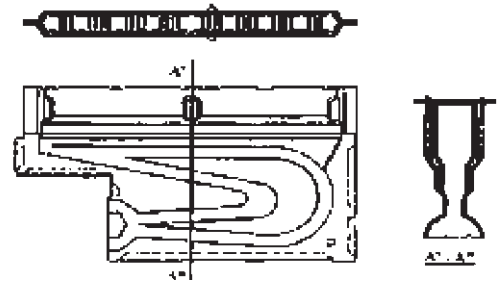
The unique water regulator mechanism ensures the hot water is maintained with no noticeable change to the desired temperature during use, even if water pressure drops due to another tap being turned on and increasing the demand.

2. Preset Bypass

A preset volume of cold water is mixed with water heated in the heat exchanger.

3. Burner

The burner assembly is made up of 16 identical stainless steel Bunsen burners, secured by an aluminized steel framework. An aluminum manifold with 32 integral injectors supplies gas to the burners, and is attached to the front lower cover of the burner box and gas control assembly.



4. Gas Control Valve

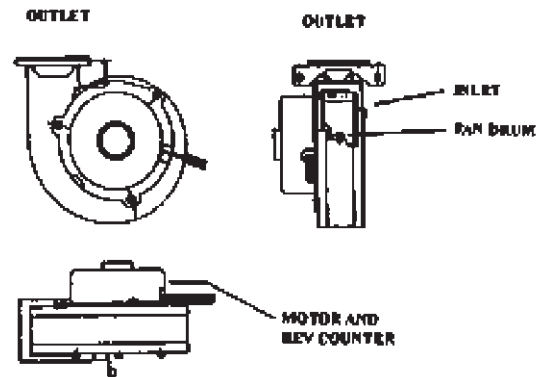
The gas control valve uses four solenoids to fully modulate within four different input ranges to respond quickly and accurately to changes in water flow rate. The four ranges are as follows: up to 18% of total btu's (using three burners), up to 33% (using five burners), up to 50% (using eight burners), and up to 100% (using sixteen burners) This increases the flexibility of the regulator/modulating valve by supplying gas equally to each burners.

5. Combustion Fan

Air for the combustion is supplied by a centrifugal fan driven by a DC motor. After a pre-purge period of 0.2 seconds, the fan speed is controlled by the PCB to provide the correct volume of air for combustion. The calculation for the fan speed is based upon incoming water temperature, water flow and the temperature selected on the remote controls.

The actual speed of the motor is continuously monitored by a magnetic pulse sensor.

This sensor emits (4) pulses per rotation of the fan. This is the fan feedback or confirmation data processed by the PCB.



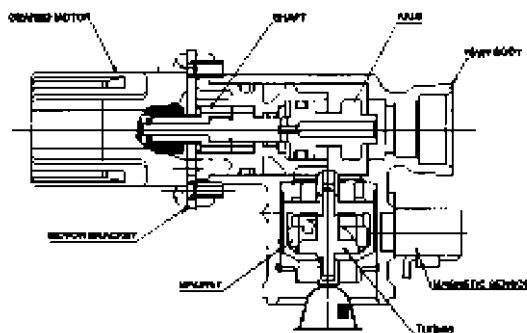
The fan speed is constantly correcting to provide optimum combustion conditions. In addition, the fan speed will determine the opening degree of the modulating gas valve. This enables the gas rate to always match the volume of air for combustion, as well as the input required to heat the water.

1. Water Flow Sensor and Water Flow Control device

Water flow is detected by a turbine/magnetic pulse generating device. Water flows through the turbine/magnetic sensor providing information to the PCB by generating a pre-determined number of pulses in proportion to the water flow. These pulses are counted by the PCB – no pulse indicates no water flow. The frequency of the magnetic pulses increases as the water flow increases, this enables the PCB to calculate the exact water flow, and determine the water flow in gallons per minute. As soon as the required water flow is detected, the PCB activates the combustion fan. The combustion fan speed is monitored by a magnetic pulse sensor. The output from this sensor is processed by the PCB which opens the gas modulating valve to a degree proportional to the fan speed. See above for further details on the combustion fan.

The water flow control consists of a plug and barrel valve which is rotated by a motor to increase or decrease the volume of water passing through the heat exchanger.

Automatic water flow control device



IV - SAFETY DEVICE FUNCTION

Flame Failure

Situated to the right of the burner in the front of the combustion chamber, the flame rod monitors the combustion process. This sensor monitors the flame intensity, while the PCB compares this signal to the feed back signal from the combustion fan motor, water flow control, and gas flow through the POV valve. If any one of the feedback signals are incorrect, the unit will shut off, preventing discharge of gas to the burner.

Over Heat Protection Device

Also referred to as an Over Heat Switch. This device is fitted to a bend section at the left side of the heat exchanger. If the flame remains on to the burner after the tap is closed and the water temperature inside the heat exchanger reaches 194° F, a 12 volt DC bi-metal cut-off switch will shut off the gas supply to the solenoids.

No Water

Should the incoming water flow become restricted or stop, the water flow sensor will cease to send a magnetic pulse signal to the PCB, in turn preventing gas to flow into the combustion chamber. If you have restricted flow, first check to ensure the inline water filter is not clogged.

Thermal Fuse (Non-Resettable)

Wrapped around the entire surface of the heat exchanger you will find a thermal fuse. This device activates in the event of excessive heat exchanger temperature or the temperature outside the heat exchanger reaches 264 °F. If the thermal fuse melts, it breaks an electronic circuit which in turn shuts off the power supply to the gas solenoids, deactivating the unit.

Combustion Fan Revolution Check

The combustion fan rpm's are continually monitored by a magnetic pulse generator connected to the PCB. If the fan revolutions deviate from the speed required for complete combustion, a signal is sent to the PCB and the revolutions adjust accordingly. (If not the unit deactivates)

Automatic Frost Protection

When the temperature inside the appliance drops below 37°F , the frost sensing device inside the appliance activates the anti-frost heaters to prevent the water inside the unit from freezing. The antifrost heaters remain ON until the temperature inside the appliance rises to 57°F. There are five (16) watt anti-frost heaters located at various points throughout the main water flow area of the appliance. The unit also incorporates the ability to fire for (3) seconds in the event the anti-frost heaters can not keep the water temperature from dropping below 37°F. This unique feature will heat the water in the lines inside the appliance back up to 57°F. ***Both of the above features function as long as the unit has power and gas.*** There is an optional freeze protection system that can be added to the unit's piping. See the auto drain down drawing in the product Owner's manual for instructions on how to install the option freeze protection in the event of a power failure in cold climates.

IV - SAFETY DEVICE FUNCTION (cont.)

Over temperature Cut-Off

The temperature of the outgoing hot water is constantly monitored by the water temperature thermistor located near the outlet of the appliance. If the outgoing water temperature reaches 5 °F above the preset temperature, the burner will automatically deactivate. The burner will ignite again when the outgoing hot water temperature falls below the preset temperature.

V - SEQUENCE OF OPERATION

The preset temperature is selected at one of the remotes controls (where fitted). Where no remote control is fitted, the default temperature can be set at 108, 120, 130, 140, 150, 160, 170, or 180 °F. To select one of the above temperatures as your default setting, you **MUST** obtain written permission and training. (Contact your technical service group)

When the unit is first plugged into 120 volts, the PCB assumes an incoming water temperature of 77°F. This prevents the appliance from starting in "High fire" and producing very hot water the first time it is used.

The data used to determine the outgoing water temperature, initially, is incoming water flow and the remote control pre-set temperature.

From the incoming water flow and remote control pre-set temperature data, the CPU is able to determine a suitable gas rate to initiate the appliance operation once a hot water tap opens.

The calculation of temperature rise and water flow is called simulation feed-forward.

The water heater calculates incoming water temperature by subtracting the theoretical temperature rise from the outgoing hot water temperature to establish the correct gas flow.

When a hot water tap is opened, water begins to flow through the water heater. The turbine in the water flow sensor begins to revolve. The revolution speed is proportional to the water flow. A sensor located inside the device relays information in the form of magnetic pulses to the main PCB to determine whether or not water is flowing, and also, the volume of water flowing. When a predetermined water flow is sensed, the ignition sequence begins.

The combustion fan pre-purges the combustion chamber. A rev counter on the combustion fan indicates the fan rpm to the main PCB. When the pre-purge cycle is completed, the PCB controls the fan rpm by varying the DC voltage to the fan motor. This maintains the correct air/gas ratio throughout the time the water heater is in use and ensures proper combustion.

The gas is ignited by direct spark and the flame is sensed by the flame rod. The opening degree of the modulating valve is determined by the combustion fan speed.

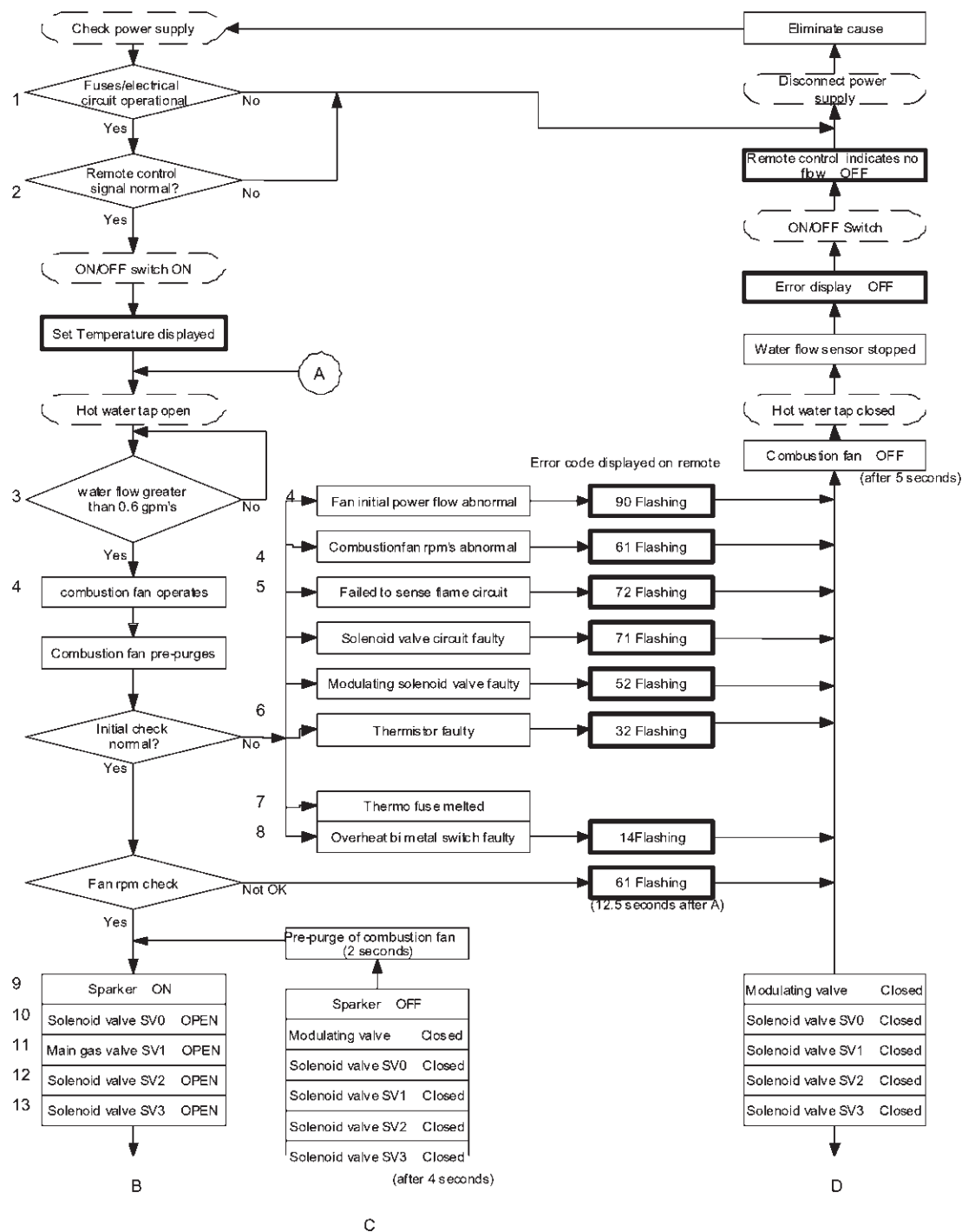
The changeover valve directs gas to one side or both sides of the burner. At the point where the changeover valve opens or closes the modulating valve is instantly re-adjusted by the PCB to compensate for the change in the number of burners in use. From the information provided by the water flow sensor and the water temperature thermistor, the PCB determines how much gas is required to heat the water to the temperature selected on the remote control.

The PCB is programmed to provide the maximum volume of water possible at a given temperature rise. As the water flow from the tap is increased, the PCB increases the gas and air flow to the burner.

V - SEQUENCE OF OPERATION (cont.)

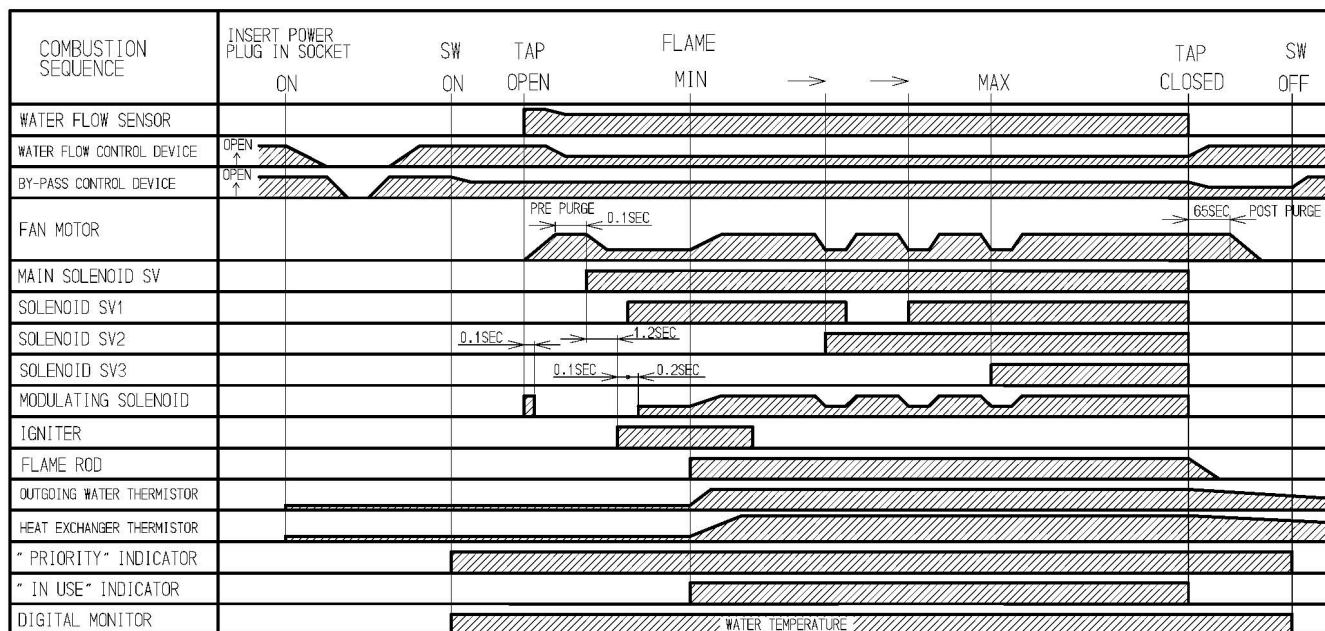
When the hot water tap is turned off, the water flow sensor stops revolving, and the magnetic pulse ceases, indicating to the PCB that there is no water flowing, in turn the PCB closes the gas valves. The combustion fan continues to operate for 65 seconds. This will provide quicker ignition when the tap is turned on and off in rapid succession, and removes the need for a pre-purge cycle allowing the burner to re-light immediately when a hot water tap is opened again.

OPERATION SEQUENCE FLOW CHART

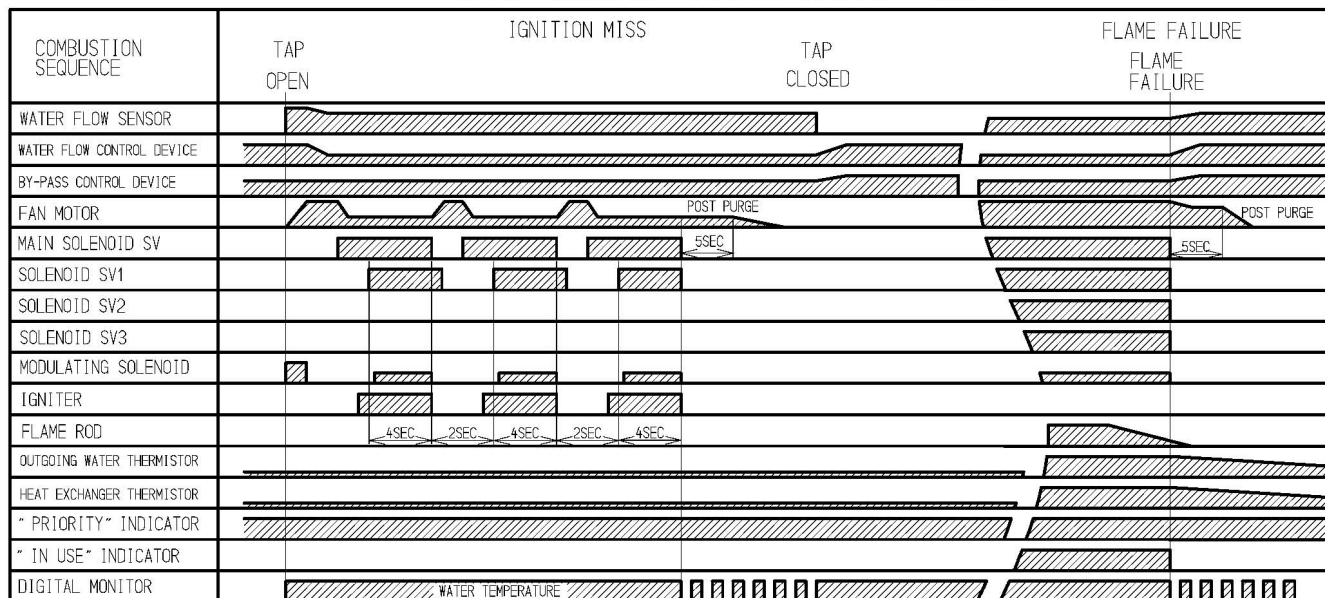


SEQUENCE TIMING CHART

NORMAL COMBUSTION SEQUENCE



ERROR SEQUENCE (IGNITION/FLAME FAILURE)

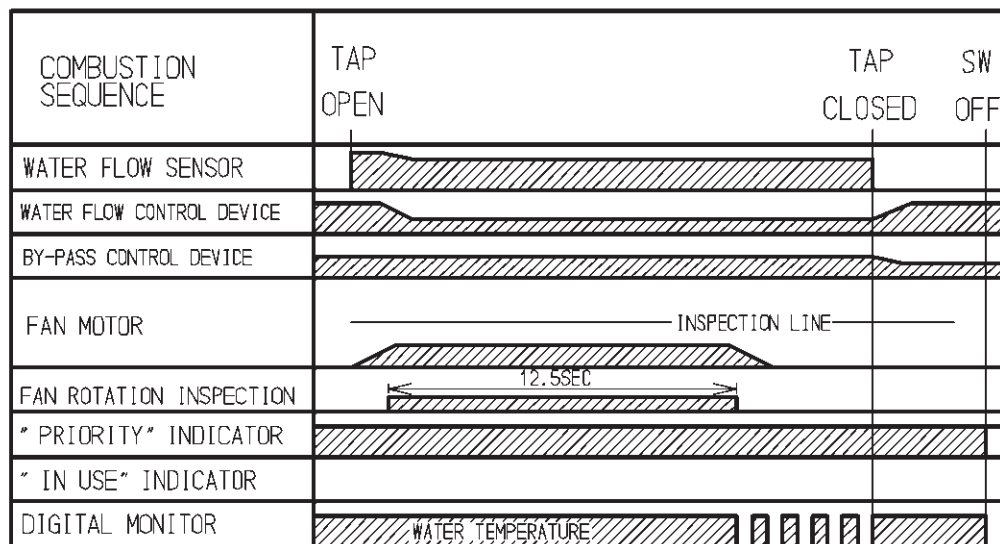


11 FLASHING

12 FLASHING

SEQUENCE TIMING CHART

PRE PURGE DEFECT SEQUENCE



61FLASHING

VI - TROUBLESHOOTING

ERROR MESSAGES

Error	Faulty	Remedy
10	Air Supply or Exhaust Blockage	Check intake and exhaust ports for obstructions. Check that nothing is blocking the flue inlet or exhaust. Did you maintain the proper clearance from combustibles around the unit?
11	No Ignition	Ensure you have gas to the appliance. Ensure gas type and pressure is correct. Bleed all air from gas lines. Verify dip switches are set properly. Disconnect all MSA controls. Ensure gas line, meter, and/or regulator is sized properly. Ensure appliance is properly grounded. Check gas solenoid valves for open or short circuits. Ensure igniter is operational. Check igniter wiring harness for damage.
12	Flame Failure	Ensure you have gas to the appliance. Ensure gas type and pressure is correct. Bleed all air from gas lines. Verify dip switches are set properly. Ensure flame rod wire is connected. Check flame rod for carbon build-up. Ensure gas line, meter, and/or regulator is sized properly. Ensure appliance is properly grounded. Check gas solenoid valves for open or short circuits. Check power supply for loose connections. Check power supply for proper voltage and voltage drops. Disconnect all MSA controls. Disconnect keypad. Disconnect and re-connect all wiring harnesses on unit and PC board. Immediate code 12 usually indicates a defective gas valve or power supply problem.
14	Thermo Fuse	Ensure dip switches are set to the proper position. Ensure high fire and low fire manifold pressure is correct. Check gas type of unit and ensure it matches gas type being used. Check heat exchanger for cracks and/or separations. Check resistance on safety circuit. Check for improper conversion of product. Check for restrictions in air flow around unit and vent exhaust discharge. Check for a low flow circulating system that is causing the unit to short cycle. Check for a foreign materials in combustion chamber and/or exhaust piping.
16	Over Temperature Warning	Check for clogged heat exchanger. Check for restrictions in air flow around unit and vent terminal. Check for a low flow circulating system that is causing the unit to short cycle. Check for foreign materials in combustion chamber and/or exhaust.

ERROR MESSAGES

Error	Faulty	Remedy
32	Outgoing Water Temperature Sensor Faulty	Check sensor wiring for damage. Check resistance on sensor. Check and clean scale from sensor. Replace sensor.
33	Heat Exchanger Outgoing Temperature Sensor Faulty	Check sensor wiring for damage. Check resistance on sensor. Check and clean scale from sensor. Replace sensor.
34	Combustion Air Temperature Sensor Faulty	Check sensor wiring for damage. Check resistance on sensor. Check and clean dirt from sensor. Ensure fan blade is tight on motor shaft and it is in good condition. Clean blower blades if dirty. Check for restrictions in air flow around unit and vent terminal. Replace sensor.
52	Modulating Solenoid Valve Signal Abnormal	Check modulating gas solenoid valve wiring harness for loose or damage terminals. Check resistance on solenoid valve.
61	Combustion Fan Failure	Ensure fan motor will turn freely. Motor will operate with a small amount of restriction. Check wiring harness to motor for damaged and/or loose connections. Check resistance on motor winding.
71	SV0, SV1, SV2, and SV3 Solenoid Valve Circuit Faulty	Check wiring harness to all solenoids for damage and/or loose connections. Check resistance on each solenoid.
72	Flame Sensing Device Faulty	Check micro amps produced by flame rod. Remove flame rod and check for carbon build-up, clean with sand paper. Ensure flame rod is touching flame when unit fires. Check inside burner chamber for any foreign material blocking flame at flame rod. Check all wiring to flame rod for damage. Replace flame rod.
LC	Scale Build-up in Heat Exchanger	Turn off power supply, then reapply power; if code does not reappear separate control wires from the unit's power supply. Flush heat exchanger. Replace heat exchanger.
No Code	Nothing happens when water flow is activated	Clean inlet water supply filter. Ensure you have at least the minimum flow rate required to fire unit. Check for pipe dope inside water flow control turbine. On new installations ensure hot and cold water lines are not crossed. Check for bleed over. Isolate unit from building by turning off hot water line to building, then open your pressure relief valve. If unit fires, there's a bleed over in your plumbing. If a circulating system is in use, it must be isolated also. Remote control does not light up but you have 12 VDC at the terminals for controls. Disconnect water flow control motor, then turn on hot water, if unit fires replace water flow control assembly. Check resistance on water flow control sensor.

VI - TROUBLESHOOTING (cont.)

QUICK REFERENCE DIAGNOSTIC POINTS

IMPORTANT SAFETY NOTES:

There are a number of (live) tests that are required when fault finding this product. Extreme care should be used at all times to avoid contact with energized components inside the water heater.

Only trained and qualified service agencies should attempt to repair this product.

Remember, before checking for resistance readings, you should disconnect the power source (unplug it) to the unit and isolate the item to be checked from the circuit.

(TR) Transformer:

Wire color	Voltage	Resistance	Connector #	Pin #'s
Black ~ White	100 ~ 120 VAC	51 ~ 63 ohms	F9	1 ~ 2
Blue ~ Brown	110 ~ 120 VAC	51 ~ 63 ohms	F7	1 ~ 3

(SV0, SV1, SV2, SV3 and POV) Gas valve and Modulating solenoids: (Set meter above 2K)

(SV0) Pink ~ Black	80 ~ 100 VDC	1,8K ~ 2K ohms	E1	1 ~ 2
(SV1) Black ~ Yellow	80 ~ 100 VDC	1,8K ~ 2K ohms	E2	2 ~ 3
(SV2) Black ~ Blue	80 ~ 100 VDC	1,8K ~ 2K ohms	E3	2 ~ 4
(SV3) Black ~ Brown	80 ~ 100 VDC	1,8K ~ 2K ohms	E4	2 ~ 5
(POV) Pink ~ Pink	2 ~ 15 VDC	67 ~ 81 ohms	C2	3 ~ 4

(M) Water Flow Control Device Servo or Geared Motor:

Red ~ Blue	11 ~ 13 VDC	22 ~ 26 ohms	B2	9 ~ 10
Grey ~ Brown	4 ~ 6 VDC	N/A	B2	5 ~ 7
Grey ~ Yellow	N/A	N/A	B2	5 ~ 8
Grey ~ Orange	11 ~ 14 VDC	N/A	B2	5 ~ 6

NOTE: The grey wire listed above turns to black at B connector on the PCB, the orange wire turns to red.

(QS) Water Flow Sensor:

Black ~ Red	11 ~ 13 VDC	5.5K ~ 6.2K	B4	5 ~ 6
Yellow ~ Black	4 ~ 7 VDC	1 meg ~ 1.4 meg	B4	1 ~ 5

By-pass Flow Control:

Brown ~ White	2 ~ 6 VDC	Unit in operating mode	G4 ~ G5	4 ~ 5
Orange ~ White			G2 ~ G5	2 ~ 5
Yellow ~ White		15 ~ 35K	G1 ~ G5	1 ~ 5
Red ~ White/Ground				3 ~ 5

(IG) Ignition System:

Grey ~ Grey	90 ~ 100 VAC	N/A	F8	2 ~ 3
-------------	--------------	-----	----	-------

(FM) Combustion Fan Motor:

Red ~ Black	6 ~ 45 VDC	N/A	A1	1 ~ 2
White ~ Black	6 ~ 45 VDC	9.2K ~ 9.4K	A1	2 ~ 4
Yellow ~ Black	11 ~ 13 VDC	3.5K ~ 3.9K	A1	2 ~ 3

Set your meter to the Hertz scale. Reading across the red and yellow wires at terminals 2 and 3 you should read between 60 and 350 Hertz.

VI - TROUBLESHOOTING (cont.)

Thermal Fuse:

Red ~ Red	100 VAC	Below 1 ohm	B ~ C	B6 ~ C1
-----------	---------	-------------	-------	---------

Overheat Switch:

Red ~ Red	100 VAC	Below 1 ohm	B ~ C	B6 ~ C1
-----------	---------	-------------	-------	---------

Flame Rod:

Place one lead of your meter to the flame rod and the other to earth or ground. With the unit running you should read between 5 ~ 150 VAC. Set your meter to the μ amp scale, series your meter in line with the flame rod. You should read 1 μ or greater for proper flame circuit. In the event of low flame circuit remove the flame rod and check for carbon and/or damage.

Heat Exchanger, Air Temperature, and Outgoing Water Temperature Thermistors:

Check all thermistors by inserting meter leads into each end of the thermistor plug. Set your meter to the 20K scale and read resistance. You should be able to apply heat to the thermistor bulb and see the resistance decrease. Then apply some ice to the thermistor and the resistance should increase. See below for examples of temperatures and resistance reading at those temperatures.

Example:

59°F	=	11.4 ~ 14K
86°F	=	6.4 ~ 7.8K
113°F	=	3.6 ~ 4.5K
140°F	=	2.2 ~ 2.7K
221°F	=	0.6 ~ 0.8K

Outgoing Water Thermistor:

White ~ White	N/A	See example above	B	B3 ~ B4
---------------	-----	-------------------	---	---------

Heat Exchanger Temperature Thermistor:

White ~ Pink at board	N/A	See example above	B	B3 ~ B12
-----------------------	-----	-------------------	---	----------

Surge Protector:

Black ~ White	108 ~ 132 VAC	N/A	Surge Protector D ₁	1 ~ 3
Blue ~ Brown	108 ~ 132 VAC	N/A	Surge Protector D ₂	1 ~ 2

With the power off you can check the continuity through the surge protector. Place one meter lead on the top pin #1 of the surge protector and pin #2 on the bottom of the surge protector. Then check across top pin #3 and bottom pin #1, if you read continuity across these two points the surge protector is good. If you do not get continuity, replace the surge protector.

Remote Controls:

Terminals D ₁	10 ~ 13 VDC digital	1.5K ~ 1.9K ohms	H	1 ~ 3
--------------------------	---------------------	------------------	---	-------

Frost Protection:

This unit has four frost protection heaters mounted at different points inside the unit to protect the water heater from freeze ups. There are two heaters located on the outlet hot water line next to the thermistor.

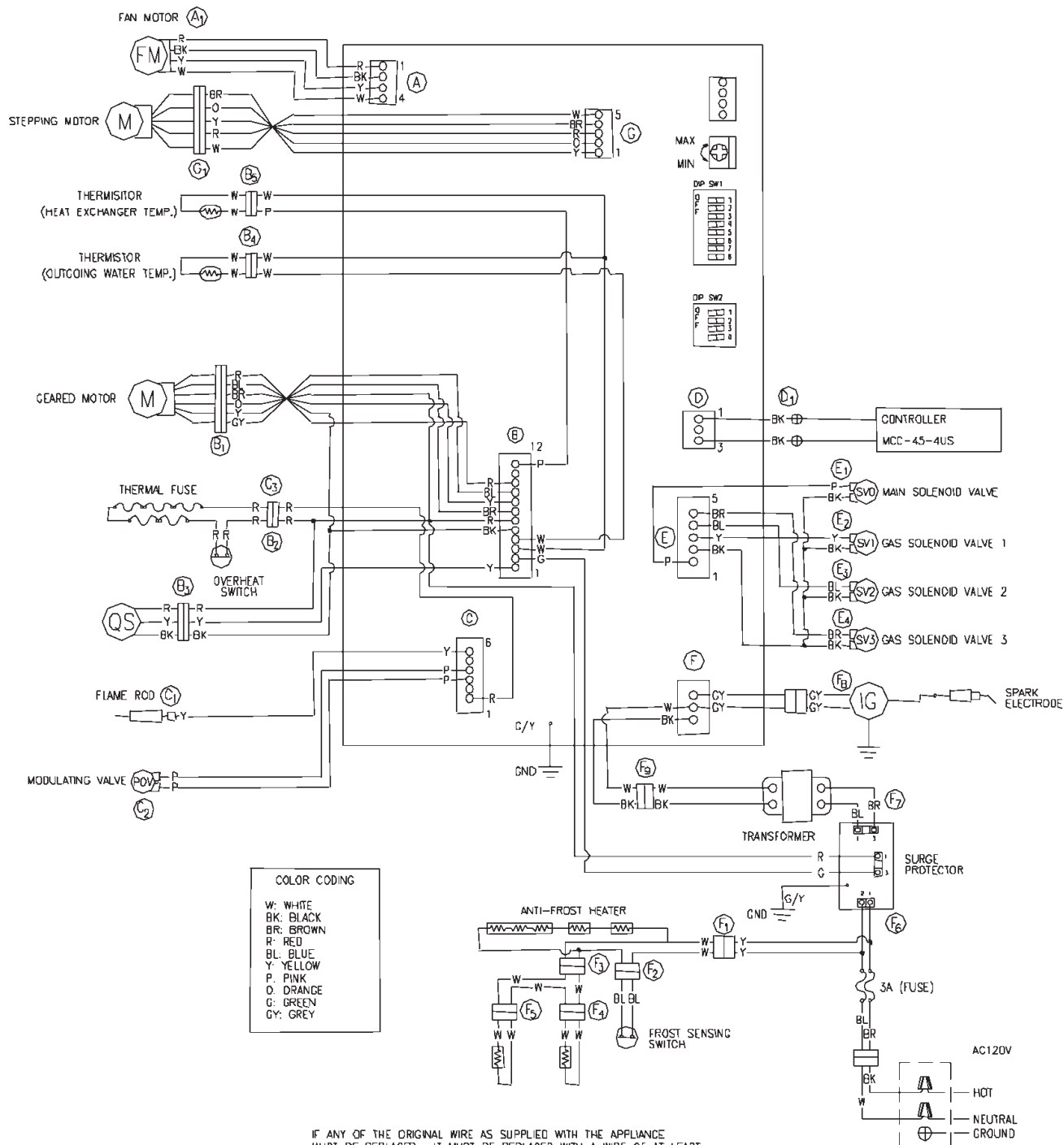
VI - TROUBLE SHOOTING (cont.)

Using a voltage meter set to the 200 ohm scale, you should have a resistance reading of 26 - 30 ohms through each of these heaters. The heater located on the heat exchanger piping should have a resistance reading of 81 - 86 ohms and the one located in the water flow sensor valve has a resistance reading of 16 - 19 ohms. Voltage throughout this circuit should be 120 VAC.

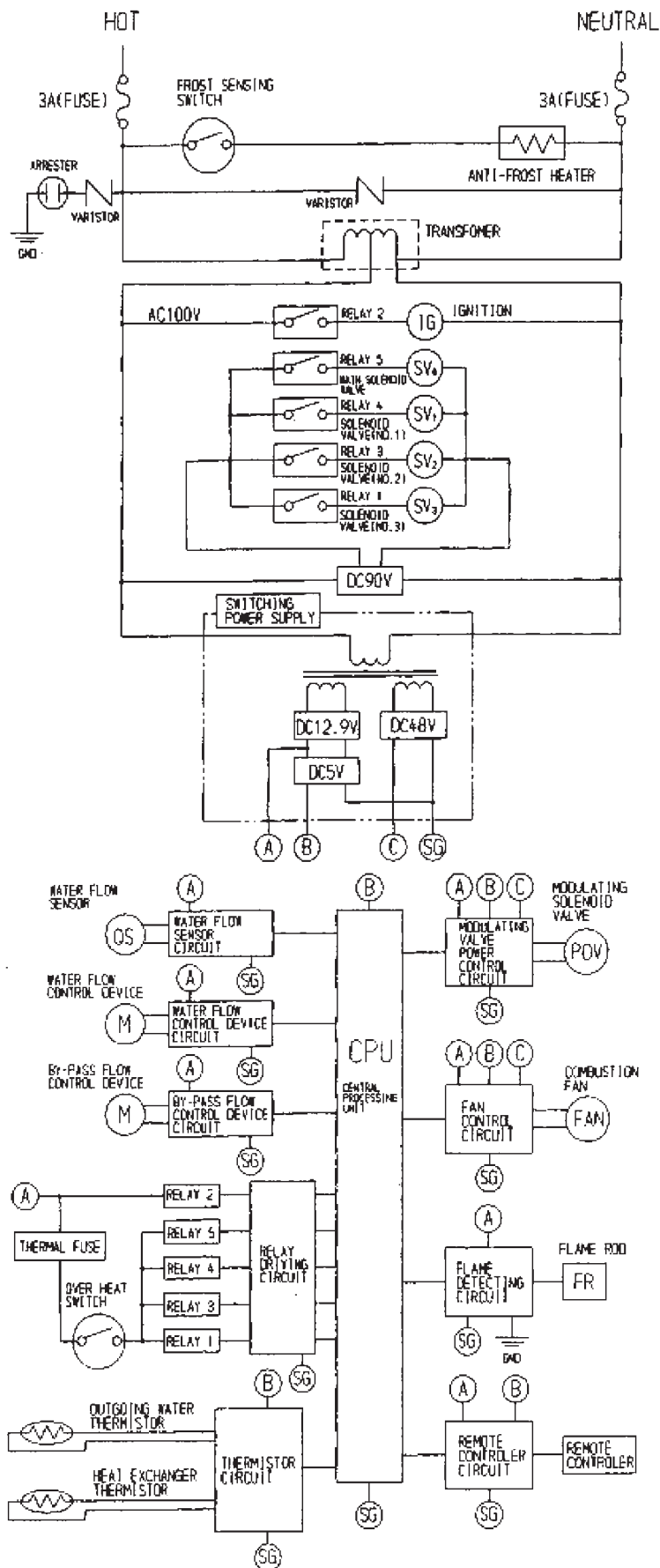
Fuses:

This unit has 2 in line (3) amp glass fuses. Remove the fuse and check continuity through them. If you have continuity through the fuse, it is good. If you cannot read continuity, the fuse is blown and must be replaced.

WIRING DIAGRAM



WIRING SCHEMATIC



VI - TROUBLESHOOTING (cont.)

Troubleshooting Flow Chart



BEFORE CARRYING OUT CHECKS MARKED WITH A # SIGN, DISCONNECT THE POWER SUPPLY.

Nature of Fault	Examination Point	Diagnostic Point	Values	Y/N	Action	Service Procedure
A. The LED on the remote control does not light up, when the system is powered up	1. Do you have voltage to the unit?	Power source	Do you have 120 VAC at the power supply?	Yes	Go to A – (2)	
				No	Plug in cord	
	2. Is supply voltage correct?	Measure voltage at power point.	120 VAC	Yes	Go to A – (3)	
				No	Check power supply circuit. Check fuses.	
	3. Check surge protector.	Inspect visually	Do you have 120 volts AC across the blue and brown wires at the surge protector?	Yes	Go to A – (4)	
				No	Go to A – (5)	
	4. Check both 3 amp electrical fuses.	# Disconnect and measure resistance to confirm if fuse is blown. Normal < than 1 MΩ	Is fuse blown?	Yes	Go to A – (5) replace fuse	
				No	Go to A – (6)	
	5. Check for short circuits.	1. Measure resistance of each solenoid valve. # Remove connector E from the PCB before measuring. Pink ~ Black (SV0) 1.7 ~ 2.1KΩ Yellow ~ Black (SV1) 1.7 ~ 2.1KΩ Brown ~ Black (SV2) 1.7 ~ 2.1KΩ (See page 38)	Are valves within those specified at left? # Measure after checking that there are no broken wires or shorts.	Yes	Go to A – (6) - 2	
				No	Replace gas valve.	IGE – 9
		1. Measure the resistance. # Disconnect sparker connector F ₈ and measure the resistance between both terminals. (See page 37)	Is resistance >1MΩ ?	Yes	Go to A (5 – 3)	
				No	Replace sparker.	IGE – 4
		3. Check wiring.	Are there any shorts?	Yes	Rectify /Replace	
				No	Replace PCB	IGE – 2
	6. Check to ensure you have 120 VAC across both terminals feeding the surge protector.	1. Measure voltage at the blue and brown wires.	100 ~ 120 VAC	Yes	Go to A (6 – 2)	
				No	Check for proper voltage to unit.	

VI - TROUBLESHOOTING (cont.)

Troubleshooting Flow Chart

BEFORE CARRYING OUT CHECKS MARKED WITH A # SIGN, DISCONNECT THE POWER SUPPLY.

Nature of Fault	Examination Point	Diagnostic Point	Values	Y/N	Action	Service Procedure
		2. Measure the voltage at connector F with appliance power supply on. F – Black ~ White 100 ~ 120 VAC F ₇ – Blue ~ Brown 100 ~ 120 VAC	Are values within those specified at left.	Yes	Go to A – (7)	
				No	Replace transformer	IGE – 7
	7. Check remotes (s) (where connected.)	Measure voltage between remote control terminals at D.	11 ~ 13 VDC Digital	Yes	Check cable for shorts or broken wires. Replace remote control.	
				No	Replace PCB.	IGE – 2
B. Digital monitor lights up, but combustion does not commence. (when remotes are connected).	1. Check water flow sensor.	1. Measure voltage between red ~ black of connector B ₄ . (See page 35)	11 ~ 13 VDC	Yes	Go to B-1-2	
				No	Replace PCB.	IGE – 2
		2. Measure voltage between yellow ~ black at connector B ₄ . (See page 35)	4 ~ 7 VDC	Yes	Go to B - 2	
				No	Replace water flow sensor.	IGE – 3
Error code "72" displayed on the digital monitor.	2. Check flame rod	# Measure resistance between flame rod terminal C ₁ and earth. (See page 36)	Resistance > 1MΩ?	Yes	Replace PCB	IGE – 2
				No	Replace flame rod	
Error code "32" displayed on the digital monitor.	3. Check outgoing water temperature thermistor.	# Disconnect connector B5 and measure resistance. Open circuit: > 1MΩ Short circuit: < 1Ω (See page 36)	Are values as shown at left?	Yes	Replace water temperature thermistor.	IGE – 6
				No	Go to B - 4	
Error code "61" displayed on the digital monitor.	4. Check combustion fan.	1. Check motor. Measure voltage between black ~ red at connector A ₁ . (See page 37)	6 ~ 45 VDC (Fan on) 0 VDC (Fan off)	Yes	Go to B – 5-2	
				No	Replace PCB	IGE – 2
		2. Check fan rotation sensor. Measure voltage between black ~ yellow at connector A ₁ . (See page 37)	11 ~ 13 VDC	Yes	Go to B – 4-3	
				No	Replace PCB	IGE – 2
		3. Measure voltage between black ~ white of connector A ₁ . (See page 37)	6 ~ 45 VDC	Yes	Go to B – 5	
				No	Replace fan	IGE – 5

VI - TROUBLESHOOTING (cont.)

Troubleshooting Flow Chart

BEFORE CARRYING OUT CHECKS MARKED WITH A # SIGN, DISCONNECT THE POWER SUPPLY.

Nature of Fault	Examination Point	Diagnostic Point	Values	Y/N	Action	Service Procedure
Error code "11" displayed on digital monitor.	5. Check ignition module.	1. Measure voltage between grey ~ grey of connector F ₈ (ignition module). (See page 37)	90 ~ 110 VAC	Yes	Go to B-5-2	
				No	Replace PCB	IGE – 2
		2. # Remove connector F ₈ and measure the resistance between ignition module and terminals. (See page 37)	Is resistance > 1MΩ?	Yes	Go to B-5-3	
				No	Adjust/ Replace ignition module	IGE – 4
		3. Check if unit is sparking.	Is the ignition module sparking?	Yes	Go to B-6	
				No	Adjust/ Replace electrode	
	6. Check main gas solenoid valve (SV0) Error code 71	1. # Disconnect the main solenoid valve connector E from the PCB, and measure the resistance between pink ~ black (SV0)	1.7 ~ 2.1KΩ	Yes	Go to B-6-2	
				No	Replace gas valve	IGE – 9
		2. Measure voltage between pink ~ black of SV0 connector. (See page 38)	80 ~ 100 VDC	Yes	Go to B-7	
				No	Replace PCB	IGE – 2
	7. Check solenoid valve (SV1)	1. # Disconnect connector E from the PCB. Measure resistance between yellow ~ black of (SV1).	1.7 ~ 2.1KΩ	Yes	Go to B-7-2	
				No	Replace gas valve	IGE – 9
		2. Measure voltage between yellow ~ black of SV1 connector. (See page 38)	80 ~ 100 VDC	Yes	Go to B-8	
				No	Replace PCB	IGE – 2
	8. Check changeover solenoid valve (SV2)	1. # Disconnect connector E from the PCB. And measure resistance between blue ~ black (SV2)	1.7 ~ 2.1KΩ	Yes	Go to B-8-2	
				No	Replace gas valve	IGE – 9
		2. Measure the voltage between blue ~ black or SV2 connector. (See page 38)	80 ~ 100 VDC	Yes	Go to B-9	
				No	Replace PCB	IGE – 2
Error code "14" displayed on digital monitor	9. Check thermal fuse	1. # Disconnect connector B ₃ and C ₃ measure resistance between red ~ red.	Is resistance < 1Ω?	Yes	Go to B-10	
				No	Replace thermal fuse	IGE – 11
	10. Check overheat (remaining flame) bi-metal switch	2. # Disconnect OHS (remaining flame) bi-metal switch festoon terminal B ₃ and C ₃ , and measure resistance between terminal on switch. (See page 40)	Is resistance < 1Ω?	Yes	Replace PCB	IGE – 2
				No	Replace remaining flame bi-metal switch	

VI - TROUBLESHOOTING (cont.)

Troubleshooting Flow Chart

BEFORE CARRYING OUT CHECKS MARKED WITH A # SIGN, DISCONNECT THE POWER SUPPLY.

Nature of Fault	Examination Point	Diagnostic Point	Values	Y/N	Action	Service Procedure
C. Combustion occurs, but flame fails. Error code "12" displayed on digital monitor.	1. Check flame rod.	1. Measure the voltage between flame rod terminal C ₁ and appliance ground.	5 ~ 150 VAC	Yes	Go to C-1-2	IGE – 2
				No	Replace PCB	
	2. Check ground wire.	2. Check to ensure flame rod bracket is not loose.	Is it secure?	Yes	Go to C-2	
				No	Replace/rectify	
		Check for faulty ground wire connections at unit, receptacle, and ground rod to home, and for broken or shorted wires.	Are connections OK?	Yes	Check for other causes of flame failure.	
				No	Replace or repair grounding circuit to unit.	
D. Cannot adjust water temperature.	1. Check hot water thermistor. (outgoing thermistor)	# Disconnect connector B ₅ and measure the resistance between white ~ white. (See page 41)	Resistance values match table on page #41	Yes	Go to D – 2	IGE – 6
				No	Replace water temperature thermistor.	
	2. Check changeover solenoid valve (SV3).	1. # Disconnect connector E from PCB and measure the resistance between brown ~ black. (See page 39)	1.7 ~ 2.1KΩ	Yes	Go to D – 2-2	IGE – 8
				No	Replace manifold assembly	
		2. Measure the voltage between brown ~ black wire of the changeover solenoid valve (SV3) at connector E. (See page 39)	80 ~ 100 VDC	Yes	Go to D – 3	IGE – 2
				No	Replace PCB	
	3. Check modulating valve.	1. # Disconnect modulating valve at C ₂ festoon terminal and measure resistance at solenoid terminals. (See page 42)	67 ~ 81Ω	Yes	Go to D – 3-2	IGE – 9
				No	replace gas valve	
		2. Measure the voltage between two harness terminals at C ₂ . (See page 42)	2 ~ 15 VDC	Yes	Go to D – 3-3	IGE – 2
				No	Replace PCB	
		3. Check whether the manifold pressure alters when remote control temperature is altered between 96° ~ 140°F.	Does the manifold pressure change?	Yes	Go to D – 4	IGE – 9
				No	Replace gas valve	
	4. Check water flow-servo.	1. # Measure resistance between red ~ blue wires of the water flow servo connector B ₂ . (See page 42)	22 ~ 26Ω	Yes	Go to D – 4-2	IGE – 3
				No	Replace water flow servo sensor.	

VI - TROUBLESHOOTING (cont.)

Troubleshooting Flow Chart

**BEFORE CARRYING OUT CHECKS MARKED WITH
A # SIGN, DISCONNECT THE POWER SUPPLY.**

Nature of Fault	Examination Point	Diagnostic Point	Values	Y/N	Action	Service Procedure
		2. Measure voltage between orange (+) and grey (-) of the water flow servo connector B ₂ .	11 ~ 13 VDC	Yes	Go to 4-3	IGE – 2
				No	Replace PCB	
		3. Measure voltage between brown ~ grey of water flow servo connector B ₂ (Don not turn water on) (See page 42)	4 ~ 6 VDC	Yes	Go to D-4-4	IGE – 3
				No	Replace water flow servo sensor.	
		4. Measure voltage between yellow ~ grey of the water flow servo connector B ₂ (Do not turn water on) (See page 42)	4 ~ 6 VDC	Yes	Normal	IGE – 3
				No	Replace water flow servo sensor.	
E. Anti-frost heater does not work.	1. check anti-frost heater.	1. # Disconnected connector F ₄ and F ₅ measure resistance across each of the heating elements. (white wires) (See page 43)	348 ~ 375Ω	Yes	Go to E-1-2	
				No	Replace Anti-frost sensing switch.	
		2. # Read resistance of the heating element that is mounted on the front of the heat exchanger. (white wires) (See page 43)	100 ~ 110Ω	Yes	Go to E-2	
				No	Replace Anti-frost heater that is defective.	
		3. Read resistance of heating elements on the heat exchanger outlet hot water line. (See page 43)	33 ~ 39Ω	Yes	Go to E-2	
				No	Replace Anti-frost heater that is defective.	
	2. Check frost sensing switch	# Disconnect connector F ₂ and measure across the bi-metal sensing switch located on the upper right hand of the heat exchanger. check this switch at temperatures below 37 °F. You can place an ice cube against the switch to activate it. (See page 43)	Is resistance <1Ω after applying ice to this switch for five minutes?	Yes	Check wiring	
				No	Replace Anti-frost sensing switch.	



Troubleshooting Procedure

BEFORE CARRYING OUT CHECKS MARKED WITH A # SIGN, DISCONNECT THE POWER SUPPLY.

Unit's wiring diagram can be found on page 27.

Appliance fails to operate (even remote control fails to operate).

1) Is the fuse blown

Fuses are located in plastic holders in the main harness, on the lower right hand side of the appliance.

Check fuse.

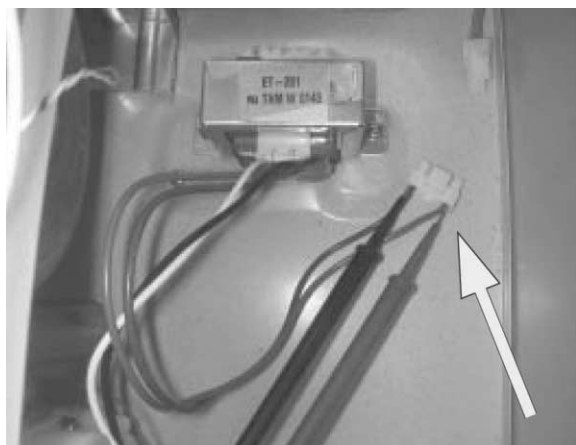
- a. Disconnect unit from power supply.
- b. # Measure resistance to check the electric fuse (3 amp)

Normal: less than 1Ω

If normal, proceed to check item 2 below.

Faulty: Replace 3 amp glass fuse. If the fuse blows again, investigate cause of short circuit.

2) Is the main transformer normal?



Check the transformer.

- a. Measure the voltage and/or resistance at connector F, black ~ white wires.

Normal: 100 ~ 120 VAC

51 ~ 63 Ω resistance

Faulty: Check for 120 ~ 125 VAC at the surge protector, blue ~ brown wires, connector F₇.

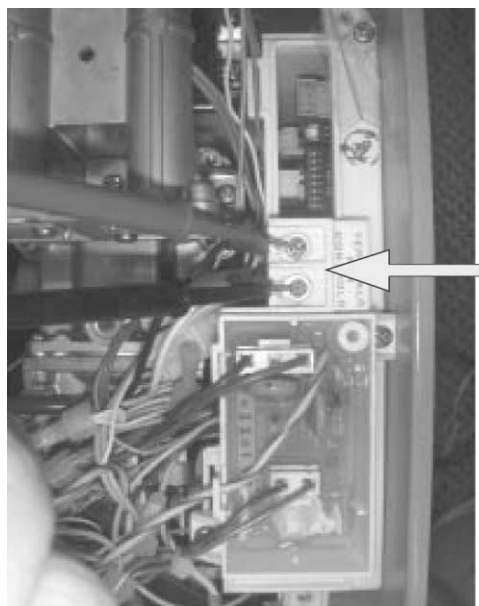
Resistance reading 51 ~ 63 Ω

If normal, check item 3 on next page.

Faulty: Replace the transformer.

(Service Procedure IGE-7, page 49)

3) Is the remote control normal ?



Check voltage between the two remote control cable connectors.

- a. Check the voltage between terminals on the remote control terminal mount D₁.

Normal: 11 ~ 13 VDC

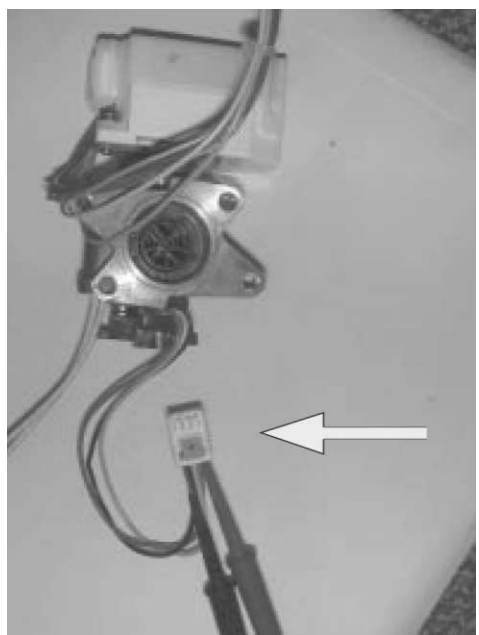
If normal, check for an open circuit or short before replacing the remote control.

Faulty: Replace PCB.

(Service Procedure IGE-2, page 47)

No combustion (despite remote control indication)

1) Is the water flow sensor normal ?



Check the water flow sensor.

- a. Check the voltage at PCB connector B4 , red and black wires.

Normal: 11 ~ 13 VDC or 5.8 ~ 6.4K Ω

If normal, check (b) below.

Faulty: Replace the PCB.

(Service Procedure IGE-2, page 47)

- b. Check the voltage at PCB connector B4, yellow and black wires.

Normal: 4 ~ 7 VDC or 1M ~ 1.2M Ω .

If normal, proceed to check item 2 on next page.

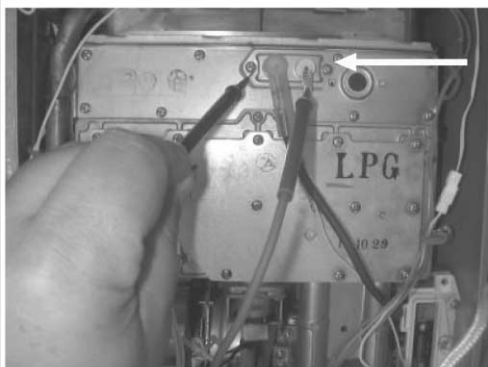
Faulty: Replace the water flow sensor.

(Service Procedure IGE-2, page 47)

VI - TROUBLESHOOTING (cont.)

BEFORE CARRYING OUT CHECKS MARKED WITH A # SIGN, DISCONNECT THE POWER SUPPLY.

2) Is the flame rod normal ? Error “72” is displayed



Checking the flame rod.

- a. # Detach the flame rod terminal C1, and re-attempt operation.
 (“72” is displayed)
 Proceed to check item 3 below.
 (no “72” displayed)
 Inspect flame rod wiring for current leak and inspect flame rod for carbon build-up.

Measure resistance between the flame rod Terminal C1 and the appliance earth.

Normal: 1 M Ω or more.

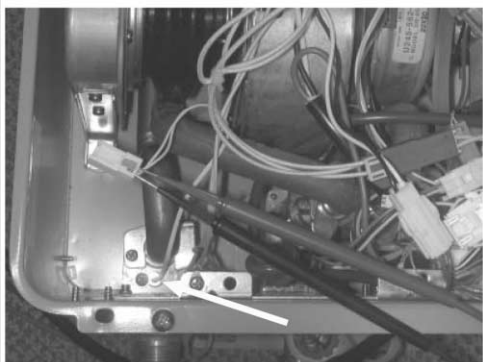
If normal, replace the PCB unit.

(Service Procedure IGE-2, page 47)

Faulty: Replace the flame rod.

See page 40 for additional information and resistance values pertaining to the flame rod.

3) Is the water temperature thermistor normal?



If error “32” is displayed, check the water temperature thermistor.

- a. # Disconnect connector B5, and measure resistance of the white ~ white wires.

Resistance > 1 M Ω = open circuit.

Resistance < 1 Ω = short circuit.

Normal: Proceed to check item 4 on the next page.

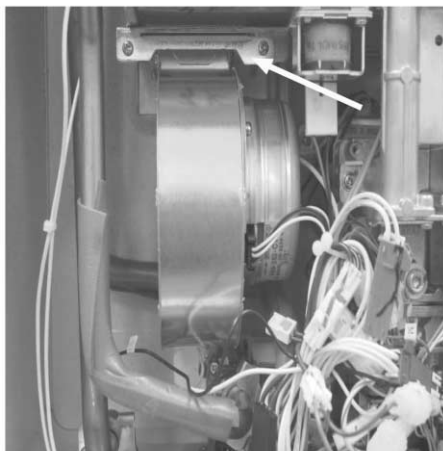
Faulty: Replace the water temperature thermistor.

(Service Procedure IGE-6, page 48)

See page 41 for additional information and resistance readings pertaining to the temperature thermistor.

BEFORE CARRYING OUT CHECKS MARKED WITH A # SIGN, DISCONNECT THE POWER SUPPLY.

4) Is the combustion fan motor normal ?



Motor check.

If error "61" is displayed, check the combustion fan.

- a. Measure voltage at connector A1. Black and red wires.
Normal: 6 ~ 45 VDC (Fan on)
0 VDC (Fan off)
If normal, check item b below.
Faulty: Replace the PCB unit.
(Service Procedure IGE-2, page 47)

Fan revolution sensor check.

- b. Measure voltage at connector A1, black and yellow wires.
Normal: 11 ~ 13 VDC or 3.1 ~ 3.7 K Ω
If normal, check item c below.
Faulty: Replace the PCB unit.
(Service Procedure IGE-2, page 47)
- c. Measure voltage at connector A1, black and white wires.
Normal: 6 ~ 45 VDC or 9 ~ 9.4 K Ω
(33 ~ 400 Hz.)
If normal, proceed to check item 5 below.
Faulty: Replace the combustion fan motor.
(Service Procedure IGE-5, page 48)

5) Is the ignition module operating normally ?

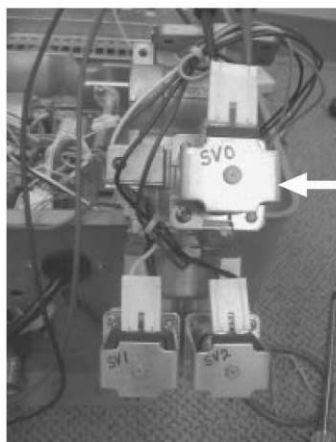


Check the spark module.

- a. Measure voltage at connector F8, grey and grey wires.
Normal: 90 ~ 110 VAC
0 VDC (when fan is off)
If normal, check b below.
Faulty: Replace the PCB unit.
(Service Procedure IGE-2, page 47)
- b. # Disconnect connector F8, and measure the resistance between the two spark terminals.
Normal: > 1 M Ω
Faulty: Replace the igniter module.
(Service Procedure IGE-5, page 48)
Electrode gap should be 3/16" to 1/4" .

BEFORE CARRYING OUT CHECKS MARKED WITH A # SIGN, DISCONNECT THE POWER SUPPLY.

6) Is the main gas solenoid valve (SV0) operating normally ?



If error "11" or "71" is displayed, check the main gas solenoid valve.

- a. # Disconnect the main gas solenoid valve (SV0) connector and measure the resistance at the solenoid terminals.

Normal: 1.7 ~ 2.1 K Ω

If normal, check b below.

Faulty: Replace gas valve.

(Service Procedure IGE-9, page 50)

- b. Measure voltage at the main gas solenoid (SV0) Pink and black wires.

Normal: 80 ~ 100 VDC

If normal, proceed to check item 7 below.

Faulty: Replace PCB unit.

(Service Procedure IGE-2, page 47)

7) Is the change over solenoid (SV1) operating normally ?



If error "11" or "71" is displayed, check the change over solenoid (SV1).

- a. # Disconnect the change over solenoid (SV1) connector, and measure resistance at the solenoid terminals.

Normal: 1.7 ~ 2.1 K Ω

If normal, check b below.

Faulty: Replace the gas valve.

(Service Procedure IGE-9, page 50)

- b. Measure voltage at the change over solenoid (SV1) yellow ~ black wires.

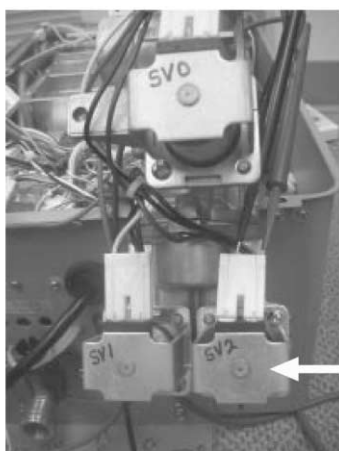
Normal: 80 ~ 100 VDC

If normal, check 8 below.

Faulty: Replace PCB unit.

(Service Procedure IGE-2, page 47)

8) Is the change over solenoid (SV2) operating normally?



If error "11" or "71" is displayed, check the change over solenoid (SV2).

- a. # Disconnect the changeover solenoid (SV2) connector, and measure the resistance at the solenoid terminals.

Normal: 1.7 – 2.1 K Ω If normal, check b below.

Faulty: Replace the gas valve.

(Service Procedure IGE-9, page 50)

- b. Measure the voltage at the changeover solenoid (SV2), blue – black wires.

Normal: 80 – 100 VDC

If normal, check 9, on next page.

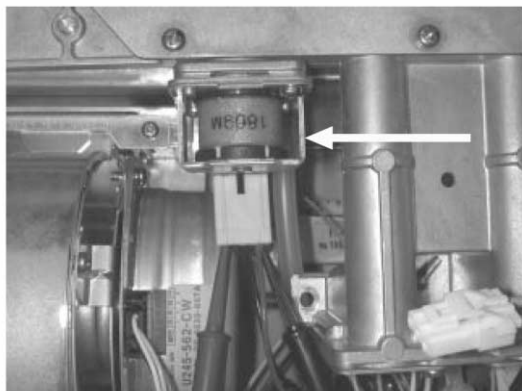
Faulty: Replace the PCB unit.

(Service Procedure IGE-2, page 47)

VI - TROUBLESHOOTING (cont.)

BEFORE CARRYING OUT CHECKS MARKED WITH A # SIGN, DISCONNECT THE POWER SUPPLY.

9) Is the change over solenoid (SV3) operating normally?



If error “11” or “71” is displayed, check the change over solenoid (SV3).

- a. # Disconnect the changeover solenoid (SV3) connector, and measure the resistance at the solenoid terminals.

Normal: 1.7 – 2.1 K Ω

If normal, check b below.

Faulty: Replace the manifold assembly.

(Service Procedure IGE-8, page 49)

- b. Measure the voltage at the changeover solenoid (SV3), brown – black wires.

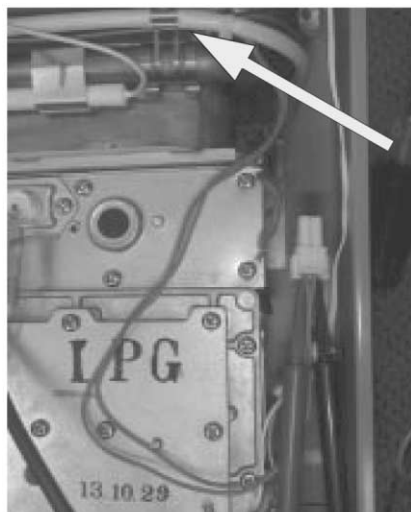
Normal: 80 – 100 VDC

If normal, reconfirm gas pressures are correct.

Faulty: Replace the PCB unit.

(Service Procedure IGE-2, page 47)

BEFORE CARRYING OUT CHECKS MARKED WITH A # SIGN, DISCONNECT THE POWER SUPPLY.



Error code "14" Check the thermal fuse.

- a. # Disconnect connector B3 and C3, measure the resistance between the red – red wires.

Normal: Less than 1 Ω

If normal, check b below.

Faulty: Check manifold gas pressure. Check heat exchanger for cracks and/or separations. If there is nothing abnormal, replace the thermal fuse.

(Service Procedure IGE-11, page 51)

- b. Check bi-metal switch, (remaining flame safety device). Measure resistance between the two terminals at B3 and C3.

Normal: Less than 1 Ω

If normal, process to item a below.

Faulty: Replace the bi-metal switch.

Combustion stops due to flame failure

1) Is the flame rod functioning normally?



- a. Measure the voltage between the flame rod terminal C₁ and the appliance earth.

Normal: 5 – 150 VAC from yellow to ground.

If normal, check b below.

Faulty: Replace the PCB unit.

(Service Procedure IGE-2, page 47)

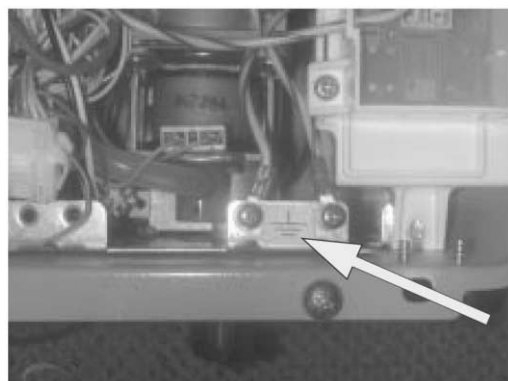
- b. Check that the flame rod attachment is not loose.

Normal: Replace the PCB unit.

(Service Procedure IGE-2, page 47)

Faulty: Secure the flame rod bracket.

2) Is the earth lead wire connected?



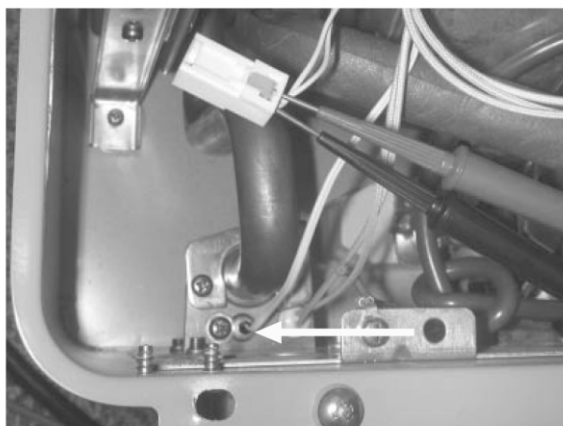
- a. Check for defective earth terminal, or an open circuit or short. If normal, investigate other possible causes for the flame failure. (Eg. Is the gas valve open ? Is the filter mesh blocked ?) Was proper venting material used? Did you regulate your gas supply pressure to the proper gas pressure for gas type being used?

Faulty: Ensure unit is properly grounded. Check ground circuit outside home at service pole. There should be an eight foot ground rod driven in the earth and a copper lead tied to the service meter. Ensure connection on ground rod is tight.

BEFORE CARRYING OUT CHECKS MARKED WITH A # SIGN, DISCONNECT THE POWER SUPPLY.

Unable to adjust hot water temperature

1) Is the water temperature thermistor operating normally ?



- a. # Disconnect the connector B5, and measure the resistance between the white wires, see below for resistance readings.

Thermistor resistance values:

59 °F = 11.4 ~ 14 K Ω

86 °F = 6.4 ~ 7.8 K Ω

113 °F = 3.6 ~ 4.5 K Ω

140 °F = 2.2 ~ 2.7 K Ω

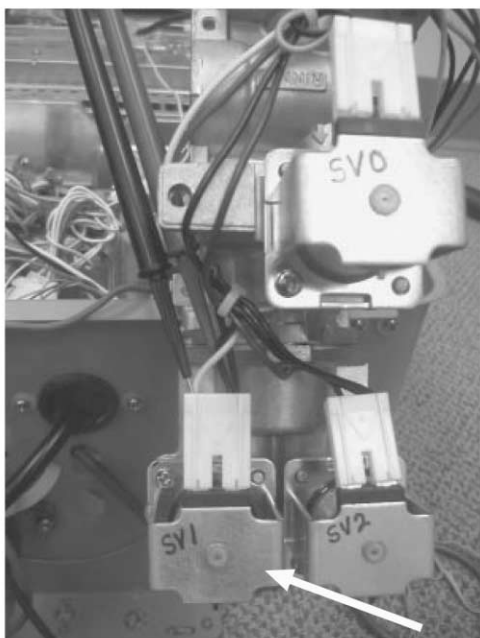
221 °F = 0.6 ~ 0.8 K Ω

Normal: Proceed to check item 2 below.

Faulty: Replace the water temperature thermistor.

(Service Procedure IGE-6, page 48)

2) Is the change over solenoid (SV1) normal ?



- a. # Disconnect the changeover solenoid (SV1) connector, and measure resistance at the solenoid terminals.

Normal: 1.7 ~ 2.1 K Ω

If normal, proceed to b.

Faulty: Replace the gas valve.

(Service Procedure IGE-9, page 50)

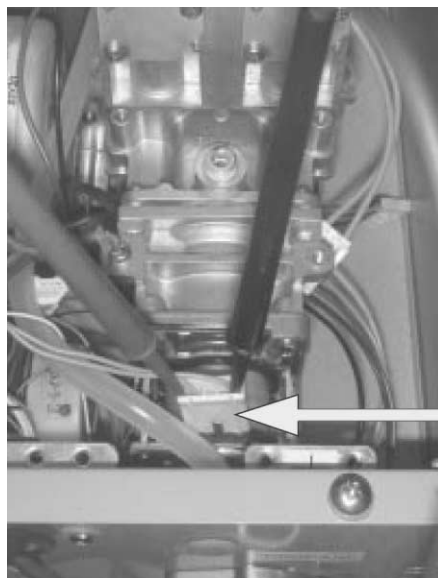
- b. Measure the voltage at the changeover solenoid (SV1) yellow ~ black wires.

Normal: 80 ~ 100 VDC

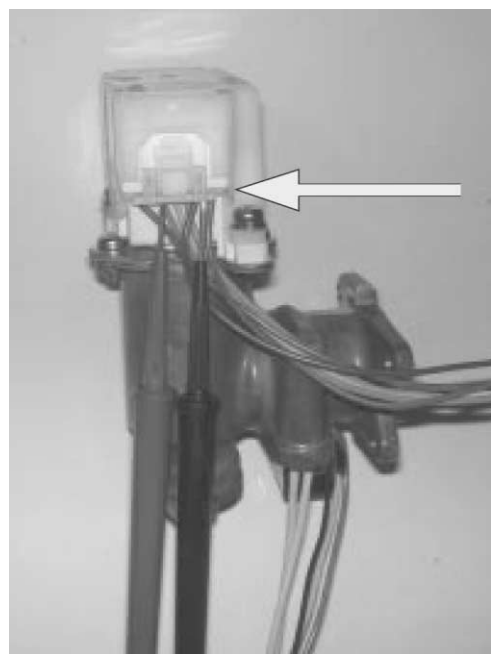
If normal, proceed to check item 3, on next page.

Faulty: Replace the PCB unit.

(Service Procedure IGE-2, page 47)

3) Is the modulating valve operating normally ? Error code 52

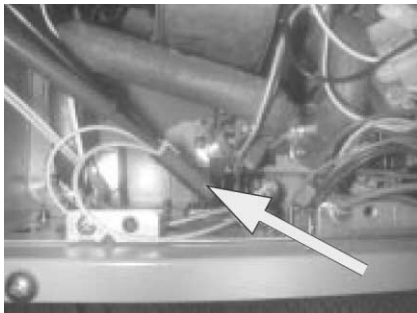
- a. # Disconnect the modulating valve festoon C2 terminals and measure the resistance at the terminals.
Normal: 67 ~ 81 Ω
If normal, check b.
Faulty: Replace gas valve.
(Service Procedure IGE-9, page 50)
- b. Re-connect terminal C2 and measure voltage across the pink ~ pink wires when the unit is firing.
Normal: 2 ~ 15 VDC
If normal, check c below.
Faulty: Replace the PCB unit.
(Service Procedure IGE-2, page 47)
- c. Investigate the change in the manifold gas pressure, when the remote control pre-set temperature is altered from 96 ~ 140 °F.
Normal: If the manifold pressure changes, proceed to check item 4 below. **DO NOT** adjust manifold pressures.
Faulty: Replace gas valve.
(Service Procedure IGE-9, page 50)

4) Is the water flow servo normal ?

- a. # Disconnect connector B2 and measure the resistance of the water flow servo, red ~ blue wires.
Normal: 22 ~ 26 Ω
If normal, proceed to b.
Faulty: Replace the water flow servo and sensor.
(Service Procedure IGE-2, page 47)
- b. Disconnect connector B2, and measure the voltage on the PCB unit side, where the orange (+), and/or grey or black (-) wires connect to the board.
Normal: 3.3 ~ 4.5 VDC
If normal, proceed to c.
Faulty: Replace the PCB unit.
(Service Procedure IGE-2, page 47)
- c. With connector B₂, connected (do not turn water ON ... wait for the water flow servo to return to fully open), measure the voltage at the brown ~ grey wires.
Normal: 4 ~ 6 VDC vent limiter OFF
Faulty: Replace the water flow servo and sensor.
(Service Procedure IGE-2, page 47)
- d. With connector B2, connected (do not turn water ON... wait for the water flow servo to return to fully open), measure the voltage at the yellow ~ grey wires.
Normal: Less than 0.5 VDC when unit is set at 120 °F and there is no water flowing through the unit.
Faulty: Replace water flow servo and sensor.
(Service Procedure IGE-2, page 47)

Anti-frost heaters do not operate

1) Are the ceramic anti-frost heaters operating normally?

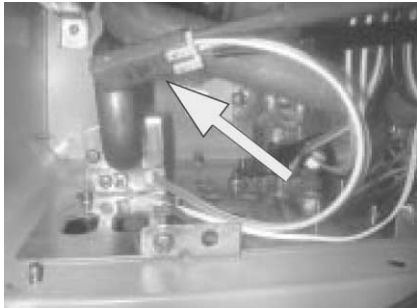


- a. # Disconnect connector F4, and measure the resistance of the heater mounted in the water flow control valve, these are white wires. Disconnect connector F5, and measure the resistance of the heater in the outlet line connector. See connectors in the first and second picture to the left.

Normal: 348 ~ 375 Ω

If normal, proceed to b.

Faulty: Replace defective element.

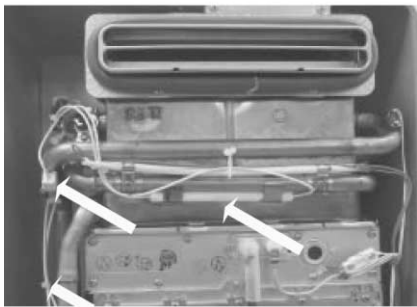


- b. # Take an ohm meter and read resistance across the heater on the face of the heat exchanger. The resistance across this element is listed below. See third picture to the left for location of this element. These are white wires.

Normal: 100 ~ 110 Ω

If normal, proceed to check item 2 below.

Faulty: Replace defective anti frost heater assembly.

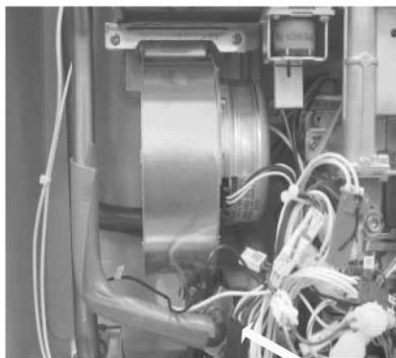


- c. Check resistance of the two heat exchanger outlet line heater elements, as shown in the third picture to the left. Check across each heater independently.

Normal: 33 ~ 39 Ω

Faulty: Replace defective anti frost heater assembly.

2) Is the frost sensor switch operating normally ?



- a. # Disconnect connector F2, and measure the resistance through this switch, measure when atmospheric temperature is 39°F + or – 3°F. (See Note) See drawing to left for location of this bimetal switch. These are white wires to this switch.

Normal: Less than 1 Ω

If normal, check wiring harness for defects.

(100 volts AC)

Faulty: Replace the frost sensing bimetal switch.

Note: If the atmospheric temperature is too high, cool the switch with ice.

VII - GAS PRESSURE SETTING PROCEDURE



*All settings/adjustments must be performed
by a qualified Service Technician.*

1. Turn unit off at power source and turn off the gas to the water heater.
2. Remove the front cover from the water heater.
3. Remove the gas pressure test port plug. Connect manometer to this port. (See Figure #1 for location of the test port plug.) Turn on the gas and power to the water heater.
4. Flow water through the water heater at the maximum flow rate obtainable, at least three gallons per minute.
5. To adjust the "**Low**" fire pressure, use small (pocket) common screwdriver to set combustion control dip switch #7 to the "**ON**" position, and switch #8 to the "**OFF**" position (see figure #2 for location of combustion control switches.) This will put the unit into forced low fire. Check the pressure reading on your manometer. If the pressure needs adjusting, remove the rubber plug from the bottom of the water heater casing (located beneath the regulator), to access the regulator adjustment screw. Adjust the regulator screw to achieve the correct gas pressure. (See figure #1 for location of the regulator adjustment screw.) Below are the proper pressures for "**Low**" fire, per gas type.

Propane	0.88" w.c. @ 10" w.c. supply	(Low fire rate of 15,000 BTU's)
Natural	0.56" w.c. @ 6" w.c. supply	(Low fire rate of 15,000 BTU's)

6. To adjust the "**High**" fire pressure, use small (pocket) common screwdriver to set combustion control dip switch #7 to the "**ON**" position, and switch #8 to the "**ON**" position (see figure #2 for location of the combustion control switches), this will put the unit into forced high fire. Check the pressure reading on your manometer. If the pressure needs adjusting, use small (pocket) common screwdriver to adjust the high pressure "**Pot**". (See figure #2 for location of "**high pressure setting pot**"). Below are the proper pressures for "**High**" fire.

Propane	5.1" w.c. @ 10" w.c. supply	(High fire rate of 199,000 BTU's)
Natural	3.4" w.c. @ 6" w.c. supply	(High fire rate of 199,000 BTU's)

7. Verify both low and high fire pressures by placing the water heater into "**Forced Low Fire**" and "**Forced High Fire**" as described in steps 5 and 6 above. This completes the gas pressure setting procedure. Dip switches #7 and #8 (combustion control switches), **MUST** be returned to the "**Off**" position, after setting the pressures.

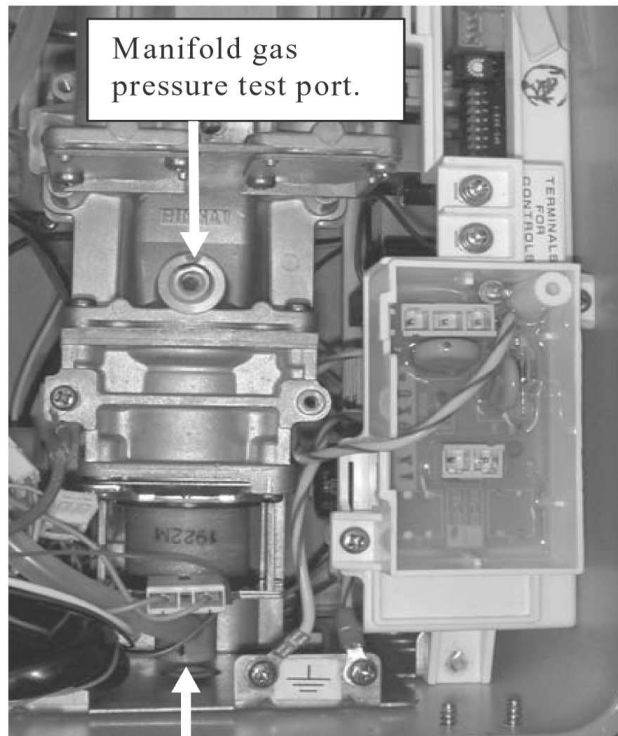
Refer to page 12 for factory default dip switch settings.

WARNING

Dip switched #7 and #8 (combustion control switches) **MUST** be returned to the "OFF" position, after setting pressures.

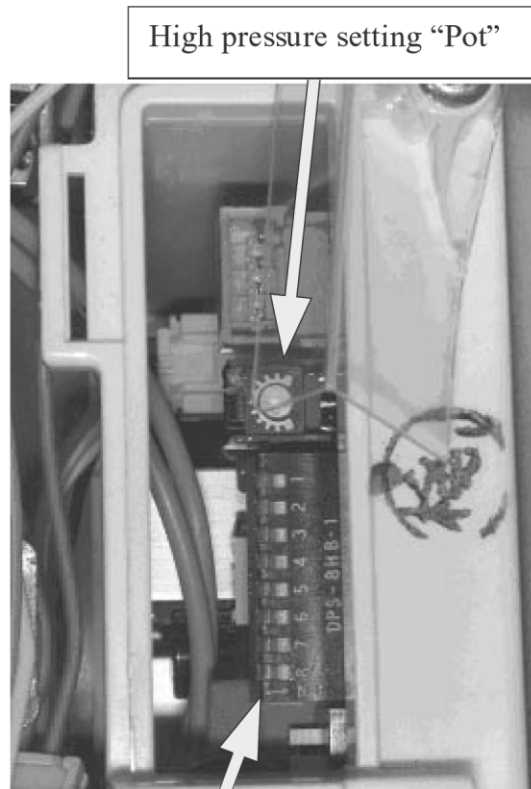
8. Turn off the gas to the water heater. Remove the manometer connection. Reinstall the pressure port plug. Turn on the gas to the water heater and check for gas leaks around test port with a leak solution.
9. Reinstall the front cover and place the unit back into operation.
10. Verify the proper water temperature, as set on the controller at your outlets. If controllers are not being used the output temperature should be 120°F, for residential models or 140° for commercial models.

Figure #1



Regulator adjustment screw used when setting low and high fire manifold gas pressures only. DO NOT, adjust this screw without following gas pressure setting procedures.

Figure #2



Dip switches #7 and #8 are used when adjusting low and high fire manifold gas pressures, as stated in the gas pressure setting procedure.



NOTE: Before proceeding with dismantling, be sure to follow the ***CAUTION*** instructions before each explanation. Always disconnect the electrical supply, turn off water and gas supply service valves, and drain all water from the unit before proceeding. **Only trained and qualified service agencies should attempt to repair this product.**

Service Procedure

IGE - 1.	Removal of the Front Panel.....	47
IGE - 2.	Removal of the PC Board.....	47
IGE - 3.	Removal of the Water Flow Control and Sensor	47
IGE - 4.	Removal of the Ignition Module.....	48
IGE - 5.	Removal of the Combustion Fan.....	48
IGE - 6.	Removal of the Water Temperature Thermistor	48
IGE - 7.	Removal of the Transformer.....	49
IGE - 8.	Removal of the Burner and Burner Manifold.....	49
IGE - 9.	Removal of the Gas Valve Assembly	50
IGE - 10.	Removal of the Heat Exchanger Assembly	50
IGE - 11.	Removal of the Thermal Fuse	51

Re-assembly in all tasks listed above in the reverse order of dismantling (unless stated otherwise.)

WARNING

Dip switched #7 and #8 (combustion control switches) **MUST** be returned to the "OFF" position, after setting pressures.

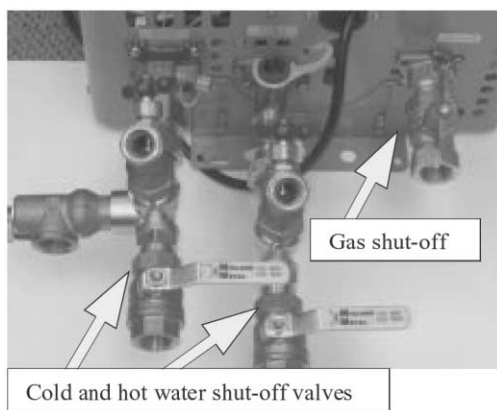
Dip switch #1 **MUST** be returned to the proper position based upon the length of vent pipe (see page 13).

IMPORTANT

When dismantling the unit you should always isolate the following items:

- Gas supply
- Electrical supply
- Water supply
- Drain all water from the appliance

The following diagram may be of assistance in locating the above.



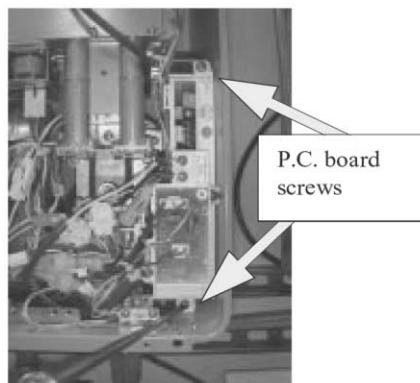
IGE - 2. Removal of PC board



CAUTION

120 volt potential exposure. Isolate the appliance and reconfirm power has been disconnected using a multimeter.

- Remove the two (2) screws holding the PCB in place with a Phillips screw driver, then pull the PC board out of the appliance.
Disconnect all connectors.



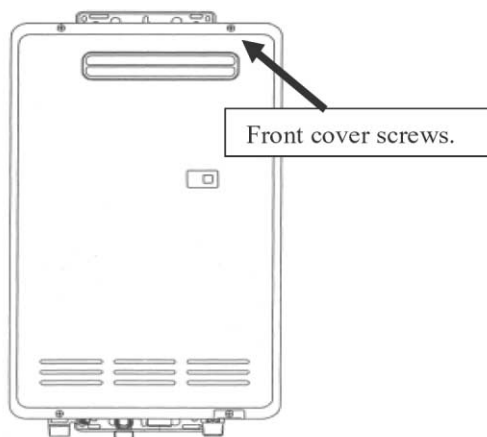
IGE - 1. Removal of the Front Panel



CAUTION

120 volt potential exposure. Isolate the appliance and reconfirm power has been disconnected using a multimeter.

- Remove the four (4) screws holding the panel in place with a Phillips driver.



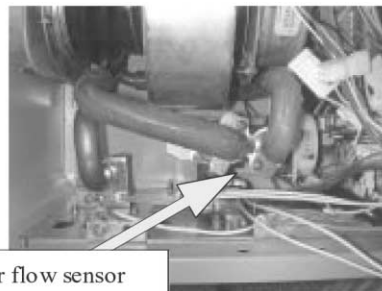
IGE - 3. Removal of the Water Flow Sensor and Water Flow Control Valve Assembly



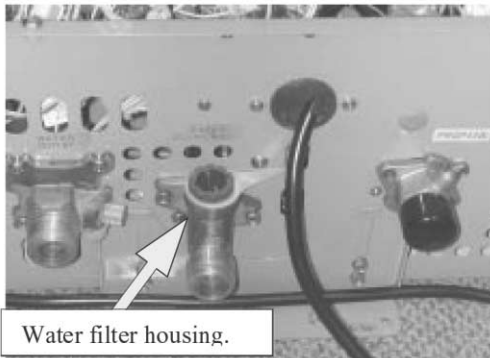
CAUTION

120 volt potential exposure. Isolate the appliance and reconfirm power has been disconnected using a multimeter.

- Remove one (1) Phillips screw from the heat exchanger water supply line and (1) screw from the bypass valve assembly. Lift the water line retainer up and over the housing it attaches to, pull water line towards yourself to disconnect water lines from the assembly. Inspect o-rings for



- a. Remove the four (4) Phillips screws that secure the water inlet filter housing to the unit. See picture below for location of screws. Once screws are removed reach into the unit and pull up and out on the flow control assembly to remove it from the appliance. Inspect o-ring for damage.



- b. Disconnect wiring harness from assembly and remove the water flow control assembly from the unit.

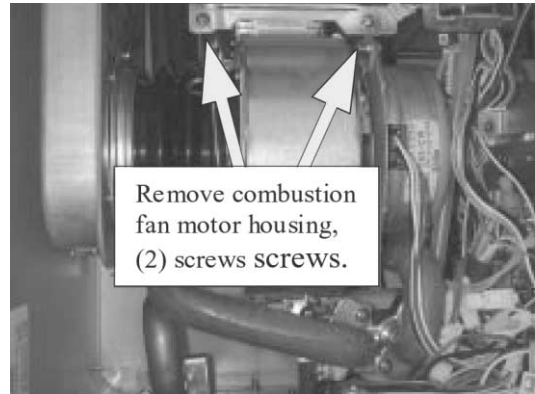
IGE - 5. Removal of the Combustion Fan:



CAUTION

120 volt potential exposure. Isolate the appliance and reconfirm power has been disconnected using a multimeter.

- a. Disconnect wiring harness from fan motor.
- b. Remove the (2) Phillips screws that secure the combustion fan motor to the fan housing. Pull the fan motor assembly towards yourself to remove it.



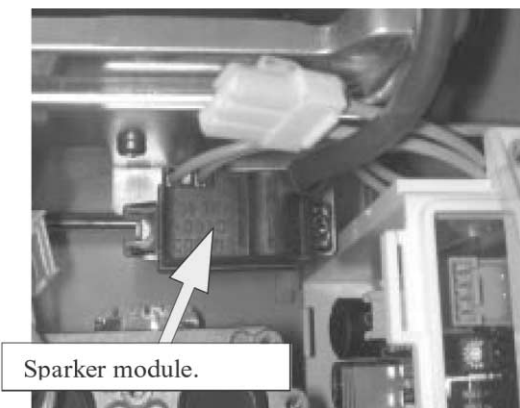
IGE - 4. Removal of Ignition Module:



CAUTION

120 volt potential exposure. Isolate the appliance and reconfirm power has been disconnected using a multimeter.

- a. Remove one (1) Phillips screw that secures the sparker module to the unit casing.
- b. Disconnect high tension lead and connector.



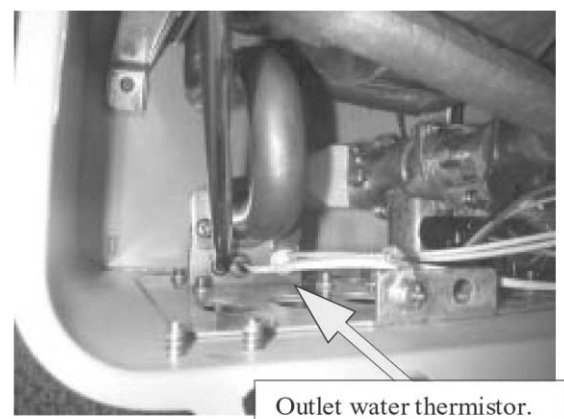
IGE - 6. Removal of the Water Temperature Thermistor:



CAUTION

120 volt potential exposure. Isolate the appliance and reconfirm power has been disconnected using a multimeter.

- a. Remove the two (2) Phillips screws that secure the thermistor in place to remove the water outlet temperature thermistor.



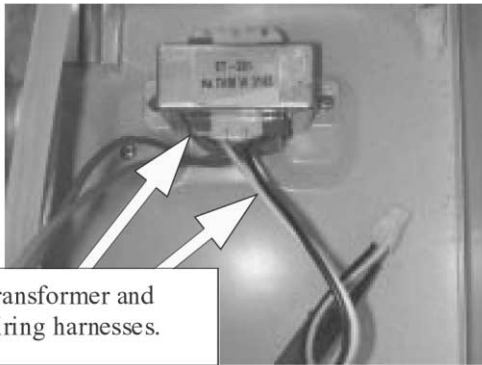
IGE - 7. Removal of Transformer:



CAUTION

120 volt potential exposure. Isolate the appliance and reconfirm power has been disconnected using a multimeter.

- Remove the combustion fan motor assembly as described in section 5-a,b.
- Remove the two (2) Phillips screws to release the transformer.
- Disconnect wiring harness connectors to transformer and pull out towards you.



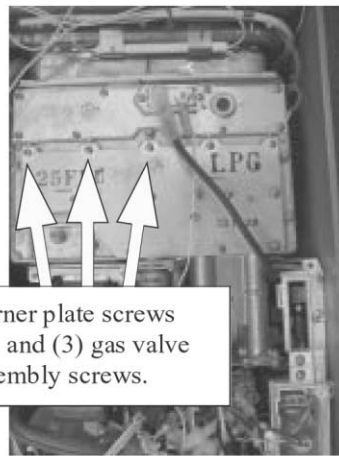
IGE - 8. Removal of Burner Manifold and the Burner:



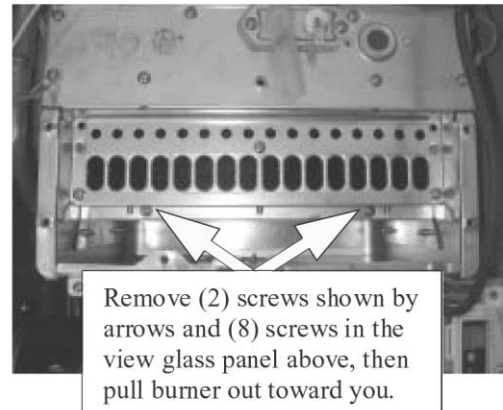
CAUTION

120 volt potential exposure. Isolate the appliance and reconfirm power has been disconnected using a multimeter.

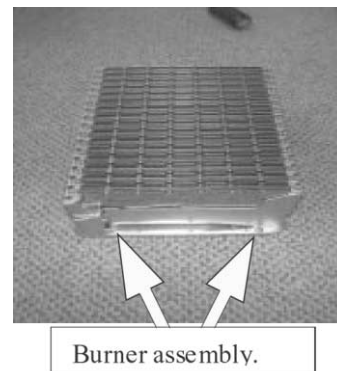
- To remove the burner manifold, remove (6) Phillip screws around the burner plate as shown in the upper right picture.
- Remove the (3) Phillip screws at the gas valve assembly.
- Grip the burner manifold and remove it from the unit.



- To remove the burner assembly remove (8) Phillip screws around the sight glass panel. Remove this panel.
- Locate the (2) Phillip screws inside the burner chamber that hold the burner assembly in place. Remove these two screws, grip the burner assembly and slide it out of the combustion housing.



- If you need to remove each burner from this housing remove the (2) Phillip screws on each side of the burner, as shown below.



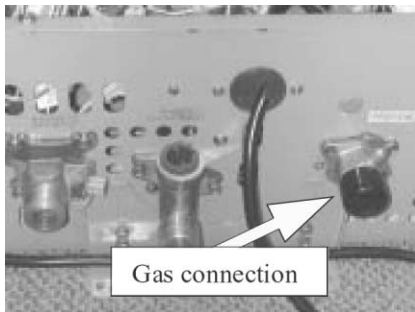
IGE - 9. Removal of the Gas Valve Assembly:



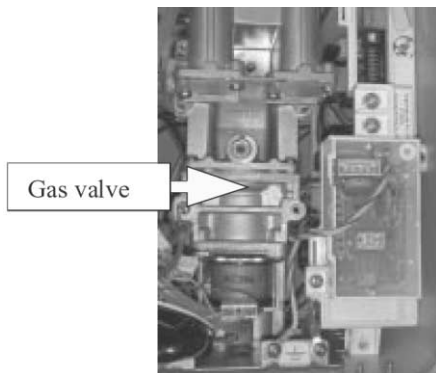
CAUTION

120 volt potential exposure. Isolate the appliance and reconfirm power has been disconnected using a multimeter.

- a. Remove the burner manifold, refer to section 8-a,b,c.
- b. Remove the four (4) Phillips screws that hold the gas connection and gas control valve in place at the bottom of the unit. Pull the gas connection down to disconnect it from the gas valve assembly. Inspect o-ring for damage and/or defects. Ensure o-ring is in place when re-assembling this connection.



- c. Disconnect connectors from solenoids, note which connector goes to each solenoid, along with the proper wire colors. Pull gas valve assembly out of unit.



IGE - 10. Removal of Heat Exchanger:

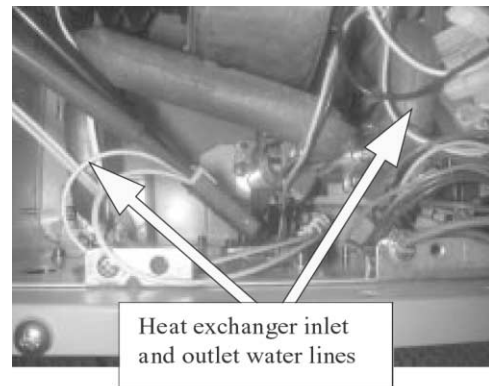


CAUTION

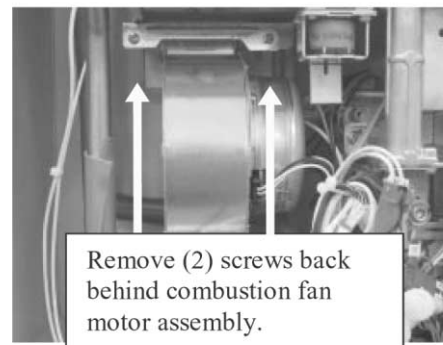
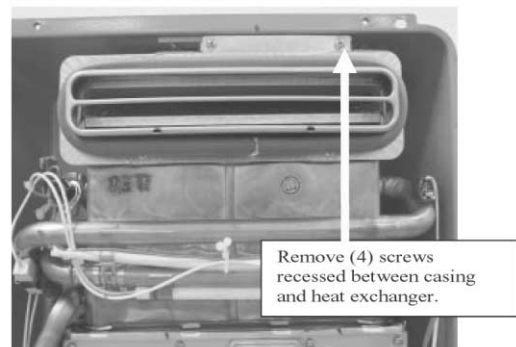
120 volt potential exposure. Isolate the appliance and reconfirm power has been disconnected using a multimeter.

- a. Remove PCB unit, refer to section 2-a.

- b. Remove the heat exchanger water connection lines, refer to section 3-a.
- c. Remove the three (3) Phillip screws securing the gas manifold assembly to the gas control valve.
- d. Remove the six (6) Phillip screws that secure the heat exchanger assembly in place.
- e. Disconnect connectors B1, B5, B6, C1, C3, F1 and F8. These are the igniter, flame rod, thermo-fuse, hot water inlet and outlet thermistor, and the anti-freeze heater connections.



- f. Pull the heat exchanger out of the heater.
- g. Transfer all components found on the old heat exchanger over to the new exchanger.



IGE - 11. Removal of Thermal Fuse:



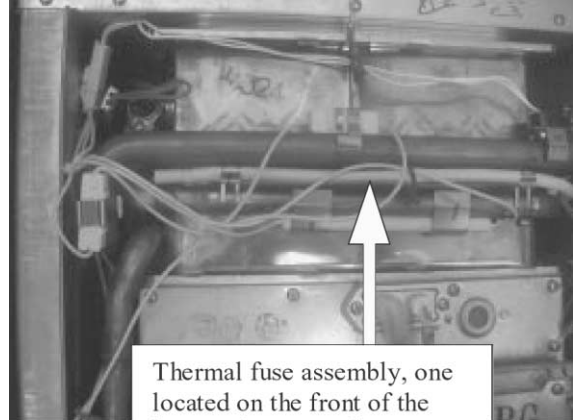
CAUTION

120 volt potential exposure. Isolate the appliance and reconfirm power has been disconnected using a multimeter.

This process may involve removing the heat exchanger if the thermo-fuse on the rear of the heat exchanger is blown.

(Service Procedure IGE-10, page 50)

- a. The unit has four thermal fuses, see picture below for location.
- b. Disconnect and remove the thermal fuse. Re-install new thermo fuse using the existing thermo fuse clips. Reconfirm inlet and manifold gas pressures are set to the proper setting. Ensure unit matches gas type being supplied to the heater.



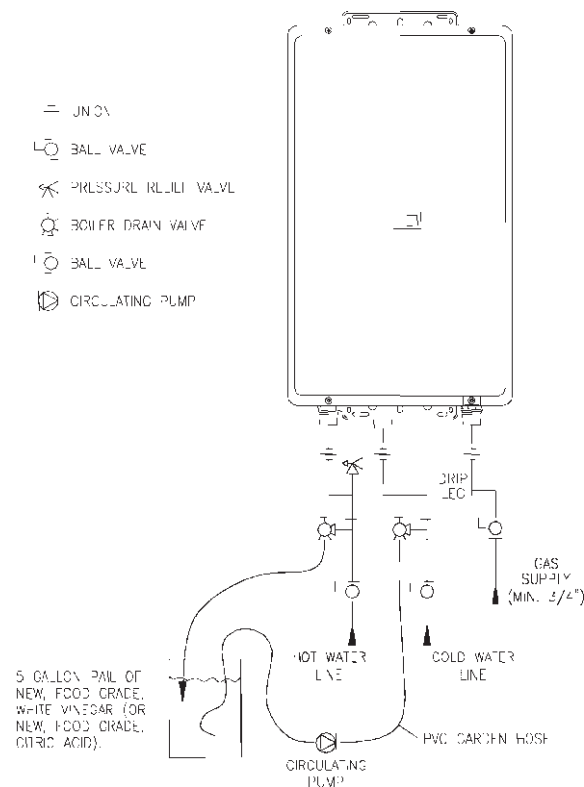
Thermal fuse assembly, one located on the front of the heat exchanger and one on the rear of this assembly.

IX - FLUSHING PROCEDURE FOR LIME SCALE REMOVAL FROM HEAT EXCHANGER

The amount of calcium carbonate (lime) released from water is in direct proportion to water temperature and usage. The higher the water temperature or water usage and the harder the water (more dissolved calcium carbonate), the more lime deposits are dropped out of the water. This is the lime scale that forms in pipes, water heaters and on cooking utensils.

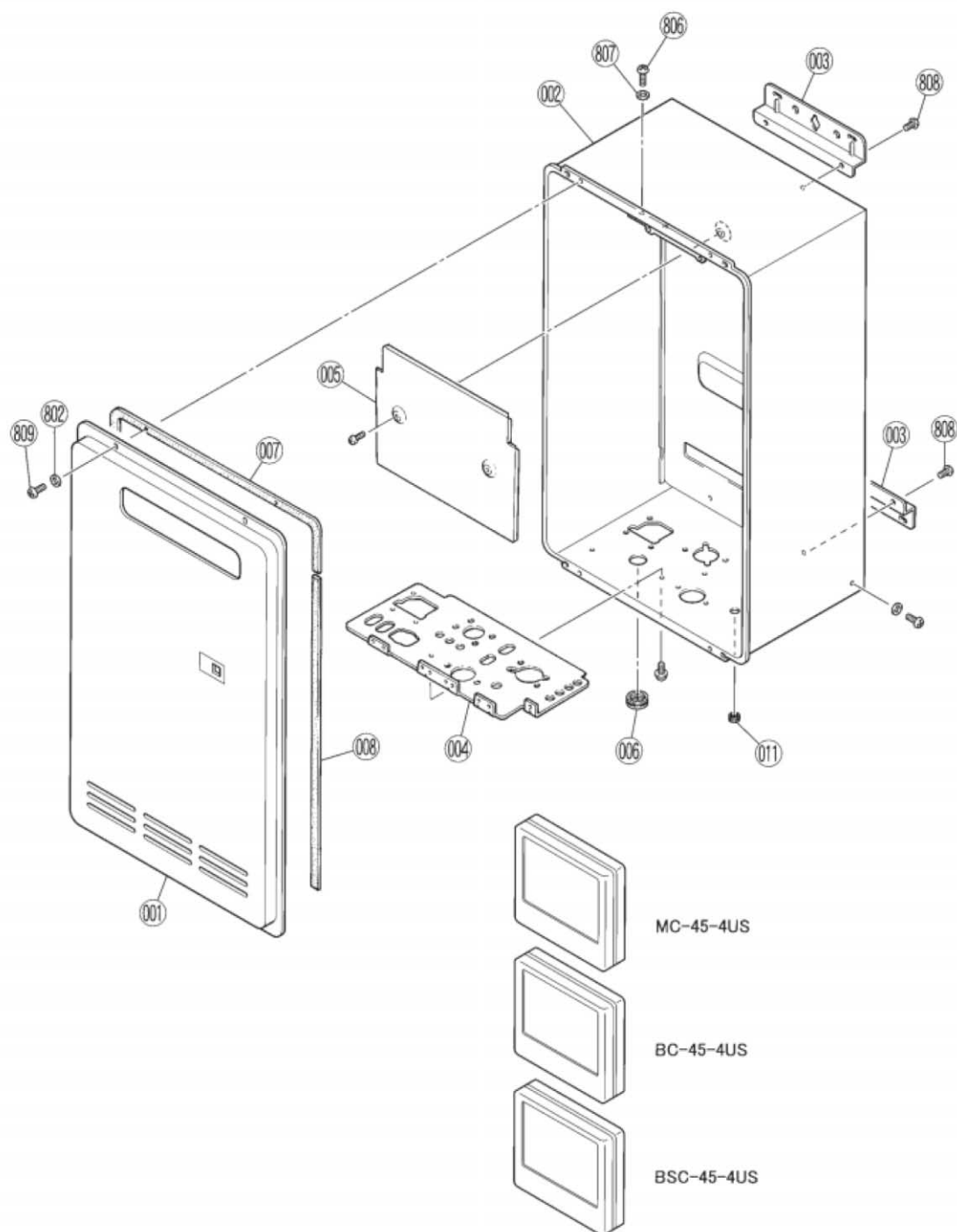
Lime accumulation reduces the efficiency and longevity of the heat exchanger coil and will cause the water heater to malfunction. The lime scale may need to be periodically removed from the heat exchanger (indicated by the "LC" code on the remote display). The usage of water softening equipment greatly reduces the hardness of the water. However, this equipment does not always remove all of the hardness (lime). The heat exchanger may occasionally need to be flushed to clear out the lime deposits. Use the following procedure and diagram to flush the heat exchanger and remove the lime scale.

1. Disconnect power to the water heater.
2. Close valves in the cold water inlet and outlet supply.
3. Connect PVC hoses (may use garden hose to the drain valve outlet fittings). Connect a circulator pump to the hose connected to the cold water inlet. See figure 11 for hose and circulator connections.
4. Pour 4 gallons of fresh vinegar into a 5 gallon bucket.
5. Place the ends of the hose into the bucket.
6. Open the drain valves to the hose fittings.
7. Turn on power to the circulating pump and allow the vinegar to circulate through the heat exchanger coil for at least 45 minutes. Heavily limed heat exchangers may require several hours.
8. Turn off power to the circulating pump.
9. Run hose from hot water outlet to a drain.
10. Close the drain valve on the cold water inlet. Leave hot water drain valve open. Open cold water inlet to flush with fresh water.
11. Allow water to flow out of the hose for 5 minutes to flush vinegar from the water heater.
12. Shut off cold water inlet valve. Remove filter screen and clean out any sediment. Reinstall.
13. Close the hot water drain valve. Open the cold water inlet and hot water supply valves.
14. Disconnect the hoses from the drain valve connections.
15. Restore power to the water heater and check operation.



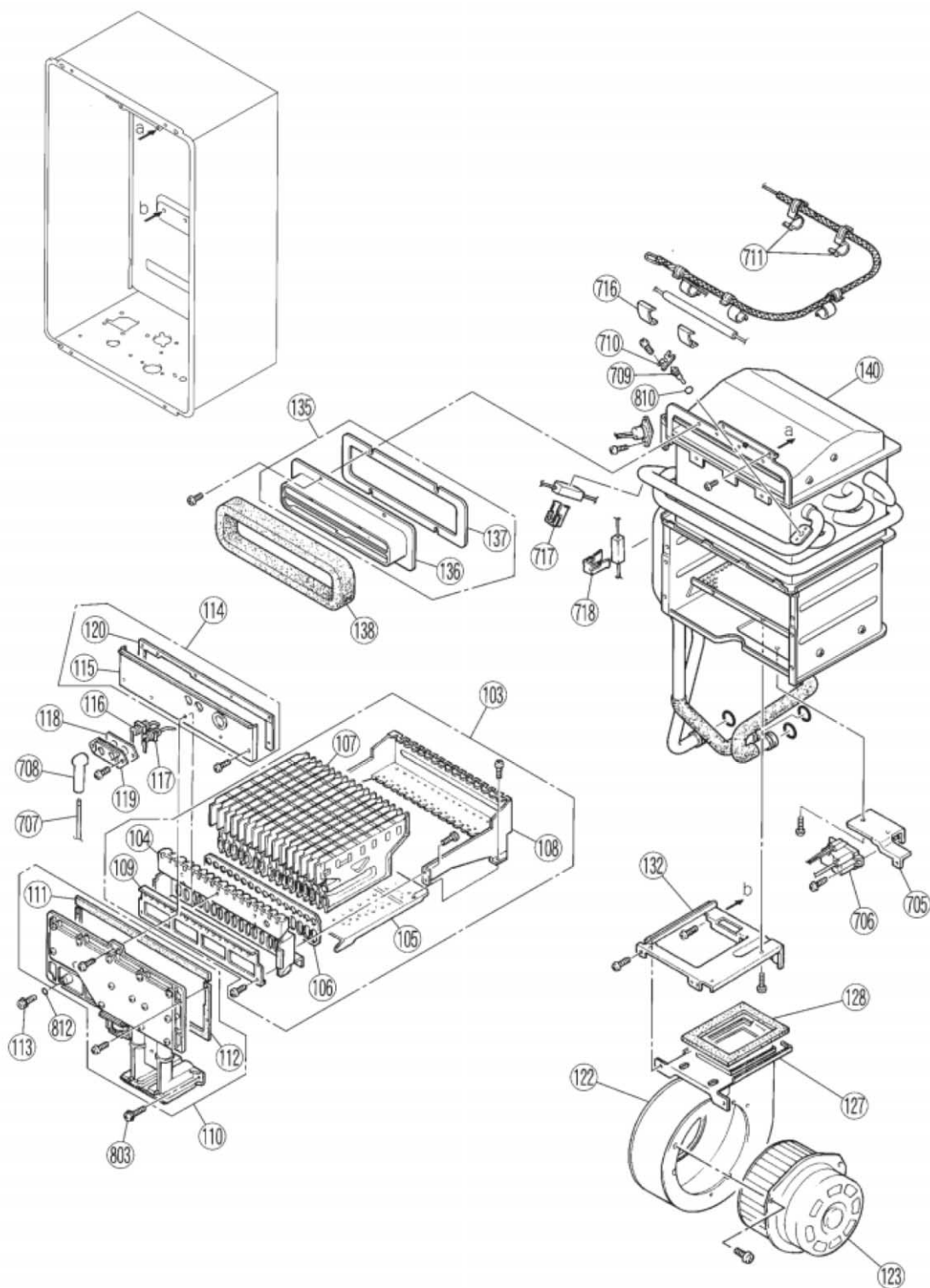
X - PARTS BREAKDOWN

DISASSEMBLED VIEW - CABINET



X - PARTS BREAKDOWN

DISASSEMBLED VIEW - INTERNALS

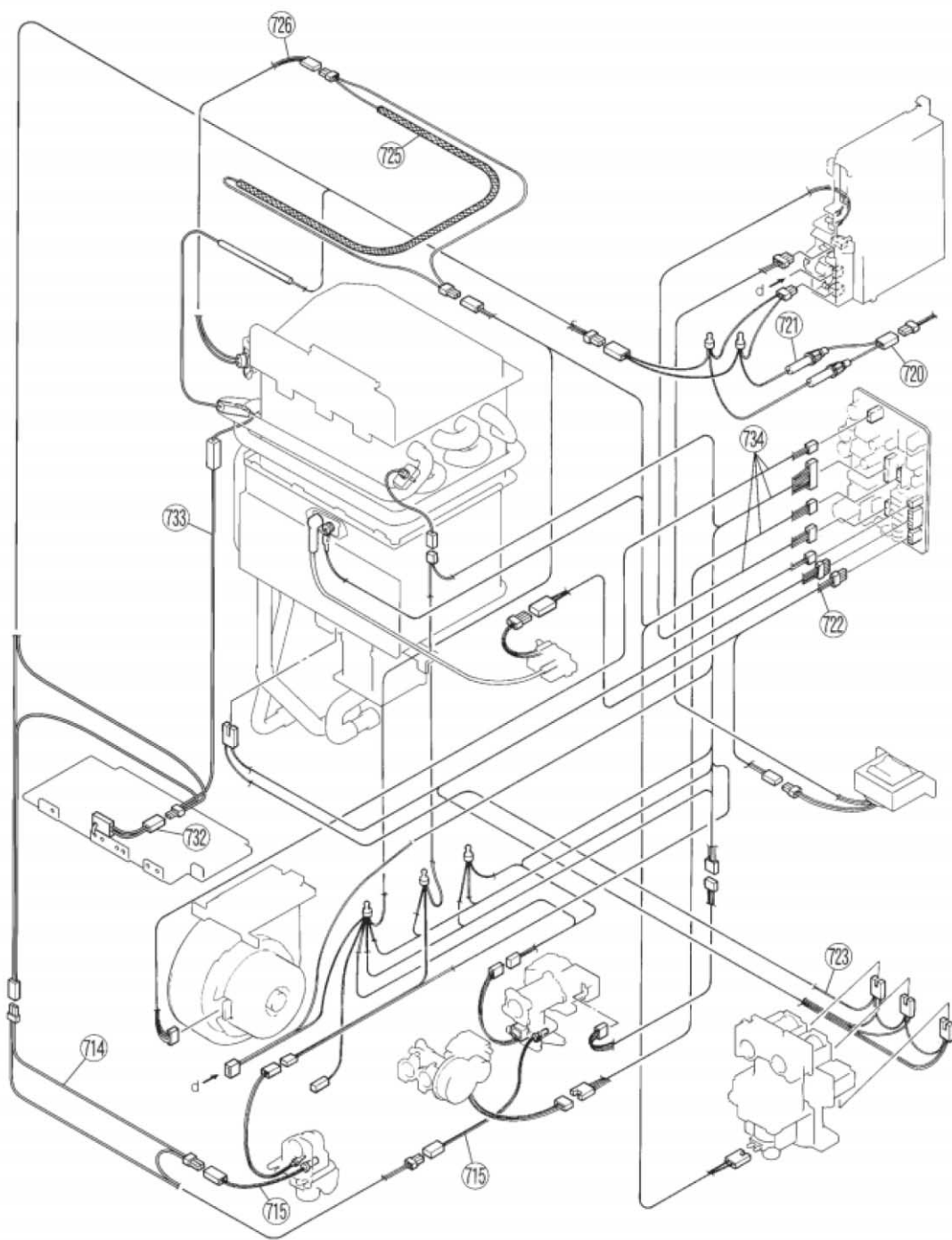


DISASSEMBLED VIEW - INTERNALS



X - PARTS BREAKDOWN

DISASSEMBLED VIEW - ELECTRICAL



PARTS LIST

Number	Description	Quantity
001	Front Panel Assembly	1
002	Casing Assembly	1
003	Wall Installation Bracket	1
004	Connection Reinforcement Panel	1
005	Heat Protection Plate	1
006	Rubber Bushing	1
007	Front Panel Gasket	1
008	Front Panel Gasket - Side	1
009	Front Air Inlet Grill	1
011	Rubber Bushing	1
102	Gas Connection (3/4" NPT)	1
103	Burner Unit Assembly	1
104	Burner Case Front	1
105	Burner Case Bottom Panel	1
106	Burner Air Orifice Plate	1
107	Bunsen Burners	16
108	Burner Case Back Panel	1
109	Damper Plate	1
110	Manifold Assembly – Natural Gas	1
110	Manifold Assembly – L.P. Gas	1
111	Gasket – Combustion Chamber	1
112	Lower Gasket – Combustion Chamber	1
113	Combustion Chamber Pressure Tap Screw	1
115	Combustion Chamber Front Plate	1
116	Spark Ignition Electrode	1
117	Flame Sense Rod	1
118	Electrode Gasket	1
119	Electrode Holder	1
120	Upper Combustion Chamber Gasket	1
122	Combustion Blower Assembly	1
123	Blower Motor	1
127	Blower Mounting Bracket	1
128	Blower Gasket	1
132	Combustion Chamber Bracket	1
136	Flue Outlet	1
137	Flue Outlet Gasket	1
138	Flue Outlet Gasket - 6	1
140	Heat Exchanger – Complete Assembly	1
400	Water Inlet – _" NPT	1
401	Water Flow Servo and Sensor Assembly	1
402	Rectifier	1
403	By-pass Servo Assembly	1
404	Stop Bracket	2
405	Plug Band	1
406	Water Filter Assembly	1
407	Filter Plug	1
408	Hot Water Outlet – _" NPT	1
409	Stop Bracket	1
410	Plug Band - Small	1
411	Drain Valve	1
702	PCB Cover - Side	1
703	PCB Cover - Front	1
704	Transformer Assembly	1
705	Ignitor Bracket	1
706	Ignitor	1
707	High Tension Lead	1
708	Spark Electrode Boot	1
709	Thermistor	2
710	Thermistor Clip - Large	1
711	Thermal Fuse Clip	5

715	120v Valve Heater Assembly	1
716	Anti-Frost Heater Clip	2
717	Anti-Frost Heater Clip A	1
718	Anti-Frost Heater Clip	1
720	Power Supply Harness	1
721	Fuse Harness	1
722	100v Harness	1
723	Solenoid Valve Harness	1
725	Thermal Fuse Harness	1
726	Mold-type Limit Switch	1
730	PCB Assembly	1
731	Surge Protector	1
732	Frost Sensing Switch	1
733	120V Anti-Frost Heater Assembly	1
734	Sensor Harness - 2	1
800	Screw	8
801	Screw	4
802	Washer	4
803	Screw	3
804	Screw	1
805	Screw	3
806	Screw	4
807	Washer	4
808	Screw	4
809	Screw	4
810	O-Ring	3
813	O-Ring	2
814	O-Ring	2
815	O-Ring	2
817	O-Ring	1
818	Gasket	2
238-44959-00	Installation and Operating Instructions	1
239-44509-00	Main Remote Temperature Control - Residential	1
239-44510-00	Main Remote Temperature Control - Commercial	1
239-44507-00	Bathroom Remote Temperature Control	1
239-44508-00	2nd Bathroom Remote Temperature Control	1

Notes

[illegible]



Ambler, PA

For U.S. and Canada field service,
contact your professional installer or
local Bradford White sales representative.

Sales/800-523-2931
Fax/215-641-1670

Technical Support/800-334-3393
Fax/269-795-1089

Warranty/800-531-2111
Fax/269-795-1089

International:
Telephone/215-641-9400
Telefax/215-641-9750

Fax on Demand:
888-538-7833



Sales/866-690-0961
905-238-0100

Fax/905-238-0105

Technical Support/800-334-3393

Email

parts@bradfordwhite.com
techserv@bradfordwhite.com

www.bradfordwhite.com
www.bradfordwhitecanada.com