Rinnai N-Series

Level III Service Presentation

Version 01032018GW

Enhancing Lives By Changing The Way Water Is Heated

Product Changes

a. Primary Heat Exchanger:

- Why Stainless Steel? The Next Generation unit adopted a zero governor gas valve system which has a high TDR (turn down ratio). With this system, the entire burner is operational. This can lead to high levels of condense, even at low input. Therefore; a stainless steel heat exchanger with corrosion resistance is necessary, as a copper heat exchanger could become clogged by corrosion.

b. Burner:

- Why use stainless steel mesh? To eliminate resonance noise in the event the burner is compromised or the flame becomes uneven. The stainless steel mesh is resistant to the generation of the combustion noise.

c. Safety Circuit:

- Why were the thermo-fuses eliminated? When using a stainless steel heat exchanger it eliminates the possibility of a hole being created due to corrosion. Even if cracks are generated due to stress, those will not proceed to the point where enough heat will escape causing overheating of other components within the appliance. Therefore; no need to use thermal fuses.

Product Changes

d. Dip Switches:

- Why eliminate dip switches? Dip switches are very small creating a possibility of mistakes when selecting a switch. For this reason, Rinnai decided to move to the parameter settings method. This procedure allows you to confirm your settings with the controller's display.

e. Gas Valve:

- Why use a zero governor gas valve? Rinnai switched to this valve system in order to satisfy the PVC 2" air/exhaust venting requirement. The current proportional gas valve would not provide the air-fuel ratio with respect to the air quantity to accomplish this task.

- This system eliminates having to set operational gas pressures.

- Maintain good combustion under blocked flue conditions and low gas pressure.

- Will dramatically reduce code 11.

Product Changes

f. Water Flow Servo:

- Why was the WFSV relocated? Because the surface temperature of the heat exchanger tubes is higher than with copper. Therefore; local heat is likely to occur at high load /low water pressure. In order to keep the water pressure inside heat exchanger as high as possible, the WFSV was relocated.

g. Pressure relief valve:

- Why was the pressure relief valve moved? When the WFSV was relocated there was a possibility pressure inside the heat exchanger could rise when the WFSV closes. Therefore; it was necessary to install a pressure relief valve on the upstream side of the water flow servo valve.

h. Flow Control Turbine:

- Located in by-pass valve – easy to remove from inside unit's cabinet.

i. Stainless Steel Clips throughout unit:

- Eliminated screws – use clips for easier/faster parts removal

Product Changes

j. Conversion Process:
- Simplified – Remove three screws on gas valve, change gas orifice and reset gas type parameter. 8 kits available, each with venturi and water heater rating plate.

k. Inlet Air Filter:
- Filtered inlet air to reduce product and burner maintenance

l. Maximum Flow Rate:
- Allows for higher flow rates in warm ground water areas

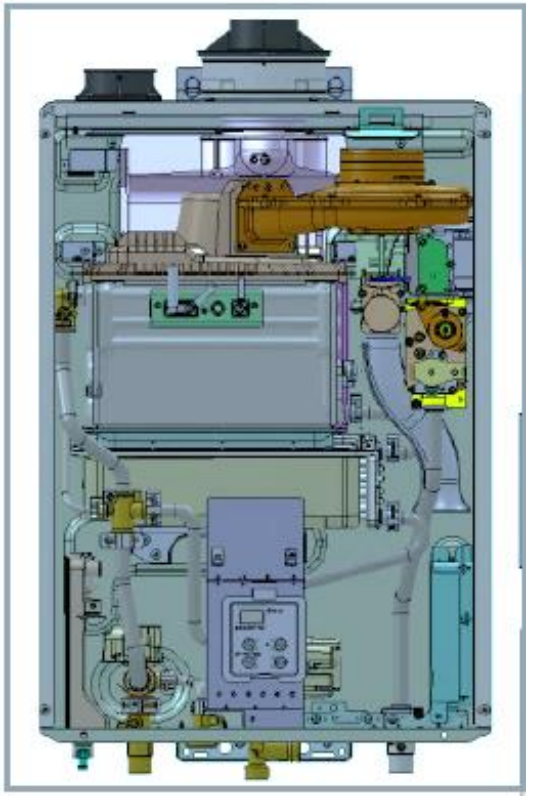
m. Condense Drain Code Eliminated:
- A blocked condense drain will post code 10, same as flue block. Always check the condense drain first before proceeding with troubleshooting the vent system.

n. Service Soon (55):
- This function replaces the LC function. It allows you to select a service schedule. Factory setting is in the DISABLE position. Set to your selection at parameter 03.

Parameter 03b = 6 months
Parameter 03c = 1 yr.
Parameter 03d = 2 yrs.

N - Series Water Heaters

External Model



Internal Model

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Residential Models

Model Designation	Full Model Number	Min Btu's	Max Btu's	Min Activation Flow Rate (approx.)	Max Flow Rate 30° Rise	Max Flow Rate 50° Rise	Max Flow Rate 70^0 Rise	Uniform Energy Factor (UEF)
RU130i	REU-N2025FF-US	15K	130K	0.4 GPM	6.6 GPM	5.0 GPM	3.5 GPM	.91
RU130e	REU-N2025W-US							.92
RU160i	REU-N2530FF-US	15K	160K	0.4 GPM	8.0 GPM	6.1 GPM	4.4 GPM	.92
RU160e	REU-N2530W-US							
RU180i	REU-N2934FF-US	15K	180K	0.4 GPM	9.0 GPM	6.9 GPM	4.9 GPM	.92
RU180e	REU-N2934W-US							
RU199i	REU-N3237FF-US	15K	199K	0.4 GPM	9.8 GPM	7.7 GPM	5.5 GPM	.93
RU199e	REU-N3237W-US							.92
*RUR160i	REU-NP2530FF-US	15K	160K	0.4 GPM	8.0 GPM	6.1 GPM	4.4 GPM	.92
*RUR160e	REU-NP2530W-US							
*RUR199i	REU-NP3237FF-US	15K	199K	0.4 GPM	9.8 GPM	7.7 GPM	5.5 GPM	.93
*RUR199e	REU-NP3237W-US							.92

*RUR residential models include an integrated circulation pump and a thermal bypass valve. The MC-195 or the Control R system must be used (purchased separately) in order for the circulation pump to operate.

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Commercial Models

Model Designation	Full Model Number	Min Btu's	Max Btu's	Min Activation Flow Rate (approx.)	Max Flow Rate 30° Rise	Max Flow Rate 50° Rise	Max Flow Rate 70^0 Rise	Uniform Energy Factor (UEF)
CU160i	REU-N2025FF-US	15K	160K	0.4 GPM	8.0 GPM	6.1 GPM	4.4 GPM	96% thermal Efficiency
CU160e	REU-N2025W-US							
CU199i	REU-N2530FF-US	15K	199K	0.4 GPM	9.8 GPM	7.7 GPM	5.5 GPM	96% thermal Efficiency
CU199e	REU-N2530W-US							

CU models are for commercial applications ONLY.

Important Information

Installation - MUST be performed by a licensed contractor.

Gas System - MUST be properly sized for gas load at location. Refer to the International Plumbing Code Book or Applicable State or Local Code for proper sizing guidelines based on total gas load at site.

Vent System - MUST use one of Rinnai's listed and tested vent systems.

Electrical System - MUST be properly sized for load at location. Refer to the National Electrical Code for details. Each unit requires 120 Volts AC, 4 amp grounded circuit.

Water System – MUST be properly sized for total water flow at location. Refer to the International Plumbing Code or Applicable State or Local Code for details. Each unit has a ¾" feed line to the appliance. .

Circulation System – MUST be properly sized. Refer to pressure drop chart in owner's manual for each unit. Pressure drop in plumbing system MUST be taken into account. If you have questions contact Rinnai engineering before installation.

Rinnai Support Centers (800)621-9419

CRC – Consumer Response Center – Front line calls and questions.
Available in office from 8 a.m. to 8 p.m. EST**,** Monday - Friday

Parts Department
Process orders Monday – Friday from 8 a.m. to 8 p.m. EST
Ship from 8:00 a.m. to 6:30 p.m. EST
Online ordering – Rinnai Parts Store 24/7

Warranty Department
Available in office from 8 a.m. to 5 p.m. EST, Monday- Friday

Technical Support Department – Technical calls
Available in office from 8 a.m. to 8 p.m. EST, Monday – Friday.
Available **24/7/365** at (888)746-6247)
E-mail @ support-tech@rinnai.us

Engineering / Applications Department – Application sizing calls
Available in office from 8 a.m. to 5 p.m. EST.

Enhancing Lives By Changing The Way Water Is Heated

General

Before Performing Service:

- Disconnect power source
- Shut off gas supply
- Shut off water supply and drain system down.

1. All components in the Rinnai tankless water heaters are field replaceable.
2. All major replacement parts are accompanied with replacement procedures.
3. N-Series Parameter Settings – See Owner's Manual for complete details. Some parameter settings will required adjustments, especially those for higher set point temperatures on the controller and installations above 2,000 ft. in elevation.
4. Please refer to each model's data sheet and/or service documentation for specific model information.
5. Rinnai pays reasonable labor, normally one hour for most all parts, exceptions; some condensing units pay two to three hours labor for burner or heat exchanger replacement.

Primary Service Tools

For service, troubleshooting, and component replacement, the following tools are needed

#2 Phillips Head (magnetic)

and

Small Phillips Head

Screw Drivers

U-Tube Manometer

or

Digital

Multimeter (Volt/Ohm Meter)

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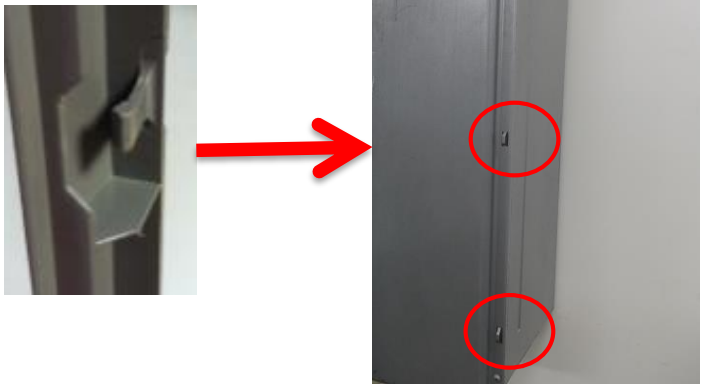
Front Panel Removal

To remove front cover press in on the plastic strip with your thumb at the red circles shown on the picture to the right.

Pull strip out away from the unit.

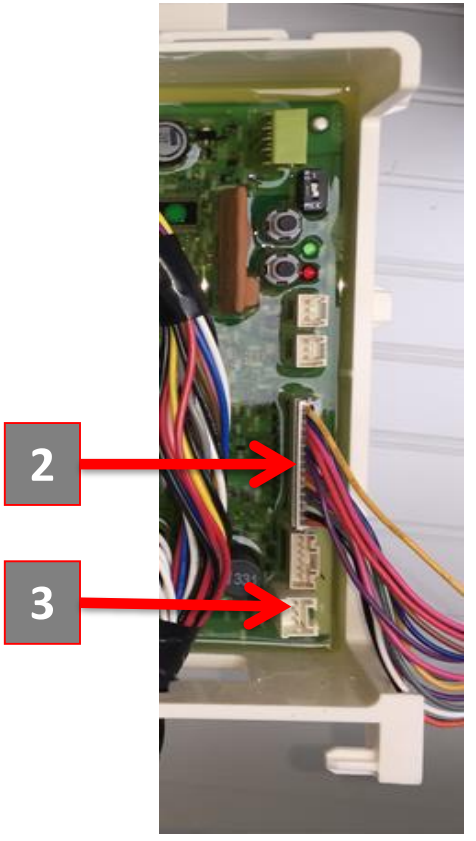
Under the plastic strip you will find four Phillips head screws securing the front cover, remove those and pull the front cover up and off the unit.

Clip on front panel plastic strips attach to. .



Controller Information

1. Remove screw shown below to pull controller from unit.
2. Unplug the 15 wire connector J on the P.C. board.
3. To add additional remote controllers use the wiring harness provided with each optional controller. Plug it into connector shown below on P.C. board.



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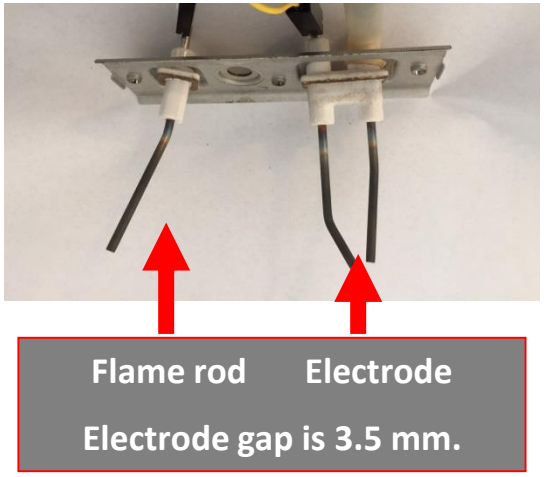
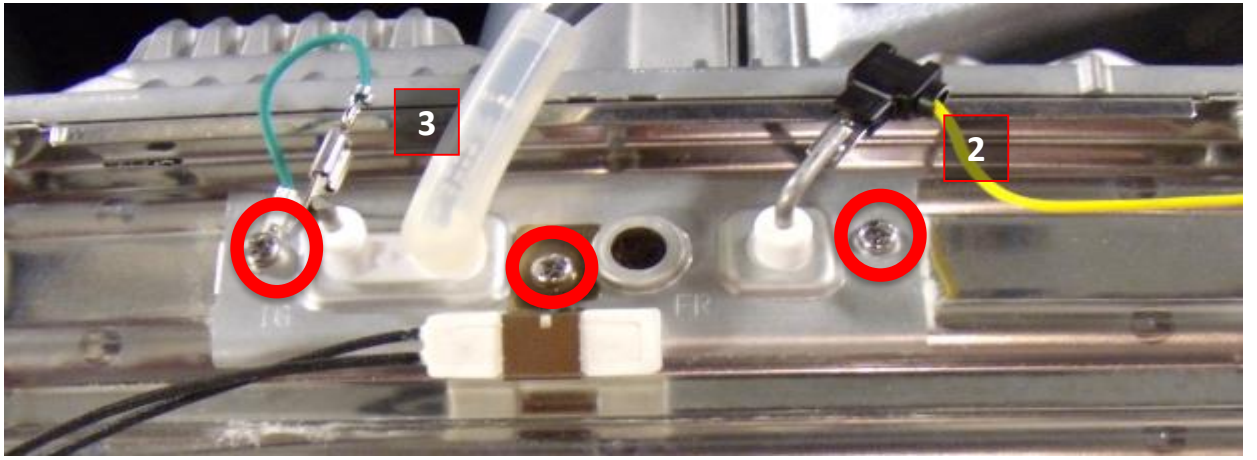
Flame Rod, Electrode & Sight Glass Plate Removal

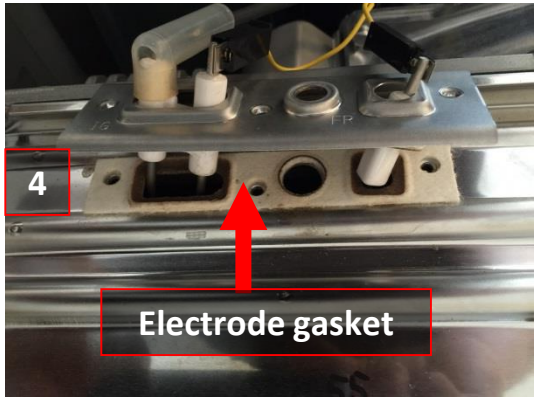
Flame Rod, Electrode and Sight Grass Removal

Ensure unit is isolated from power and gas supply.

1. Remove (3) screws shown with red circles.
2. Unplug yellow flame rod wire.
3. Unplug black electrode cable and green wire to casing.
4. Remove sight grass plate, flame rods and electrode from unit.
5. Before reassembly install new electrode gasket, never reuse.







The flame rod has a special coating. Cleaning the flame rod may remove this coating leading to code 12's.

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Heat Exchanger Thermistor Removal

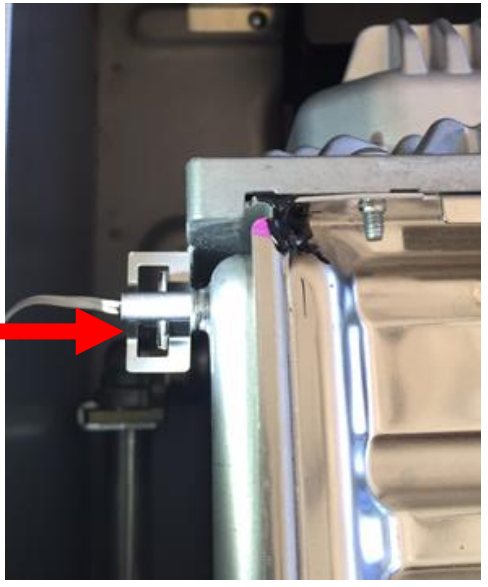
Heat Exchanger Thermistor Removal

Ensure unit is isolated from water, power and gas. Open a fixture to release any hot water or water pressure remaining in the system.

1. Remove the heat exchanger thermistor by pulling retainer clip off thermistor. Pull thermistor out of position. Ensure O-ring is intact and in good condition before reinstalling it. Make sure the retainer clip is installed in the proper orientation. After reinstalling the clip pull on the thermistor, (not the wire) to ensure it is held into position and cannot be pulled out of connection.
2. Follow the thermistor wires down about ten inches to a green electrical connection. Unplug that connector and pull the thermistor out of the unit.

1

Remove retainer clip



Thermistor location

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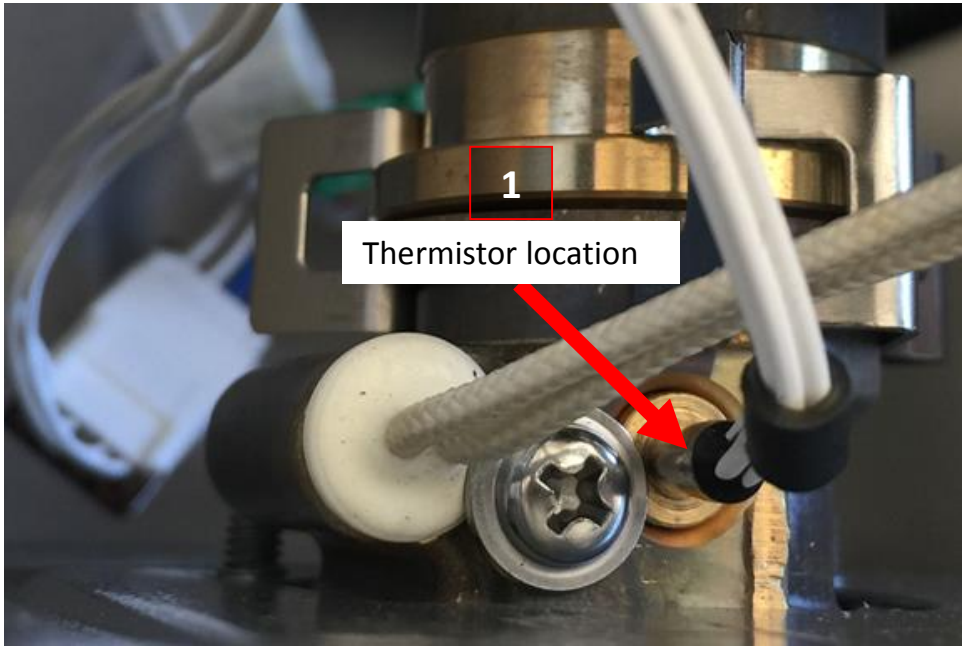
Outgoing Water Thermistor Removal

Outgoing Water Thermistor Removal

Ensure unit is isolated from water, power and gas. Open a fixture to release any hot water or water pressure remaining in the system

1. Remove the outgoing water temperature thermistor shown below with red arrow. Remove Phillips head screw and pull thermistor out of position, ensuring O-ring is intact and in good condition.
2. Follow thermistor wire back to electrical connector, unplug at that point and remove the thermistor from the unit.
3. Reinstall in reverse order.



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Bi-metal Over Heat Switch

Bi-metal Over Heat Switch

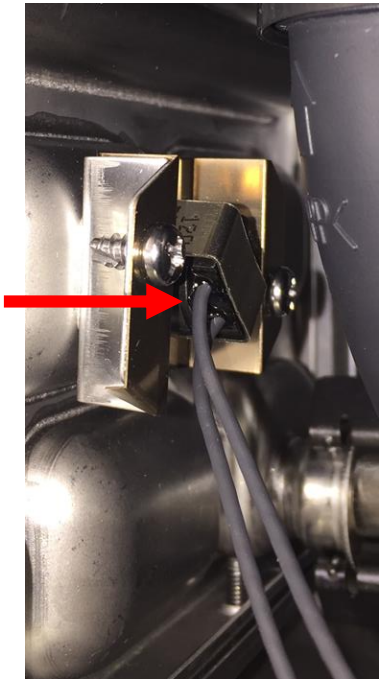
Ensure unit is isolated from power and gas supply.

The overheat bi-metal circuit activates based on the temperature range listed below. Bi-metal switch automatically reset once the temperature drops below the activation point.

1. Overheat switch - located on the right side of the primary heat exchanger. Activation temperature is 230˚F (110˚C), resets at 203 ˚F (95˚C).
2. If bi-metal activates code 14 will appear on water heater controller.

1

Bi-metal switch close-up



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Bi-metal switch located on right side of HEX

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Overheat Safety Protection

The Rinnai Safety "Line of Defense"
Multiple layers of technology ensure safe operation

Heat Exchanger bi-metal opens at 230°F and resets at 203°F.

The heat exchanger bi-metal will post a code 14 on the controller

If the outlet thermistor detects 9°F over the temperature set point…

The flame will turn off until the temperature decreases (no code is posted)

Code 54 will post on the controller, if the exhaust temperature thermistor detects 162 ˚F

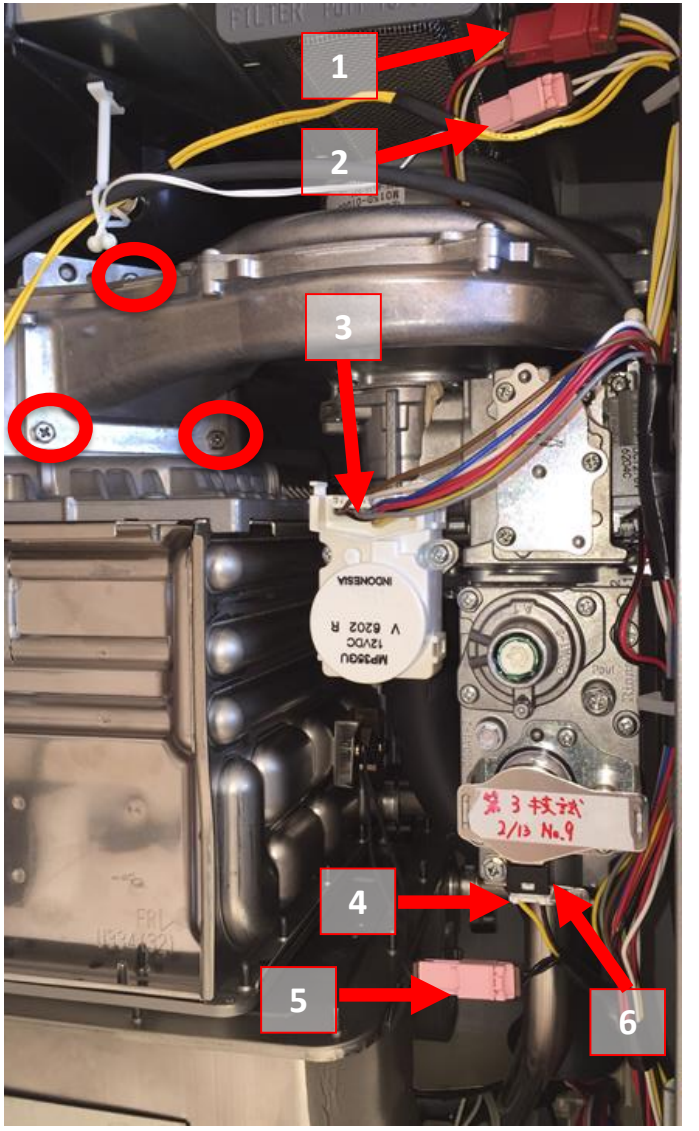
If the exhaust temperature thermistor breaks or shorts, code 38 will post on the controller

Gas Valve and Fan Motor Removal

Combustion Fan/Gas Valve Removal

Ensure unit is isolated from power and gas.

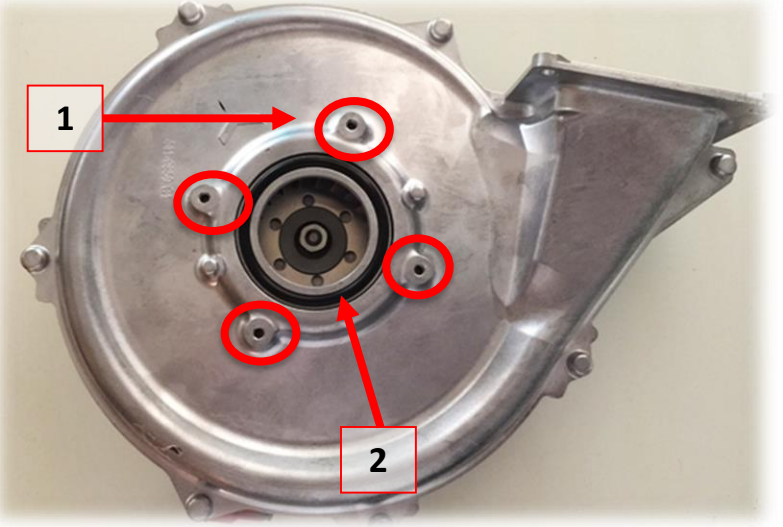
1. Unplug red fan motor connector.
2. Unplug pink exhaust temperature thermistor connector.
3. Unplug gas valve, 8 pin connector.
4. Unplug gas valve, 2 pin connector.
5. Unplug pink heat exchanger bi-metal switch connector.
6. Remove (1) retaining screw from gas line at gas valve.
7. Remove (3) fan housing screws shown in red circles.
8. Remove fan motor/gas valve assembly from unit.



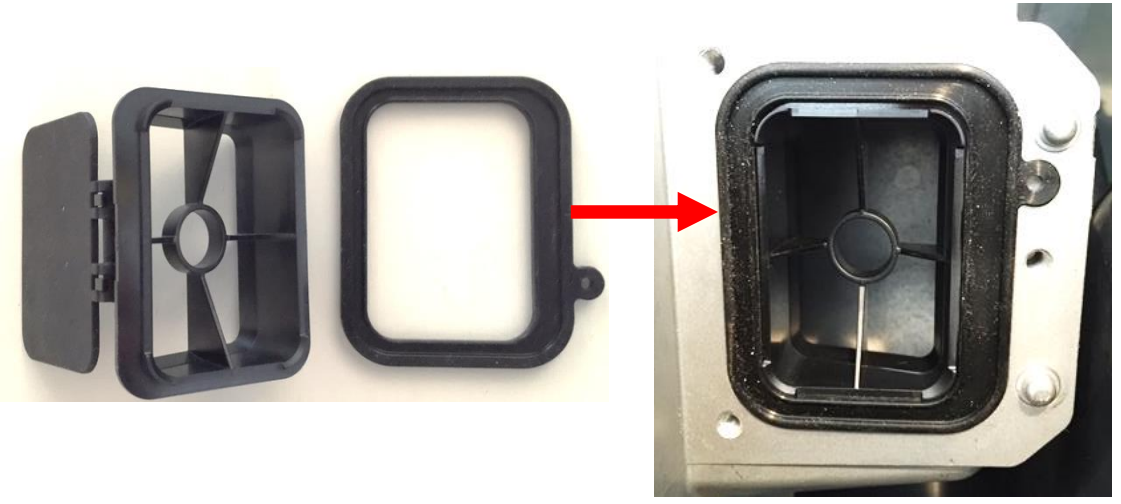
Combustion Fan/Gas Valve Removal

1. Remove fan motor assembly from gas valve, remove (4) screws from bottom of fan housing shown in red circles.

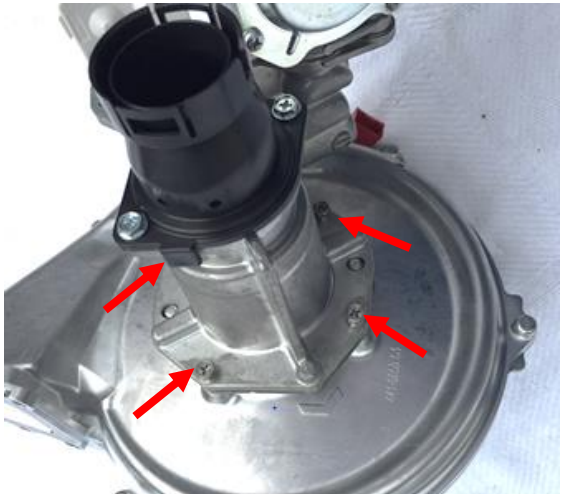
2. Replace O-ring between fan assembly and gas valve.



Fan/Exhaust check valve



Note: When power is applied to the unit the fan motor will cycle on for 10 seconds.



Screws shown in item 1 above

Heat Exchanger Assembly

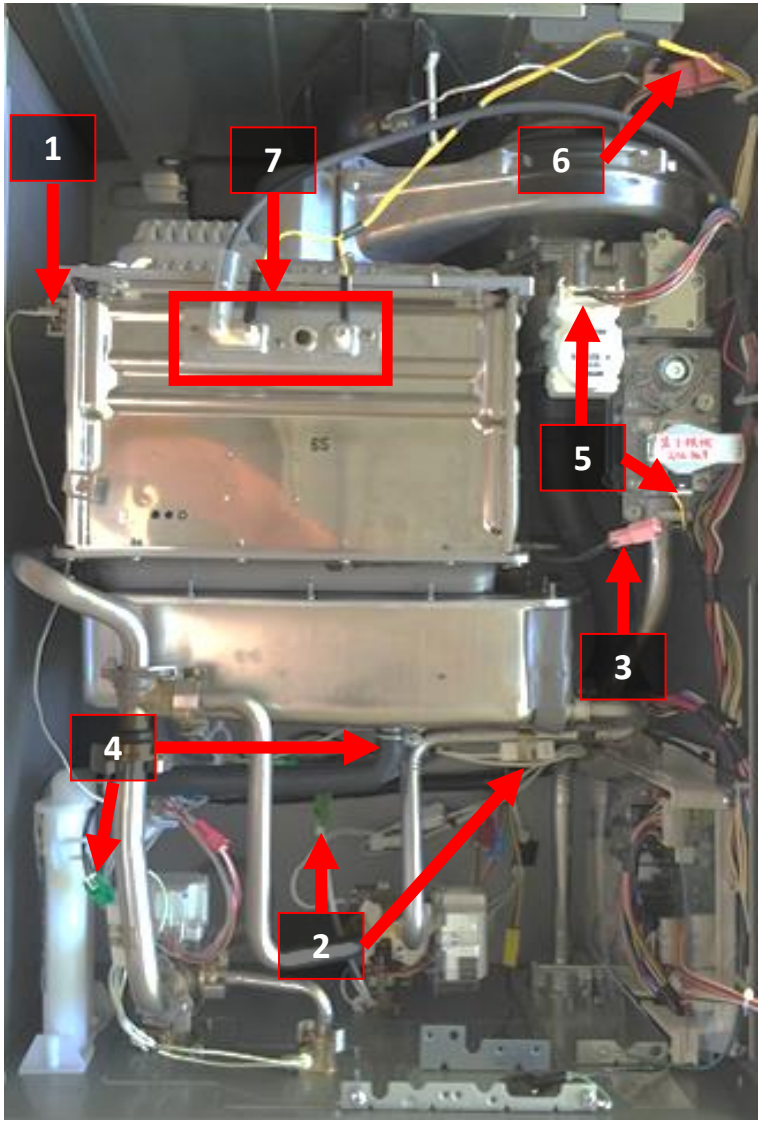
Which includes the air box, burner & Secondary Heat Exchanger

The Sensei Heat Exchanger is made of 444 Stainless Steel which is more corrosion-resistant than 430 SS,

Heat Exchanger Assembly Removal

Turn off power supply, water and gas to product. Then disconnect the following wiring harnesses to begin removing burner and heat exchanger assembly.

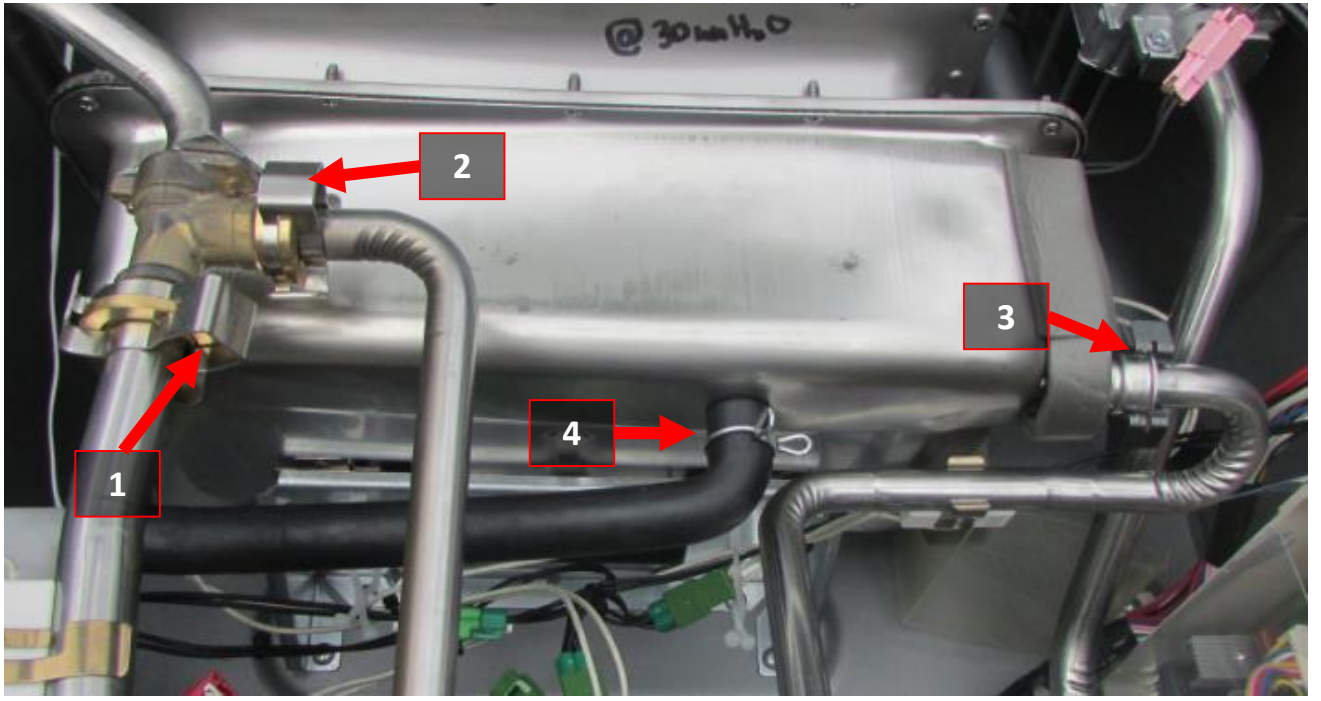
1. Unplug heat exchanger thermistor, follow wire down to green connector.
2. Unplug ceramic heater at green connector and unclip ceramic heater from secondary heat exchanger feed line.
3. Unplug bi-metal switch at pink connector.
4. Unplug condense trap ceramic heater at green connector, disconnect black rubber drain line from bottom of secondary heat exchanger.
5. Unplug zero governor gas valve connectors.
6. Unplug combustion motor connector.
7. Unplug electrode/flame rod connectors inside red square.



Heat Exchanger Assembly Removal

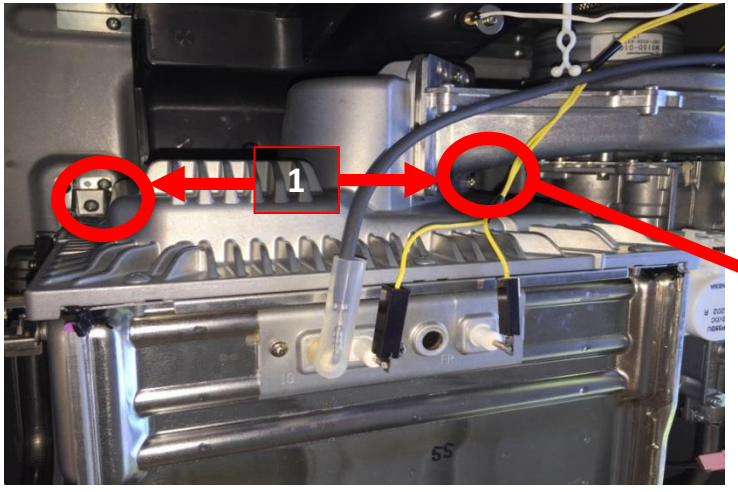
Next, ensure the water supply is turned off and pressure bled from system

1. Remove stainless steel clip stamped 18-28 on hot water outlet line. Pull line loose from fitting.
2. Remove stainless steel clip stamped 14-23 on bypass line. Pull line loose from fitting.
3. Remove stainless steel clip stamped 14-20 on inlet water line to secondary heat exchanger.
4. Removal condensate hose wire clamp and hose

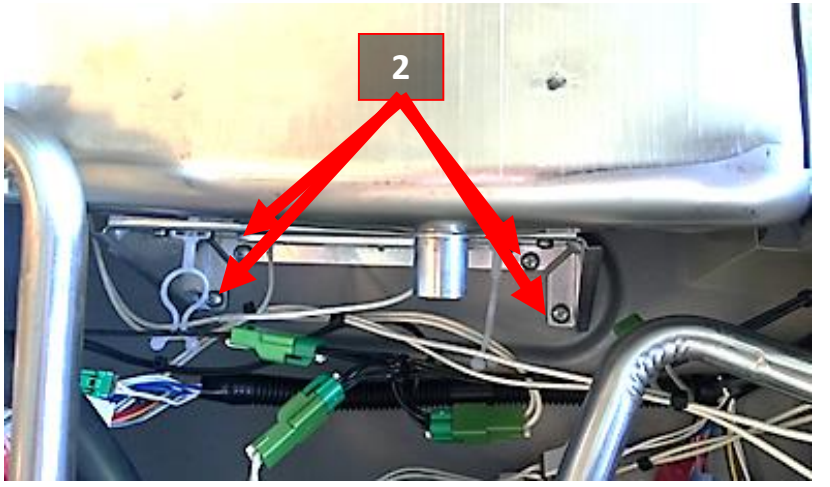


Heat Exchanger Assembly Removal

1. Remove (2) screw from the top right & left hand side of primary heat exchanger inside red circles.
2. Remove (4) screws from the secondary heat exchanger bracket.
3. Remove (1) screw from black plastic air box top center of water heater.
4. Lift bottom of secondary heat exchanger out towards you about two inches. Pull down on assembly to disengage it from the exhaust port. Pull assembly free from unit taking care not to damage any wiring harnesses.



Screws in step 1



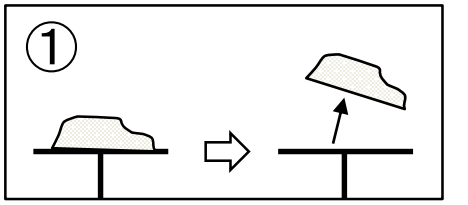
Instructions for Heat Exchanger Replacement

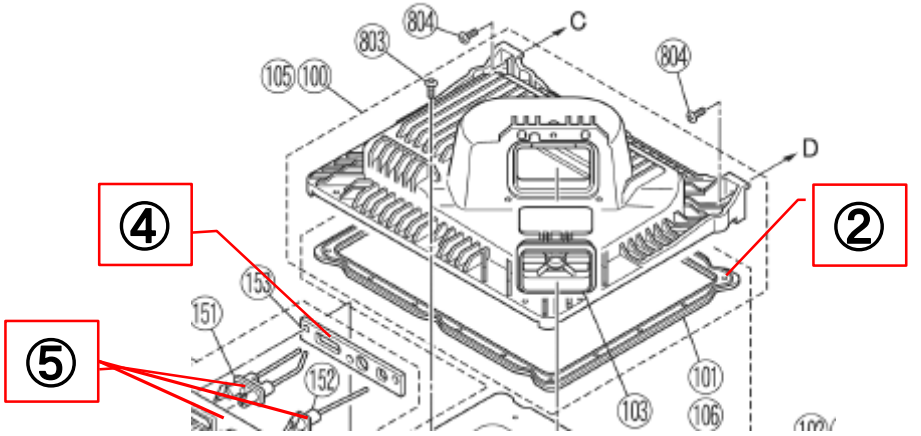
① Stainless heat exchanger flange face : Remove caulking material at the four corners of the heat exchanger. Make sure surface is clean/flat to maintain airtightness. Caulking material is not needed for replacement heat exchanger.

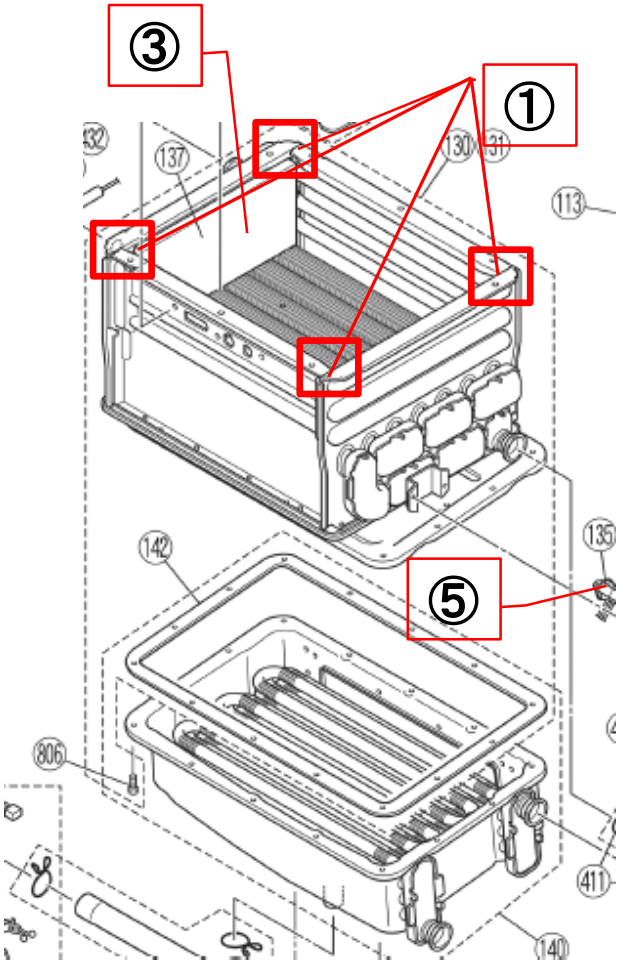
② Burner gasket : Replace burner gasket with a new one.

③ Thermal insulation : Insert new one at a predetermined position inside the heat exchanger.

④ Replace electrode gasket, electrode and flame rod when replacing the heat exchanger.







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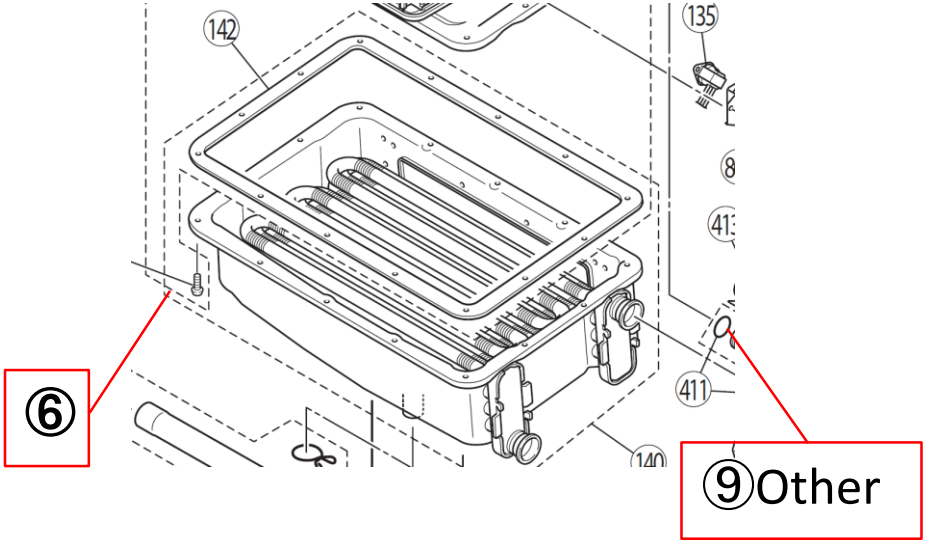
Instructions for Heat Exchanger Replacement

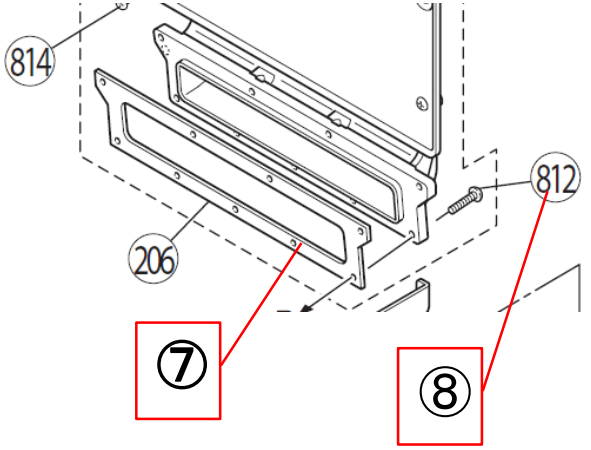
⑥ Replace secondary heat exchanger fixing screw:

⑦ Replace secondary heat exchanger gasket : Ensure surface is clean before installing new gasket.

⑧ Repace duct fixing screws (4) screws with white coating:

⑨ Replace O-rings in water circuit : Please compare the size of O-ring to old O-ring. Using the wrong size O-ring can lead to water leakage.





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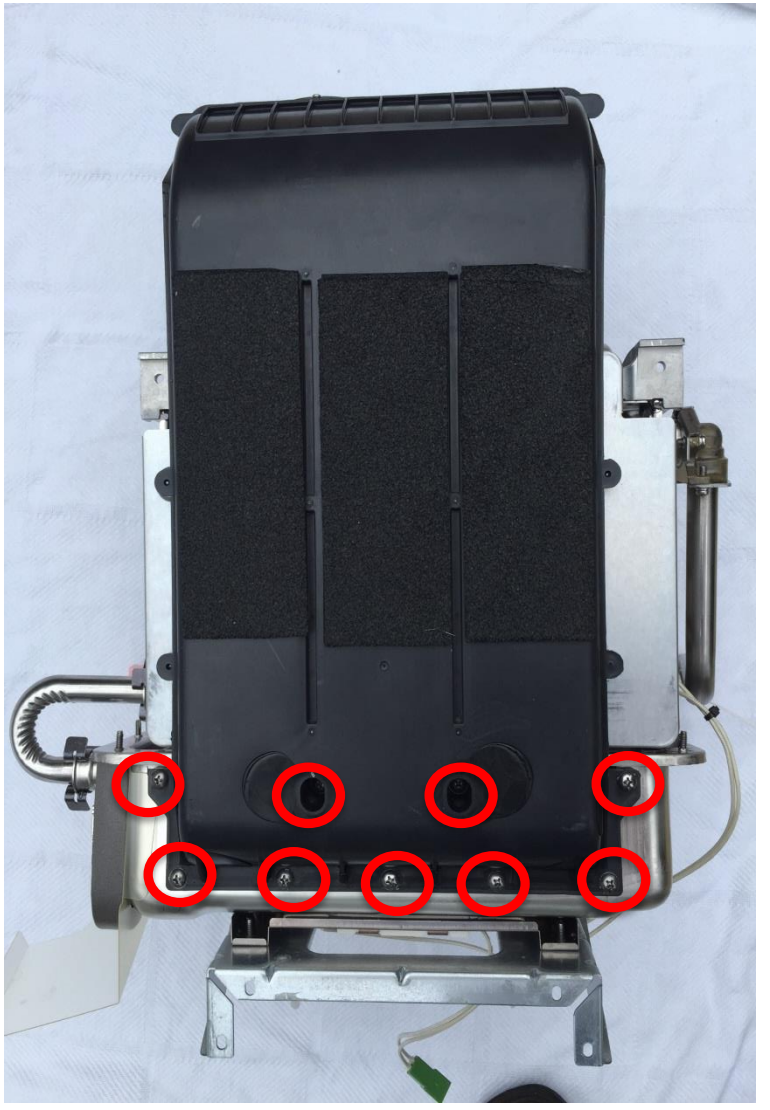
Air Box Removal

Air Box Removal

1. Remove the (9) screws shown in red circles and pull the air box away from primary/secondary heat exchangers.

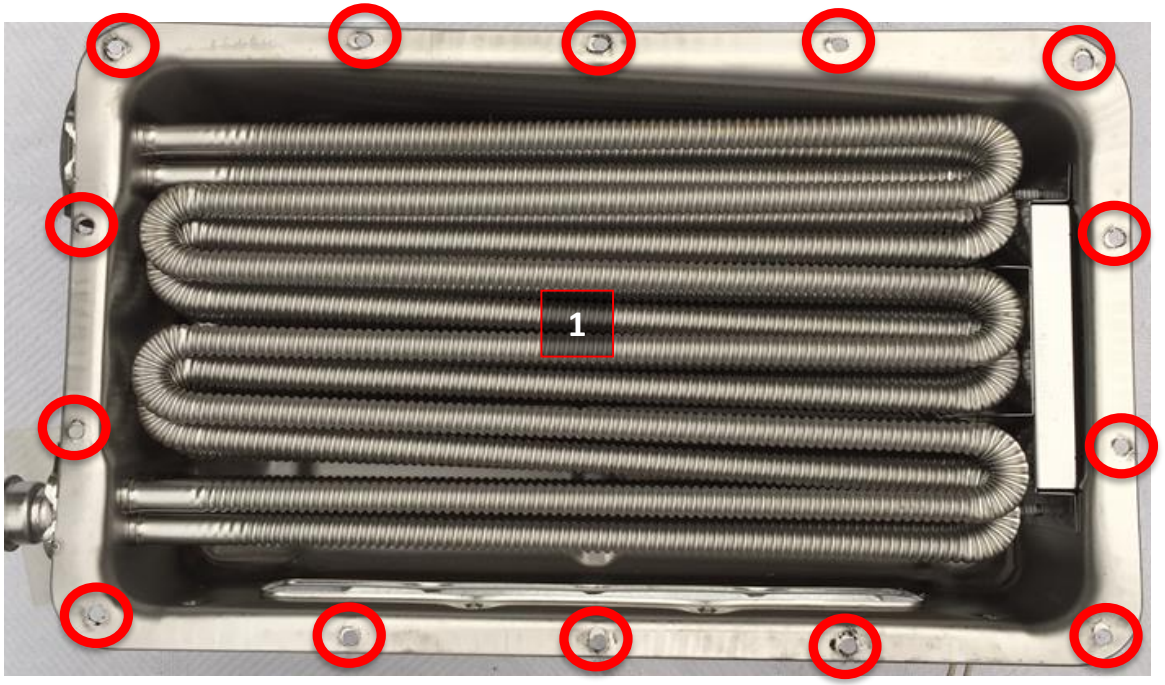


Primary & Secondary Heat Exchanger Disassembly

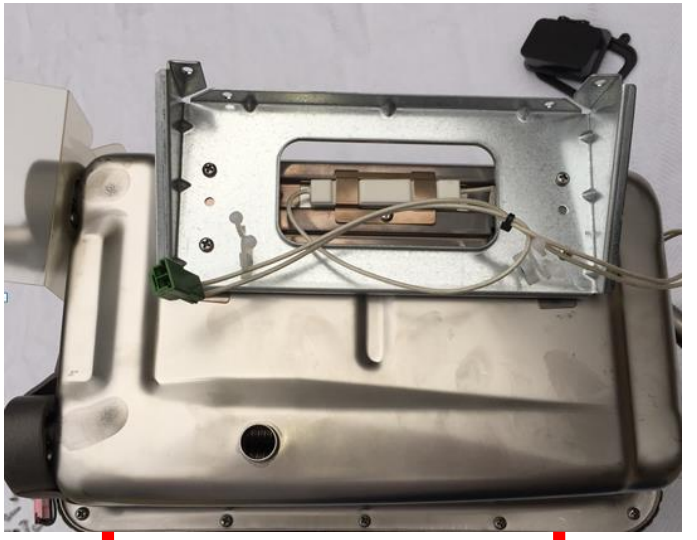
Primary/Secondary Heat Exchanger Disassembly

1. Remove (14) screws shown in red circles, separate secondary & primary heat exchangers, see example to right.

Top of Secondary Heat Exchanger surface



Bottom view of secondary heat exchanger



Primary HEX surface

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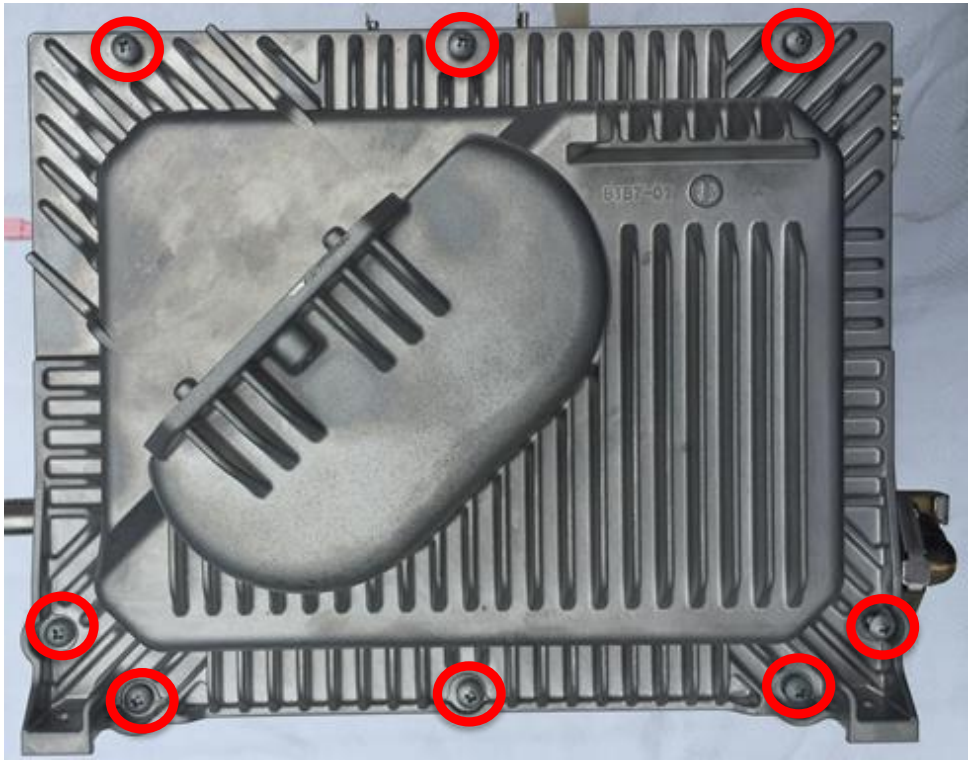
Burner Disassembly

Burner Disassembly

1. Remove (8) screws shown in red circles, pull burner plate and burner assembly from unit. The burner right bottom fits in inside the burner plate pictured at top. Burner gasket MUST be replaced before reassembly.

Burner plate



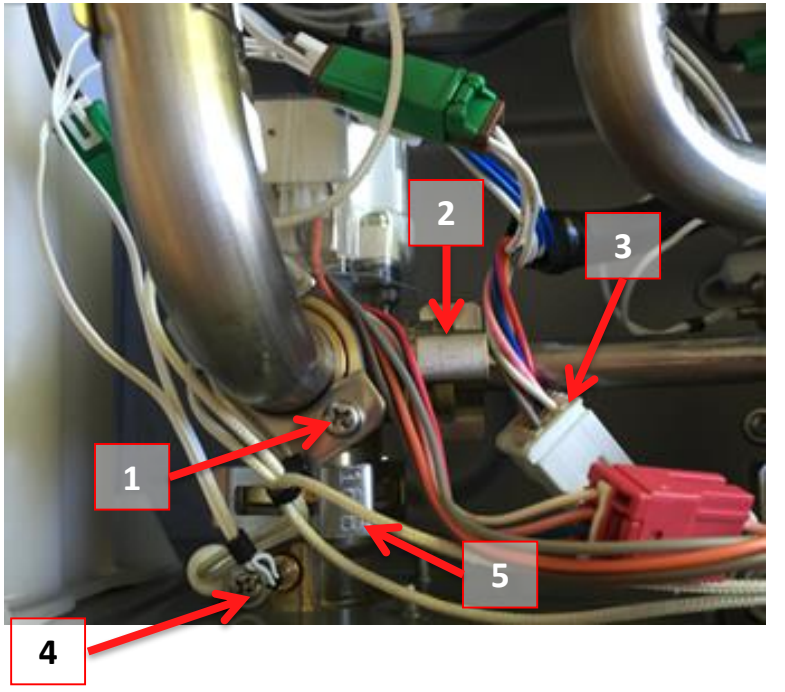
Burner Assembly

Water Flow Servo Valve Removal

Water Flow Servo (WFSV) Valve Removal

Ensure unit is isolated from water & power. Bleed water pressure from system.

1. Remove (1) screw from WFSV valve housing. Rotate retainer to release outlet water line. Pull copper line away from WFSV.
2. Remove stainless steel clip stamped 10-17 holding PRV line in place. Pull line loose from bypass valve.
3. Unplug WFSV control valve seven wire connector (white, pink, blue, red, grey, brown and orange wires).
4. Remove one screw holding ceramic anti-frost heater in place, pull heater element out of WFSV body.
5. Remove stainless steel clip stamped 16-B from bypass valve. Pull WFSV out of water heater.
6. Replace all O-rings before reassembling WFSV.



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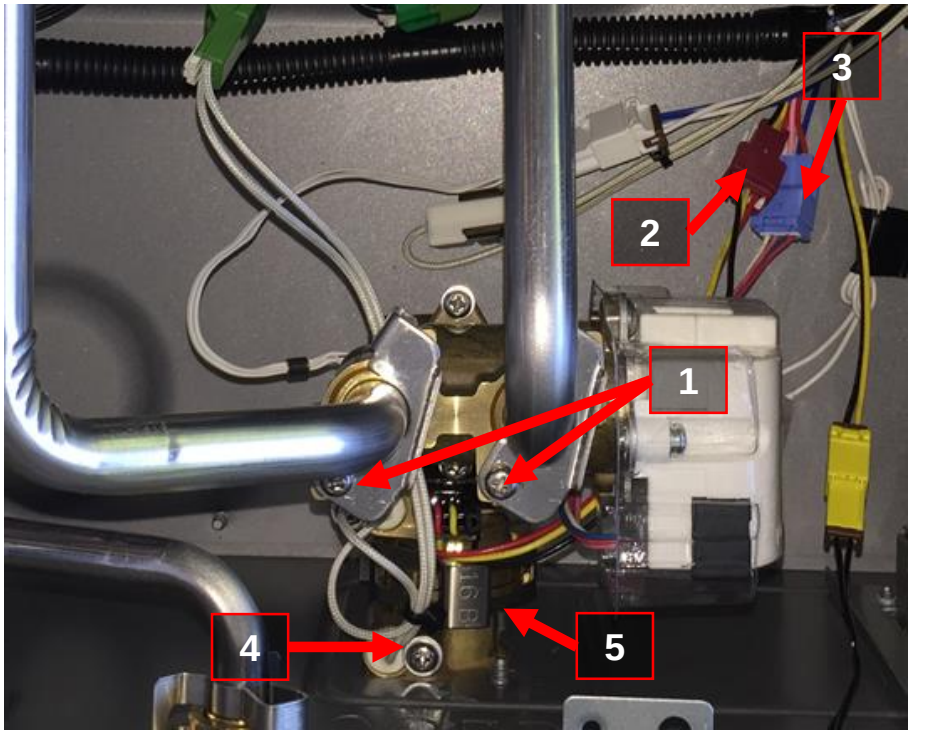
Bypass Valve & Flow Turbine Removal

Bypass Valve Assembly

Ensure unit is isolated from water & power. Bleed water pressure from system.

1. Remove (2) screws and retainers. Pull water lines loose from bypass valve assembly.
2. Unplug red three wire connector (black, yellow & red wires).
3. Unplug lite blue four wire connector (red, blue, pink & white wires).
4. Remove (1) screw holding ceramic heater in place. Pull ceramic heater from bypass valve body.
5. Remove stainless steel clip stamped 16-B from bypass valve. Pull complete bypass valve assembly from unit.
6. Replace all O-rings before reassembling.

Bypass Valve



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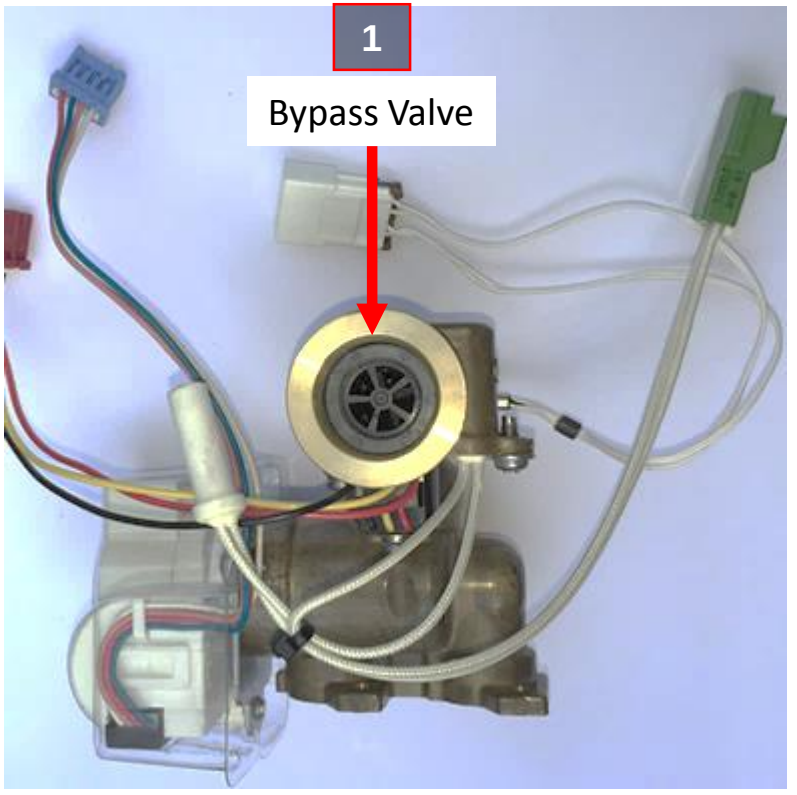
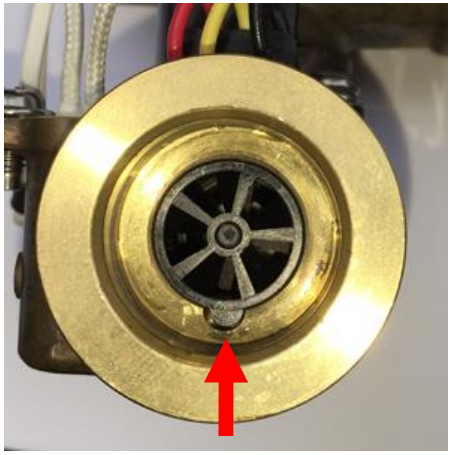
Flow Turbine Removal from Bypass Valve

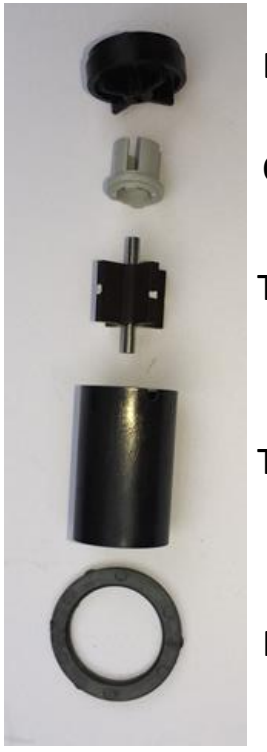
1. To remove turbine from assembly, remove the retainer. **CAUTION: Turbine is fragile!!!** With the retainer ring out use needle nose pliers and slide the turbine assembly out of the bypass valve. To disassemble turbine remove end cap and impeller from the turbine housing. Clean all components with running water and a soft brush and reassembly in reverse order. NOTE: the notch in the turbine housing fits into the grooved out slot in the bypass valve housing.
2. Turbine assembly broken down - proper assembly order, item 2.





2

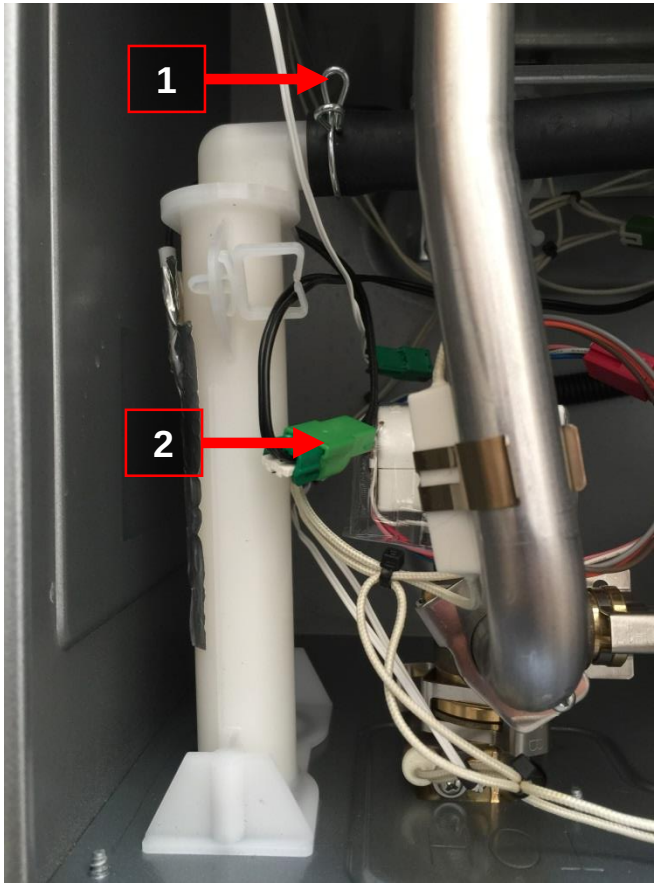
Turbine Assembly

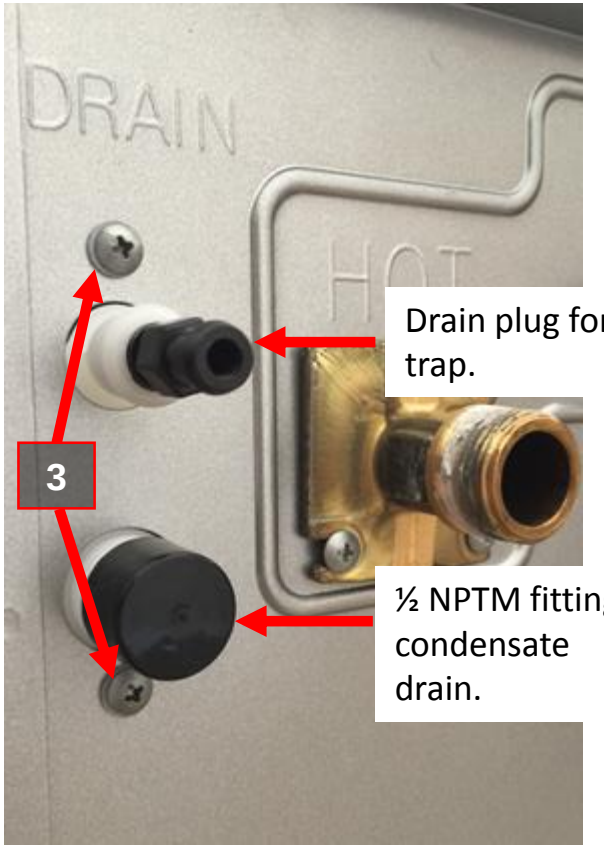


Condensate Trap Removal

Condensate Trap Removal

1. Compress clamp and slide off drain pipe and condense trap connection.
2. Unplug ceramic heater for condensate trap.
3. Remove (2) screws holding condensate trap to the unit. Remove condensate trap from unit.





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P.C. Board Removal

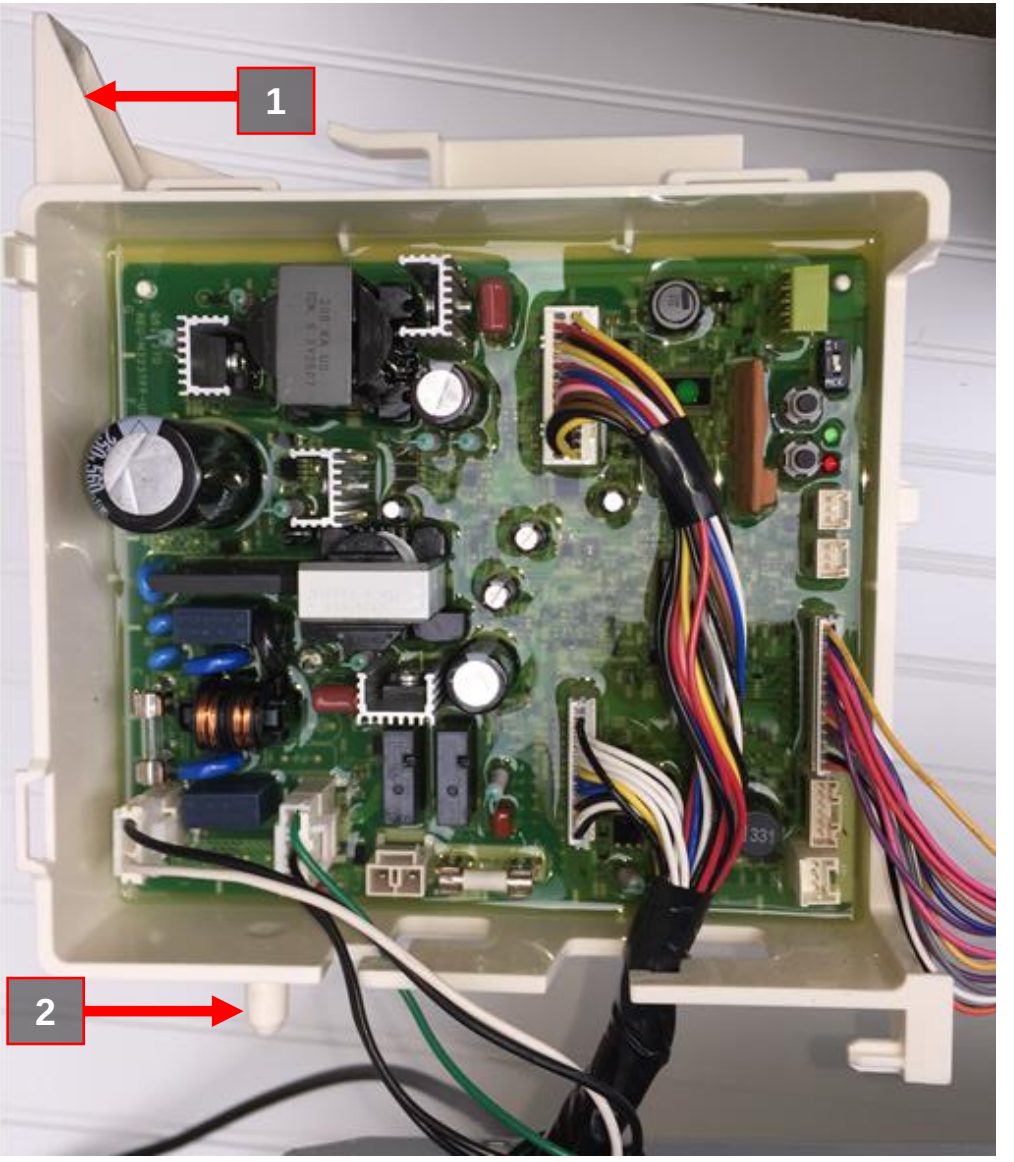
PC Board Removal

Disconnect power supply to the unit.

1. Remove screw from the top of P.C. board.

2. Pull the P.C. board up off of the plastic peg in the bottom of the unit.

3. Pull P.C. board out cabinet, disconnect all wiring harness connections on board. Take care not to stress the connections when unplugging them. Press in on the latch to release each connector before unplugging it. A small screw driver can be used to push in on these latches.



NOTE: Keep the old board for data transfer to new board. A cable will be supplied with new P.C.B to allow data transfer.

If the micro processor on the old board is damaged, you will need to manually program each of the 14 parameters, instructions provided with new board.

Product Reassembly

Re-assemble in opposite order of disassembly

All screws should be placed in the correct location.

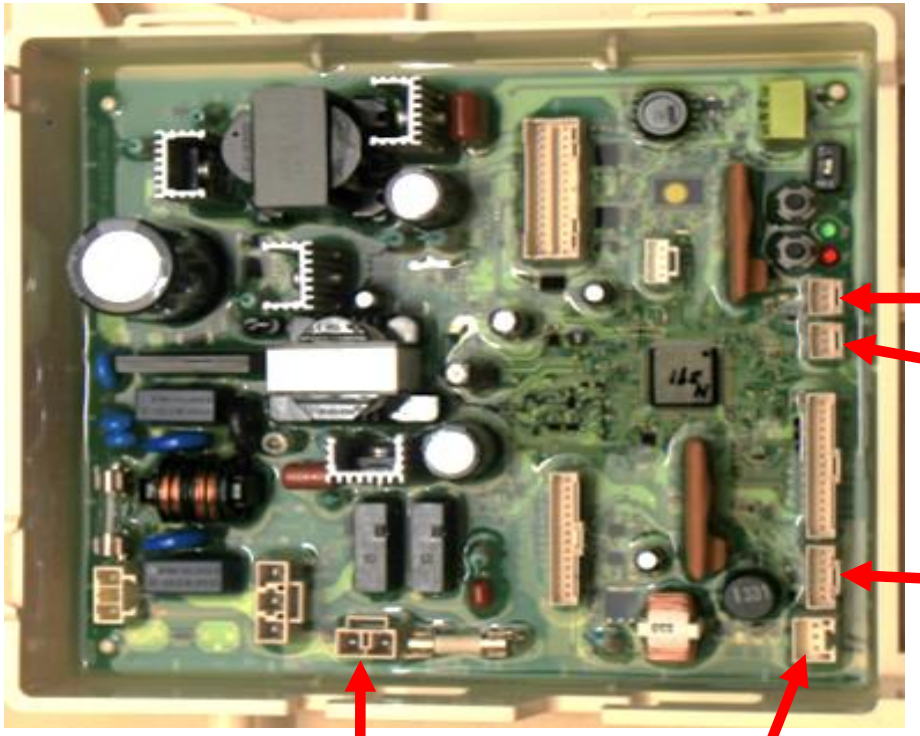
DO NOT over tighten screws

All wiring harness connections must be plugged up to correct connectors

Note: Do not apply power until the product is inspected by the instructor!

Accessory Connections

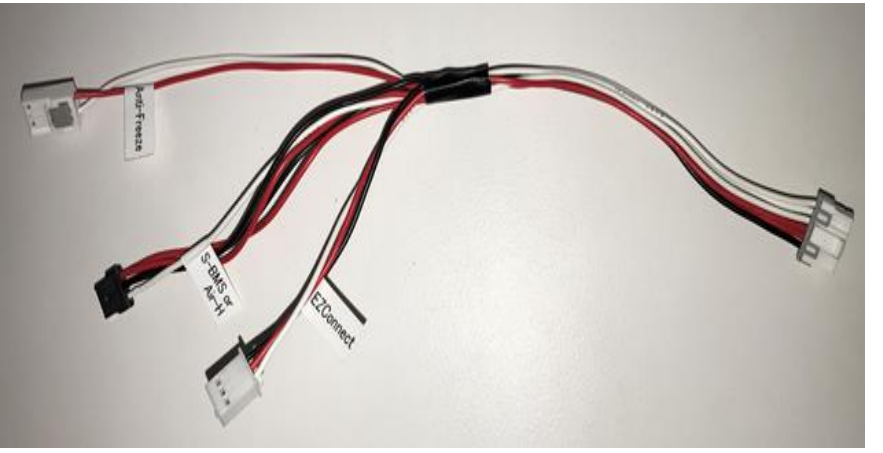
Optional Accessory Harnesses/Connector Locations

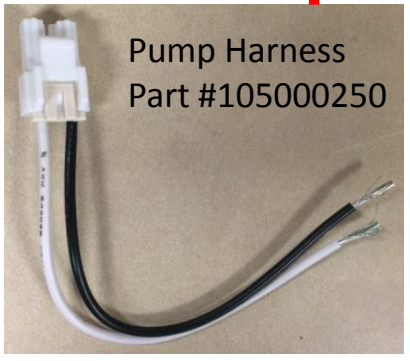


Part #REU-CSA-C1 = 3 meter Cascade Communication Harness
Part #REU-CSA-C2 = 8 meter Cascade Communication Harness

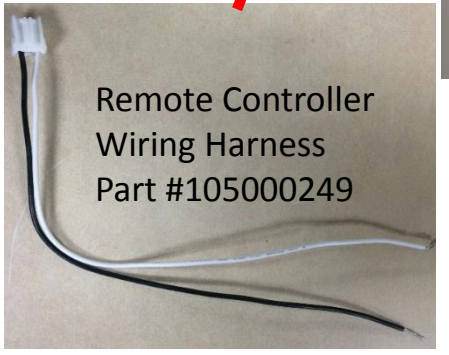
Cascade Communication harness (IN)

Cascade Communication harness (OUT)





Pump Harness
Part #105000250



Remote Controller
Wiring Harness
Part #105000249

Part #REU-EZC-2 is the wiring harness shown above. This harness is for the EZ-CONNECT, S-BMS, Air-Handler & Anti-Freeze accessories.

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Electrical Values

and

Fault Codes

Electrical Diagnostic Points

Verifying electrical values of individual components must be conducted correctly and safely. Verifying incoming supply voltage is the most common metering needed in the field—especially during installation.

Key points when troubleshooting electrical values:

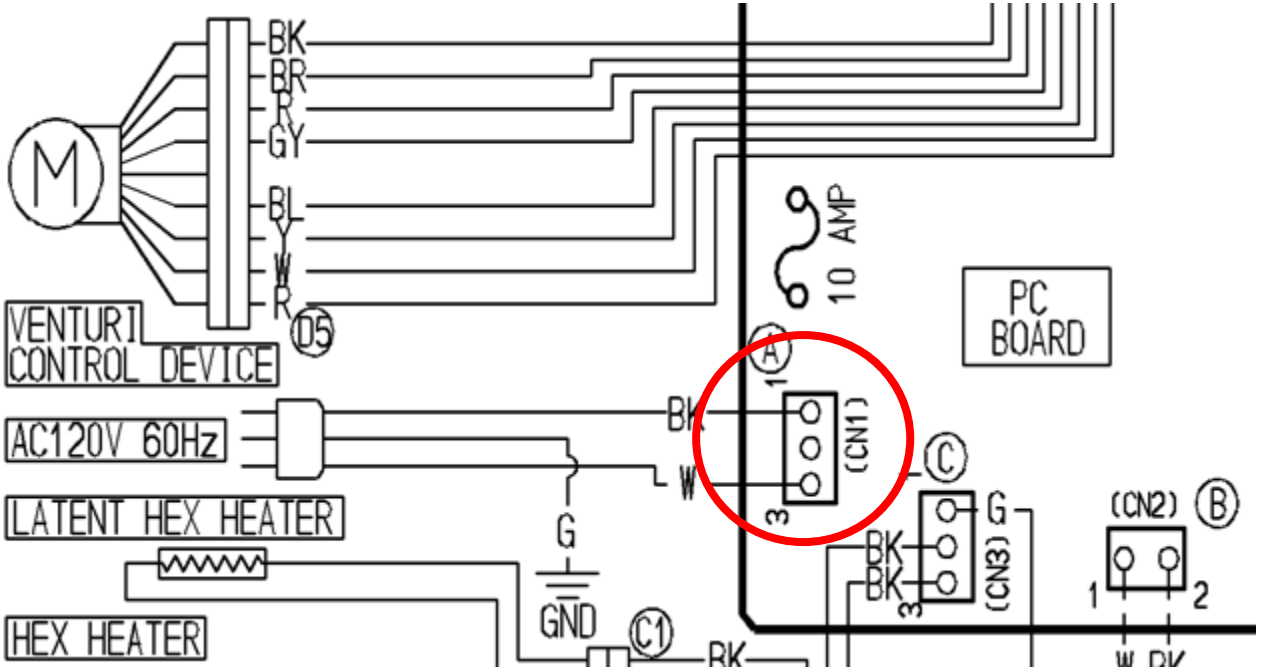
1. Ensure volt meter probes are solidly contacting metal
2. Apply probes to the back of electrical connections where wires enter electrical connector to prevent possible damage to plugs.
3. Know your meter and how to set it for each type of measurement. Always set meter to next highest value from range listed in troubleshooting sheets.

Ω = Ohms or resistance	K = X1000/ ex. 6K Ω = 6000 Ohms
VAC or V~ = AC voltage	VDC or V- = DC voltage

4. When measuring resistance, ensure the component is disconnected from the circuit board AND the power supply has been turned OFF.
5. When measuring a solenoid's resistance, place the meter probes on the solenoid's lugs (connection points) with the wires disconnected from solenoid.
6. A correct resistance reading from a solenoid or transformer coil is not a guarantee that the component is good, as the windings can open under load. An incorrect value is a very good indication that the component is bad though.

Power Supply

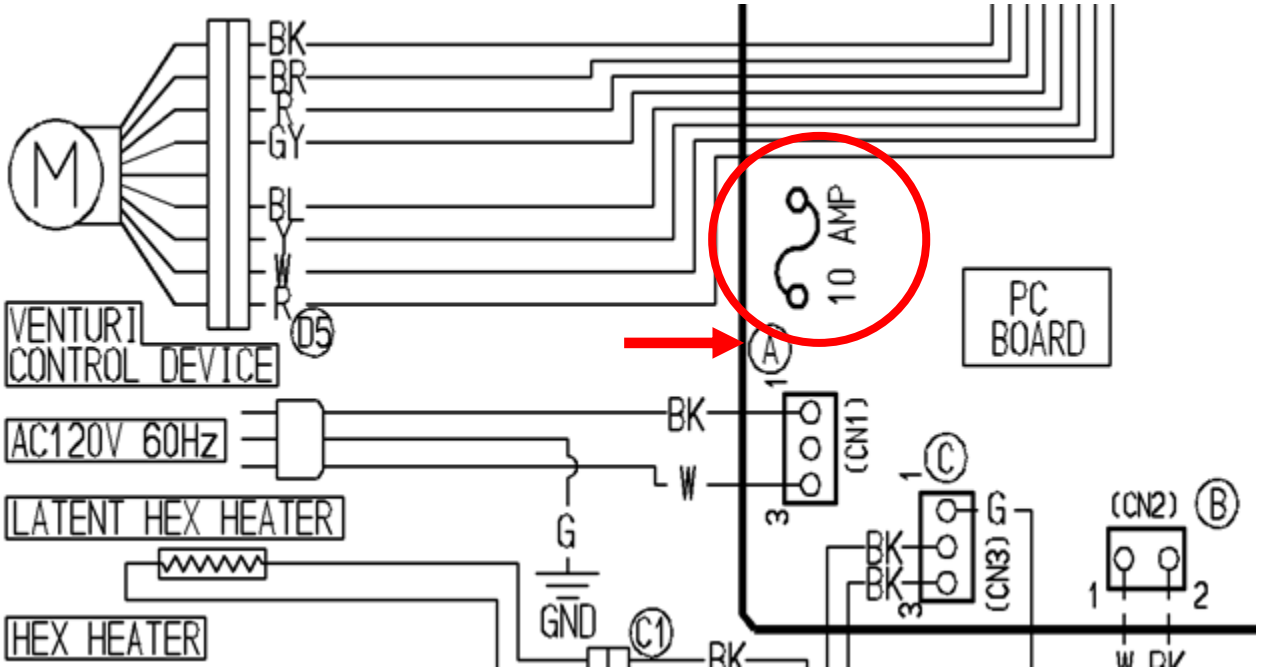
1. Check for 120 V.A.C. **Power Supply** to the water heater – (**Plug CN1**):
   a. Connector “A” pin 1 white wire & pin 3 black wire.



Power Supply Fuse

When measuring resistance always make sure the power supply to the unit is turned off and the component being check is isolated from the P.C. board.

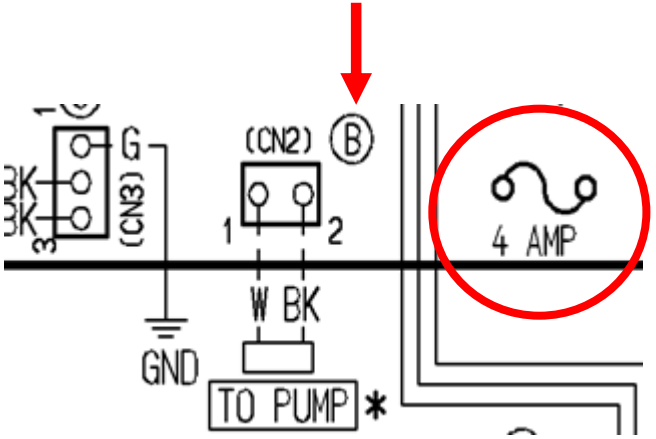
1. Verify **10 Amp Fuse** is not blown, found next to connector A. Replace if blown.



Pump Circuit Fuse

When measuring resistance always make sure the power supply to the unit is turned off and the component being check is isolated from the P.C. board.

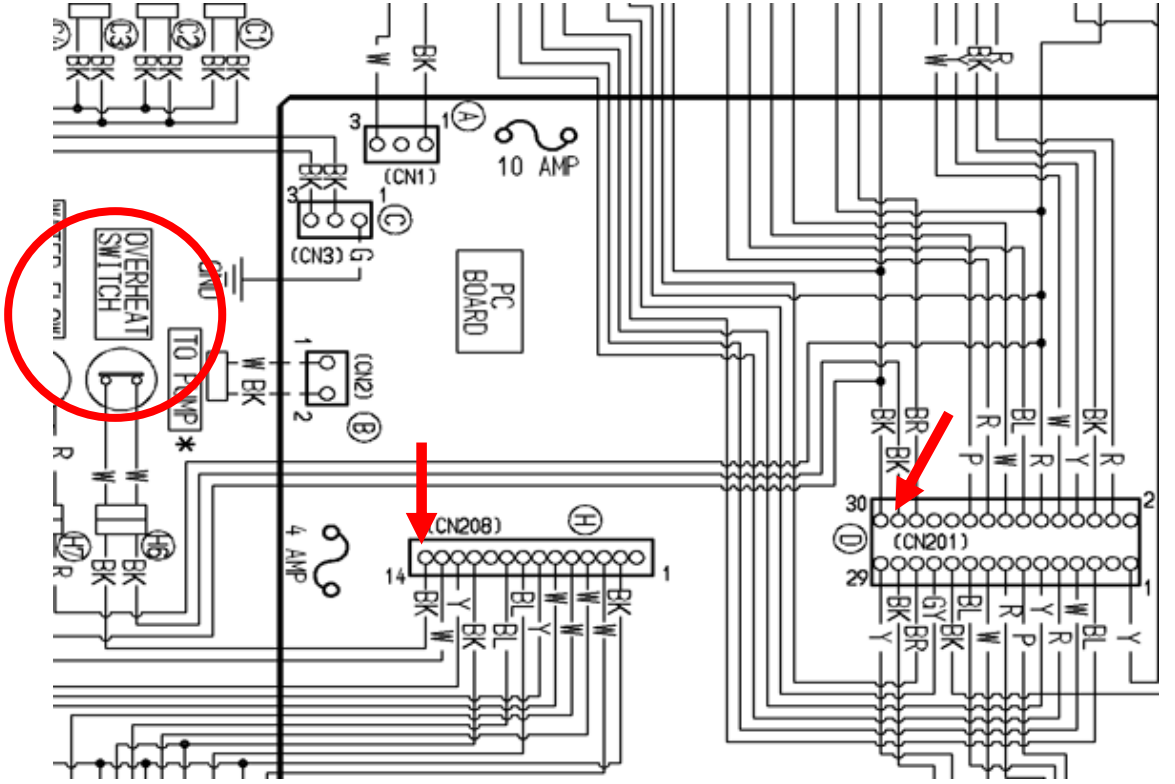
1. Verify **4 Amp Fuse** for pump circuit is not blown next to connector B.



Overheat Switch

When measuring resistance always make sure the power supply to the unit is turned off and the component being check is isolated from the P.C. board.

1. Measure resistance and/or voltage of the **Overheat Switch on P.C. board at Connector H**:
   a. Connector ”H” on P.C. board pin #14 black wire & connector “D” pin 28 black = Less than 1 ohm or 11 ~ 13 VDC



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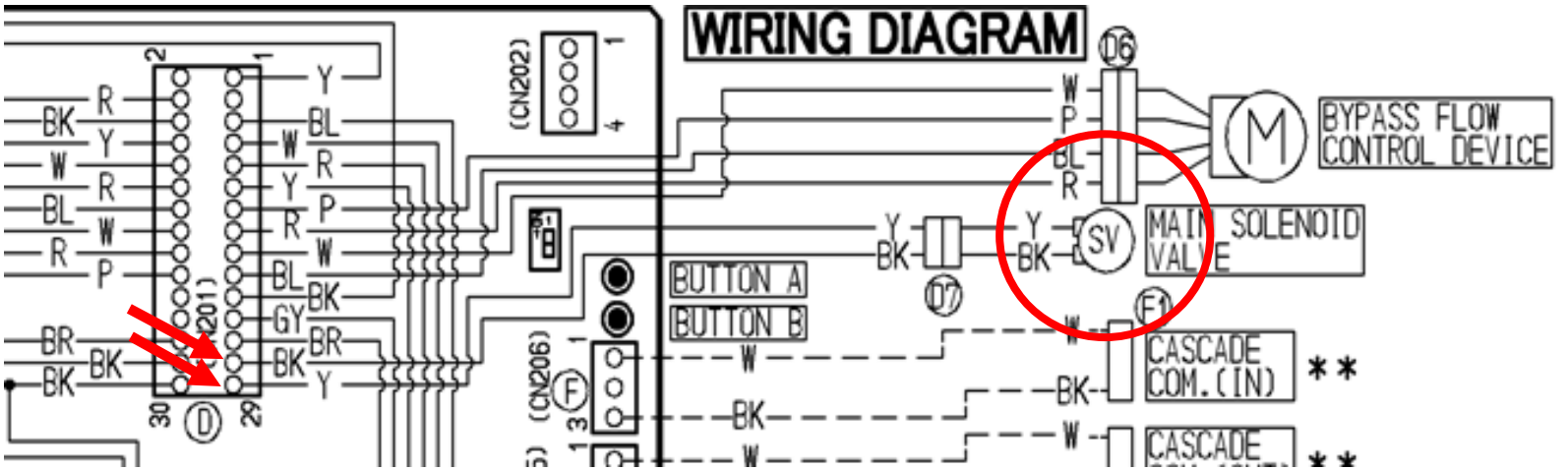
Main Gas Solenoid Valve

When measuring resistance always make sure the power supply to the unit is turned off and the component being check is isolated from the P.C. board.

1. Measure resistance and/or voltage of the **Main Gas Valve Solenoid on P.C. board at Connector D:**
   a. Connector “D” on P.C. board black wire pin #27 & yellow wire pin #29 = 18 ~ 22 ohms or 11 ~ 13 VDC.

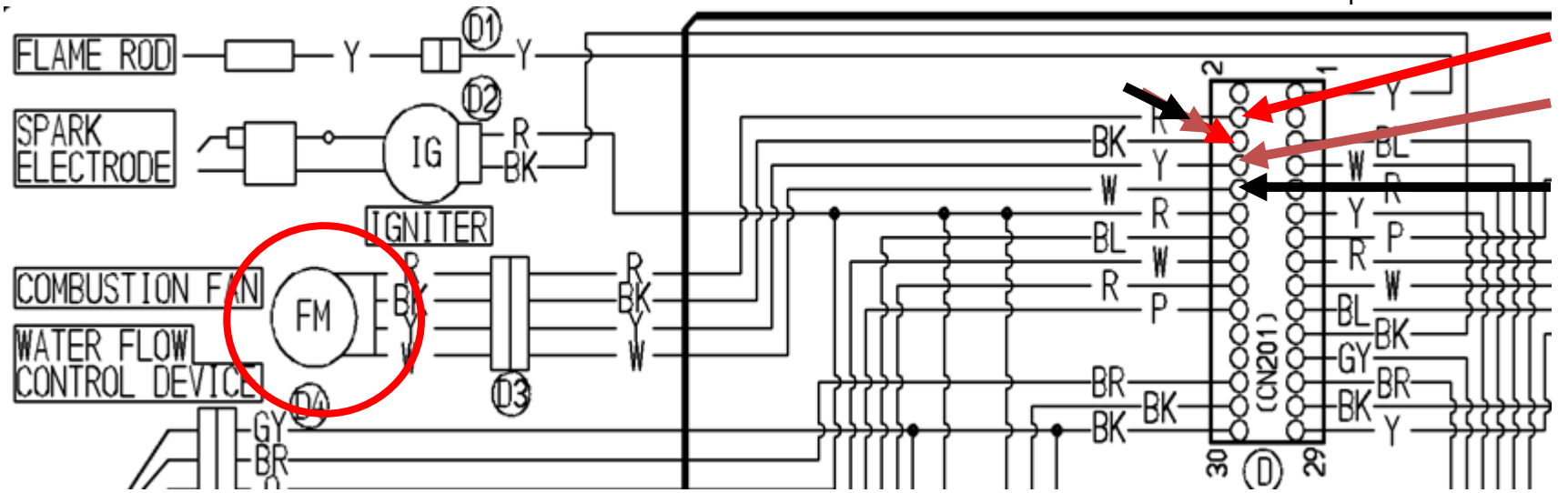


Combustion Fan

When measuring resistance always make sure the power supply to the unit is turned off and the component being check is isolated from the P.C. board. Voltage readings will occur when fan motor is energized.

1. Measure voltage of the **Fan Motor on P.C board at Connector D**:
   a. Connector “D” red wire pin #4 & black wire pin #6 =7 ~ 48 VDC at red arrows.
   b. Connector “D” white wire pin #10 & black wire pin #6 = 10 ~ 12 VDC at black arrows.
   c. Connector “D” yellow wire pin #8 & black wire pin #6 = 11 ~ 13 VDC at brown arrows.

Pin #2 is the common wire for all three test points

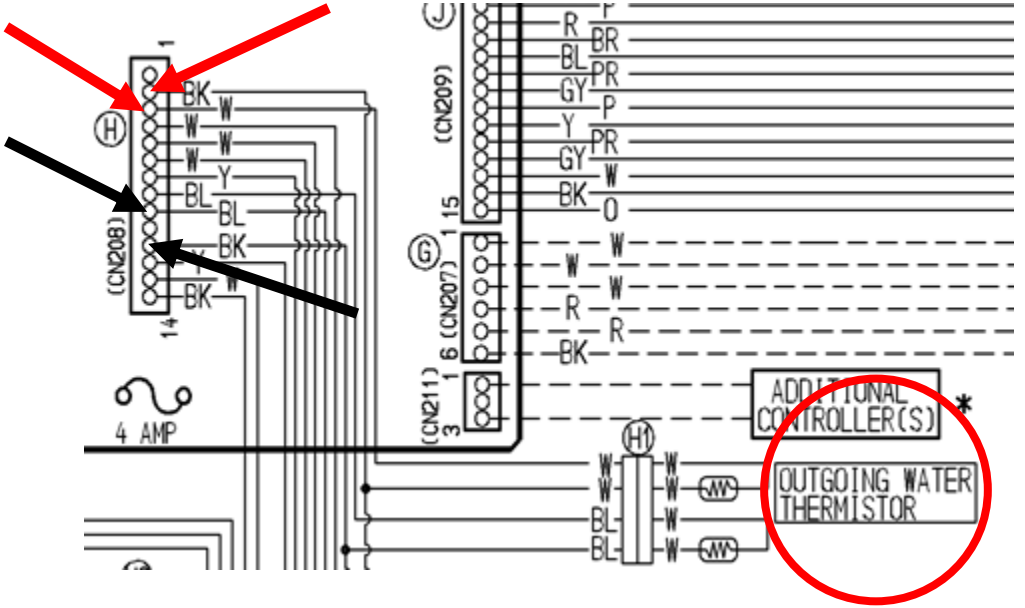


Enhancing Lives By Changing The Way Water Is Heated

Outgoing Water Thermistor

When measuring resistance always make sure the power supply to the unit is turned off and the component being check is isolated from the P.C. board.

1. Measure resistance of **Outgoing Water Thermistor on P.C. board at Connector H**:
   a. Connector “H” white wire pin #2 (turns black at P.C. board) & white wire pin #3 at red arrows.
   b. Connector “H” blue wire pin #9 & blue wire (turn black at P.C. board) pin #11 at black arrows.



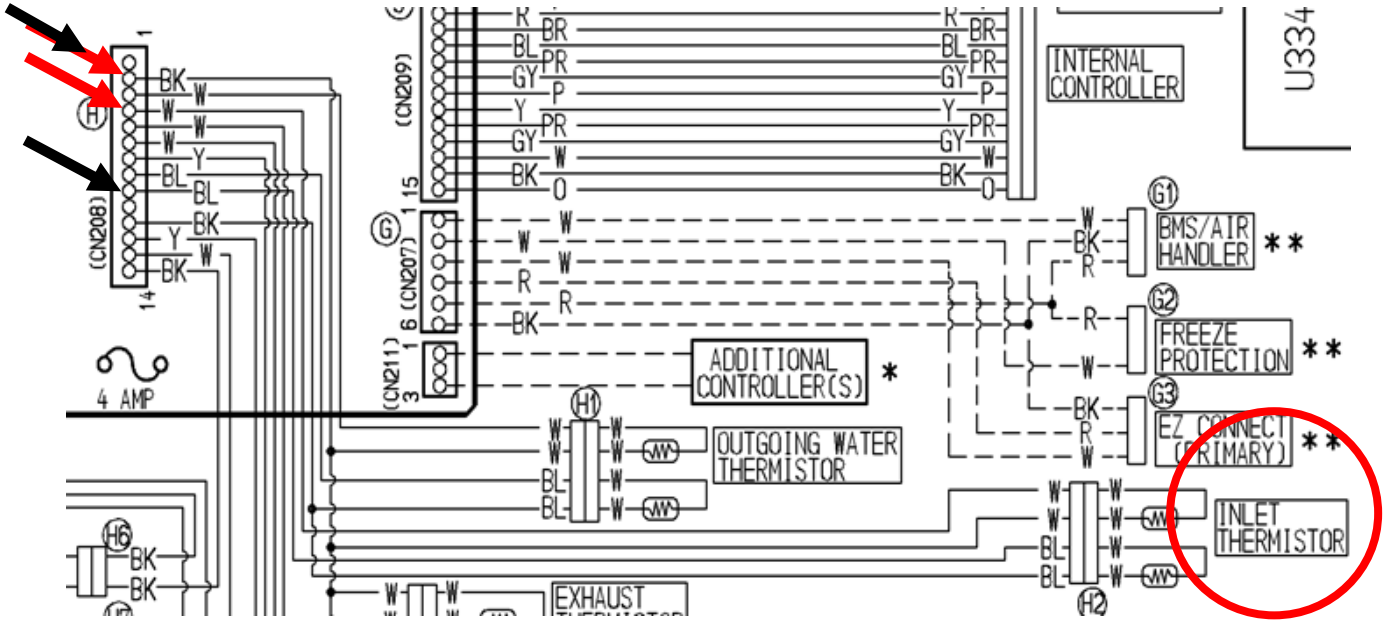
Resistance Values		
59˚F	=	11.4 ~ 14K ohms
86˚F	=	6.4 ~ 7.8K ohms
113˚F	=	3.6 ~ 4.5K ohms
140˚F	=	2.2 ~ 2.7K ohms
221˚F	=	0.6 ~ 0.8K ohms

Inlet Water Thermistor

When measuring resistance always make sure the power supply to the unit is turned off and the component being check is isolated from the P.C. board.

1. Measure resistance of I**nlet Water Thermistor on P.C. board at Connector H**:
   a. Connector “H” white wire (turns black at P.C. board) pin #2 & white wire pin #4 at red arrows.
   b. Connector “H” blue wire pin #9 & blue wire pin # 2 turn black at P.C. at black arrows.

Pin #2 is the common wire for all three test points



Resistance Values		
59 ˚F	=	11.4 ~ 14K ohms
86 ˚F	=	6.4 ~ 7.8K ohms
113 ˚F	=	3.6 ~ 4.5K ohms
140˚F	=	2.2 ~ 2.7K ohms
221 ˚F	=	0.6 ~ 0.8K ohms

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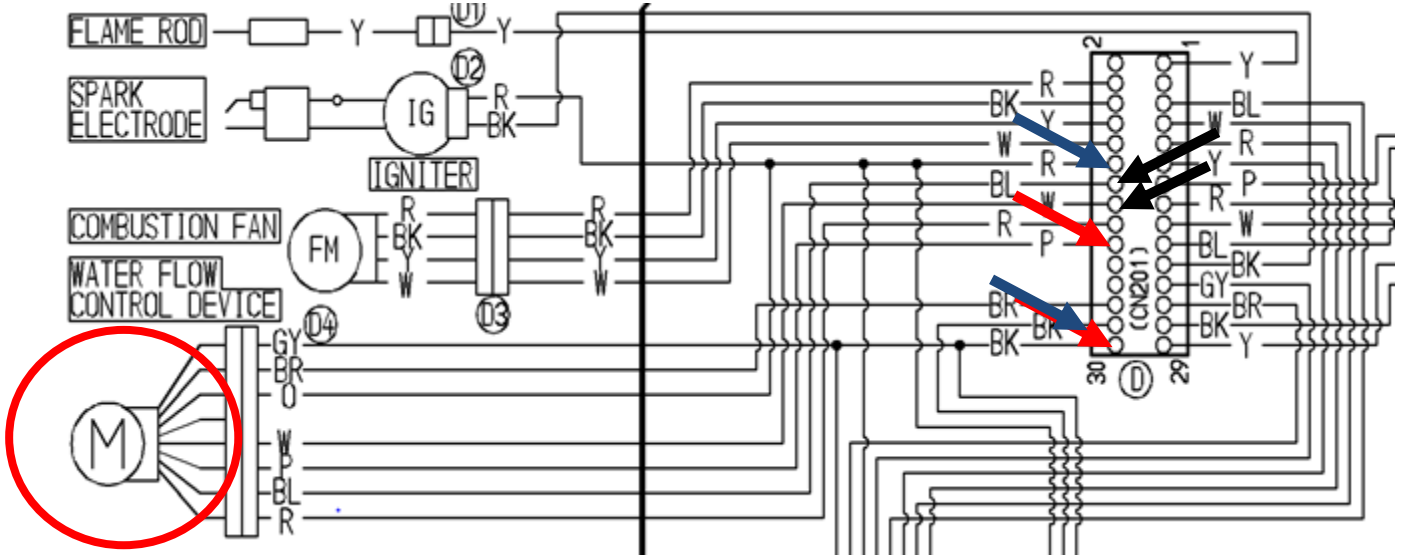
Water Flow Control Device

When measuring resistance always make sure the power supply to the unit is turned off and the component being check is isolated from the P.C. board.

1. Measure resistance or voltage of **Water Flow Control Device (WFSV) on P.C. board at Connector D**:
   a. Connector “D” red wire (turns black at P.C. board) pin #30 & pink wire pin #20 = 44 ~ 52Ω at red arrows.
   b. Connector “D” white wire pin #16 & blue wire pin #14= 44 ~ 52Ω at black arrows.
   c. Connector “D” grey wire (turns black at P.C. board) pin #30 & orange wire pin #12 (turns red at P.C. board) at blue arrows = 12 ~ 14 VDC when 120 VAC power supply is on.

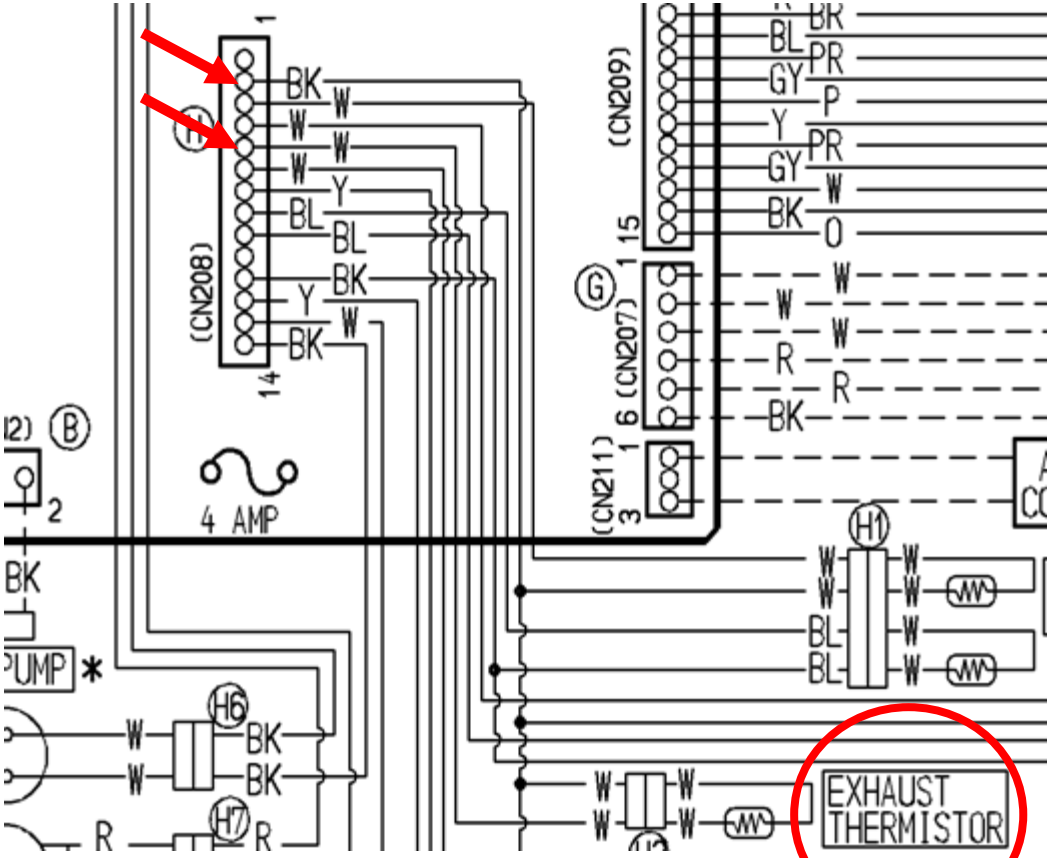
Pin #30 is the common wire for item a & c



Exhaust Temperature Thermistor

When measuring resistance always make sure the power supply to the unit is turned off and the component being check is isolated from the P.C. board.

1. Measure resistance of **Exhaust Temperature Thermistor on P.C. board at Connector H**:
   a. Connector “H” white wire pin #2 (turns black at P.C. board) & white wire pin #5

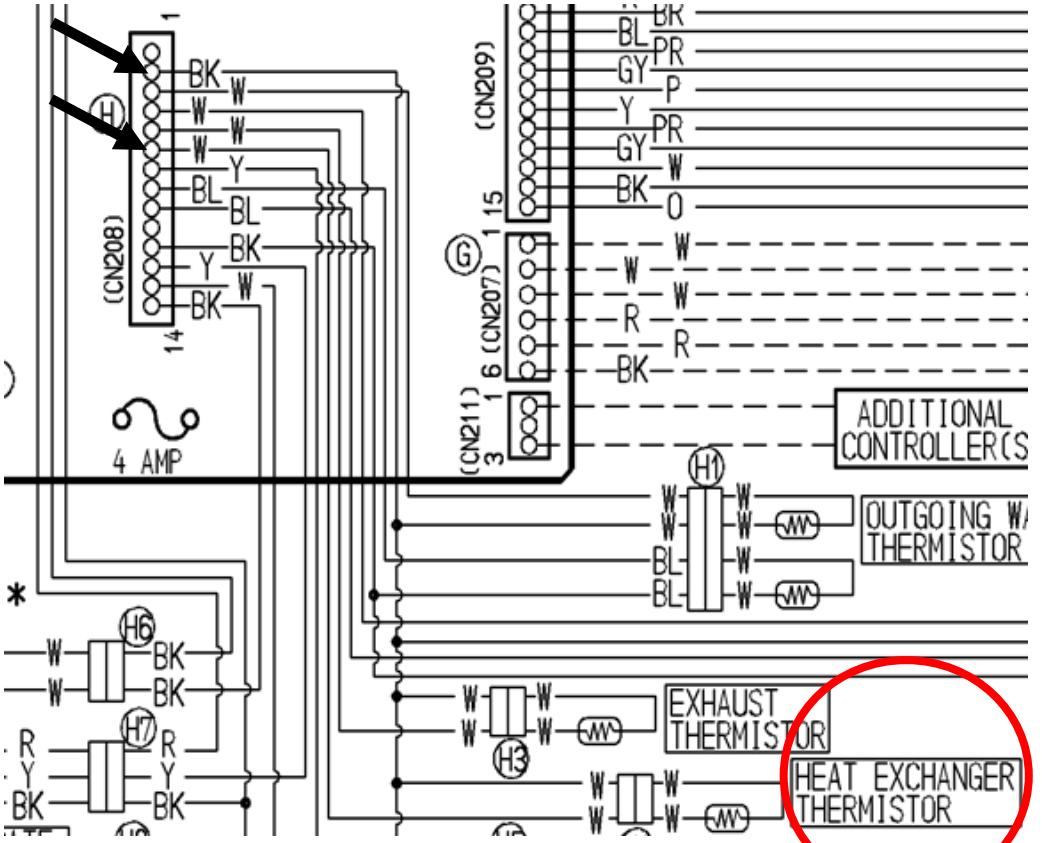


59 ˚F	=	11.4 ~ 14K ohms
86 ˚F	=	6.4 ~ 7.8K ohms
113 ˚F	=	3.6 ~ 4.5K ohms
140˚F	=	2.2 ~ 2.7K ohms
221 ˚F	=	0.6 ~ 0.8K ohms

Heat Exchanger Thermistor

When measuring resistance always make sure the power supply to the unit is turned off and the component being check is isolated from the P.C. board.

1. Measure resistance of **Heat Exchanger Thermistor on the P.C. board at Connector H)**:
   a. Connector “H” white wire pin #2 (turns black at P.C. board) & white wire pin #6.

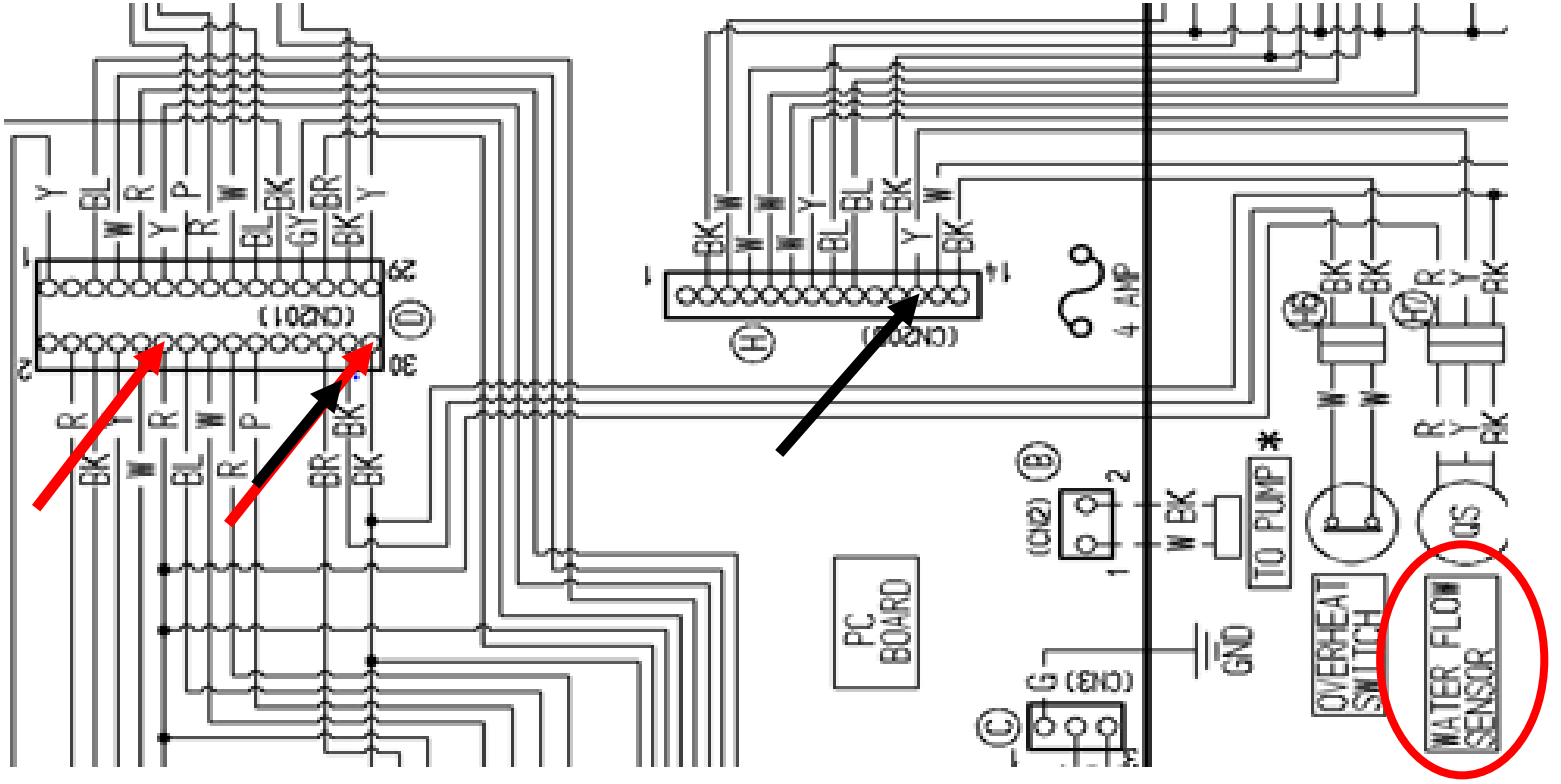


Resistance Values		
59 ˚F	=	11.4 ~ 14K ohms
86 ˚F	=	6.4 ~ 7.8K ohms
113 ˚F	=	3.6 ~ 4.5K ohms
140˚F	=	2.2 ~ 2.7K ohms
221 ˚F	=	0.6 ~ 0.8K ohms

Water Flow Sensor

Power must be turned on to the appliance for this section of troubleshooting.

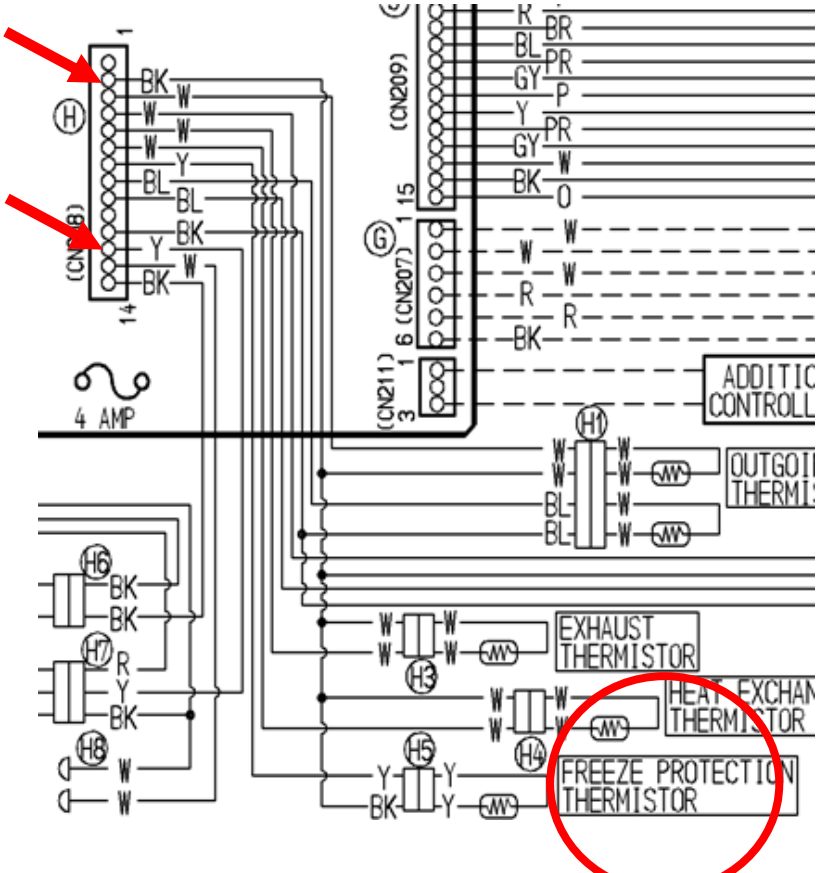
1. Measure voltage of **Water Flow Sensor on P.C. board at Connector H & D on P.C. board:**
   a. Connector “D” black wire pin #30 & red wire pin #12 should have 11 ~ 13 VDC or less than 1 ohm at red arrows
   b. Connector “H” yellow wire pin #12 & Connector “D” pin #30 black wire should have 4 ~ 7 VDC at black arrows.



Freeze Protection Thermistor

When measuring resistance always make sure the power supply to the unit is turned off and the component being check is isolated from the P.C. board.

1. Measure voltage of **Freeze Protection Thermistor on the P.C. board at Connector H**:
   a. Connector “H” black wire pin #2 & yellow wire pin #12.



Resistance Values		
59˚F	=	11.4 ~ 14K ohms
86˚F	=	6.4 ~ 7.8K ohms
113˚F	=	3.6 ~ 4.5K ohms
140˚F	=	2.2 ~ 2.7K ohms
221˚F	=	0.6 ~ 0.8K ohms

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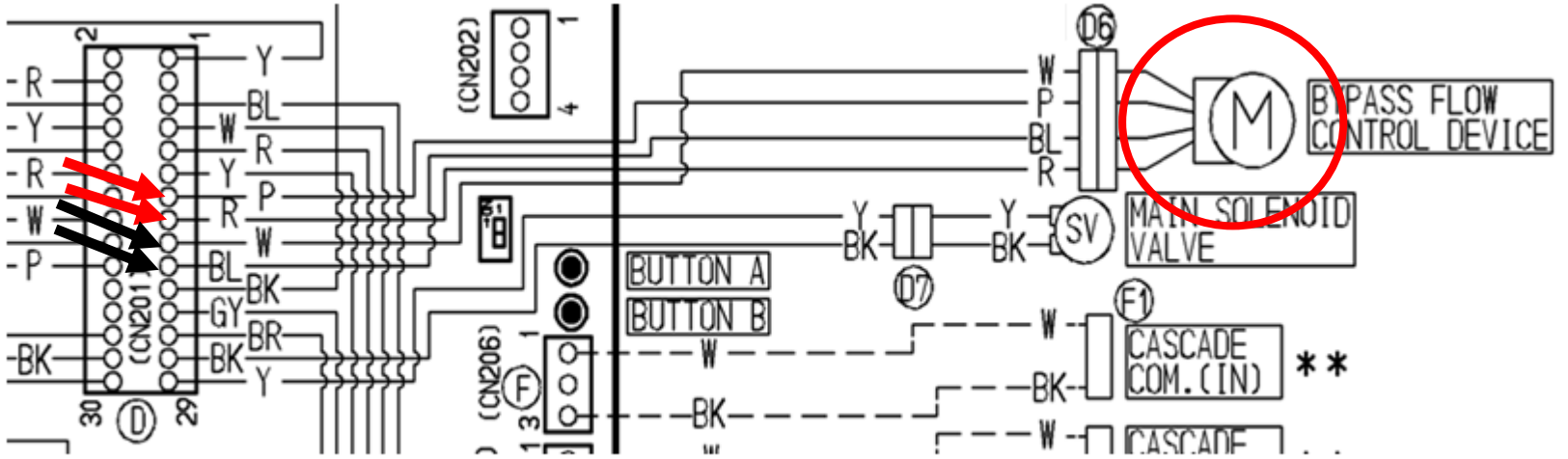
By-Pass Flow Control Valve

When measuring resistance always make sure the power supply to the unit is turned off and the component being check is isolated from the P.C. board.

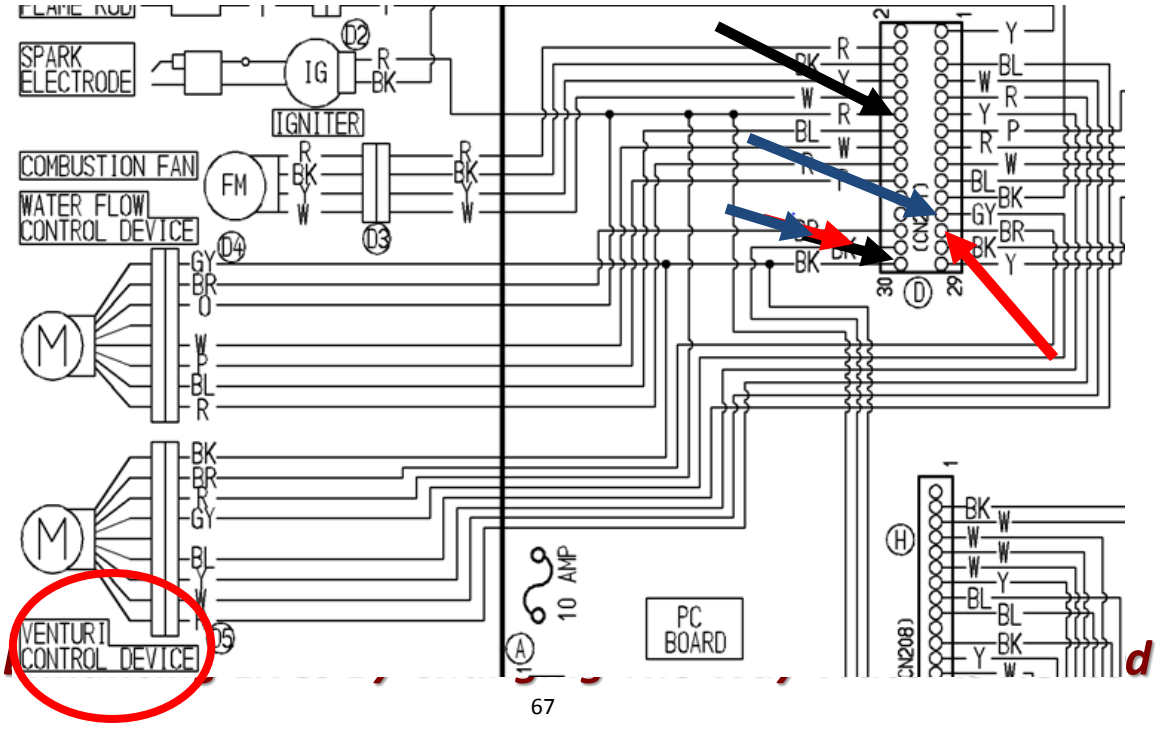
1. Measure resistance of **By-Pass Flow Control Valve on the P.C. board at Connector D:**
   a. Connector “D” red wire pin #15 & pink wire pin #13 – 44 ~ 52Ω.
   b. Connector “D” white wire pin #17 & blue wire pin #19 – 44 ~ 52Ω.



Venturi Control Device Servo

Power must be turned on to the appliance for this section of troubleshooting.

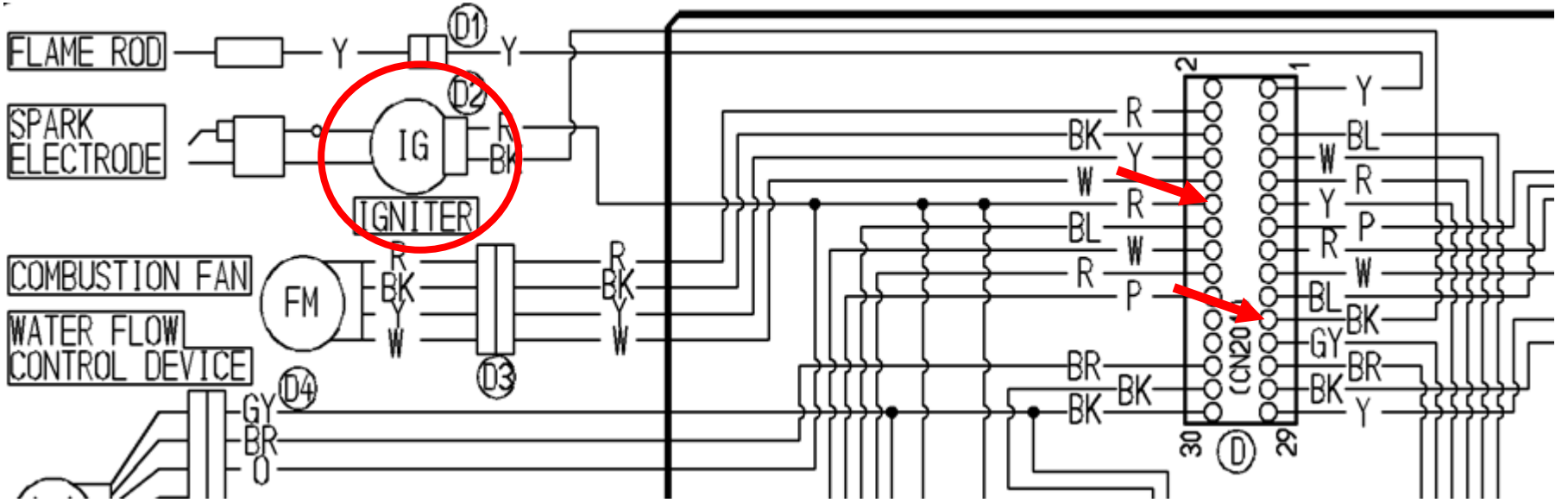
1. Measure resistance of **Venturi Control Device Servo on the P.C. board at Connector D:**
   a. Connector "D" Red wire pin #12 & Black wire pin #30 at the P.C. board = 12 ~ 14 VDC when 120 VAC is on feeding unit at black arrows.
   b. Connector "D" Brown wire pin #25 & Black wire pin #30 at the P.C. board = Less than 1 VDC at red arrows.
   c. Connector "D" Grey wire pin #23 & Black wire pin #30 at the P.C. board = Less than 1 VDC at blue arrows.
   d. Connector "D" Blue wire pin #5 and white wire pin #7 = 35 ~ 41 ohms
   e. Connector "D" Yellow wire pin #11 and Red wire pin #9 = 35 ~ 41 ohms



Spark Electrode

When measuring resistance always make sure the power supply to the unit is turned off and the component being check is isolated from the P.C. board

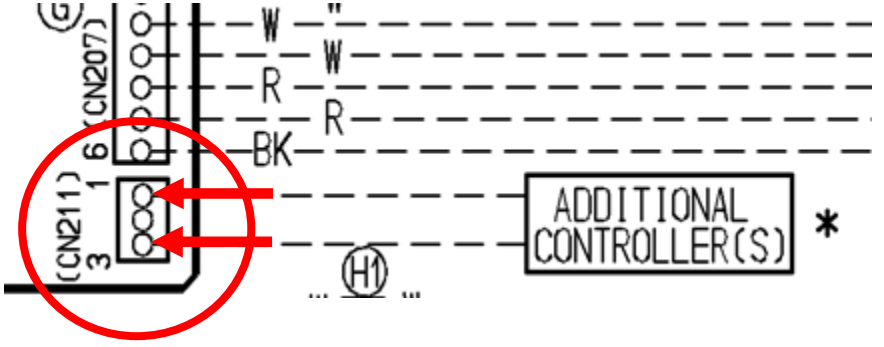
1. Measure resistance or voltage of **Igniter System on the P.C. board at Connector D:**
   a. Connector “D” Black wire pin #21 & red wire pin #12 = 34K ~ 40KΩ or 11 ~ 13 VDC during ignition cycle.



Additional Controller(s)

When measuring resistance always make sure the power supply to the unit is turned off and the component being check is isolated from the P.C. board

1. Measure voltage of **Additional Remote Controller(s) on the P.C. board at Connector CN211:**
   a. Connector “CN211” on the P.C. board check across terminals 1 & 3 for 10 ~ 13 VDC.

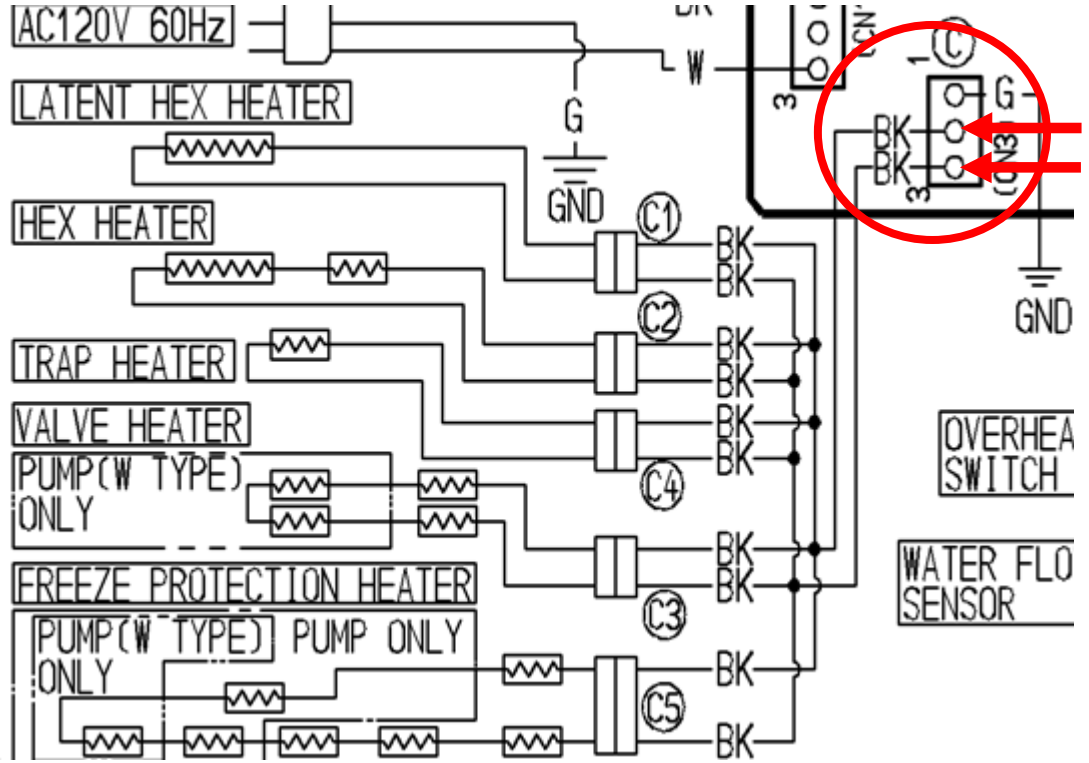


Note: The activation flow rate for the N-Series Water Heaters is 0.4 gpm.
No need to make any adjustments when set above 120 degrees Fahrenheit.

Freeze Protection Heater Circuit

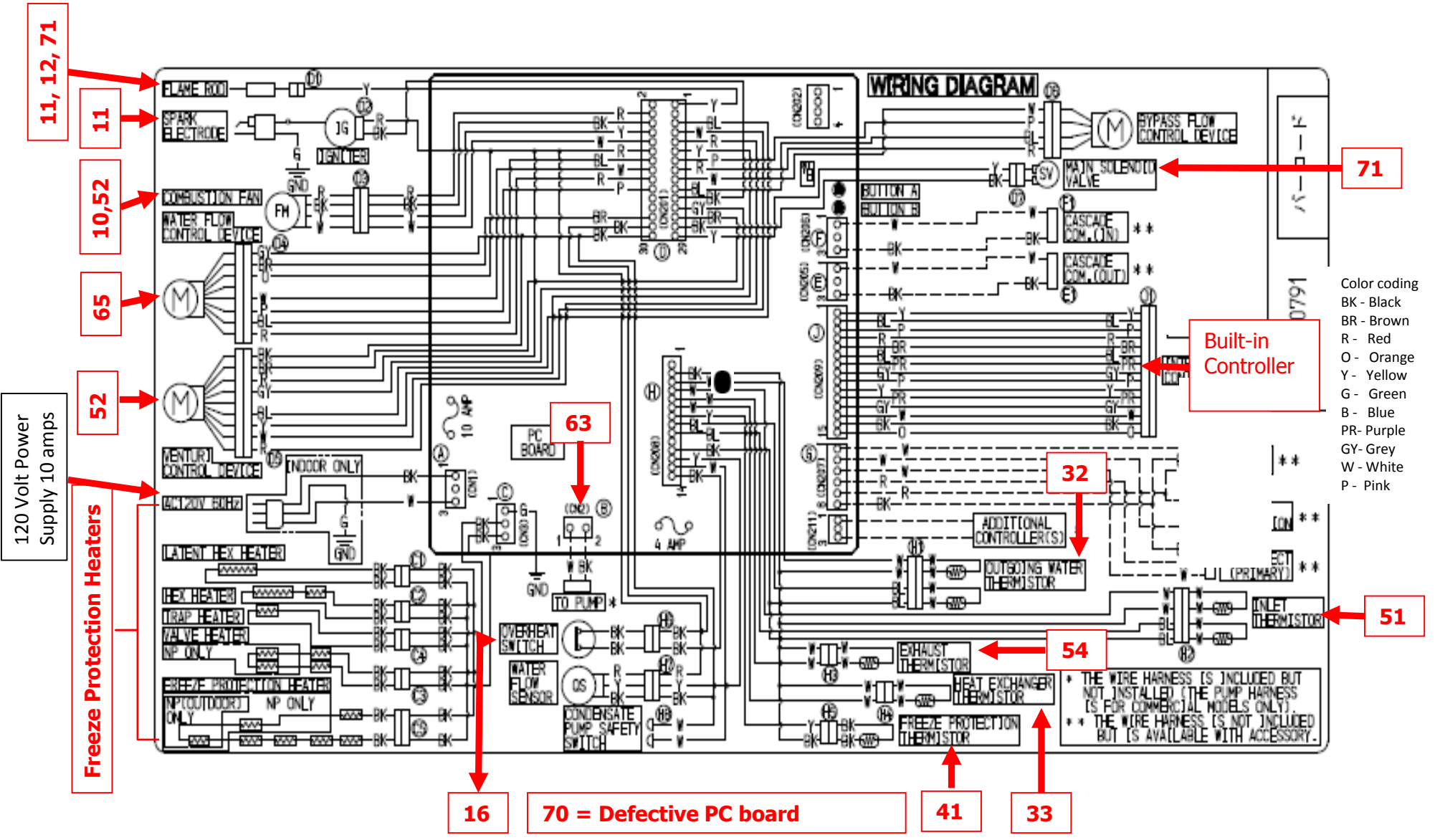
Power must be turned on to the appliance for this section of troubleshooting.

1. Check for 120 VAC to **Freeze Protection Heater Circuit on the P.C. board at Connector C**:
   a. Connector “C” black wire pin #2 & black wire pin #3



Maintenance Diagnostic Codes/Diagram

Maintenance Diagnostic Codes/Diagram



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Electrical

Electrical Input Ratings

Electrical Requirements (Installer shall provide electrical outlet connections) Each unit has a 10 amp glass fuse built into the wiring harness. Maximum load for the N-Series Products should be less than 4 amps in units without a circulation pump built-in or connected to the unit.	N-Series Water Heaters requires 120 VAC, 60 Hz. 4 amp properly grounded circuit power source when used without a circulation pump connected to the unit. Internal N-Series units: 75 watts normal operation; 2 watts standby; 146 watts anti-frost protection. External N-Series units: 71 watts normal operation; 2 watts standby; 168 watts anti-frost protection.

Controller (Maintenance Monitor Functions):

To enter the maintenance monitor display mode:

Press and **hold** the DOWN arrow, in two seconds press the ON/OFF button at the same time. Release both buttons, First “01” will be displayed followed by a display of the flow rate in GPM. Pressing the UP arrow will change the display to “02” followed by the output water temperature and so on.

Code	Reading	Units	Description / Notes
01	Water Flow Rate	0.1 GPM	GPM through WH (decimal not shown).
02	Outgoing Temperature	Deg. Fahrenheit	Outgoing Water Temperature.
03	Combustion Hours	X100 Hours	Total Combustion Hours.
04	Combustion Cycles.	See chart to right	Total Combustion Cycles.
05	Fan Frequency	Hertz	Fan Motor Hertz (if operating).
06	Additional Controllers Connected	Connected or not	1 = Connected & 2 = Not connected
07	Water Flow Servo Position.	Position	0 = Partially Open / 1 = Open / 2 = Closed
08	Inlet Water Temperature.	Deg. Fahrenheit	Calculated Inlet Water Temperature.
09	Fan Current.	X10 mA	Fan Current Draw (if operating).
10	Total Bath Fill Volume.	Gallons	Volume of Water During Bath Fill Mode.
11	HEX Outlet Water Temperature	Deg. Fahrenheit	Heat exchanger outlet water temperature
12	Bypass Flow Control Position.	Degrees	Degrees of opening (if equipped)
15	Freeze Protection Temperature	Deg. Fahrenheit	Temperature of water in unit (indoor units)
17	Freeze Protection Temperature	Deg. Fahrenheit	Temperature of water in unit (outdoor units)
19	Total Pump Operating Hours	X100 hours	Pump operation time in hundreds of hours
20	Total Pump Cycles	See chart to right	Pump operation time in thousands of hours
21	Exhaust Temperature	Deg. Fahrenheit	Exhaust Temperature at Thermistor

04 Combustion Cycles Details
20 Pump Cycles Details

CYCLE COUNT	LOW NUMBER	HIGH NUMBER
0-999	0	999
1,000-9,999	10-	99-
10,000-65,535	1- -	6- -

Enhancing Lives By Changing The Way Water Is Heated

Controller (Maintenance Monitor Functions):

Press and **hold** the DOWN arrow, in two seconds press the ON/OFF button at the same time. Release both buttons, First “01” will be displayed followed by a display of the flow rate in GPM. Pressing the UP arrow will change the display to “02” followed by the output water temperature and so on.

Code	Reading	Units	Description / Notes	
A0	Total water usage	X1 gallon	Total gallons X1 gallon per minute	**Note: The following diagnostic functions apply to the N-Series Rinnai Water Heaters.**
A1	Total water usage	x1,000 gallons	Total gallons X1,000 gallons	
A2	Total water usage	x1,000,000 gallons	Total gallons X1,000,000 gallons	
C0	Total Calorie	1 Kcal/min.	X1Kcal/min	
C1	Total Calorie	1,000 Kcal/min	X1.000 Kcal/min	
C2	Total Calorie	1,000,000 Kcal/min	X1,000,000 Kcal/min	

Fault Codes

A fault code will flash on the temperature controller when a error is detected. The unit may stop operating (code dependent). Turning off water flow or power will clear the code.

ERROR	FAULT	REMEDY
03	Power interruption during Bath fill (Water will not flow when power returns)	- Turn off all hot water taps and press the ON/OFF button twice.
05	Bypass Flow Control	- Measure resistance values of the by-pass flow control - Replace By-Pass Servo valve assembly
10	Air Supply or Exhaust Blockage	- Ensure internal air filter is not clogged, clean if necessary. - Ensure combustion air and exhaust venting is not blocked and approved venting is being used. - Check all vent components for proper connections. - Ensure vent length is within limits. - Check fan for blockage and proper operation. - Verify high altitude parameter was properly set. - Ensure exhaust check valve behind fan is not stuck in the closed position. - Replace fan
	Condensate trap is full (N – Series Water Heaters)	- Check condensate drain line for blockage. - Check for proper slope of drain line. - Ensure drain line does not have any sags, allowing water to build-up in pipe. - Ensure condensate drain line and termination is not frozen up.
11	No Ignition	- Check air filter to ensure it is not clogged, clean if necessary. - Check that the gas is turned on at the water heater, gas meter, or cylinder. - If the system is Propane, ensure the tank has adequate quantity of gas in it. - Ensure the appliance and circuit board are properly grounded. - Ensure gas type and inlet gas pressure are correct. - Ensure gas line, meter and or regulator are sized properly. - Bleed all air from the gas lines.

Fault Codes

11	No Ignition	- Verify parameters for vent length are set properly. - Verify unit has been set up for the proper gas supply, LP or Natural - Ensure the igniter is operational. - Check igniter wiring harness for damage. - Check igniter gap for proper setting, should be 3.5 mm. - Check gas solenoid valves for open or short circuits. - Check burner for blockage. - Check burner mesh for damage. - Verify parameter for high altitude was properly set. - Check for continuously wind over 40 miles per hour - Ensure exhaust check valve behind fan mount is not stuck in the closed position. - Verify nothing is stuck in the gas valve venturi. - Confirm the appropriate orifice venturi is being used in the gas valve - Replace fan
12	Flame Failure	- Check for obstructions in the flue outlet. - If the system is propane, ensure the tank has adequate quantity in it. - Ensure the gas line, meter and / or regulator is sized properly. - Ensure gas type and inlet gas pressure is correct. - Bleed all air from the gas line. - Ensure proper venting material was installed. - Check parameter for high altitude was properly set. - Check power supply for proper voltage and voltage drops. - Ensure flame rod wire is connected and for carbon build-up on flame rod. - Disconnect and reconnect all wiring harnesses on unit and PC Board. - Check for DC shorts at components. - Check gas solenoid valves for open or short circuits. - Remove burner plate and inspect burner mesh for damage or debris. - Ensure the internal air filter is clean. - Verify proper venturi for gas type being used is installed in gas valve.

Fault Codes

14	Heat Exchanger Overheat	- Measure resistance of Overheat Switch. (See Electrical Diagnostics) - Check heat exchanger surface for hot spots which indicate blockage due to scale. Refer to instructions in manual for flushing heat exchanger. Hard water must be treated to prevent scale build up or damage to the heat exchanger. - Ensure unit is not set in the forced High fire setting. - Ensure the only dip switch on the P.C. board is in the OFF position.
15	Venturi Control	– Check gas solenoid wire harness for loose or damaged terminals . – Measure resistance of gas valve solenoids. – Ensure gas valve is getting voltage when unit is trying to fire up. – Ensure fan motor is getting voltage when unit is trying to fire up. – Check fan motor for proper operation. . – Replace gas valve. – Replace fan motor
16	High Outgoing Water Temperature (Safety shutdown – outlet water temperature exceeded 203 °F (95°C)	- Check for restrictions in air flow around the vent terminal. - Check fan for proper operation. - Check for foreign materials in the combustion chamber and exhaust piping. - Check for blockage in the heat exchanger. - Confirm unit has been set up to operate on gas type connected to the unit - Replace gas valve assembly
17	Venturi Blockage	- Ensure Venturi isn't blocked. - Replace venturi and zero governor gas valve assembly. - Contact Rinnai for assistance in re-setting unit if error re-appears
19	Electrical grounding	- Check components for an electrical short. - Confirm all wiring harnesses are properly connected
21	Data transfer error	- If the P.C. board has been replaced, ensure the data transfer process is complete. - Ensure all parameters were properly programmed for model of water heater in use. - Ensure data transfer instructions were followed when installing new P.C. board. - Data transfer not confirmed, follow step by step instructions for programming unit. - Manually program all 14 parameters for your installation and product type per instructions provided with new P.C. board.

Fault Codes

25	Condensate pump error or drain is clogged (Accessory pump connected to condense safety shut off inside water heater)	- Check pump for proper operation (external pump) - Check pump to ensure it has power. - Ensure pump is operational and drain line is not clogges. - Check all wiring connections - Ensure drain line is not clogged and has an air gap in it
32	Outgoing Water Temperature Thermistor	- Check sensor wiring for damage. - Measure resistance of sensor. - Clean sensor of scale build-up. - Replace Sensor. - Code 41 will allow the water heater to continue operating but the freeze protection system will be disabled.
38	Exhaust Gas Temperature Thermistor	
41	Freeze Protection Thermistor	
51	Inlet Water Temperature Thermistor	
52	Gas Valve	– Check flame rod/wiring for loose, broken or damaged components or connections. – Check gas solenoid wire harness for loose or damaged terminals . – Measure resistance of gas valve solenoids. – Ensure gas valve is getting voltage when unit is trying to fire up. – Ensure fan motor is getting voltage when unit is trying to fire up. – Check fan motor for proper operation. – Replace gas valve. – Contact Rinnai for assistance in re-setting unit if error re-appears
54	High Exhaust Gas Temperature	– Ensure inlet water temperature is not to high. – Check for blockage n the vent system's intake or exhaust flue – Check for blockage (build-up of debris) in heat exchanger fins. – Ensure unit was properly converted, if gas type has been changed. – Check heat exchanger surface for hot spots which indicate blockage due to scale build-up - flush heat exchanger or replace based on damage noted to surface. - Clear diagnostic code by resetting the main power supply to the water heater.

Fault Codes

61	Combustion Fan	- Ensure combustion fan spins freely. - Inspect fan motor wiring harness for broken, damaged and loose connectors - Measure resistance value of fan motor, see electrical diagnostics for values. - Inspect vent system intake and exhaust for blockage or ice build-up in termination - Replace fan motor
63	Pump error (internal pump)	- Ensure Cross Over Valve (COV) plug was installed for COV installation. - Check both water filters on unit for blockage, (1) for water inlet & (1) for circulation mode. - Ensure internal pump check valve is functioning properly - Check circulation pump wiring harness for loose, damage or broken connections. - Ensure all manual valves installed in circulation line are open - Ensure water flow servo valve did not fail in the closed position. - Ensure parameters are properly set for the type circulation mode being used, (Cross Over or dedicated mode). See owner's manual for details.
65	Water Flow Control	- Measure resistance values of the water flow control (See Electrical Diagnostics) - The water flow control valve has failed to close during the bath fill function. immediately turn off the water and discontinue the bath fill function.
70	P.C. Board	– Check all wiring harnesses connections on the P.C. board and at each component in the water heater for loose, damaged or broken connections. – Replace the P.C. board.
71	Gas Solenoid Valve Fault	- Ensure the ONLY dip switch on PC board is in the "OFF" position. - Ensure gas control valve wiring is not damaged, loose or broken. - Ensure ceramic heater circuit is not grounded or shorted out. - Replace PC Board.
72	Flame Rod	- Inspect flame rod wiring for loose, damage or broken connectors - Verify heat exchanger is not leaking - Replace flame rod - Replace PC Board.

Fault Codes

SS	Service Soon Alert	- **55** is a time-based service indicator set during installation. See section "3.12 Parameter Settings" in owner's manual for additional details on setting and changing the **55** indicator. - **55** indicates that it is time for service. The heat exchanger should be flushed to prevent damage (refer to section "5.3 Flushing the Heat Exchanger" in owner's manual for more information). **Hard water must be treated to prevent scale build-up or damage to the heat exchanger.** - To reset the **55** code, push the **On/Off** button on the temperature controller 5 times in 5 seconds.
NO Code	Unit does not operate or post an error code when water flow is initiated.	- Check/clean inlet water supply filter. - Ensure the minimum activation water flow rate is met. - Ensure hot and cold water lines are not reversed / cross connected. - Ensure there is not a crossover / cross connection somewhere in the building plumbing or a plumbing fixture. - Check to ensure the water flow turbine spins freely. - Measure resistance of the water flow sensor. - If the display is blank and clicking is coming from the unit, disconnect the water flow servo motor. If the display comes on, replace the water flow servo.
SE	Cascade Diagnostic Display (Commercial units only)	- With cascade connections on commercial units, the primary unit's display will flash between "SE" and the selected set temperature when an error code is displayed on any secondary unit.
FF	Maintenance Indicator	- Placeholder in Diagnostic code history indicating that a service provider performed maintenance or service. Enter this code after performing service by pressing the UP, DOWN and ON/OFF button simultaneously.

Warranty

&

Maintenance

Limited Warranty

Item	Residential Applications	Commercial Applications
Heat Exchanger	*15 Years	**8 Years
All Other Parts and Components	5 Years	5 Years
Reasonable Labor	1 Year	1 Year
Notes:		

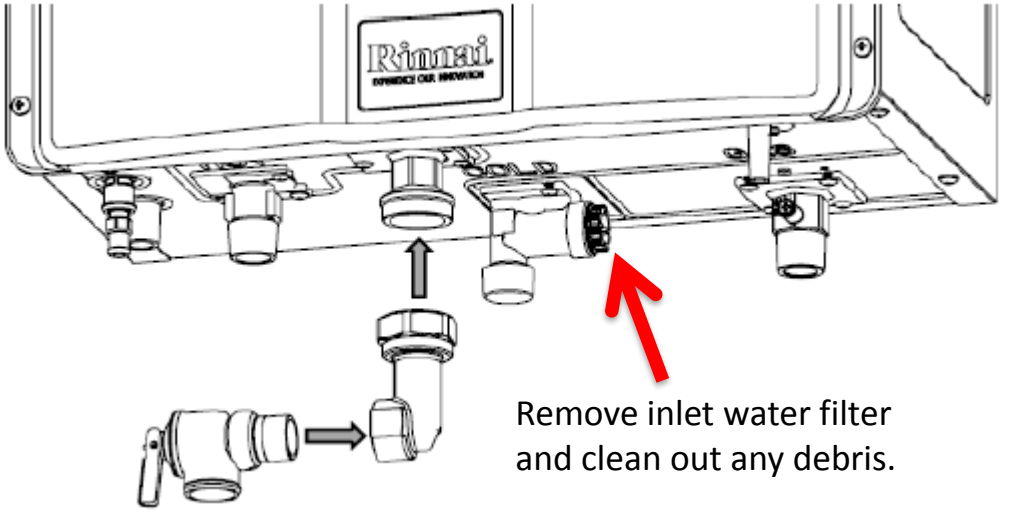
* The heat exchanger warranty will be 15 years or 12,000 operation hours, whichever occurs first.

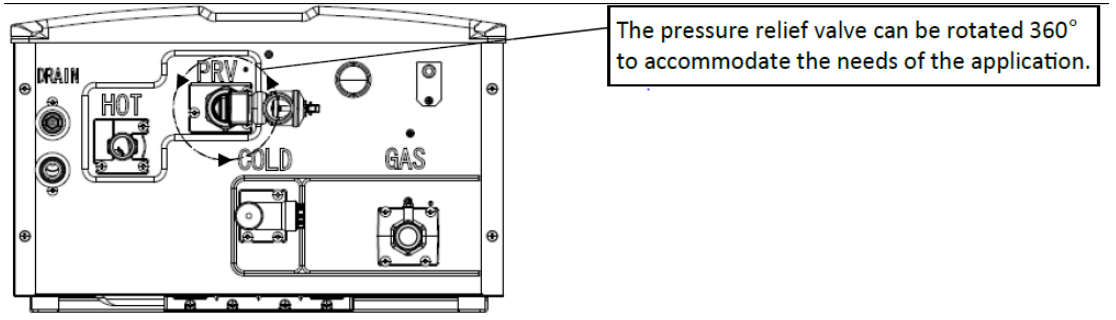
** From date of purchase, period of coverage is reduced to 8 years or 12,000 operation hours, whichever occurs first, if the Rinnai Water Heater temperature setting exceeds 160 °F (71 °C).

- The integrated controller has a 1 year warranty on parts.
- See owner's manual for complete details

Maintenance

- Rinnai recommends that the inlet water filter be cleaned before the initial operation of a new unit and periodically thereafter.
- Before removing the inlet filter, ensure that the water supply has been turned off, and all pressure in the hot water system has been drained off by opening a hot water tap to ensure no water is flowing.
- The filter is located in the cold water supply connection fitting.
- The filter assembly should be hand tightened only.
- Check for leaks after reinstalling filter.





Enhancing Lives By Changing The Way Water Is Heated

Maintenance

The appliance must be inspected annually by a licensed professional. Repairs and maintenance shall be performed by a licensed professional. The licensed professional must verify proper operation after servicing.

Cleaning

It is imperative that control compartments, burners, and circulating air passageways of the appliance be kept clean.

Clean as follows:

1. Turn off and disconnect electrical power. Allow to cool.
2. Close the water shut off valves. Remove and clean the water inlet filter.
3. Remove the front panel by removing 4 screws.
4. Use pressurized air to remove dust from the main burner, heat exchanger, and fan blades. Do not use a wet cloth or spray cleaners on the burner. Do not use volatile substances such as benzene and thinners. They may ignite or fade the paint.
5. Use soft dry cloth to wipe cabinet.

Vent System

The vent system should be inspected at least annually for blockages or damage. If the vent is blocked contact a licensed professional.

Motors

Motors are permanently lubricated and do not need periodic lubrication. However you must keep fan and motor free of dust and dirt by cleaning annually.

Temperature Controller

Use a soft damp cloth to clean the temperature controller. Do not use solvents.

Snow Accumulation

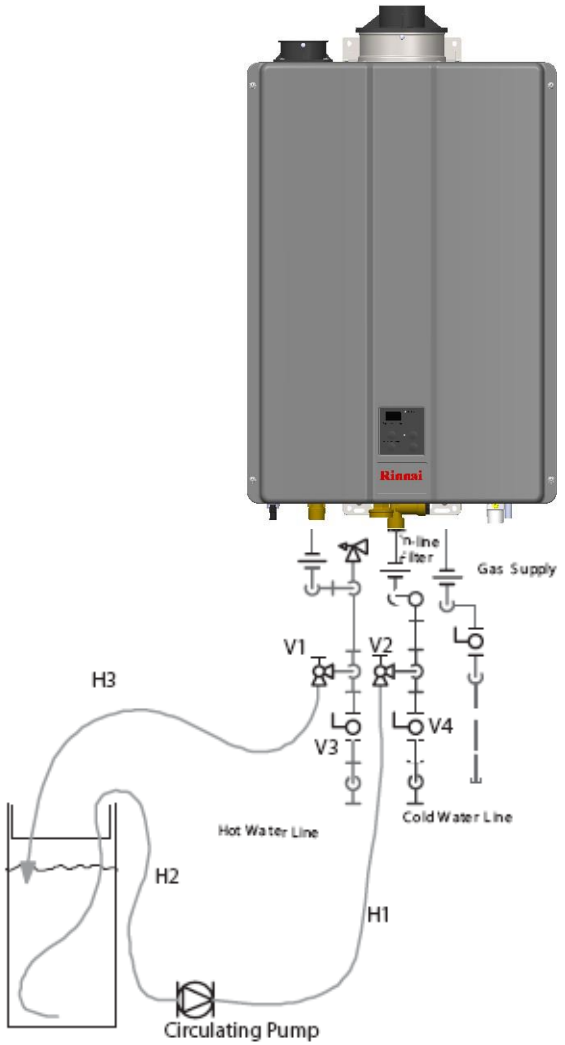
Keep the area around flue terminal free of snow and ice. The appliance will not function properly if the intake air or exhaust is impeded (blocked or partially blocked) by obstructions.

Coastal Installations

Installations located in or near coastal areas may require additional maintenance due to corrosive airborne ocean salt.

Maintenance: Heat exchanger flush procedure.

The Rinnai SENSEI™ N - Series water heaters include a service indicated / reminder. When selected in the parameter settings an "SS" code will display on the controller indicating it is time to flush and service the water heater. Failure to service the appliance may cause damage to the heat exchanger. Damage caused by scale build-up is not covered under the water heater's warranty. Rinnai strongly recommends installation of the included isolation valves to allow for proper servicing of the water heater.



1. Turn off power at the controller, Disconnect electrical power to the water heater, Disconnect from MSB ,Cascade or E-Z connect cables from unit (if applicable).
2. Close the shutoff valves on both the hot and cold water lines (V3 and V4)
3. Connect pump outlet hose (H1) to the cold water line at service valve V2
4. Connect drain hose (H3) to service valve V1
5. Pour approximately 4 gallons of virgin food grade white vinegar into pail
6. Place the drain hose (H3) and the hose (H2) to the pump inlet into the cleaning solution
7. Reconnect power to unit and allow Water flow servo and Water flow by-pass time to reset to start position, approximately 10-15 seconds. Disconnect power again before flushing.
8. Open both service valves (V1 and V2) on the hot and cold water lines
9. Operate the pump and allow the cleaning solution to circulate through the water heater for at least 1 hour at a rate of 4 GPM (15.1 L/min).
10. Turn off the pump
11. Rinse the cleaning solution from the water heater by:
    a. Remove the free end of the drain hose (H3) from the pail and place in a suitable drain
    b. Close service valve, V2, and open shutoff valve, V4. Do not open shutoff valve, V3.
    c. Allow water to flow through the water heater for 5 minutes
    d. Close service valve, V1 and shutoff valve V4.
12. Disconnect all hoses
13. Remove the in-line filter at the cold water inlet and clean out any residue
    a. Place the filter back into the unit.
14. Open shutoff valves V3 and V4.
15. Reconnect MSA, Cascade or E-Z Connect cable (if applicable). Restore electrical power to the water heater.

Enhancing Lives By Changing The Way Water Is Heated

Water Recommendations

- Minimum inlet water pressure 50 psi (Recommended 60 – 80 psi), Maximum inlet water pressure 150 psi.
- The water must be potable, free of corrosive chemicals, sand, dirt, or other contaminates. The maximum levels (with the exception of total hardness and dissolved carbon dioxide) which come from CFR, Title 40, Chapter 1 – EPA, Subchapter D, Part 143 - National Secondary Drinking Water Regulations.

	Total Hardness	Aluminum	Chlorides	Copper	Dissolved Carbon Dioxide (CO_2)	Iron	Manganese	pH	TDS (Total Dissolved Solids)	Zinc
MAXIMUM LEVELS	Up to 200 mg/L (11.7 gpg)	Up to 0.2 mg/L	Up to 250 mg/L	Up to 1.0 mg/L	Up to 15.0 mg/L or PPM	Up to 0.3 mg/L	Up to 0.05 mg/L	6.5 to 8.5	Up to 500 mg/L	Up to 5 mg/L

- If the water heater is installed in an area where water leakage from the unit or the plumbing connections could result in water damage to the area surrounding, floors or lower levels of the structure, a suitable drain pan MUST be installed under the appliances.
- Rinnai recommends the use of water treatment in hard water areas.
- Water heaters utilizing a circulation system will require the installation of an expansion tank.
- DO NOT use Rinnai water heaters as a pool or spa heater.
- DO NOT use Rinnai water heaters in closed loop applications.
- A water treatment system MUST be used in areas known to have hard water in order to maintain the product's parts/labor warranty.
- The air in beauty shops, dry cleaning stores, photo processing labs, and storage areas for pool supplies often contains chemical compounds that can effect the operation of the water heater or cause internal component failures. Therefore it is recommended that outdoor models be used for these locations.
- Refer to owner's manual for complete details pertaining to your product's warranty.

Enhancing Lives By Changing The Way Water Is Heated

Gas Requirements

Gas Supply - Troubleshooting

Issues caused by insufficient gas supply:

- Poor appliance operation
- Error code 10, 11 and 12's.
- Rumbling noises due to insufficient air/gas mixture (this will also occur with incorrect venting)
- Installation may operate correctly until winter, then furnace kicks on and gas demand increases. Now gas system is determined to be undersized due to not taking into account gas load at full capacity.

- If symptoms exist suggesting a gas supply issue as mentioned above you will need a gas manometer to verify the incoming gas pressure. Various manometers are available for testing gas pressure, see two examples below.

U-tube or Slack tube manometers

Digital manometers

Enhancing Lives By Changing The Way Water Is Heated

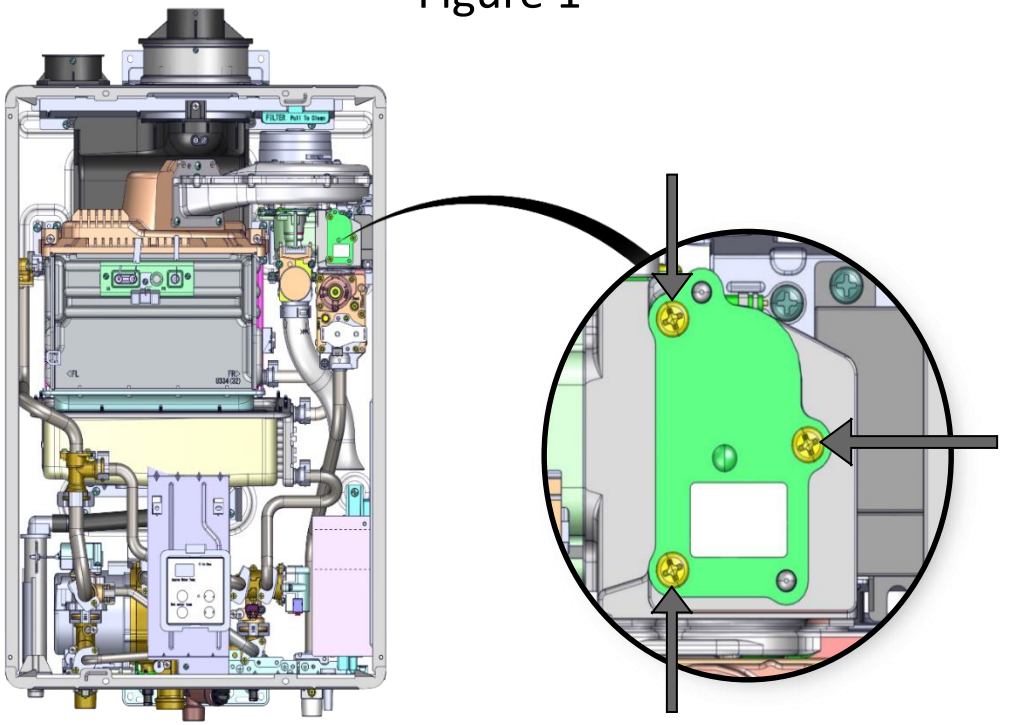
Gas

- An adequate gas supply is critical for proper operation of all Rinnai water heaters.
- The inlet gas pressure to the N-Series water heaters must be within the limits shown on the product's rating plate, Natural Gas = 3.5" – 10.5" W.C. and Propane Gas = 8.0" – 13.5"
- For gas pipe sizing refer to the National Fuel Gas Code, NFPA 54 or applicable State or Local Codes.
- If the gas supply piping is properly sized, your inlet gas pressure should never drop more than 0.3 inches of water column on Natural or 0.5 inches on Propane gas when using black iron piping with all gas appliances firing on high fire.
- If using a gas piping other than black iron, please refer to that manufacturer's pressure drop and line sizing charts for the proper pressure drops and line sizing data.
- Ensure all gas appliance connectors (flexible lines) are approved and sized to handle the Btu load of the appliance it is being connected to.
- Insufficient gas supply can result in:
  - Poor appliance operation and/or water heater shutdown due to fault codes.
  - Noisy operation due to an incorrect gas/air mixture.
  - Failure of heat exchanger over a period of time due to condensation forming in combustion chamber. This hold true for all gas appliances.
  - Soot build-up inside heat exchanger.

Gas Conversion Process

1. Disconnect the electrical power.
2. Turn off the gas supply.
3. Remove (4) screws securing the front panel, remove of unit.
4. Locate orifice cover plate on top portion of gas valve. (Figure 1)
5. Remove 3 screws securing orifice cover plate. (Figure 1)

Figure 1



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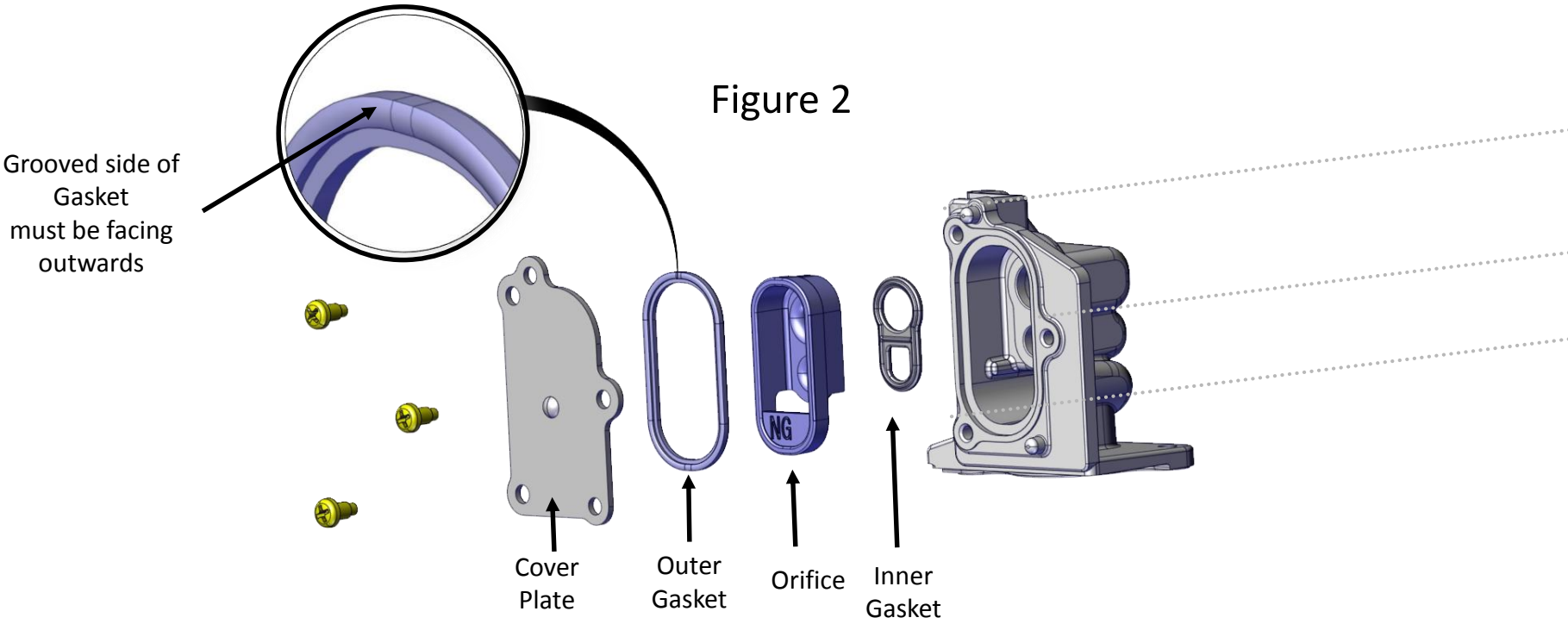
Gas Conversion Process - Continue

6. Remove the plastic orifice from the housing. (Figure 2)
7. Install the new inner and outer gaskets on to the new orifice. (Figure 2)
8. Install new orifice into housing. (Check the gas type displayed on the orifice: Red Orifice is LPG, Blue Orifice is NG).
9. Confirm gasket is correctly in place — Groove side of gasket must be facing outwards. Reinstall orifice cover plate using 3 screws to secure it to the gas valve.
10. Turn on the power and gas, then inspect for gas leaks.
11. Proceed to "Parameter Settings" section to complete the conversion.

Figure 2



Enhancing Lives By Changing The Way Water Is Heated

Programming Parameter Settings

Parameter Adjustment

The following parameters may require adjustments during installation:

- **Maximum Temperature Parameter 1** — Default maximum output temperature;
  - Residential 120°F (49° C).
  - Commercial 140°F (60° C).

  Residential units can be programmed to deliver up to 140°F (60° C).
  Commercial units can be programmed to deliver up to 185°F (85°C).

- **Altitude Parameter 2** — Default altitude is 0 — 2,000 Ft (0 — 610 m).
  Installations over 2,001 ft. require a parameter change.
  These units can be installed in applications up to 10,200 ft.

- **Maximum Water Flow Rate** *(the rate at which water flows through the water heater)* — Default water flow rate is "standard flow rate" and can be adjusted to "high flow rate." For regions with warm ground water temperatures, selecting "High Flow Rate" will enable increased water flow through the water heater.

⚠ WARNING Only licensed professionals who are trained for servicing Rinnai Tankless Water Heaters are permitted to adjust parameter settings. Adjust only the parameter settings discussed in this section; adjusting additional parameter settings may result in property damage, personal injury, or death.

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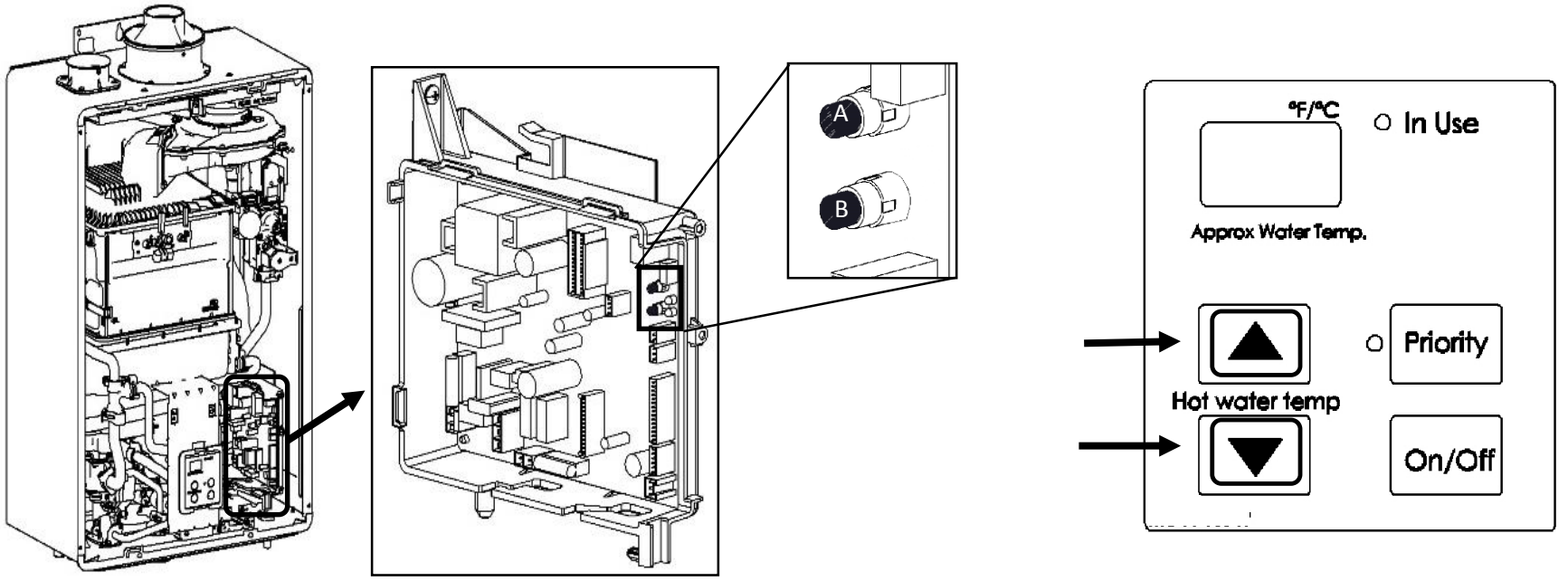
Adjusting Parameters

1. Locate the PC Board (lower right side of unit)
2. Locate the two push buttons (A and B) on the PC Board.
3. Press the “A” button
4. Use the ▲ and down ▼ buttons on the controller to select a setting number (*See Parameter Settings Table).*

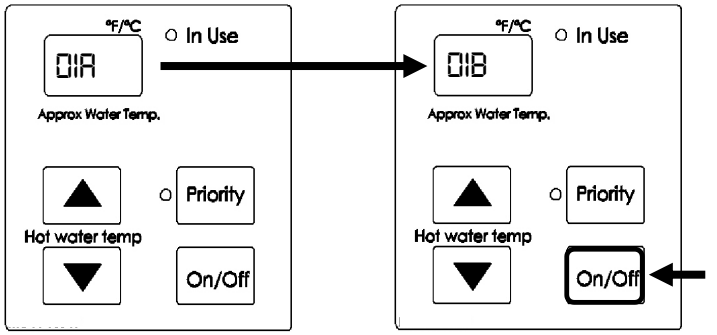


Enhancing Lives By Changing The Way Water Is Heated

Adjusting Parameters

5. Once the desired parameter setting number is selected, use the “On/Off” button on the controller to change the selection for that setting number.

Example: Display will change from 01A to 01b for Maximum Temperature setting (as shown below).



6. To exit the parameter setting mode press the “A” button on the PC board for 1 second, this will lock in your selection.

Enhancing Lives By Changing The Way Water Is Heated

Parameter Setting Table

Setting Number	Setting Description	Selection					
		A	B	C	D	E	F
01	Maximum Set Temperature	120°F – *Residential* 140°F – *Commercial*	140°F – *Residential* 185°F – *Commercial*				
02	High Altitude	Level 0 0 - 2,000 ft. (0 - 610M)	Level 1 2,001 ft. - 5,400ft. (610m - 1,646m)	Level 2 5,401ft. - 7,700ft. (1,646m - 2,347m)	Level 3 7,701ft. - 10,200ft. (2,347m - 3,109m)		
03	Service Soon[1]	Disable	0.5 Yr.	1 Yr.	2 Yr.		
04	Recirculation Settings	No Recirculation	Recirculation Modes				
			Dedicated Mode	Cross Over Mode			
				Long Loop	Short Loop		
05	Recirculation Mode[2]	Comfort	Economy				
06	Control Switch	BMS[3]	AH				
07	EZ Connect	2 Units	1 Unit				
08	Cascade[4]	Secondary	Primary				

Enhancing Lives By Changing The Way Water Is Heated

Parameter Setting Table

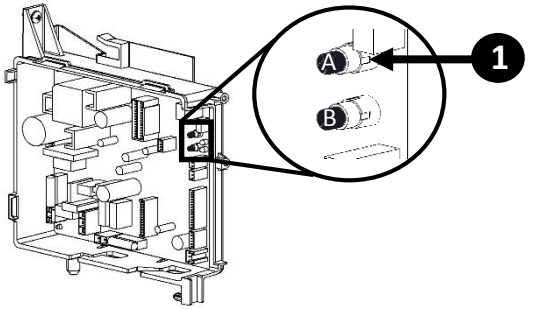
Setting Number	Setting Description	Selection					
		A	B	C	D	E	F
09	Units in Standby (Cascade)[4]	1	2	3	4	5	6
10	Gas Type	NG	LP				
11	Maximum Flow Rate[5]	Standard	High				
12	Water Heater Model	Commercial Without Pump (CU)	With Pump (Integrated Pump)				
13		199KBtu (3237)	180KBtu (2934)	160KBtu (2530)	130KBtu (2024)		
14		Internal (Indoor)	External (Outdoor)				

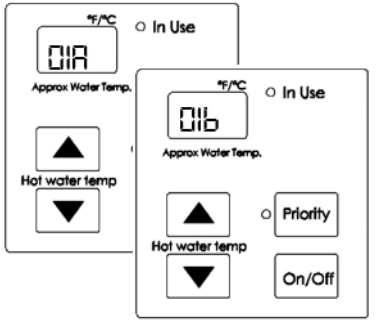
Default is **A** for all settings above except 10, 12, 13, and 14 which are factory set.

[1] See section "3.13 Service Indicator in owner's manual (Service Soon, 55)" for more information.
[2] Setting 05 is available only if setting 04b is selected.
Comfort mode cycles the pump more frequently, ensuring the loop temperature remains higher (but also uses more energy).
Economy mode cycles the pump less often, using less energy to maintain the circulation loop temperature.
[3] BMS = Building Management System
[4] Setting 09 is available only if setting 08b is selected.
[5] Selecting "High" will increase the water flow rate to the maximum capacity.

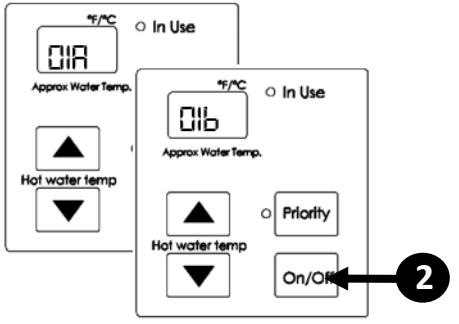
Adjust Maximum Temperature

1. Press and hold the top push button (“A”) on the PC Board for 1 second. The display will indicate the currently selected temperature setting (01A or 01b).



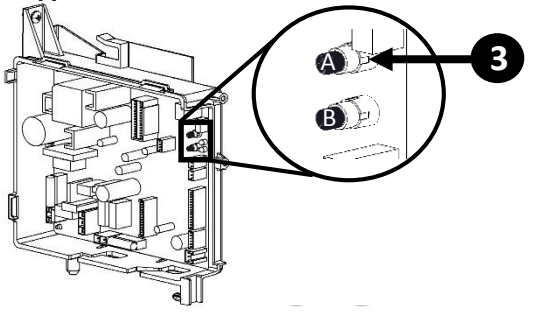


2. Press the “On/Off” button to scroll through the available temperature settings.



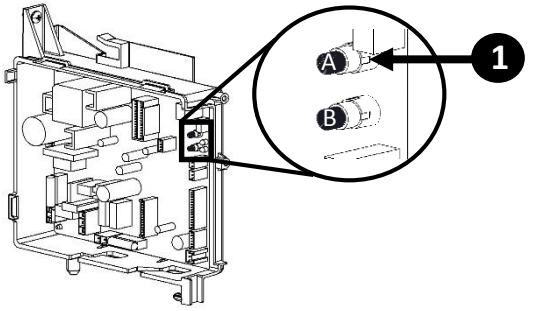
Setting	Maximum Temperature
01A	120°F (49°C) Factory Default (*Residential)* 140°F (60°C) Factory Default (*Commercial*
01b	140°F (60°C) (*Residential)* 185°F (85°C) (*Commercial*

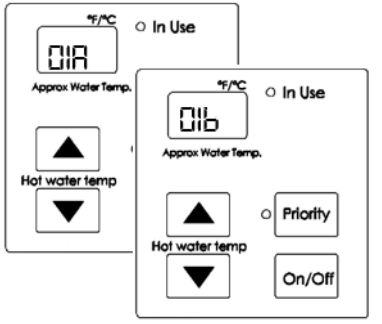
3. When the desired temperature setting appears in the display, press the top push button (“A”) on the PC board for 1 second to save the setting and return the water heater to normal operation mode.



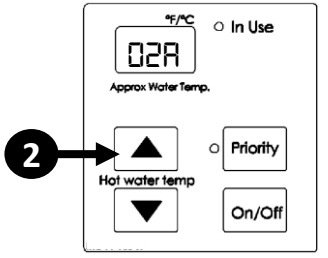
Adjust Altitude

1. Press and hold the top push button (“A”) on the PC Board for 1 second. The display will initially indicate the active temperature setting (01A or 01b).





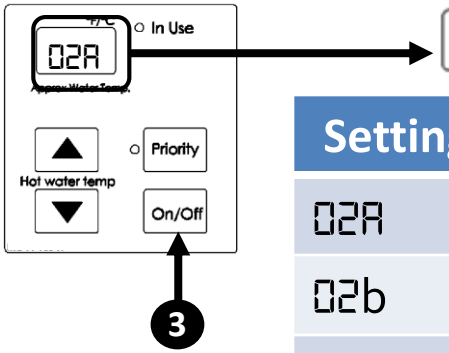
2. Press the (Up) ▲ button on the controller until parameter 02A, 02b, 02c or 02d appears.

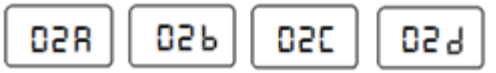


Enhancing Lives By Changing The Way Water Is Heated

Adjust Altitude

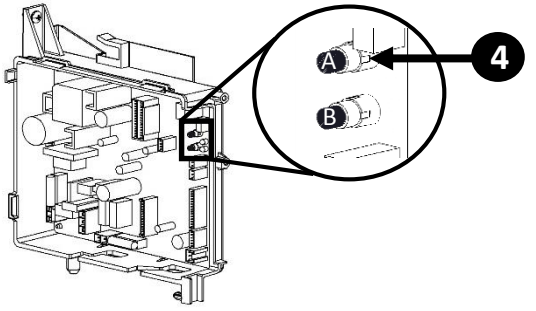
3. Press the (On/Off) button on the controller to scroll to the desired altitude setting.





Setting	Altitude
02A	**Level 0 (Default):** 0 - 2,000 Ft (0-610 m)
02b	**Level 1:** 2,001 – 5,400 Ft (610 – 1,646 m)
02C	**Level 2:** 5,401 – 7,700 Ft (1,646 – 2,347 m)
02d	**Level 3:** 7,701 – 10,200 (2,347 – 3,109 m)

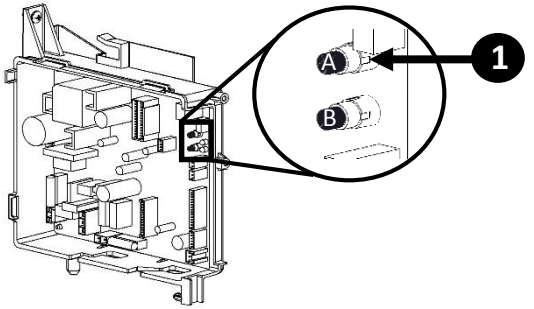
4. When the desired altitude setting appears in the display, press the top push button (“A”) on the PC board for 1 second to save the setting and return the water heater to normal operation mode.

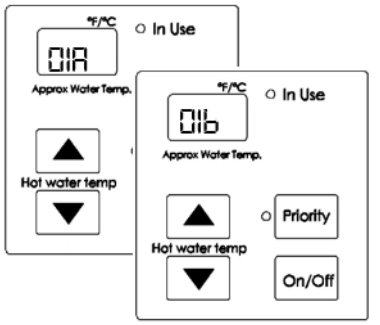


Enhancing Lives By Changing The Way Water Is Heated

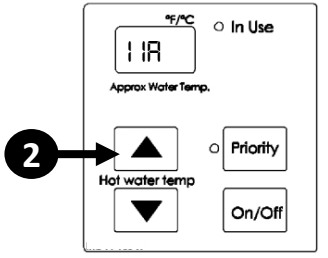
Adjust Maximum Flow Rate

1. Press and hold the top push button (“A”) on the PC Board for 1 second. The display will initially indicate the active temperature setting (01A or 01b).





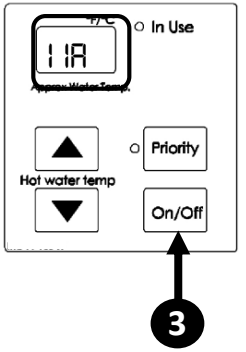
2. Press the (Up) ▲ button on the controller to scroll to the active Maximum Flow Rate (11A or 11b).



Enhancing Lives By Changing The Way Water Is Heated

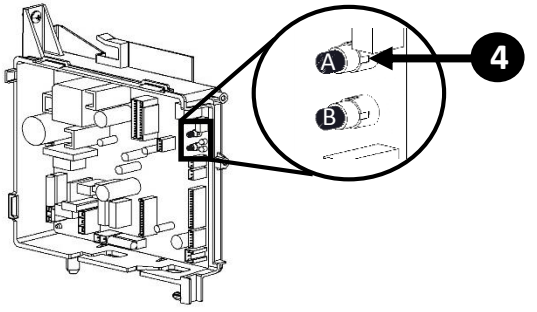
Adjust Maximum Flow Rate

3. Press the On/Off button on the controller to scroll to the desired Maximum Flow Rate setting.



Setting	Maximum Flow Rate
1 1A	**Standard Flow Rate (Default)**
1 1b	**High Flow Rate**

4. When the desired altitude setting appears in the display, press the top push button (“A”) on the PC Board for 1 second to save the setting and return the water heater to normal operation mode.

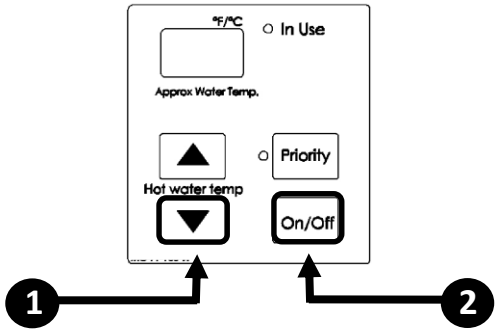


Enhancing Lives By Changing The Way Water Is Heated

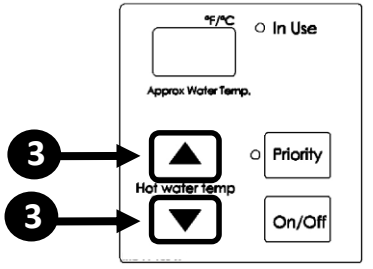
To Obtain Performance Data

1. Press and hold the ▼ (Down) button.

2. While holding the ▼ (Down) button for 2 seconds, press and hold the “On/Off” button (hold both buttons simultaneously).



3. Use the ▲ (Up) and ▼ (Down) buttons to scroll to the desired diagnostic information described below.



Enhancing Lives By Changing The Way Water Is Heated

Performance Data Details

#	DATA	UNIT
01	Water Flow Rate	0.1 gal/min
02	Outgoing Temperature	°F
03	Combustion Hours	x100 Hours
04	Combustion Cycles	See following information
05	Fan Frequency	Hz
06	Additional Controllers Connected	See following information
07	Water Flow Servo Position	0=mid, 1=Open, 2=Closed
08	Inlet Temperature	°F
09	Fan Current	x10 mA
10	Total Bath Fill Amount	gallons
11	HEX Outlet Temperature	°F
12	By-Pass Flow Control Position	Degrees of opening
15	Freeze Protection Temperature (*Indoor Unit Only)*	°F
17	Freeze Protection Temperature (*Outdoor Unit Only)*	°F
19	Pump Hours	x100 Hours
20	Pump Cycles	See following information
21	Exhaust Temperature	°F

Performance Data Details

Performance Data 04 & 20 = Combustion & Pump Cycles

CYCLE COUNT	LOW NUMBER	HIGH NUMBER
0-999	0	999
1,000-9,999	10-	99-
10,000-65,535	1- -	6- -

Performance Data 06 = Additional Controllers Connected to Product

CONTROLLER MODEL	CONNECTED	NOT CONNECTED
MC	001	000
BC	010	000
BSC & BSC2	100, 200 (QTY2)	000

Maximum Vent Length Quick Reference Vent Diameter / Vent Type / # of Units	RU130i, RU160i RU180i, RU199i	RUR160i RUR199i	CU160i CU199i	Demand Duo W/CU199
	Maximum Equivalent Length in Feet			
CONCENTRIC DIRECT VENT				
2” x 4” Concentric (Direct Vent)	65	65	65	65
3” x 5” Concentric (Direct Vent)	150	150	150	150
TWIN PIPE DIRECT VENT				
2" PVC/CPVC/PP (Dual Pipe - Direct Vent)	65	65	65	65
3" PVC/CPVC/PP (Dual Pipe - Direct Vent)	150	150	150	150
3” Centrotherm PP, Vent System (Dual Pipe - Direct Vent)	150	150	150	150
SINGLE PIPE, NON-DIRECT VENT (Room Air)				
2" PVC/CPVC/PP (Single Pipe – Room Air)	65	65	65	65
3" PVC/CPVC/PP (Single Pipe – Room Air)	150	150	150	150
PVC / CPVC / PP DIRECT COMMON VENT, RESIDENTIAL				
3” PVC/CPVC (Dual Pipe - Direct Vent) 2 units	65	65		
4” PVC/CPVC (Dual Pipe - Direct Vent) 2 units	65	150		
6” PVC/CPVC (Dual Pipe - Direct Vent) 2 units	65	150		
PVC / CPVC / PP NON – DIRECT COMMON VENT (Room Air), RESIDENTIAL				
3” PVC/CPVC (Single Pipe - Room Air) 2 units	65	65		
4” PVC/CPVC (Single Pipe - Room Air) 2 units	65	150		
6” PVC/CPVC (Single Pipe - Room Air) 2 units	65	150		

NOTE: When calculating vent lengths, the termination configuration may have a length equivalency that will need to be added to the length of straight pipe and the elbow equivalencies (listed below). For two-pipe vent installations, use the calculated length of the intake or exhaust, whichever is longer. Do not add them together. See installation manual for specifics.

Equivalent lengths – 2” x 4” / 3” x 5” concentric vent	
90° Elbow = 6 feet	45° Elbow = 3 feet

Equivalent lengths –2”, 3”, 4”, 6” PVC/CPVC/PP or Common vent	
90° Elbow = 10 feet	45° Elbow = 5 feet

NOTE: This document is meant as a guide and not as a replacement for the information contained in the applicable water heater and/or common vent installation manuals. Refer to the appropriate manual for complete details.

Enhancing Lives By Changing The Way Water Is Heated

Maximum Vent Length Quick Reference Vent Diameter / Vent Type / # of Units	CU160i		CU199i		Demand Duo W/CU199	
	Maximum Equivalent Length in Feet					
PVC / CPVC / PP DIRECT COMMON VENT / NON - DIRECT COMMON VENT (Room Air), COMMERCIAL						
	3" Header		3" Header		3" Header	
3" Vent (Dual Pipe - Direct Vent / Single Pipe - Room Air) 2 Units	90		65		65	
	4" Header	6" Header	4" Header	6" Header	4" Header	6" Header
4" Vent (Dual Pipe - Direct Vent / Single Pipe - Room Air) 2 Units	150		150		150	
4" Vent (Dual Pipe - Direct Vent / Single Pipe - Room Air) 3 Units	100		150		150	
4" Vent (Dual Pipe - Direct Vent / Single Pipe - Room Air) 4 Units	65		65		65	
6" Vent (Dual Pipe - Direct Vent / Single Pipe - Room Air) 2 Units	150	150	150	150	150	150
6" Vent (Dual Pipe - Direct Vent / Single Pipe - Room Air) 3 Units	150	150	150	150	150	150
6" Vent (Dual Pipe - Direct Vent / Single Pipe - Room Air) 4 Units	150	150	150	150	150	150
6" Vent (Dual Pipe - Direct Vent / Single Pipe - Room Air) 5 Units			150	150	150	150
6" Vent (Dual Pipe - Direct Vent / Single Pipe - Room Air) 6 Units			150	150	150	150
6" Vent (Dual Pipe - Direct Vent / Single Pipe - Room Air) 7 Units			70	150	70	150
6" Vent (Dual Pipe - Direct Vent / Single Pipe - Room Air) 8 Units				150		150

NOTE: When calculating vent lengths, the termination configuration may have a length equivalency that will need to be added to the length of straight pipe and the elbow equivalencies (listed below). For two-pipe vent installations, use the calculated length of the intake or exhaust, whichever is longer. Do not add them together. See installation manual for specifics.

Equivalent lengths – 3", 4", 6" PVC/CPVC/PP Common vent	
90° Elbow = 10 feet	45° Elbow = 5 feet

NOTE: This document is meant as a guide and not as a replacement for the information contained in the applicable water heater and/or common vent installation manuals. Refer to the appropriate manual for complete details.

Enhancing Lives By Changing The Way Water Is Heated

Notes

Residential Units

- Residential units up to (24) can be linked together using the MSB system.
- Cascading is NOT allowed with residential units, only commercial product.
- Two units can be linked together with the EZConnect cable.
- The Next Generation commercial pump model and a non pump commercial model can be used in a two unit application using circulation without the use of a PVA valve. Programming of the this product allows for the elimination of the PVA valve.
- To date there is not commercial version of the RUR unit. The residential RUR can be used in commercial applications as long as the internal pump can handle the head loss across the water heater and building plumbing system. NOTE; only MSB's can be used in this application. Cascading is only allowed with commercial product. In addition, if using the residential RUR the set point temperature will be limited to 140 degree outlet temperature. Rinnai would recommend using all non RUR commercial products with a circulation pump sized to your system. This will allow cascading the units and a set point temperature up to 185 degrees.

Commercial Units

- Commercial units can be cascaded together with up to 24 units, no need for the MSB's.
- A commercial unit can be added to an existing system using RU or RUC products with the existing MSB system.
- Two commercial units can be linked together with the EZConnect cable.
- The Next Generation commercial pump model and a non pump commercial model can be used in a two unit application with circulation without the use of a PVA valve. Just use an EZConnect cable between the two units. Factory programming will unit allows to operator without using the PVA.
- If cascading set parameter 08 on the primary unit to parameter 08b. That unit will now become the primary water heater, all others will be secondary units. Next, place the jumper provided with the cascade cable in the top cascade connector on the P.C board of the primary unit. Then, plug the cascade cable into the bottom cascade connector and link that unit to the second water plugging that cable into top cascade connector on the second unit. Next, continue cascading units plugging the cascade cable from the second unit into the top connector of the third unit, repeat this process out to the remaining units. On the last unit the bottom cascade connector will be empty, place the jumper provided with your cascade cables in that

connector. The primary unit will show the temperature setting when power is applied. The remaining (secondary) units will show --.-- Next press the ON/OFF button one time on each of the remaining units to set their order of secondary priority. A number will appear a the controller showing 01 – through the number of units you have in the system, showing order of priority. The primary unit is the only unit that will show the set point temperature, all others show the number selected as a secondary unit 1 – 24).

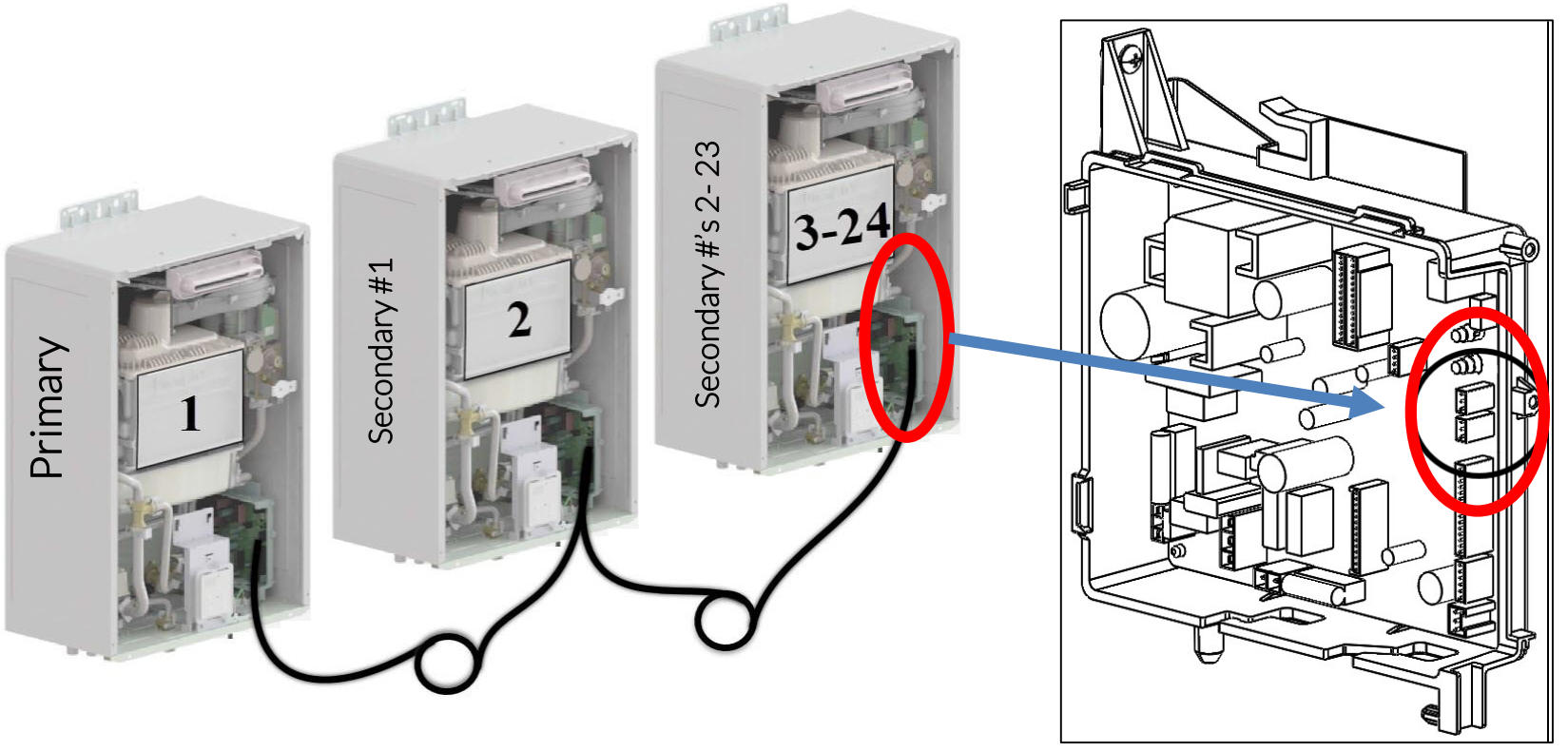
- Next, you will need to go to parameter 09 and select the number of units you want to be on standby. You can select up to six units to be on standby, see parameter settings below for number of units in standby.

  09A = 1 unit
  09B = 2 units
  09C = 3 units
  09D = 4 units
  09E = 5 units
  09F = 6 units

Cascading Multiple Units – Commercial ONLY

With the use of cascade cable(s) up to 24 water heaters can be electronically connected.

- The cascade connection enables all connected water heaters to modulate operation and function as one single hot water source.
- The connection will rotate water heater operation to ensure equal usage among the entire system.



NOTE: For proper operation do not combine different models with cascade communication.

Enhancing Lives By Changing The Way Water Is Heated

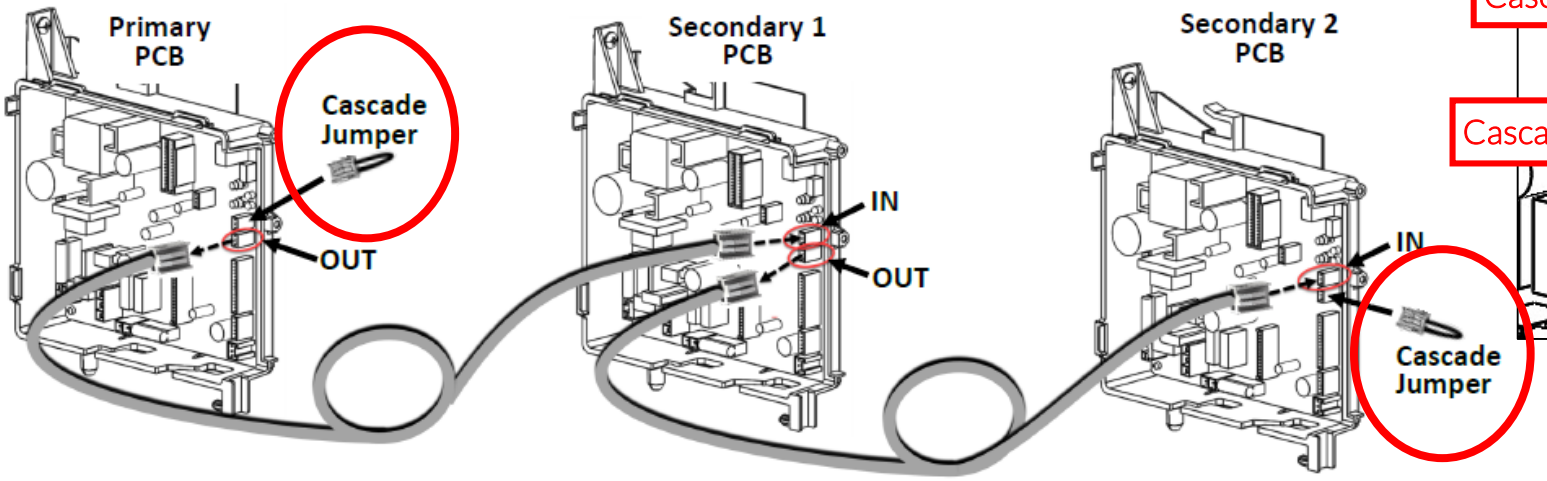
Cascading Multiple Units – Commercial ONLY

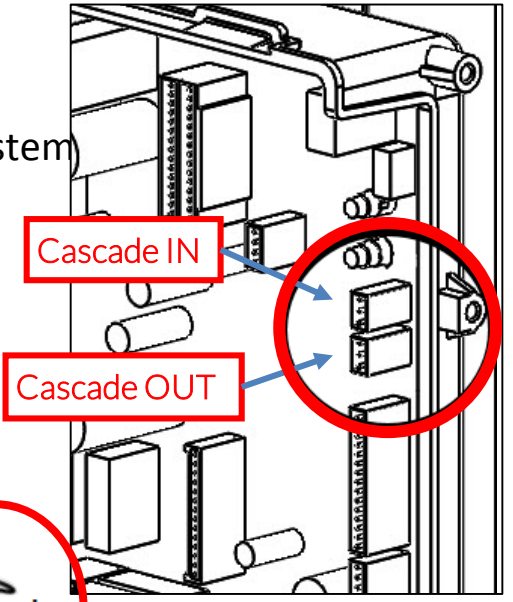
A single cascade cable accessory is all that is needed to connect two commercial water heaters. Each cable accessory includes:

- One cable 26 ft. (8 m) or 10 ft. (3 m) - Based on which length you order
- Two cascade jumpers.

Installation:

1. Connect one end of the Cascade Cable to the “Cascade OUT” accessory port on the first (primary) water heater’s PC Board.
2. Connect the other end of the Cascade cable to the “Cascade IN” accessory port on the next (secondary) water heater’s PC Board.
3. Repeat steps 1. and 2. for each subsequent water heater in the system.
4. Connect the “Cascade Jumper” (included with the cascade cable) to the open accessory ports (open ports should be on the first and last water heater in the system)
5. Proceed to “Programming Cascade Communication” in the manual.





Cascading Multiple Units – Commercial ONLY

Programming Cascade Communication. See section 3.12 Parameter Settings of the install manual.

Setting #	Setting Description		Selection					
			A	B	C	D	E	F
08 (Commercial ONLY)	Cascade		Secondary (1-24)	Primary				
09 (Commercial ONLY)	Units In Standby (Cascade)		1	2	3	4	5	6

Setting # 08 Cascade:

- **Primary:** Select the water heater intended to be the primary water heater for cascade communication. Set the parameter for this water heater to **"Primary" –** (**08b**). **NOTE:** This controller will display the set temperature for the system.

- **Secondary:** Factory Default setting for each water heater is set to **"Secondary" - (08A).** Parameter adjustment will only be necessary on the water heater identified as "Primary". **NOTE:** Secondary water heater controller(s) will display " **- - -** " when the primary unit is selected.

Setting # 09 Units in Standby:

- Adjust the parameter setting of the **Primary** unit to select the number of water heaters in standby mode. Up to 6 units can be selected to be in the standby mode. Standby units will maintain operation with the water flow control valve in the Open position. The standby units will be ready to fire when sufficient water flow is detected.

- The remaining secondary water heaters will maintain operation with the water flow servo valve closed and will operate when water flow demand increases to the point additional units are needed.

Setting Secondary ID:

- After identifying the **"Primary"** water heater in the parameter settings, set the **ID** for ALL remaining water heaters in the system by pressing the On/Off button on each controller.

- When a position ID setting is successful, the controller on that unit will change from " **- - -** " to show the newly set ID number. The secondary ID will be displayed in the order the buttons are pressed on the secondary units.

- Example**:** First secondary unit will show " **– 01** " , Second secondary unit will show " **– 02** " and so on.

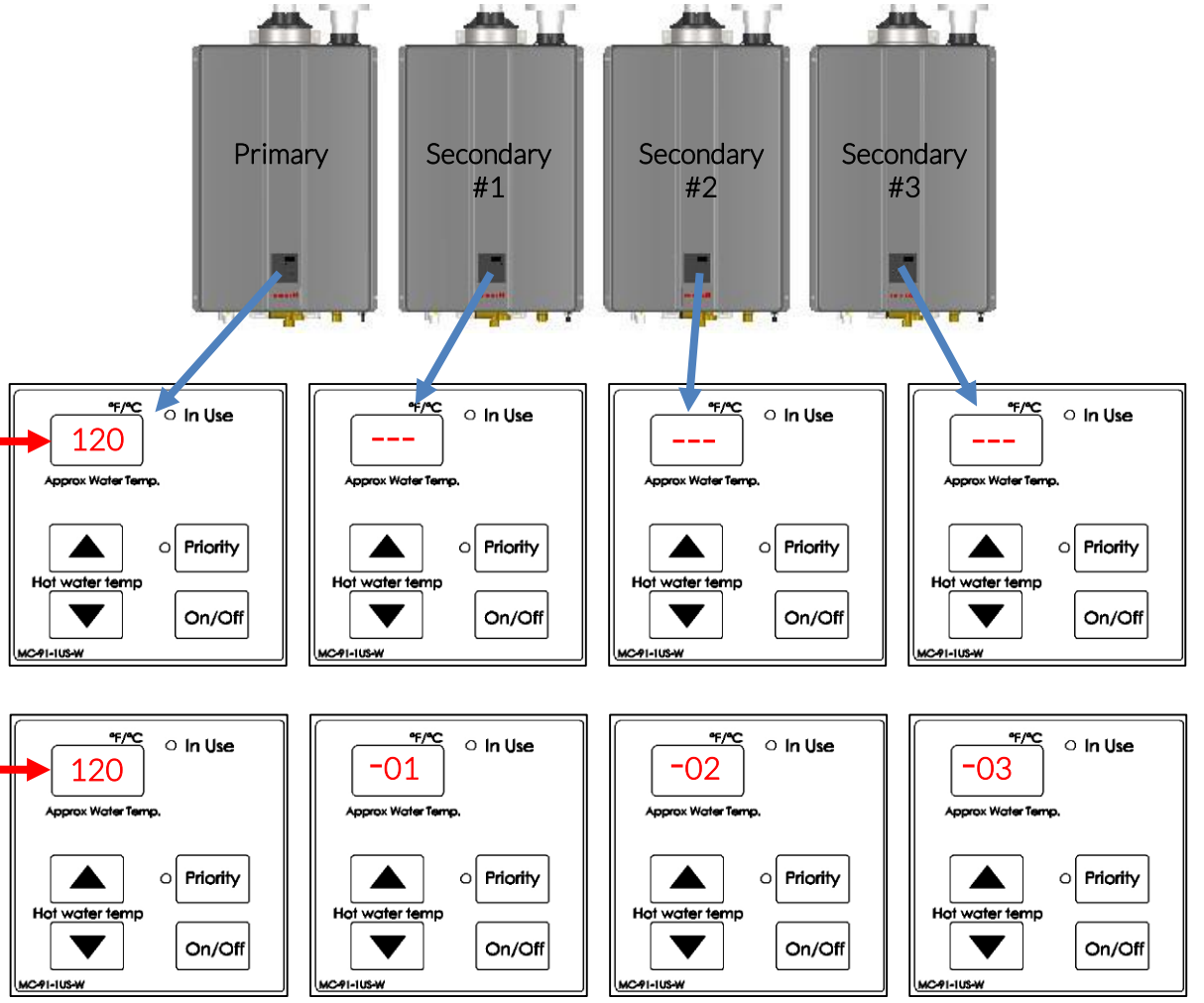
Cascading Multiple Units – Commercial ONLY

Programming Cascade Communication: Display examples.

- When the primary and secondary units are designated through the parameter settings the display will be as shown below.

When the Primary unit is designated through parameter setting #08 the displays will show the set temperature. Secondary units will show "- - -"

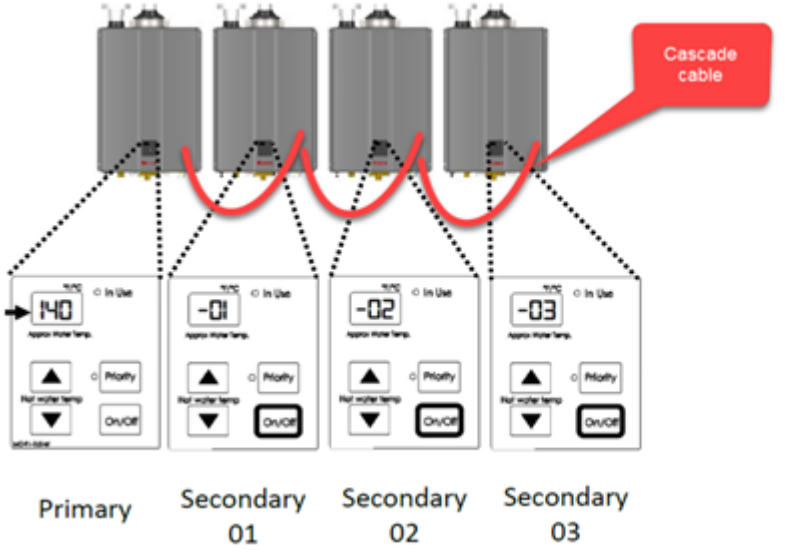
After the Primary unit is designated, press the On/Off button on the secondary units in order. The displays will change from the "---" to show the ID number of each unit in the Cascade system.



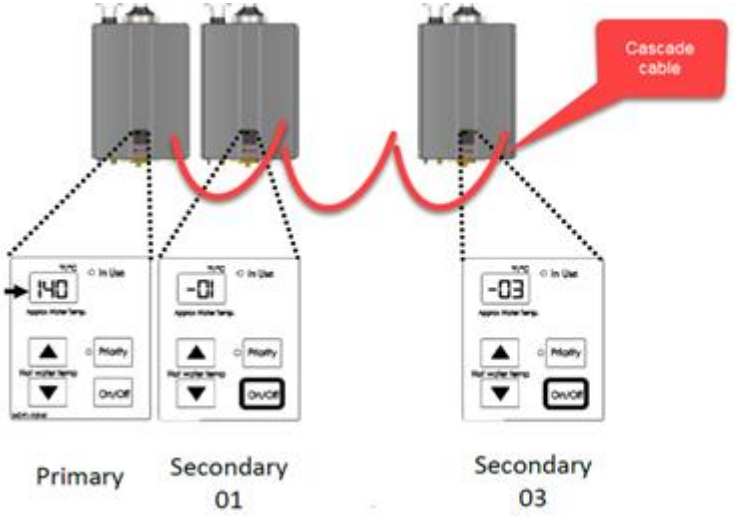
Enhancing Lives By Changing The Way Water Is Heated

Servicing or Replacing a Cascading Unit

While servicing or replacing a unit using Rinnai's cascade system you MUST isolate that unit from the system. Follow the steps noted to the right and following slide.



Commercial application with 3 or more water heaters

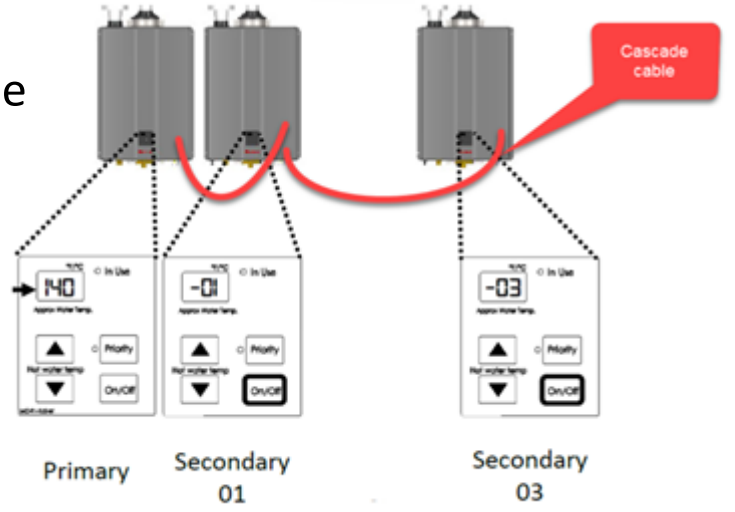


What happens if the third unit (secondary 02) fails and needs to be removed for repair or service?

Enhancing Lives By Changing The Way Water Is Heated

Servicing or Replacing a Cascading Unit

Once service or unit replacement is complete, reconnect the cascade cables back to that unit to place it back into the system rotation.



Would you have to move the cascade cable from "out" of Secondary 01 to the "in" of secondary 03?

Is there anything else you would need to do?

Voltage and Resistance Values

Electrical Diagnostic Points

When measuring resistance always make sure the power supply to the unit is turned off and the component being check is isolated from the P.C. board.

1. Check for 120 V.A.C. **Power Supply** to the water heater – (**Plug CN1**):
   a. Connector "A" pin 1 white wire & pin 3 black wire.

2. Verify **10 Amp Fuse** is not blown next to connector A. Check fuse…

3. Measure resistance and/or voltage of the **Overheat Switch** – **(Plug H6**):
   a. Connector "H" pin #14 black wire & connector "D" pin 28 black – Less than 1 ohm or 11 ~ 13 VDC.

4. Measure resistance and/or voltage of the **Main Gas Valve Solenoid – (Plug D7):**
   a. Connector "D" black wire pin #27 & yellow wire pin #29 – 18 ~ 22 ohms or 11 ~ 13 VDC.

5. Measure resistance and/or voltage of the **Fan Motor – (Plug D3)**:
   a. Connector "D" red wire pin #4 & black wire pin #6 – N/AΩ or 7 ~ 48 VDC.
   b. Connector "D" white wire pin #10 & black wire pin #6 – 10 ~ 12 VDC.
   c. Connector "D" yellow wire pin #8 & black wire pin #6 – 11 ~ 13 VDC.

6. Measure resistance of **Outgoing Water Thermistor – (Plug H1)**:
   a. Connector "H" white wire pin #2 (turns black before getting back to board) & white wire pin #3 - See values below.
   b. Connector "H" blue wire pin #9 & blue wire (turn black before getting back to board) pin #11 - See values below.

59 ˚F	=	11.8 ~ 13.3K ohms
86 ˚F	=	6.7 ~ 7.4K ohms
113 ˚F	=	3.9 ~ 4.3K ohms
140˚F	=	2.4 ~ 2.7K ohms
221 ˚F	=	0.66 ~ 0.76K ohm**s.**

Enhancing Lives By Changing The Way Water Is Heated

Electrical Diagnostic Points

7. Measure resistance of I**nlet Water Thermistor – (Plug H2)**:
   a. Connector "H" white wire (turns black before getting back to board) pin #2 & white wire pin #4 - See values below.
   b. Connector "H" blue wire pin #9 & blue wire (turn black before getting back to board) pin #11 - See values below.

8. Measure resistance or voltage of **Water Flow Servo Valve – (Plug D4)**:
   a. Connector "D" red wire (turns black before getting back to the board) pin #30 & pink wire pin #20 – 44 ~ 52Ω.
   b. Connector "D" white wire pin #16 & blue wire pin #14 – 44 ~ 52Ω.
   c. Connector "D" grey wire (turns black before getting to board) pin #30 & orange wire pin #12 = 12 ~ 14 VDC,

9. Measure resistance of **Exhaust Temperature Thermistor - (Plug H3)**:
   a. Connector "H" white wire pin #2 (turns black before getting back to board) & white wire pin #5 – See values below.

10. Measure resistance of **Heat Exchanger Thermistor - (Plug H4)**:
    a. Connector "H" white wire pin #2 (turns black before getting back to board) & white wire pin #6 – See values below.

11. Measure voltage of **Freeze Protection Thermistor - (Plug H5)**:
    a. Connector "H" white wire pin #2 & yellow wire pin #12. See resistance value below.

12. Check for 120 VAC to **Freeze Protection Heater Circuit** - **(Plugs C1 ~ C5**):
    a. Connector "C" black wire pin #2 & black wire pin #3 - See values below.

59 ˚F	=	11.8 ~ 13.3K ohms
86 ˚F	=	6.7 ~ 7.4K ohms
113 ˚F	=	3.9 ~ 4.3K ohms
140˚F	=	2.4 ~ 2.7K ohms
221 ˚F	=	0.66 ~ 0.76K ohms.

Enhancing Lives By Changing The Way Water Is Heated

Electrical Diagnostic Points

13. Measure resistance of **Water Flow Sensor - (Plug H7)**:
    a. Connector “H” black wire pin #30 & Connector D red wire pin #12 – 4 ~ 7 VDC

14. Measure resistance of **By-Pass Flow Control Valve - (Plug D4):**
    a. Connector “D” red wire pin #15 & pink wire pin #13 – 44 ~ 52Ω.
    b. Connector “D” white wire pin #17 & blue wire pin #19 – 44 ~ 52Ω.

15. Measure resistance of **Venturi Control Device Servo - (Plug D5):**
    a. Connector “D” Red wire pin #12 & Black wire pin #30 at the P.C. board = 12 ~ 14 VDC when 120 VAC
    b. Connector “D” Brown wire pin #25 & Black wire pin #30 at the P.C. board = Less than 1 VDC
    c. Connector “D” Grey wire pin #23 & Black wire pin #30 at the P.C. board = Less than 1 VDC
    d. Connector “D” Blue wire pin #5 and white wire pin #7 = 35 ~ 41 ohms
    e. Connector “D” Yellow wire pin #11 and Red wire pin #9 = 35 ~ 41 ohms

16. Measure resistance or voltage of Sparker Electrode **- (Plug D2):**
    a. Connector “D” Red wire pin #12 & Black wire pin #21 – 11 ~ 13 VDC or 34K ~ 40 KΩ.

17. Measure voltage of **Additional Remote Controller(s):**
    a. Connector “H” Yellow wire pin #1 & Black wire pin #3 = 4 ~ 7 VDC.