LowNOx Commercial Gas Electronic Spark Ignition Sequence

The Universal™ gas LowNOx series water heaters contain an electronic spark ignition system. The heater is connected to a 120VAC power source required by the transformer. The transformer steps down the 120VAC to 24-volt AC control voltage. When the heater is turned on (1), a black wire carries power to the 24V step-down transformer and the relay switch. The yellow wire from the transformer (2) carries the 24V from the transformer to the thermostat. In a normal stand-by condition, 24V is passed directly to the damper assembly by the yellow wire and connected to the 24V terminal. This terminal controls the closing of the damper after the thermostat is satisfied.

When the thermostat calls for heat (3), contacts close and pass the 24V through the blue wire to the damper assembly TH terminal. A microswitch inside the damper does two things. (4) First, the microswitch breaks contact from the 24V terminal that closes the damper and connects the TH terminal. The TH terminal provides power to the damper motor that drives the damper blade open. The damper blade, being open, will allow combustion gases to escape through the flue ways and vent. Second, when the damper is opened to the correct position, a microswitch passes the 24V control voltage to the Relay switch. (5)

The relay switch becomes a critical safety device as well as a power controller. 24V power is passes along the blue wire to the pressure switch to verify the switch is open (6). If this safety is passed, then the relay allows 120V power to pass (7) to the blower motor. The blower motor ramps up and creates a positive pressure for the pressure switch. The pressure switch closes (9) and 24V power is passed to the 24V terminal of the Honeywell control module

Power is now being supplied to the 24V terminal of the control module (10) by the red wire. This is the only wire that feeds power to the control module. The control module now starts a 90 second try for ignition. It may only take a second or two for the pilot burner to ignite. The control module attempts two events simultaneously. The ignition control module generates a 10,000 volt spark at the pilot electrode assembly (11) and attempts to light the pilot. You will hear a distinctive ‘clicking or arcing’ noise. At the same time the control module sends 24V from the PV (pilot valve) terminal (11) to the ECO along the brown wire. (12)

If the ECO has been tripped due to an overheated tank, the sequence will stop here. The spark ignitor will continue to spark for 90 seconds; then stop. If the ECO is not tripped, 24V is relayed through the ECO to the PV terminal of the gas valve (13) along the brown wire. This activates the first automatic valve and pilot gas is allowed to flow through the pilot supply tube to the pilot burner.

The pilot gas is ignited by the sparking pilot electrode and the pilot flame (14) is established. Through a flame recognition of at least one microamp (a very small electrical current produced by the flame), the ignition control module ends the spark generation. After the pilot is lit and recognized by the electronic controls, the ignition control module energizes the main valve.

The ignition control opens the second automatic valve by relaying 24V from the MV (main valve) terminal (15) to the gas control valve along the blue wire. Gas begins to flow to the main burner while the pilot light remains lit. The main burner lights (16) and begins to heat the water in the tank.

When the water temperature reaches thermostat setting, the thermostat contacts (3) will open and suspend power to the damper assembly. Several things will happen. First, without 24V relayed by the blue wire, the damper motor closes the damper blade. How does this happen? Remember the microswitch and yellow wire connected to the 24V terminal of the damper? The microswitch reconnects the 24V terminal and relays power to the damper motor to reverse direction and close. Second, without 24V relayed by the red wire, the relay switch and eventually the control module will not receive power. The pilot valve and main valve, held open by 24V, are closed. The main burner will shut off and the heater is back into stand-by mode.

LowNOx Commercial Gas Electronic Spark Ignition Sequence

Sequence of Operations

All voltages are AC and can be measured to ground.

Tank is cold and full of water. Heater is wired to a 120 VAC source. Gas supply is connected to heater and valve is set to ON position.	Fill tank Replace fuse or reset breaker at service panel Turn gas valve to ON Turn ON/OFF switch to ON	
(1) 120V is extended from the switch to the 24V step down transformer.	Check for 120V at the transformer	Replace switch Check wiring to switch
24V is extended from the transformer (2) to the thermostat.	Check for 24V at the thermostat	Check gray grounding wire. Replace transformer
(3) Thermostat demands heat. 24V is extended through the blue wire to the damper motor.	Check for 24V at the damper motor	Replace thermostat
(4) Damper opens. 24V is extended through the red wire to the relay. (5)	Check for 24V at the "24V" and "24V GND" terminals of the ignition control module Check for damper binding or obstruction Verify 24V at red wire on the relay	Replace damper assembly Remove obstruction
(6) At the same time, 24V is passes via the #6 pigtail at the relay from damper to the pressure switch along the blue wire.	Verify 24V at the blue wire NC terminal of the pressure switch.	
NOTE: The yellow wire on the pressure switch is a common wire. It does not have any power to ground.	The yellow spade terminal on the pressure switch is the largest of three terminals. Connects only fit one way. The red and the blue wires spade terminals are the same size and must be positioned on the relay as follows: Blue wire: NC (normally closed) (6) Red wire: NO (normally open) (9)	
Relay circuit performs safety check on pressure switch. Verifies the pressure switch is open thru 24V blue wire and yellow wire.	If the blue wire is not connected to the pressure switch, the safety check fails and the blower will not come on. If the pressure switch is damaged and stuck closed, the safety check fails and the blower motor will not come on.	

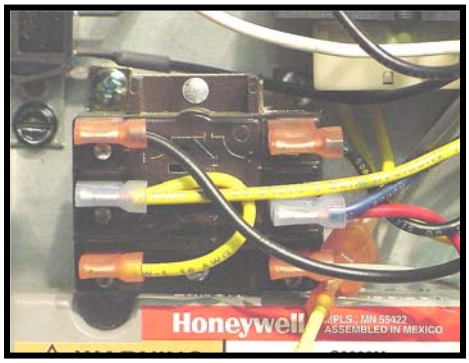
LowNOx Commercial Gas Electronic Spark Ignition Sequence

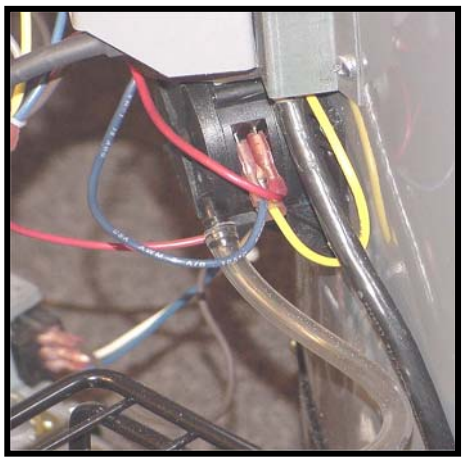
(7) If the safety check passes, 24V causes the connection inside the relay to close allowing120V (hot side) to pass to blower.	Blower motor should come on. Verify 120V to ground at #3 on relay; then on #1 on relay.	Check and replace relay. Verify 120V to unit.
(8) The blower motor creates a positive pressure inside the mixing chamber and causes the pressure switch to close.	Verify positive pressure at 0.2 inches w/c. Check to see if the tube is free & clear. Verify blower motor is operating.	
(9) Closing the pressure switch causes 24V power to move to the control module thru the red wire.	Verify 24V at the red wire on the pressure switch or on the 24V terminal of the control module. Check to see if the tube is free & clear.	
24V is extended from the ignition control (10) to the pilot electrode. (11) You should hear it sparking. At the same time, 24V is extended to the ECO. (12)	Check for 24V at the PV and GND terminal of the ignition module Electric spark generator in the ignition module produces a continuous 10,000V spark pulse through the orange cable. Visually check pilot electrode assembly for a spark Check ignition cable for continuity	Replace control module Replace pilot electrode Replace ignition cable
24V is extended through the ECO to the pilot side PV terminal of the gas valve. (13)	Check for 24V at the PV terminal of the gas valve ECO may be tripped due to water too hot Remember - At the same time there is power at the PV terminal of the gas valve, the pilot electrode should be sparking.	Cool tank to reset ECO Replace ECO
(14) Pilot flame ignites and remains lit. Spark generator shuts off.	Check gas control valve. Verify 24V at the PV terminal of the gas valve. Verify minimum gas pressure at the inlet and outlet sides of the gas valve. Check grounding of pilot electrode assembly Check pilot electrode for cracks Check gap of pilot electrode Pilot flame is rectified by the ignition control module	Check gas pressure Check pilot burner for obstructions Replace gas valve Tighten pilot electrode assembly Replace pilot electrode Gap to 1/8” Replace ignition module

(15) 24V is extended to the MV terminal of the gas valve. Main burner ignites (16).	Check for 24V at the MV terminal of the ignition control module Verify minimum gas pressure at the inlet and outlet sides of the gas valve. Check main burner supply tube and burner tray for obstructions Check for 24V at the MV terminal of the gas valve	Replace ignition module Adjust gas pressure Clean or replace Replace gas valve
Water is heated to thermostat setting.	Verify calibration of thermostat	Replace thermostat
Water is hot. Thermostat opens and suspends power to damper motor. Damper closes.	Check thermostat Check damper for obstructions to closing Check for 24V at the 24V and COM terminal of damper motor	Replace thermostat Replace damper assembly
Blower motor, main burner, and pilot shut off.	Heater is in stand-by until the thermostat demands heat	

Sequence of Operations on Relay Switch:

1. 24 volts from Damper (red wire) applied to Pin #6. Power is forwarded along the blue wire to the “NC” terminal of the Pressure switch.
2. 24V travels thru the pressure switch to the “C” terminal of the switch and back to pins #4 and #5 on the relay.
3. The 24V at pin #5 and #2 (ground side) energizes a coil inside the relay. This coil closes switches inside the relay between pins #4 and #6; and between pins #1 and #3.
4. 120 volts waiting at pin #3 is forwarded thru pin #1 and provides power to the blower motor via the black wire.
5. The blower comes up to speed and pressurizes the plenum box of the burner assembly. This causes the pressure switch to operate and close.
6. The pressure witch closes from terminal “C” to the “NO” terminal. At the same time, power is disconnected from the “NC” terminal.
7. 24V is now routed from the pressure switch to the ignition control module via the red wire.





LowNOx Commercial Gas Electronic Spark Ignition Sequence