Service and Troubleshooting

- **"I just installed this water heater and it's not starting; what do I do?"**

- usually followed by some additional colorful language ☺

Understanding the Sequence of Operation:

1. Flow sensor detects water movement;
2. Fan turns on to pre-purge the vent;
3. Igniter starts sparking across the igniter rod gap;
4. Gas valves open and flame ignites in burner;
5. Flame sensor detects flame;
6. PCB calculates BTU requirement using inlet water temperature, set temperature and flow rate;
7. APS and GPS calculate the volumes of air and gas respectively based on the differential pressure between sensor's high and low;
8. PCB adjusts fan speed to ensure air matches gas delivery;
9. Gas valves adjust in stages to properly deliver heat within burner;
10. Water (flow) Adjustment Valve (WAV) assists in controlling the velocity of water through the heater to maintain set point temperature.

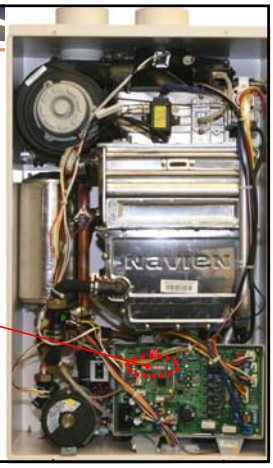
Service and Troubleshooting

Step 1:

- **Check the Dip Switch Settings**

Service and Troubleshooting

- **there are 2 sets of settings: 1 set has 6 switches; the other has 8;**
- **They are located under the LEDs on the board**



Service and Troubleshooting

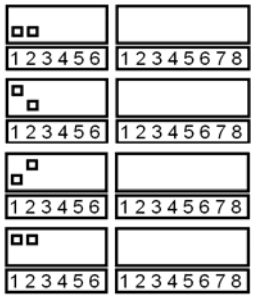
The Set of 6 Dip Switch Settings

		DIP SWITCHES					
FUNCTION	**OPTIONS**	**1**	**2**	**3**	**4**	**5**	**6**
Manual Burner Control	Normal Operation (default)	OFF	OFF				
	Maximum Burn	ON	OFF				
	1 Stage Minimum Burn	OFF	ON				
	3 Stage Minimum Burn	ON	ON				
Gas Type	OFF=NG ON=LP			ON=LP OFF=NG			
Condensing Model	OFF= CONDENSING				OFF		
Model Selection (BTU)	CR/CC-180, CR/CC-180-A					OFF	OFF
	CR/CC-210, CR/CC-210-A					ON	OFF
	CR/CC-240, CR/CC-240-A					OFF	ON

Service and Troubleshooting

Set of 6 Dip Switches:

Switches #1 & #2 manually set the burner firing for gas valve testing and manifold pressure testing



NORMAL FIRE:
1 DOWN & 2 DOWN

MAXIMUM FIRE:
1 UP & 2 DOWN

MINIMUM FIRE:
1 DOWN & 2 UP

MIN 3-FRAMES OPEN:
1 UP & 2 UP

7

Service and Troubleshooting

Set of 6 Dip Switches:

Manual Burner Control:
Switches #1 and #2 on the set of 6 Switches

- When operating the water heater normally, both switches #1 and #2 must be in the down position;
- The other three settings (Maximum, Minimum and 3 Stage Minimum) are used only to set up and test the gas manifold pressure (when necessary) and burner operation and should not be used at any other time;
- Please ensure to reset the DIP switches to "normal operation" (switches #1 and #2 down) after any manifold testing;

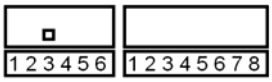
8

Service and Troubleshooting

Set of 6 Dip Switches:

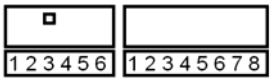
Switch #3 selects the gas type between natural gas and liquid propane:

CR/CC NG



Natural Gas (NG)
#3: DOWN

CR/CC LP



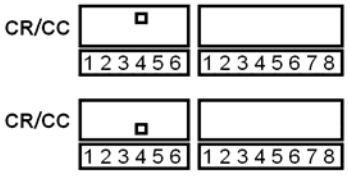
Liquid Propane (LP):
#3: UP

9

Service and Troubleshooting

Set of 6 Dip Switches:

For single unit installations, switch #4 should be kept in the UP (default) position. For Multi-Unit installations, switch #4 in the UP (ON) position identifies individual venting or 'no common venting'; switch #4 in the DOWN (OFF) position identifies common venting:



#4: UP (ON) = Single Venting or Multi-Unit without Common Venting

#4: DOWN (OFF) = Multi-Unit Common Venting

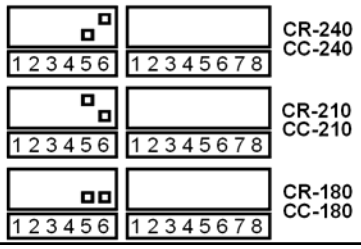
10

Service and Troubleshooting

Set of 6 Dip Switches:

Switches #5 & #6 select the model (or BTU) type:

CR-CC Model/ BTU Settings



11

Service and Troubleshooting

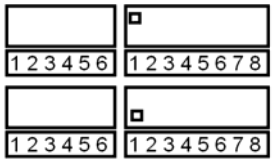
The Set of 8 Dip Switches:

		DIP SWITCHES							
Function	Option	1	2	3	4	5	6	7	8
Ready-Link Multi-Unit Master/Slave Select	If Master in Multi-Unit System= ON If Single unit or Slave = OFF	OFF (default)							
Country Model Select	OFF=North America		OFF						
Not In Use	OFF			OFF					
Programable 24 Hour Recirculation Timer	CR-A/CC-A Model but with Recirculation OFF				OFF	OFF			
	CR-A/CC-A Model with Automatic Recirculation (No Timer)				ON	OFF			
	CR-A/CC-A Model with Recirculation Timer				OFF	ON			
	CR/CC Model - No Pump and Buffer Tank				ON	ON			
Residential / Commercial Select	Commercial (CC) = ON						CC=ON		
	Residential (CR) = OFF						CR=OFF		
Temperature Select	CR= 110°F (43°C) CC= 120°F (49°C)							OFF	OFF
	CR= 120°F (49°C) CC= 140°F (60°C)							OFF	ON
	CR= 130°F (54°C) CC= 160°F (71°C)							ON	OFF
	CR= 140°F (60°C) CC= 185°F (85°C)							ON	ON

Service and Troubleshooting

Set of 8 Dip Switches:

Switches #1 is used to identify the MASTER unit only in a multi-unit system:



Master Unit in Multi-system: #1: UP

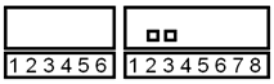
Slave Unit in Multi-system: #1: DOWN

13

Service and Troubleshooting

Set of 8 Dip Switches:

Switches #2 and #3 are not presently used.
They must both be kept in the DOWN position.



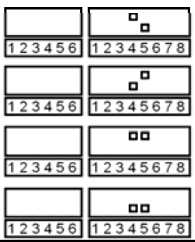
#2 & #3: DOWN

14

Service and Troubleshooting

Set of 8 Dip Switches:

Switches #4 and #5 determine the use
(or non-use) of the recirculation timer:



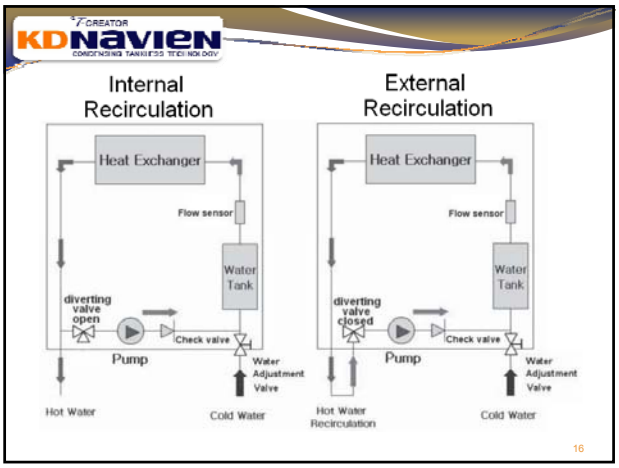
Recirculation Timer OFF #4: UP #5: DOWN

Recirculation Timer ON #4: DOWN #5: UP

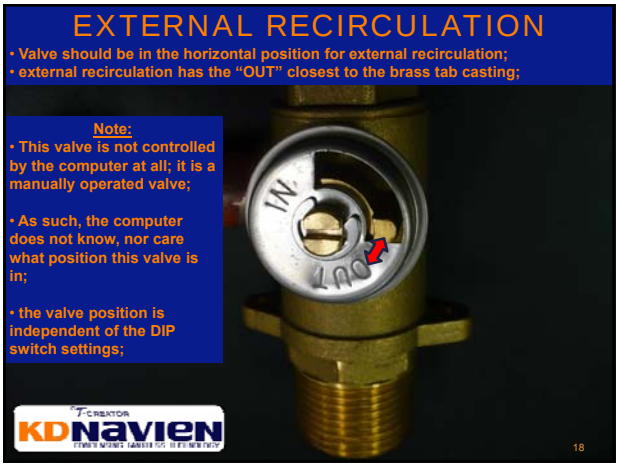
For CR units
Recirculation Pump OFF #4: UP #5: UP

For CR-A units:
Recirculation Pump OFF #4: DOWN #5: DOWN

15

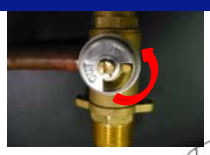

Internal Recirculation
External Recirculation
Heat Exchanger
Flow sensor
Water Tank
diverting valve open
Check valve
Pump
Water Adjustment Valve
Hot Water
Cold Water
Heat Exchanger
Flow sensor
Water Tank
diverting valve closed
Check valve
Pump
Water Adjustment Valve
Hot Water Recirculation
Cold Water
16

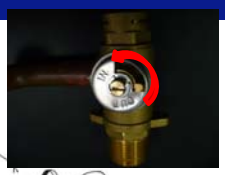

INTERNAL RECIRCULATION
• Valve should be in the vertical position for internal recirculation (factory default position);
• internal recirculation has the "IN" closest to the brass tab casting;
IN
OUT
17

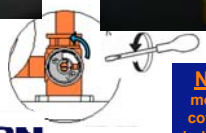

EXTERNAL RECIRCULATION
• Valve should be in the horizontal position for external recirculation;
• external recirculation has the "OUT" closest to the brass tab casting;
Note:
• This valve is not controlled by the computer at all; it is a manually operated valve;
• As such, the computer does not know, nor care what position this valve is in;
• the valve position is independent of the DIP switch settings;
IN
OUT
18

SWITCHING FROM INTERNAL TO EXTERNAL RECIRCULATION

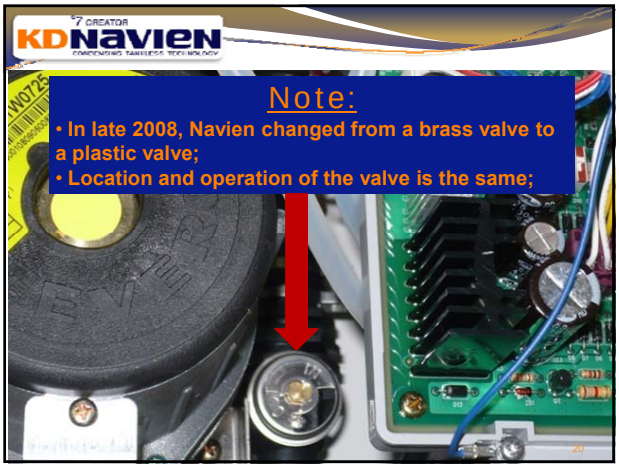
- To switch from INTERNAL to EXTERNAL , use a long neck, flat head screw driver to rotate the valve ¼ turn counter clockwise; be sure to not over-torque;
- To switch from EXTERNAL to INTERNAL, rotate the valve ¼ turn clockwise;







Note: the brass tab does not move; the round stainless steel cover plate with "IN" and "OUT" indicated rotates; the brass tab is part of the casting and is fixed;



Service and Troubleshooting

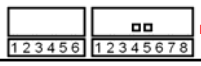
Set of 8 Dip Switches:

Switches #4 and #5 determine the use (or non-use) of the recirculation timer:

Recirculation Timer OFF #4: UP #5: DOWN

Recirculation Timer ON #4: DOWN #5: UP

For CR units
Recirculation Pump OFF #4: UP #5: UP



For CR-A units:
Recirculation Pump OFF #4: DOWN #5: DOWN

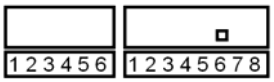
22

Service and Troubleshooting

Set of 8 Dip Switches Settings:

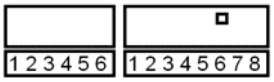
Switch #6 selects unit type between CR and CC:

CR



CR: 6 DOWN

CC



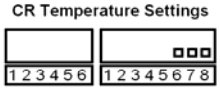
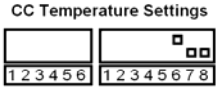
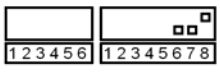
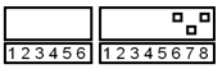
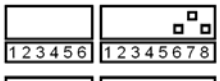
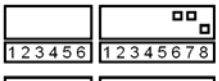
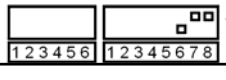
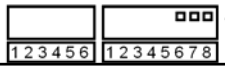
CC: 6 UP

23

Temperature DIP Switch Settings

Set of 8 Dip Switches:

Switches #6, #7 & #8 determine the temperature:

CR Temperature Settings		CC Temperature Settings	
	110F		120F
	120F		140F
	130F		160F
	140F		185F

24

Navien Default DIP Switch Settings

25

CR-A Default DIP Switch Settings

CR-A Default Settings (without recirculation timer)

1 2 3 4 5 6	1 2 3 4 5 6 7 8

CR-240A NG 120F

CR-210A NG 120F

CR-180A NG 120F

CR-240A LP 120F

CR-210A LP 120F

CR-180A LP 120F

26

CR-A Default DIP Switch Settings

CR-A Settings (with recirculation timer)

1 2 3 4 5 6	1 2 3 4 5 6 7 8

CR-240A NG 120F

CR-210A NG 120F

CR-180A NG 120F

CR-240A LP 120F

CR-210A LP 120F

CR-180A LP 120F

27

CR Default DIP Switch Settings

CR Default Settings

123456	12345678
CR-240 NG 120F	
CR-210 NG 120F	
CR-180 NG 120F	
CR-240 LP 120F	
CR-210 LP 120F	
CR-180 LP 120F	

28

CC-A Default DIP Switch Settings

CC-A Default Settings (without recirculation timer)

123456	12345678
CC-240A NG 160F	
CC-210A NG 160F	
CC-180A NG 160F	
CC-240A LP 160F	
CC-210A LP 160F	
CC-180A LP 160F	

29

CC-A Default DIP Switch Settings

CC-A Settings (with recirculation timer)

123456	12345678
CC-240A NG 160F	
CC-210A NG 160F	
CC-180A NG 160F	
CC-240A LP 160F	
CC-210A LP 160F	
CC-180A LP 160F	

30

CC Default DIP Switch Settings

CC Default Settings

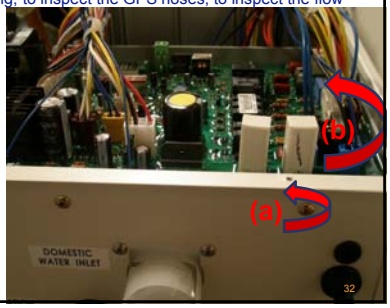
CC-240 NG 160F	123456 / 12345678
CC-210 NG 160F	123456 / 12345678
CC-180 NG 160F	123456 / 12345678
CC-240 LP 160F	123456 / 12345678
CC-210 LP 160F	123456 / 12345678
CC-180 LP 160F	123456 / 12345678

31

Accessing Behind the Computer Board:

NAVIEN TIP

There are many instances when you may need to inspect behind the computer board (to run the remote control and/or the Ready link communication cable wiring, to inspect the GPS hoses, to inspect the flow (water) adjustment valve (WAV), etc.). To access behind the board, remove the screw that attaches the right leg of the PCB to the bottom of the case (a). With that screw removed, the PCB will pivot out towards you to the left (b).



32

Service and Troubleshooting

Step 2:

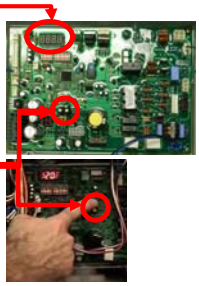
Is there power?

33

Service and Troubleshooting

Step 2: Is there power?

- The 4 – 7 segment LEDs on the computer board will turn off after 5 minutes of non-use to save energy;
- Do not assume that because there is nothing lit up on those LEDs that the board is defective;
- On the computer board, there are 2 white buttons, either one above the other or side-by-side depending on the board version (see next slides); locate, press and hold the upper button (if 1 above the other) or the left button (if side-by-side) and the display LEDs will light again; Note: do not press both buttons;
- If the LEDs do not light up, follow the next slides:



34

Service and Troubleshooting

Step 2: Is there power?

- Reconfirm that the power cord is plugged in and that there is power to the electrical outlet;
- Check that the GFCI is switched to the ON position;
- Check that the power connector to the board is securely attached; ensure there is no corrosion, no water and no loose wiring at that connection;

Main power connection to board from GFCI

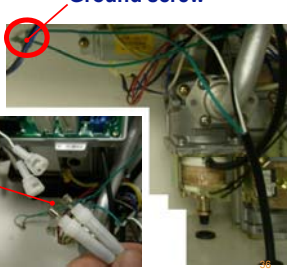
35

Service and Troubleshooting

Step 2: Is there power?

- Check to ensure the ground wire is securely screwed into the back of the case;
- Check the 5A glass fuses in located in the white fuse holders behind the computer board;

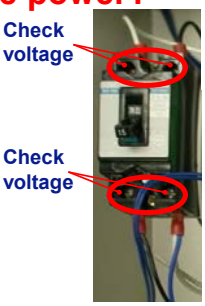
Ground screw



Service and Troubleshooting

Step 2: Is there power?

- Check voltage at both at inlet and outlet of the GFCI;
- Inlet wiring: white on left; black on right; should be AC 97~138V;
- Oultet wiring: black on left; blue on right; should be AC 97~138V;



37

Service and Troubleshooting

Step 2: Is there power?

- If the LEDs on the computer board still do not light, ensure the transformer connections are secure and that there is no corrosion, no water and no loose wiring at the connections;
- Check the voltages at the 3 connections (see ratings on next page)

38

Service and Troubleshooting

Step 2: Is there power?

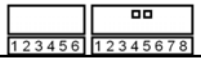
Power Transformer			Target	Range
M	CN2	RED-RED	AC150V	AC 123~177V
		WHITE-BLACK	AC120V	AC 97~138V
I	CN20	BLUE-BLUE	AC19V	AC 16~24V
H	CN3	YELLOW-YELLOW	AC9V	AC 7~11V
		WHITE-WHITE	AC26V	AC 22~33V

39

Service and Troubleshooting

Step 2: Is there power?

- If the GFCI is tripping, ensure unit is plugged in to a grounded outlet with proper polarity;
- Check for water in and around the contacts of the GFCI and all computer board connections;
- In the "A" model only, unplug the recirculation pump from the computer board and move switches #4 and #5 on the set of 8 switches both to the up position;



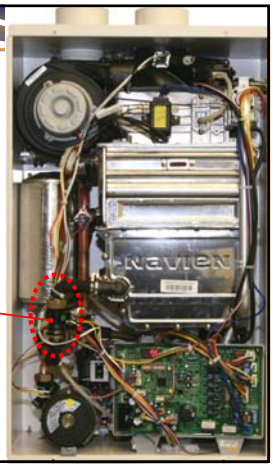
Unplug pump from board (maroon colored connector with 1 white and 1 yellow wire)

40

Service and Troubleshooting

Step 3:

Determine if there is flow…



Service and Troubleshooting

Step 3:

- The PCB can display various information regarding the water heater condition;
- data points include the software version, software production date, set temperature, flow rate, the Hot outlet water temperature and the Cold inlet water temperature, water flow adjustment valve (WAV) position, etc.;

42

Service and Troubleshooting

1	Flow Rate	2.64 / 10.0	2.64 gal/min(2 decimals) or 10.0€/min (1 decimal) (depending on software version)
2	Outlet Temperature	H 120	H120 = 120°F
3	Inlet Temperature	C 40	C 40 = 40°F
4	GPS Sensor Value Sensor Value Range	P.100 P.49 P.147	P.100 = 100 - 2.0V
5	Model	n24-	n/s = Condensing/Standard Model 18/21/24 = 180/210/240 Model -/A: without/with PUMP type [n24A=Condensing, 240, A model]
6	Start Count	123	# of starts since last GFI reset
7	Water Adjustment Valve Value	F.34 F.220 Fully Open Fully Closed	WAV Feedback Voltage A/D Value Display

43

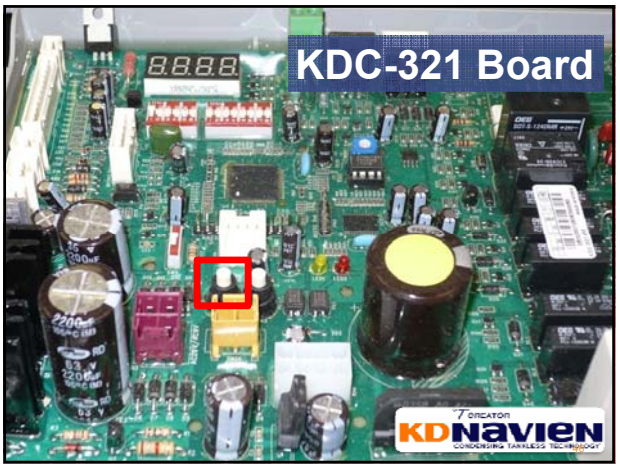
Service and Troubleshooting

Step 3:

- To retrieve this information, you need to access the computer board;
- On the computer board, there are 2 white buttons, either 1 above the other or side-by-side depending on the board version (see next two slides for position);
- Locate, press and hold the upper button (if 1 above the other) or the left button (if side-by-side); do not press both;
- Once you press and hold the button, the information will begin to scroll;
- Once you see the data point you need, take you hand off the button and the scrolling will stop.

KDC-320 Board

44



KDNaVIEN

Service and Troubleshooting

Step 3:

- Begin scrolling through the data points;
- Once a 1 decimal point number appears on the display, remove your finger from the button;
- The 0.0 represents the flow rate in litres per minute. There are 3.78 litres per gallon so as a rough approximation, divide by 4 for gallons per minute (GPM);

KDC-320 Board

47

KDNaVIEN

Service and Troubleshooting

Step 3:

- **F-F-I-G**
- **F**low, **F**an, **I**gniter, **G**as
- If the flow rate reads 0.0, the sensor impeller is not spinning and thus the flow sensor is not reading any flow;
- the unit will NOT attempt to fire and there will be no error code;
- We need to determine why there is no flow being sensed;

KDC-320 Board

48

How Does The Flow Sensor Work?

- Within the sensor, there is a small impeller that when it rotates, sends a pulse signal to the computer board telling the unit that there is a flow of water; based on the speed of the rotation, the computer calculates the volume flow rate through the heater;
- If this impeller is not spinning or the Hall sensor is not sensing the rotation, there will be no signal for the unit to fire;
- Thus on a "no hot water" call, the first thing is to check for flow on the computer board;

Impeller

HALL SENSOR EXAMPLE.lnk

49

Service and Troubleshooting

Step 3:

A "no flow" (0.0) reading can be caused by:

- Improper connection of the flow sensor to the board;
- Flow sensor impeller jammed or damaged;
- Cold inlet filter and flow sensor filter clogged with debris;
- Internal check valve not holding;
- Cross piping outside of the unit;

KDC-320 Board

50

Service and Troubleshooting

Step 3:

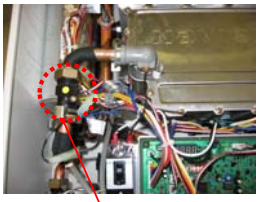
A "no flow" (0.0) action plan:

- Check flow sensor connection on the board;
- Check for cross piping;
- Check flow sensor impeller for proper rotation;
- Clean flow sensor screen and inlet filer screen;
- Inspect internal check valve;

KDC-320 Board

51

Location Of The Flow Sensor



Water Flow Sensor

52

Removal of Flow Sensor

- Close the manual shut off valve on the gas line;
- Close the manual shut off valve on the cold water line;
- On the set of 8 DIP switch settings, move switch #4 and #5 to the UP position;
- Drain the water heater completely (see operating manual);
- Remove the brass nut connected to the top of the flow sensor (Fig.1 on next page);
- Do not lose the red gasket located between the brass nut and the top of the flow sensor;

53

Removal of Flow Sensor

- Be sure not to drain water on to the GFCI or the computer board below; when removing the brass nut from the flow sensor, immediately raise the brass nut upwards to create a trap to prevent water from dripping;
- Remove the stainless spring clip at the bottom of the flow sensor (Fig.2 on next page);
- Unseat the flow sensor from the copper pipe;
- Do not remove the screw; do not disconnect the flow sensor from the board;

54

Removal of Flow Sensor

- Close the manual shut off valve on the gas line;

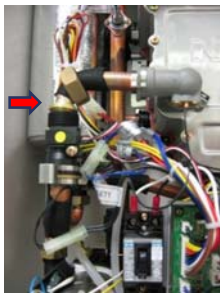


Fig.1

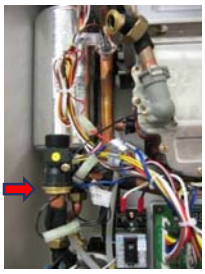


Fig.2

55

Testing of the Flow Sensor

- Once the flow sensor is free, turn on the power to the water heater and set the LED to flow rate (0.0);
- Do not remove the screw; do not disconnect the flow sensor from the board;
- Blow through the non-threaded end of the flow sensor; you should be able to hear the impeller spinning and it will create a whirling, kazoo type sound;
- The numbers on the LED display should go up to as high as 35~45 and then back down when you stop.

56

Testing of the Flow Sensor

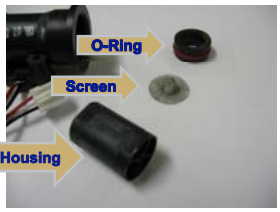
- If there is no flow reading on the board, check once more to make sure the flow sensor is connected properly to the board;
- Press the rectangular Hall sensor (the component with the red, white and black wires attached) against the body of the flow sensor to ensure there is good contact (see graphic to right) and check for a flow reading on the LED;
- If these above two steps do not result in a flow reading, the next step is to disassemble the flow sensor.

Disassembly of the Flow Sensor

- Place your hand over the non-threaded end;
- Using a blunt object (screwdriver, pen, etc.), press firmly down on the center shaft of the flow sensor located at the threaded end;
- All internal components of the flow sensor will then come out of the non-threaded end;

Disassembly of the Flow Sensor

- The internals consist of three parts.
  - O-ring
  - Screen
  - Impeller & housing (4 parts)



- Clean screen using water and/or an old toothbrush;

Disassembly Of The Impeller

- If the flow sensor is not producing a whirling sound, it may be that the impeller is not moving freely; disassembly of the impeller housing will be required;
- By removing the top and bottom, the impeller will be revealed;

Disassembly Of The Impeller

- There should be 4 parts total:
  1) End cap (bottom)
  2) Impeller
  3) Housing Sleeve (or Casing)
  4) End cap with stainless steel pin (top)

61

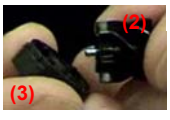
Examination of the Impeller

- Examine the impeller for any type of residue or debris that may have built up on the veins or on the center shaft/axle;
- Examine veins of impeller for any damage (cracking, flaking);
- Clean off the ends of the shaft/axle and lubricate with plumber's grease or kitchen cooking oil;

62

Reassembly Of The Impeller

- Locate the bottom of the impeller (2) (with the wide base) and insert that end into the end cap (bottom) (3);



Reassembly Of The Impeller

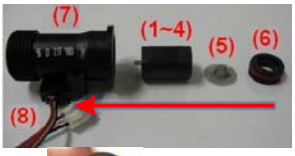
- Place the impeller housing (3) over the impeller;
- attach the end piece with the stainless steel stub (4) to complete the impeller reassembly;
- The impeller housing sleeve should clip together with the top and bottoms caps.




64

Reassembly of the Flow Sensor

- Place the assembled impeller housing (1~4) with the stainless steel pin end (4) towards the threaded end of the flow sensor body sleeve (7); align the flat edges;
- Insert the screen (5) with the pointed end facing outward;
- Insert the o-ring (6) with the thin end (has 3 indents in a triangle pattern) in towards the screen;





65

Reassembly & Test of the Flow Sensor

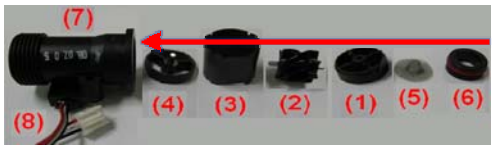
- Pack the o-ring (6) in with your thumb until it is snug in the flow sensor sleeve (7);
- The reassembly is complete;
- Before reconnecting the flow sensor to the piping, confirm that the flow sensor is working properly by setting the computer board to display the flow rate (0.0);
- Blow through the non-threaded end and the flow rate should indicate a peak flow of between 35~45;




66

Test of the Flow Sensor

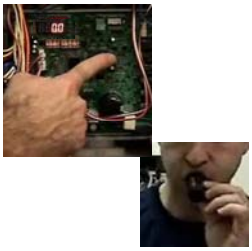
- If you do not see flow, re-confirm that the flow sensor is plugged into the board;
- Reconfirm that the impeller is in the proper direction;
- Reconfirm that the base of the impeller (2) lines up with the hole sensor (8) (approximately);
- Reconfirm order of assembly as below:



67

Re-Test of the Flow Sensor

- Reconfirm that the flow sensor is working properly by setting the computer board to display the flow rate (0.0);
- Blow through the non-threaded end and the flow rate should indicate a peak flow of between 35~45;
- If still no flow, replace flow sensor;
- The flow sensor is part #52 in the exploded view in the manuals and Navien part # BH1406004A



68

Re-Test of the Flow Sensor

- If the flow rate displayed is between 35~45, then your flow sensor is detecting properly;

Reassemble water ways:

- Reseat the non-threaded end of flow sensor onto the copper fitting and reattach the stainless spring clip;
- Place red gasket ring on top of the flow sensor and screw on the brass nut; be sure not to cross thread; hand-tighten + ¼ turn with a wrench to secure; overtigthening may damage gasket;

69

Re-Test of the Water Heater

- Open cold water valve to ensure no leaks; re-fill the system as outlined in the owner's manual;
- Confirm flow sensor operating by checking flow rate on the LED; flow rate should climb and then stabilize;
- Open manual gas shut-off valve and confirm burner ignition; if error code 003E appears, just re-set the unit by turning off and on the unit at the GFCI breaker located on the upper left corner of the computer board;
- If ignition is confirmed, use the information button to check outlet temperature (the H value) to confirm hot water delivery;
- Reset DIP switches #4 and #5 for desired timer/pump function on A models.

70

Service and Troubleshooting

Step 4:

F-F-I-G

- **F**low, **F**an, **I**gniter, **G**as
- If the flow rate displayed reads greater that 2.0 litres per minute (0.5 GPM), the fan should start to pre-purge the vent;
- If the fan does not start, the unit will not open the gas valves and it will deliver a 009E error code; this error code can also be displayed if the RPMs of the fan are not correct;
- We then have to troubleshoot the fan;

71

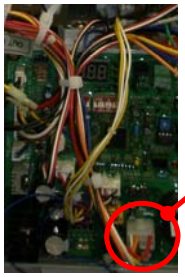
Service and Troubleshooting

Step 4:

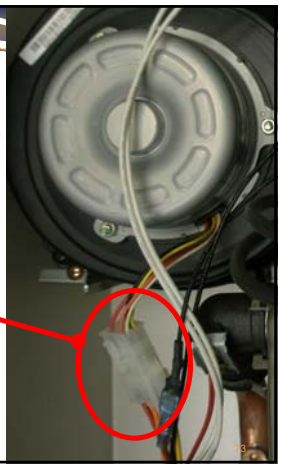
- To troubleshoot the fan, first thing to do is turn the water heater off using the breaker located on the left side of the computer board (indicated in yellow below);
- Whenever you supply power to the unit, either by turning the breaker on or plugging the unit in, the fan should start;
- If the fan does not start, check the two electrical connections (1 at the computer board and 1 male/female connection);

72

- There are 2 connections to check: 1 at the computer board (a) and 1 male/female connection near the fan itself (b);
- at both connections, check to ensure the plug is fully inserted and check to make sure there is no loose wiring, corrosion on the wiring or water in the clip.



(a)

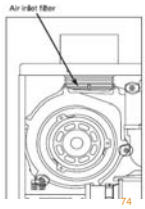


(b)

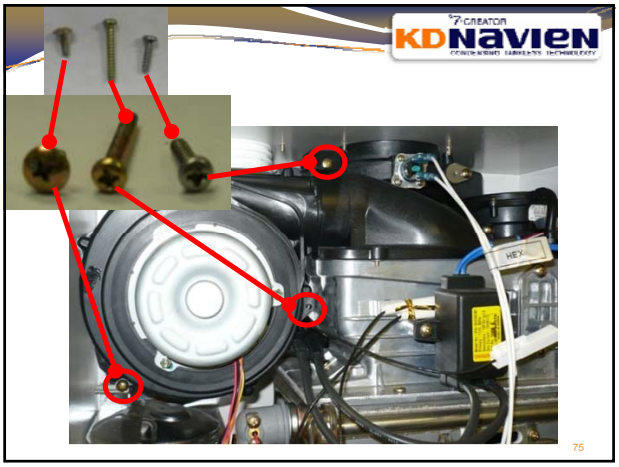
73

- If the fan does not start, or if the 009E error code continues to display (see error code section for 009E troubleshooting), the fan may need to be replaced;
- The instructions for removal are included in the owner's operating manual (orange) under the air intake filter cleaning instructions;

To access the filter, you will need to remove the fan. There are three Philips screws that need to be removed. The screws are located in the circled areas in the diagram to the right. Make note of which screw is taken from which hole as the sizes are different. Once the screws are removed, gently wiggle and slide the fan to the left, then pull it out towards the front.



74



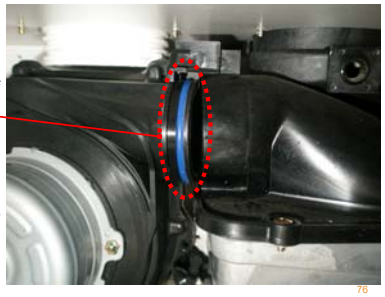
75

Service and Troubleshooting

Step 4:

Fan Removal

- Once the 3 screws are removed, push the fan backwards into the upper left hand corner of the case;
- The joint will open and you will see the blue o-ring;
- Once free, undo the male/female connector and the fan will be removed;
- Replace with new fan.

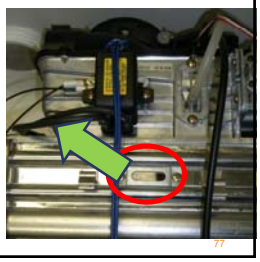


76

Service and Troubleshooting

Step 5: F-F-I-G

- Flow, Fan, Igniter, Gas
- If there is flow and the fan starts, the next step in the sequence of operations is that the igniter will start to spark;
- To see if the igniter is working or not, do a visual inspection through the flame viewing window;



77

Service and Troubleshooting

Step 5:

F-F-I-G

- Flow, Fan, Igniter, Gas
- To troubleshoot the igniter, check to ensure connection to the board is secure;

78

Step 5:

- If the board connection is fine, check the connections to the igniter rods located on the left side of the burner; you will need to remove fan to access;

79

Service and Troubleshooting

Step 5:

- If that ignitor still is not sparking, then we need to check whether or not we get voltage off the board;

	Igniter		Target	Range
R	CN17	BLUE-BLUE	AC120V	AC 97~138V

80

Service and Troubleshooting

Step 6: F-F-I-G

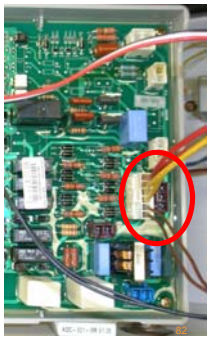
- Flow, Fan, Igniter, Gas
- To troubleshoot the gas, first step is to check the two main gas valves;
- The two main solenoid gas valves are powered in series with the brown wires; check that the connections are secure on all 4 contacts;

81

Service and Troubleshooting

Step 6:

- Check to make sure the gas valve driver connection is secure and that there is no damage to the wires (no corrosion, no water, no loose wires);



Service and Troubleshooting

Step 6:

- To check if either of these two valves are opening, disconnect the wiring to 1 of the 2 solenoid valves and jump between the two disconnected contacts (as the circuit is in series) – be sure to have the power "off" when working with the bare contacts;
- Reset the water heater and start water flow. Once the unit attempts to start, listen for the clicking at the connected valve; if you hear a click, that valve is probably operating;
- Reattach the disconnected valve and the then disconnect the other valve and perform the same test;

Service and Troubleshooting

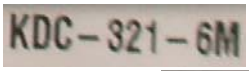
Step 6:

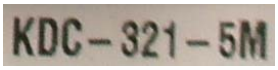
- If neither of the 2 main gas solenoid valves open, then check the computer board to make sure the gas valve driver connection on the PCB is providing the proper supply voltage;
- If the board is not supplying the proper voltages, check the voltages of the transformer at connection H/CN3;
- If the transformer supply power at H/CN3 is proper, then the PCB will need to be replaced; this is however a very rare situation;

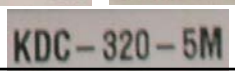
Service and Troubleshooting

Board Replacement:

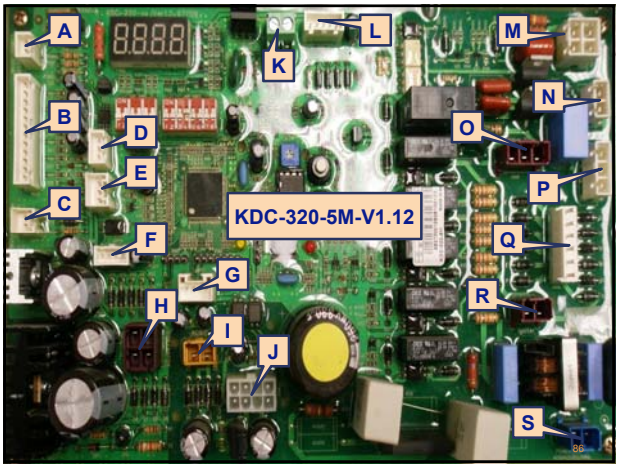
- Over the past year, Navien has made many upgrades to the software and that has required some connector changes on the board itself. Please use the explanation below to identify the board type and software version you have. You will need this information when talking with Navien Tech Support;
- The board hardware version is located on a sticker that is attached to the right leg of the computer board;



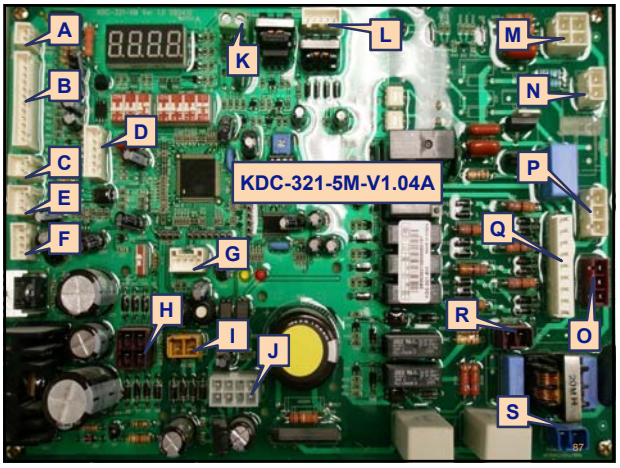




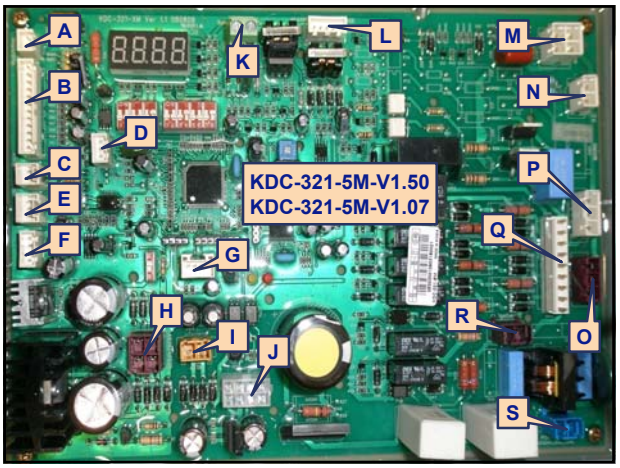
85

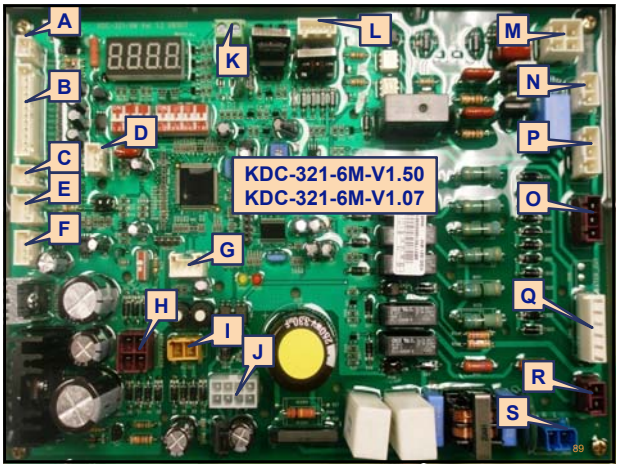


86



87





Service and Troubleshooting

Board Replacement:

Hardware Changes:

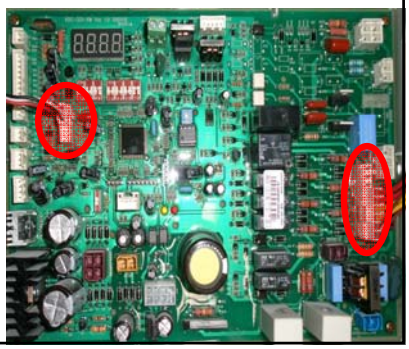
- 320 Board – U1.04~1.16 (discontinued) – had a 6 pin gas valve connection and a 3 pin WAV (water adjustment valve) connection;
- 321-5M – U1.01~1.04 can be used for CC or CR models – has a 9 pin gas valve connection and a 6 pin WAV connection; field adjustments to both (female) clips is required;
- 321-6M – U1.05~1.07 and U1.50 can be used only for CR models – has a 3 pin gas valve connection and a 6 pin WAV connection;
- 321-5M – U1.05~1.07 and U1.50 can be used for both CC and CR models - has a 3 pin gas valve connection and a 9 pin WAV connection; field adjustment to the 9 pin (female) gas valve clip is required;

90

Service and Troubleshooting

PCB Hardware Changes:

- All KDC-321 boards can be used to replace KDC-320 boards;
- The KDC-321-6M is for CR units but any 321-5M can also be used;
- When using a KDC-321-5M board, they have a 9 pin gas valve connection and some versions have a 6 pin WAV connection;
- field adjustments to both (female) clips is required;



Service and Troubleshooting

- When replacing a KDC-320-5M board with a KDC-321-5M, the 6 pin gas valve connector attaches to the bottom 6 pins (of 9) and the WAV connects to the top 3 pins (of 6);
- removing the tab from the end of the connector will allow for a smooth connection;

Service and Troubleshooting

Board Replacement:

Software Upgrade Versions:

- KDC-320 Boards: U1.04 to U1.16
- All versions from U1.13 to U1.16 are working well and a change out is not typically required;
- Only if you are getting temperature fluctuations with a version older than U1.13, and only if you have ruled out all other causes (flow sensor, pressure balancing shower valves, etc.), then the board may be upgraded to see if the performance improves; you must call Navien Tech Support for an Return Goods Authorization (RGA);
- Note however that these are much older versions if a problem was to occur, it should have occurred already, thus this should be a rare situation.

93

Service and Troubleshooting

Board Replacement:

Software Upgrade Versions:

- KDC-321-6M or KDC-321-5M boards: U1.04 to U1.05 – modifications have been made to software U1.04 and U1.05;
- In February, 2009, we made a change in the software naming pattern; the newest software pattern begins at U1.50;
- The most recent software is U1.50 followed by U1.07; both of these versions are working well;
- Note there is no KDC-321-5MU1.08~U1.49/KDC-321-6MU1.08~U1.49);
- Only if you are getting temperature fluctuations with a version older than U1.07, and only if you have ruled out all other causes (flow sensor, pressure balancing shower valves, etc.), then the board may be upgraded to see if the performance improves; you must call Navien Tech Support for an Return Goods Authorization (RGA) to change a board or to request an on-site upgrade (only available in select areas).

94

Service and Troubleshooting

Step 6:

- Once all these 6 steps have been followed, you should have flame in the viewing window;
- The previous steps were used to get flame inside the heater; the next steps are to deal with possible component issues;
- Most of next components have an error code associated with them, thus they are easier to diagnose.

95

Error Description:

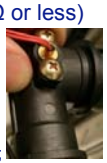
Code	Description	Code	Description
001E	Outlet Boiling	022E	Inlet Thermistor Short
003E	Ignition Failure	027E	Abnormal activity of the Air Pressure Sensor
004E	False Flame Detection	030E	Exhaust High Limit (Overheat)
007E	Outlet Thermistor Open	032E	Buffer Tank (Inlet2) Thermistor Open
008E	Outlet Thermistor Short	033E	Buffer Tank (Inlet2) Thermistor Short
009E	Fan Motor error	034E	Water Adjustment Valve (WAV) Error
010E	Air Pressure Sensor (APS) error	035E	Gas Pressure Sensor (GPS) error
012E	Flame Loss	036E	Cascade Communication Error
015E	Communication Error with Computer Board	037E	Water Leak Detected / Water Adjustment Valve Closed
016E	Water High Limit	038E	Pump or Flow Sensor Abnormal Operation Error
021E	Inlet thermistor open	039E	Flow Sensor Error
		048E	Low Gas pressure (LP Model Only)

96

001E Boiling Inside Heat Exchanger

Error Condition:

Outlet thermistor (2 red wires at elbow and at CN13 on PCB) reads a temperature equal or higher than 208°F (a resistance of 0.8KΩ or less)



Possible Causes:

1. Insufficient flow;
2. Flow obstruction in heat exchanger;
3. Scale build up inside heat exchanger;
4. Thermistor error/damage;
5. DIP switch #1 on set of 6 is set to "on" = maximum fire;
6. Improper BTU selection (on DIP switches #5 & #6);

97

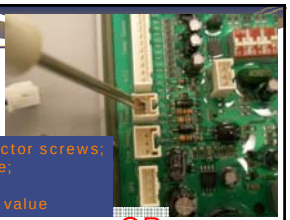
001E Boiling Inside Heat Exchanger

Possible Remedies:

1. Check DIP switch settings; reconfirm the 6 set for proper settings, especially switches #1, #3, #5 and #6;
2. Check to ensure proper flow rate through the heater (see next page for minimum flow requirements);
3. Test performance of the flow adjustment valve by shorting the leak detection wires (C/CN11) and resetting multiple times; observe the F.34~F.220 number (fully open and fully closed respectively) on the display to confirm proper opening and closing (see next page);
4. Clean inlet filters (cold inlet, recirculation inlet and flow sensor inlet). Note that units produced after October 31th, 2008 do not have a filter in the flow sensor;
5. Check outlet thermistor to ensure there is no damage to the wires (no corrosion, no water in connectors, no loose wires);
6. Check the outlet temperature with a separate thermometer to confirm thermistor accuracy or error; remove outlet thermistor from PCB and check resistance of outlet thermistor;
7. Check for evidence of scale on inner walls of outlet piping; descale if necessary;

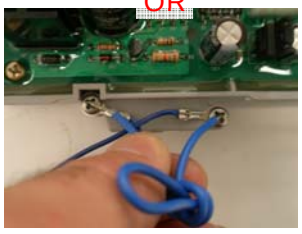
98

Testing the Flow Adjustment Valve:



- short pins at C/CN11 or at leak detector screws;
- check F valve on PCB for F.220 value;
- reset GFCI;
- check F valve again on PCB for F.34 value

OR



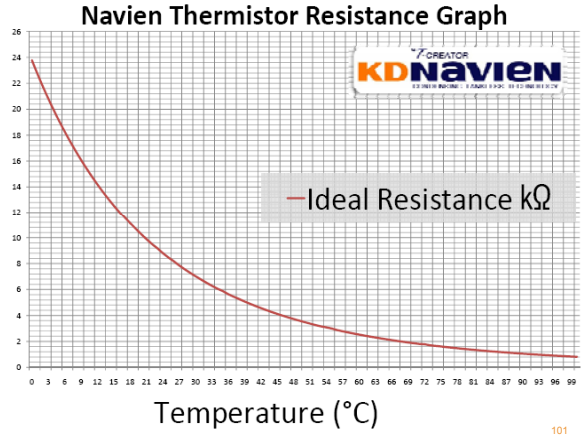
001E Boiling Inside Heat Exchanger

Minimum Flow Requirements to Prevent Overheating:

Delta T	Min GPM	Min LPM
Δt = 10°F	3.20	12.0
Δt = 15°F	2.10	8.0
Δt = 20°F	1.70	6.3
Δt = 50°F	0.70	2.5
Δt = 65°F	0.50	1.9
Δt = 80°F	0.40	1.6

100

Navien Thermistor Resistance Graph



101

003E Ignition Failure:

Error Condition:

During burning operation, the software requires a consistent current of 2~10μA (with the median value being 3~4μA) for a minimum of 10 seconds or greater. Program will try to restart 3 times before locking out on a 003E

Possible Causes:

1. Insufficient gas or air in the gas line;
2. Improper gas DIP switch settings;
3. Damaged, disconnected or restricted Air-Gas Feedback hose (to modulating gas valve); also check all APS & GPS hoses;
4. Igniter failure;
5. Dirty flame rod or damaged flame rod wire;
6. Faulty transformer
7. Improper gas valve connector alignment on KDC-320 to KDC-321-5M board upgrade;

102

003E Ignition Failure:

Possible Remedies:

1. Check to ensure manual shut-off valve on the main gas supply is open;
2. Ensure the gas line has been bled of any and all air;
3. Check DIP switch settings to ensure proper settings;
4. Turn water flow on and off repeatedly; check to ensure fan starts when flow is turned on and check for spark from igniter in the viewing window once fan starts;
5. Check to ensure all rubber hoses are securely attached to their appropriate components (especially Air-Gas Feedback to modulating valve); check for disconnection, pinching, restrictions, tears, cuts, cracking or any other such damage;

103

003E Ignition Failure:

Possible Remedies (continued):

6. Check gas volume in tank (for propane installs);
7. Check gas line pressure and gas regulators using a manometer at the dirt pocket to ensure gas pressure is maintained while the unit is operating at maximum fire (range is NG: 3.5” WC ~ 10.5” WC; LP: 8.0” WC~13.0” WC);
8. Check transformer to ensure proper voltage;
9. Check connections to main gas valves (brown wires);
10. Check connections to upper gas valves (red, yellow wires);
11. Check exhaust and intake pipes for obstructions;
12. Check condensate line to ensure properly draining;
13. Check the manifold gas pressure (see instructions to follow);

104

003E Ignition Failure:

Possible Remedies (continued):

14. Check voltage to igniter from PCB; if voltage is not correct, replace PCB

Igniter			Target	Range
R	CN17	BLUE-BLUE	AC120V	AC 97~138V

15. Check current of flame rod (thin black wire) at white male/female connector; if current is not correct, clean or replace flame rod.
16. Check voltage across black and green/yellow wires; if voltage is not correct, ensure electrical outlet is grounded and that green wire is properly attached to the back of case (inside).

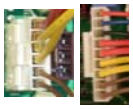
Flame Rod & Ground			Target	Range
N	CN19	Black-Green/Yellow		DC 10~20V
		Black-Green/Yellow	2~10μA	0~20μA

003E Ignition Failure:

Possible Remedies (continued):

17. Check voltage to the two main gas valves from the PCB; if voltage is not correct, replace PCB

	Main Gas Valves		Target	Range
Q	CN15	Brown-Brown		DC 83-120V
	CN15	Brown-Brown		0.8~2.4kΩ



6 pin 9pin

18. Check the resistance between the two main gas valve wires (brown-brown); if the resistance is not correct, replace gas valve assembly;
19. Check voltage across the modulating gas valve; if voltage is not correct, check connection to PCB;

	Modulating Gas Valve		Target	Range
A	CN14	Black-Black		DC 2-10V

106

004E False Flame Detection:

Error Condition:

On a signal for flow, the program does a pre-startup safety check. If during that safety check, the program detects a current from the flame rod, it will lock out on 004E. As this is a pre-start check, there should be no flame current detected thus signals component failure.

Possible Causes:

1. Flame rod or flame rod wire damage;
2. Program damage;

107

004E False Flame Detection:

Possible Remedies:

1. Ensure electrical outlet is properly grounded;
2. Ensure the grounding wire and ground screw (located behind the computer board) are securely attached to the case .
3. Check the flame rod/ground wire connections to ensure there is no damage to the wires (no corrosion, no water, no loose wires, no damaged wires);
4. Check voltage across black and green/yellow wires; if voltage is not correct, ensure electrical outlet is properly grounded and that the green wire is properly attached (grounded) to the back of inside case;
5. Check current of flame rod (thin black wire) at white male/female connector; if current is being detected (1~20μA) when the flame is off, replace the PCB;

	Flame Rod & Ground		Target	Range
N	CN19	Black-Green/Yellow		DC 10~20V
		Black-Green/Yellow	2~10μA	0~20μA

108

004E False Flame Detection:

Possible Remedies:

6. Check current of flame rod (thin black wire) at white male/female connector; if current is not being detected (1~20μA) when the flame is on, or if the current is out of range, replace the flame rod;

Flame Rod & Ground			Target	Range
N	CN19	Black-Green/Yellow		DC 10~20V
		Black-Green/Yellow	2~10μA	0~20μA

109

007E Outlet Thermistor OPEN Error:

Error Condition:

If the thermistor reads a value equal to or greater than 38 kΩ (14°F or -10°C or lower). In reality (other than a frozen heat exchanger), the outlet thermistor should never see such a low value as we are running water through the heater, not ice. As such, we are using this extreme cold temperature resistance value (high kΩ) as a proxy for a damaged thermistor.

Possible Causes:

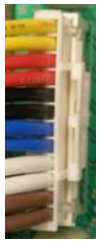
1. Thermistor damage or failure
2. Program damage;
3. Frozen heat exchanger.

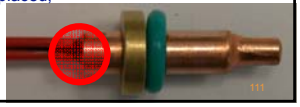
110

007E Outlet Thermistor OPEN Error:

Possible Remedies:

1. Check outlet thermistor wire connections to ensure there is no damage to the wires (no corrosion, no water, no loose wires); this typically occurs at the point where the wire meets the metal probe (see red highlight below);
2. Disconnect thermistor from the board and check the resistance; if the wiring is damaged, the resistance should be higher than 20kΩ; if so, replace thermistor;
3. If the thermistor is reading the proper resistance, then the PCB may need to be replaced;





111

008E Outlet Thermistor SHORT Error:

Error Condition:

If the thermistor reads a value equal to or greater than 248°F (120°C). In reality, the outlet thermistor should never see such a high value as we are running water through the heater, not steam. As such, we are using this hot temperature resistance value (very low kΩ) to indicate a short in (or damage to) the outlet thermistor. If there is a short, there is no resistance so kΩ should approach zero.

Possible Causes:

1. Water in the thermistor wiring connections;
2. Bare thermistor wires crossing (thermistor damage);
3. Program damage;
4. Mis-wiring of thermistor order at PCB connector;

112

008E Outlet Thermistor SHORT Error:

Possible Remedies:

1. Check outlet thermistor wire connections to ensure there is no damage to the wires (no corrosion, no water, no loose wires, no cut & crossed wiring); this typically occurs at the male/female connection between the probe and the PCB or at the PCB connection point;
2. Disconnect thermistor from the board and check the resistance of the outlet thermistor; if the wiring is shorting, the resistance should be lower than 0.8kΩ; if so, replace thermistor;
3. If the thermistor is reading the proper resistance, then the PCB may need to be replaced;

113

009E Fan Motor RPM Error:

Error Condition:

The fan motor RPMs are less than or equal to 400 RPMs with simultaneous “no air pressure” detected for 5 seconds; will attempt to sense air pressure 3 times before locking out on 009E;

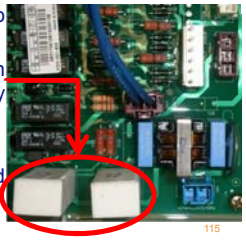
Possible Causes:

1. Damage to the ceramic tower (right) on the PCB;
2. Improper voltage from the computer board;
3. Fan motor intake clogged or air intake screen clogged;
4. Fan motor damage;
5. Other PCB damage;

114

009E Fan Motor RPM Error:

1. Check to ensure the fan wiring harness connections (at the male/female connection and where it connects to the computer board) are secure and that there is no damage to the wires (no corrosion, no water, no loose wires);
2. Check the ceramic towers on computer board to ensure they are not loose in any way;
3. Check venting for obstructions;
4. Remove fan motor housing and inspect for obstructions or water;



115

009E Fan Motor RPM Error:

5. Check the power supply to the fan motor by checking the voltage between the black and red wires of connection #8. If the voltage is not within the proper range, check the PCB and transformer for proper voltages and replace parts if necessary;

Fan Motor			Target	Range
J	CN8	Black-Red		DC 120~180V
		Black-White		DC 2~8V

6. Check to see if there is any pulse output from the fan motor by checking the voltage between the black and white wires of connection #8. Voltage should be between 2~8VDC; if the voltage is not within that proper range, replace the fan assembly.

116

010E Air Pressure Sensor Error:

Error Condition:

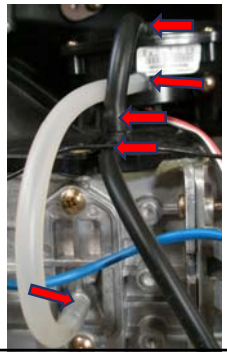
Either there is no air pressure (DC 0.1V) or air pressure is too high (>DC 4.5V) as detected by the APS for a period of 5 seconds; this is determined by the output voltage from APS being outside the normal range of DC 0.3~4.0V;

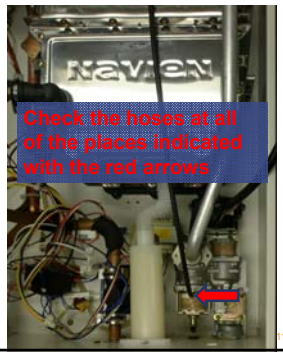
Possible Causes:

1. Damage to APS hoses and/or Air-Gas Feedback hose;
2. Blockage or restriction in intake and/or exhaust vent;
3. Condensate drain blockage;
4. APS component failure;
5. High altitude adjustment required;
6. Improper potentiometer adjustment;

117

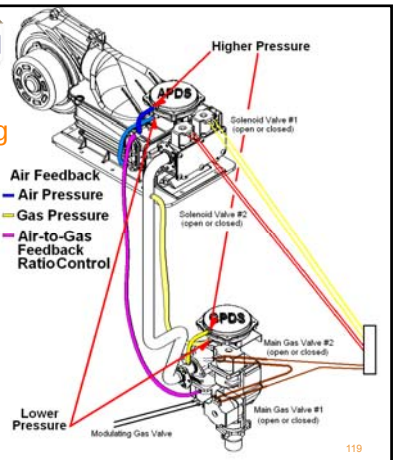
010E Air Pressure Sensor Error:





118

Understanding the Navien Combustion System Components

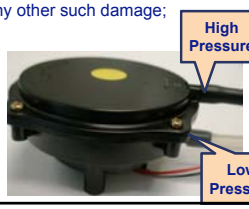


119

010E Air Pressure Sensor Error:

Possible Remedies:

1. Check venting (intake and exhaust) for obstructions;
2. Check APS connection at computer board to ensure it is securely connected, there is no loose wiring, corrosion or water;
3. Check to ensure all rubber hoses are securely attached to their appropriate components; Check all rubber tubing in the water heater for tears, cuts, cracking or any other such damage;
4. Ensure that plastic tie wraps are not pinching the rubber hoses;
5. Ensure Low Pressure and High pressure hoses are attached to the appropriate nipples on the APS;
6. Check condensate hose for proper draining;



010E Air Pressure Sensor Error:

Possible Remedies:

6. Remove hoses from APS and blow (and hold) and suck (and hold) through each nipple (H and L) to ensure that the diaphragm is moving and holding pressure (both high pressure and vacuum); you should hear a click each time;
7. Check the fan motor for proper operation (see 009E fan motor slides for procedure);
8. Check the voltage between the black and red wires of the APS. The target voltage is 5V. If the voltage is not in that range, check the connector (CN6 / G) at the PCB or replace the APS.
9. Check the voltage between the black and white wires of the APS. If there is no voltage or the voltage is outside the stated range (below), replace the APS.

Air Pressure Sensor			Target	Range
G	CN6	Black-Red (Input)	DC 5V	DC 4.5~5.5V
		Black-White (Output while in Standby)	DC 0.2~0.6V	DC 0~4.5V
		Black-White (Output while Operating)	DC 1~4V	DC 0~4.5V

010E Air Pressure Sensor Error:

Possible Remedies:

One common 010E cause is damage to the Air/Gas feedback hose nipple at the top of the burner (see picture 1). This damage is often caused by the front cover of the heater banging this nipple when installing or removing the cover. Take precautions to not let the cover slip down.

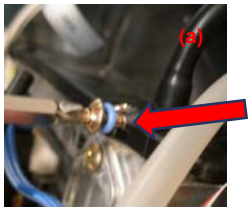
If this nipple (which is connected to the top plate on the burner) gets damaged, it is difficult to replace because the entire heat exchanger has to be removed.

010E Air Pressure Sensor Error:

Possible Remedies:

We can attempt to repair the nipple on site:

Step 1: insert a threaded screw into the broken nipple to seal the opening. Use a rubber washer or sealant to ensure there are no air leaks. Confirm there are no leaks by blowing in hose that leads to the High zone of the APS (a).



To repair this nipple break, you will need a threaded screw, a rubber washer or sealant, a small tee, a knife to cut the hoses and possibly some additional hose.

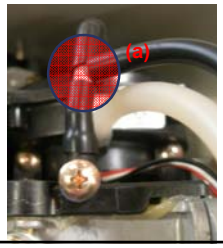
123

010E Air Pressure Sensor Error:

Possible Remedies:

We can attempt to repair the nipple on site:

Step 2: insert a tee between the High zone of the APS. Attach the thin feedback hose to the long part of the tee (a). Ensure that the modified hoses are not bent or damaged in any way.

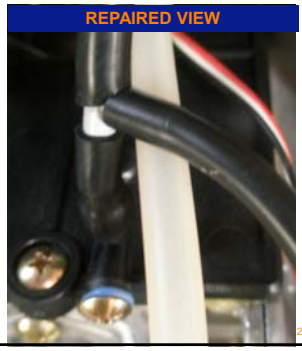


124

010E Air Pressure Sensor Error:

ORIGINAL VIEW

REPAIRED VIEW



125

012E Flame Loss:

Error Condition:

Software requires a consistent current of 2~10μA from the flame rod to maintain flame. Upon loss of the flame sensing current, the program will attempt to restart 20 times. If after 20 times, the software still cannot maintain a constant current, the unit will lockout on a 012E error.

Possible Causes:

1. Insufficient gas supply;
2. Damaged, disconnected or restricted Air-Gas Feedback hose (to modulating gas valve);
3. Dirty flame rod or damaged flame rod wire;
4. Loss of ground wire connection;

126

012E Flame Loss:

Possible Remedies:

1. Check to ensure manual shut-off valve on the main gas supply is open;
2. Ensure the gas line has been bled of any and all air;
3. Check DIP switches for proper gas type and for proper model (BTU) settings;
4. Check to ensure all rubber hoses are securely attached to their appropriate components (especially Air-Gas Feedback to modulating valve); check for disconnection, pinching, restrictions, tears, cuts, cracking or any other such damage;
5. Check gas line pressure using a manometer to ensure gas pressure is in range (NG: 3.5" WC ~ 10.5" WC; LP: 8.0" WC~13.0" WC); turn on all hot water faucets in the building; the heater should maintain approximately 7" W.C. (for NG) and 11" W.C. (for LP) when running at maximum BTUs;

127

012E Flame Loss:

Possible Remedies (continued):

6. Check gas volume in tank (for propane installs);
7. Check gas regulators for proper operation;
8. Check the manifold gas pressure (see instructions to follow);
9. Check current of flame rod (thin black wire) at white male/female connector; if current is not in range, clean or replace flame rod;
10. Check voltage across black and green/yellow wires; if voltage is not correct, ensure electrical outlet is grounded and that green wire is properly attached to the back of case (inside).

Flame Rod & Ground			Target	Range
N	CN19	Black-Green/Yellow		DC 10~20V
		Black-Green/Yellow	2~10μA	0~20μA

128

012E Flame Loss:

Possible Remedies (continued):

11. Check voltage across the modulating gas valve; if voltage is not correct, check connection to PCB;

Modulating Gas Valve			Target	Range
A	CN14	Black-Black		DC 2-10V

129

015E Communication Error With Computer Board:

Error Condition:

The software has detected a erroneous value from one of the electrical components on, or connected to the board; could but does not necessarily mean the computer board needs to be changed. The unit will lockout on a 015E error.

Possible Causes:

1. Internal damage to PCB;
2. Feedback error from GPS (at CN#7);
3. Water on board; damaged, disconnected, corrosion, loose wires or water shorted components;
4. EMI (electro magnetic interference);

130

015E Communication Error With Computer Board:

Possible Remedies:

1. Check all PCB connections for proper contact;
2. Ensure remote control has magnet attached closest to the control board;
3. Disconnect all components, including the remote control, from the board; check each component for wire damage, corrosion or water;
4. Re-insert connections S, M, I and H. The LED display should appear on the PCB;
5. We are trying to identify which component is causing the error so before plugging in subsequent components, reset the breaker to clear any errors; Re-insert the remaining connections 1-by-1 in the following order: B, G, F, then all others 1-by-1;
6. If a connection is made and the 015E appears, that is the suspect component; check that component's connection at the PCB for proper contact, water (short), damage, etc. and reset; if error continues, replace suspect component and the PCB.

131

015E Communication Error With Computer Board:

Possible Remedies:

7. Ensure remote control has the black magnet supplied with orange wire attached closest to the control board to reduce EMI;

132

016E Water High Limit / Overheat Cut-off Fuse Error:

2 Possible Error Conditions:

1. The normally closed water temperature high-limit switch detected a temperature greater than 92°C (198°F) and has opened; OR
2. The normally closed overheat cut-off fuse has burnt through indicating an excessive heat around the burner and/or heat exchanger. Under both conditions, the unit will lockout on a 016E error.

Possible Causes:

1. DIP switch #1 on set of 6 set to "ON" = maximum fire;
2. Improper BTU selection on DIP switches (i.e.: CR-180 but set for CR-240);
3. Insufficient flow (low water pressure or external recirculation pump too small);
4. Wire/contact disconnection or damage;
5. Flow obstruction in heat exchanger; scale build up inside heat exchanger;

133

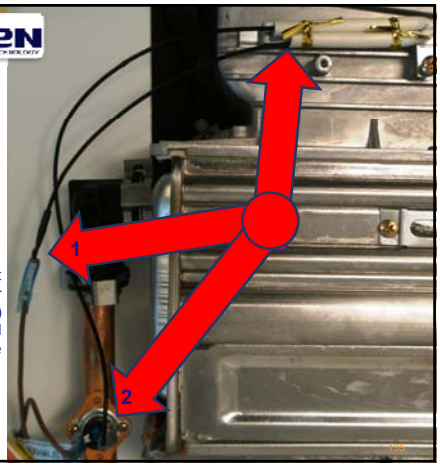
016E Water High Limit Switch:

• Normally closed;
• Opens (and locks out the heater) when a temperature greater than 92°C (198°F) is detected;

016E

Overheat Cut-off Fuse:

Unit will lockout on 016E if either contacts (1 & 2) are disconnected or if the fuse wire is cut;

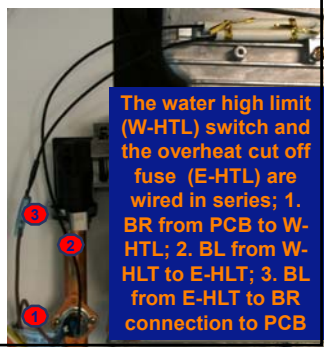


135

016E Water High Limit / Overheat Cut-off Fuse Error:

Possible Remedies:

1. Check DIP switch settings; reconfirm the 6 set for proper settings, especially switches #1, #5 and #6;
2. Check all connections to ensure proper contact; confirm there are no cuts in the wiring;
3. Check to ensure proper flow rate through the heater (see next page for minimum flow requirements);



The water high limit (W-HTL) switch and the overheat cut off fuse (E-HTL) are wired in series; 1. BR from PCB to W-HTL; 2. BL from W-HLT to E-HLT; 3. BL from E-HLT to BR connection to PCB

016E Boiling Inside Heat Exchanger

Minimum Flow Requirements to Prevent Overheating:

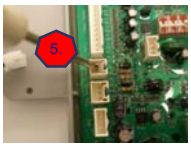
Delta T	Min GPM	Min LPM
Δt = 10°F	3.20	12.0
Δt = 15°F	2.10	8.0
Δt = 20°F	1.70	6.3
Δt = 50°F	0.70	2.5
Δt = 65°F	0.50	1.9
Δt = 80°F	0.40	1.6

137

016E Water High Limit / Overheat Cut-off Fuse Error:

Possible Remedies:

4. Clean inlet filter, recirculation filter (depending on model) and flow sensor filter. Note that units produced after October, 2008 do not have a filter in the flow sensor;
5. Test performance of the flow adjustment valve by shorting the leak detection wires (CN11 or "C") and resetting multiple times; observe the F.34~F.220 number (fully open and fully closed respectively) on the display to confirm proper opening and closing (see 001E page);
6. Check the outlet temperature with a separate thermometer to confirm high limit switch accuracy or error;
7. Check for evidence of scale on inner walls of outlet piping; descale if necessary;



138

016E Water High Limit / Overheat Cut-off Fuse Error:

Possible Remedies:

8. Check potentiometer settings to ensure in factory default position (see manifold gas pressure testing procedure);
9. Check gas line pressure using a manometer to ensure gas pressure is in range (NG: 3.5" WC ~ 10.5" WC; LP: 8.0" WC~13.0" WC);
10. Check manifold gas pressure (see manifold gas pressure testing procedure);

139

021E Inlet Thermistor OPEN Error:

Error Condition:

If the thermistor reads a value equal to or greater than 38 kΩ (14°F or -10°C or lower). In reality (other than a frozen heat exchanger), the outlet thermistor should never see such a low value as we are running water through the heater, not ice. As such, we are using this cold temperature resistance value (high kΩ) as a proxy for a damaged thermistor.

Possible Causes:

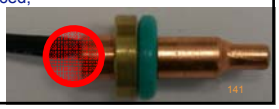
1. Thermistor damage or failure
2. Program damage;
3. Frozen heat exchanger.

140

021E Inlet Thermistor OPEN Error:

Possible Remedies:

1. Check outlet thermistor wire connections to ensure there is no damage to the wires (no corrosion, no water, no loose wires); this typically occurs at the point where the wire meets the metal probe (see red highlight below);
2. Disconnect thermistor from the board and check the resistance; if the wiring is damaged, the resistance should be higher than 20kΩ; if so, replace thermistor;
3. If the thermistor is reading the proper resistance, then the PCB may need to be replaced;



141

022E Inlet Thermistor SHORT Error:

Error Condition:

If the thermistor reads a value equal to or greater than 248°F (120°C). In reality, the outlet thermistor should never see such a high value as we are running water through the heater, not steam. As such, we are using this hot temperature resistance value (very low kΩ) to indicate a short in (or damage to) the outlet thermistor. If there is a short, there is no resistance so kΩ should approach zero.

Possible Causes:

1. Water in the thermistor wiring connections;
2. Bare thermistor wires crossing (thermistor damage);
3. Program damage;
4. Mis-wiring of thermistor order at PCB connector;

142

022E Inlet Thermistor SHORT Error:

Possible Remedies:

1. Check outlet thermistor wire connections to ensure there is no damage to the wires (no corrosion, no water, no loose wires, no cut & crossed wiring); this typically occurs at the male/female connection between the probe and the PCB or at the PCB connection point;
2. Disconnect thermistor from the board and check the resistance of the outlet thermistor; if the wiring is shorting, the resistance should be lower than 0.8kΩ; if so, replace thermistor;
3. If the thermistor is reading the proper resistance, then the PCB may need to be replaced;




143

027E Abnormal APS Error:

Error Condition:

The initial APS output voltage (feedback value) is not within the normal operating rage.

Possible Causes:

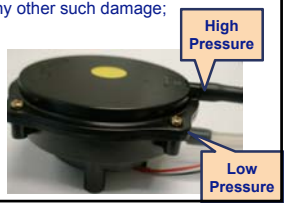
1. Damaged wiring connections at G (CN6);
2. Damage to APS hoses and/or Air-Gas Feedback hose;
3. Blockage or restriction in intake and/or exhaust vent;
4. Condensate drain blockage;
5. APS component failure;
6. PCB damage;

144

027E Abnormal APS Error:

Possible Remedies:

1. Check venting (intake and exhaust) for obstructions;
2. Check APS connection at computer board to ensure it is securely connected, there is no loose or damaged wiring, corrosion or water;
3. Check to ensure all rubber hoses are securely attached to their appropriate components; Check all rubber tubing in the water heater for tears, cuts, cracking or any other such damage;
4. Ensure that plastic tie wraps are not pinching the rubber hoses;
5. Ensure Low Pressure and High pressure hoses are attached to the appropriate nipples on the APS;
6. Check condensate hose for proper draining;



027E Abnormal APS Error:

Possible Remedies:

6. Remove hoses from APS and blow (and hold) and suck (and hold) through each nipple (H and L) to ensure that the diaphragm is moving and holding pressure (both high pressure and vacuum); you should hear a click each time;
7. Check the voltage between the black and white wires of the APS at connector G (CN6). If there is no voltage or the voltage is outside the stated ranges (below), replace the APS.
8. If the APS is normal in both standby and operating modes, replace PCB.

Air Pressure Sensor			Target	Range
G	CN6	Black-Red (Input)	DC 5V	DC 4.5~5.5V
		Black-White (Output while in Standby)	DC 0.2~0.6V	DC 0~4.5V
		Black-White (Output while Operating)	DC 1~4V	DC 0~4.5V

146

030E Exhaust High Limit Error:

Error Condition:

The normally closed exhaust temperature high-limit switch detected a temperature greater than 65°C (149°F) and has opened;

The unit will shutdown on a 030E error (will automatically restart when error condition is rectified);

Possible Causes:

1. Loose connection wire or wire damage at high-limit switch or at PCB (CN13 or connection "B");
2. Improper DIP switch settings;
3. Low flow rate (below minimum BTU rate) and/or;
4. High inlet water temperature on recirculation loop (storage tank or heating application);
5. Switch damage or malfunction;
6. Scale buildup in heat exchanger;

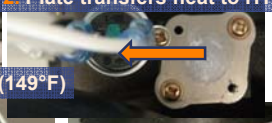
030E Exhaust High Limit Error:

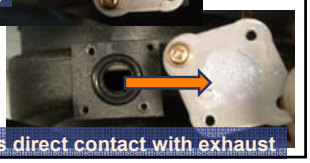
4. Unit locks out on 030E

- Normally closed;
- Opens (and shuts down the heater) when a temperature greater than 65°C (149°F) is detected;

2. Plate transfers heat to HTL switch

3. Switch opens at 65°C (149°F)



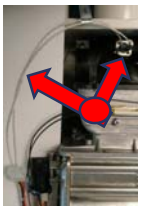


1. Plate has direct contact with exhaust

030E Exhaust High Limit Error:

Possible Remedies:

1. Check DIP switch settings (particularly #1, #5 and #6 on the set of 6 switches and #6, #7 and #8 on the set of 8 switches);
2. Check the flow rate through the heater. If low, clean inlet filter, recirculation inlet filter (depending on model) and flow sensor filter. Note that units produced after October, 2008 do not have a filter in the flow sensor;
3. Test performance of the flow adjustment valve by shorting the leak detection wires (CN11 or "C") and resetting multiple times; observe the F.34~F.220 number (fully open and fully closed respectively) on the display to confirm proper opening and closing;
4. Check the exhaust temperature with a separate thermometer to confirm high limit switch accuracy or error;
5. Check for evidence of scale on inner walls of outlet piping; descale if necessary;



149

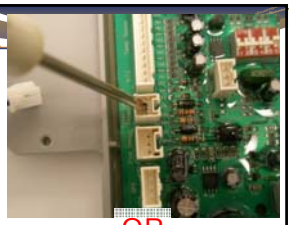
030E Exhaust High Limit Error:

Minimum Flow Requirements to Prevent Overheating:

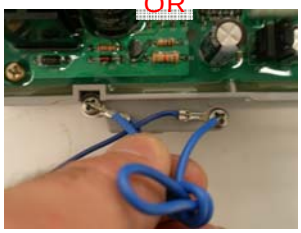
Delta T	Min GPM	Min LPM
Δt = 10°F	3.20	12.0
Δt = 15°F	2.10	8.0
Δt = 20°F	1.70	6.3
Δt = 50°F	0.70	2.5
Δt = 65°F	0.50	1.9
Δt = 80°F	0.40	1.6

150

Testing the Flow Adjustment Valve:
short then reset breaker



OR



030E Exhaust High Limit Error:

Possible Remedies:

6. Check potentiometer settings to ensure in factory default position; if the potentiometer was the face of a clock, the factory default setting would be at the 12:30PM mark (see manifold gas pressure testing procedure);
7. Check gas line pressure using a manometer to ensure gas pressure is in range (NG: 3.5" WC ~ 10.5" WC; LP: 8.0" WC~13.0" WC);
8. Check manifold gas pressure (see manifold gas pressure testing procedure);

152

032E Inlet Thermistor #2 OPEN Error:

Error Condition:

If the thermistor reads a value equal to or greater than 38 kΩ (14°F or -10°C or lower). In reality (other than a frozen heat exchanger), the outlet thermistor should never see such a low value as we are running water through the heater, not ice. As such, we are using this cold temperature resistance value (high kΩ) as a proxy for a damaged thermistor.

Possible Causes:

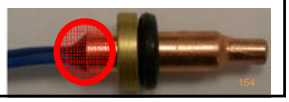
1. Thermistor damage or failure
2. Program damage;
3. Frozen heat exchanger.

153

032E Inlet Thermistor #2 OPEN Error:

Possible Remedies:

1. Check outlet thermistor wire connections to ensure there is no damage to the wires (no corrosion, no water, no loose wires); this typically occurs at the point where the wire meets the metal probe (see red highlight below);
2. Disconnect thermistor from the board and check the resistance; if the wiring is damaged, the resistance should be higher than 20kΩ; if so, replace thermistor;
3. If the thermistor is reading the proper resistance, then the PCB may need to be replaced;



154

033E Inlet Thermistor #2 SHORT Error:

Error Condition:

If the thermistor reads a value equal to or greater than 248°F (120°C). In reality, the outlet thermistor should never see such a high value as we are running water through the heater, not steam. As such, we are using this hot temperature resistance value (very low kΩ) to indicate a short in (or damage to) the outlet thermistor. If there is a short, there is no resistance so kΩ should approach zero.

Possible Causes:

1. Water in the thermistor wiring connections;
2. Bare thermistor wires crossing (thermistor damage);
3. Program damage;
4. Mis-wiring of thermistor order at PCB connector;

155

033E Inlet Thermistor #2 SHORT Error:

Possible Remedies:

1. Check outlet thermistor wire connections to ensure there is no damage to the wires (no corrosion, no water, no loose wires, no cut & crossed wiring); this typically occurs at the male/female connection between the probe and the PCB or at the PCB connection point;
2. Disconnect thermistor from the board and check the resistance of the outlet thermistor; if the wiring is shorting, the resistance should be lower than 0.8kΩ; if so, replace thermistor;
3. If the thermistor is reading the proper resistance, then the PCB may need to be replaced;

156

034E Water Adjustment Valve (WAV) Error:

Error Condition:

If the water (flow) adjustment valve (WAV) does not open when commanded by the PCB, the unit will shut down on a 34E. This error could be the result of a malfunctioning WAV, WAV feedback sensor or PCB.

Possible Causes:

1. Water (flow) adjustment valve motor connection to the PCB is disconnected or damaged;
2. WAV feedback connection to the PCB is disconnected or spring-loaded feedback sensor is damaged;
3. WAV valve is blocked with debris;
4. WAV feedback sensor is damaged;
5. Multiple unit cascade system is set up incorrectly (see cascade setup procedure to reset);

157

034E Water Adjustment Valve (WAV) Error:

Possible Remedies:

1. Check the WAV motor connection on the PCB (P/CN10) to ensure it is properly connected; ensure there is no damage to the wires (no corrosion, no water, no loose wires, etc.);

Water Adjustment Valve (WAV) Motor			Target	Range
P	CN10	Blue-Yellow (Clockwise CW to close)	AC120V	AC 97~138V
		Blue-Orange (Counter Clockwise CCW to open)	AC120V	AC 97~138V

2. Check the WAV feedback connection on the PCB (D/CN22) to ensure it is properly connected; ensure there is no damage to the wires (no corrosion, no water, no loose wires, etc.); if sub-error 14.01 or 14.02 (a circuit open error and circuit short error respectively) flashes on the LED after 0034E, this indicates a possible cut in one or more of the WAV feedback wires;

WAV Feedback Sensor			Target	Range
D	CN22	Black-Red (Input)	DC 5V	DC 4.5~5.5V
		Black-White (Output while Operating)		DC 0~5V

158

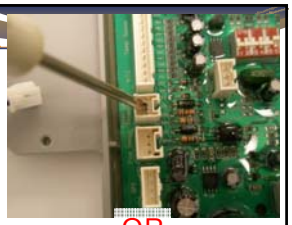
034E Water Adjustment Valve (WAV) Error:

Possible Remedies:

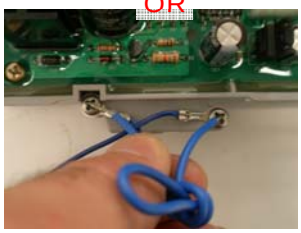
3. Test performance of the water (flow) adjustment valve by shorting the leak detection wires (C/CN11) and resetting multiple times; observe the F.34~F.220 number (fully open and fully closed respectively) on the display to confirm proper opening and closing (see next slide);
4. If the valve is not rotating properly (as determined by the F value on the PCB LED display), then disassemble the motor from the black valve body;

5. Jump the leak detection to see if the shaft of the motor rotates; reset the GFCI and again check the shaft motor rotation; if the shaft is moving, the motor is fine; blow through to ensure the valve is closing tightly;
6. If the motor is not moving, check the connection at the PCB to ensure the voltage from the PCB is proper. If the PCB is supplying the proper voltage, then replace the WAV motor; if the PCB is not supplying the proper voltage, replace the PCB.

Testing the Flow Adjustment Valve:
short then reset breaker



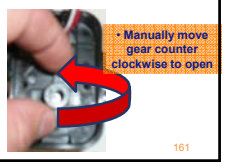
OR



034E Water Adjustment Valve (WAV) Error:

Possible Remedies:

7. If the motor is rotating but the valve is not opening, it could be blocked by debris or stuck in the closed position; once the motor is removed, remove the black cover and then remove the white plastic gear plate; once the white gear plate is removed, the valve shaft will be visible; use your hand, pliers or channel locks to manually rotate the shaft counterclockwise to open. Close and re-open to free the movement if stuck with debris such as sand; Visually inspect the rotation of the valve to ensure it is opening and closing; blow through the end to ensure the free passage of air when it is open and that the air doesn't pass through when it is closed; reattach motor; retry the F valve test;



161

034E Water Adjustment Valve (WAV) Error:

Possible Remedies:

8. In a cascade system, ensure the units are communicating properly by shutting all water flow and then adjusting the temperature on the remote control attached to the master unit; if the temperature on the PCB LED of each unit adjusts with each change of temperature on the remote control, the cascade is set up properly. If not, then reset the cascade system;

- To reset the cascade system, stop the flow and turn the power off to all units in the system; turn the existing master into a slave by moving DIP switch #1 on the set of 8 to the down position; select a new master unit and move DIP switch #1 on the set of 8 to the up position; you must remove the remote control wire from the old master and connect it to the new master;
- Turn the power to the new master unit first and then to all other salves in the system; H000 should appear in the PCB LED of the new master; S000 should appear in the PCB LED of all the slave units;
- Select a slave unit; press and hold the two white buttons simultaneously (see next page); S001 will appear on the PCB LED of that unit; proceed to do the same for all slave units in the system.

162

034E Water Adjustment Valve (WAV) Error:

Possible Remedies:

- Using the same procedure, do the new master unit last; when you press and hold the two buttons, the PCB LED on the master unit will go blank and then reappear after a few seconds with the set temperature of the remote control.
- At the same time, all of the PCB LEDs in the system should then display the same set temperature that is indicated on the remote control attached to the master;
- Test the cascade communication by adjusting the temperature on the remote control. Each time the temperature is changed on the remote control attached to the master, the temperature displayed on the PCB LEDs of all slave units should all change. If they all do, the cascade communication is set up properly; if any unit is not communicating properly, the re-set will have to be done again.
- Retest to ensure 034E does not reappear.

164

035E Gas Pressure Sensor Error:

Error Condition:

Either there is no gas pressure (DC 0.1V) or gas pressure is too high (>DC 4.5V) as detected by the GPS for a period of 5 seconds; this is determined by the output voltage from GPS being outside the normal range of DC 0.3~4.0V;

Possible Causes:

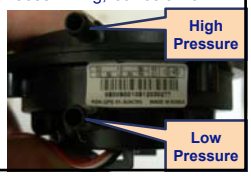
1. No/Low gas supply to the unit;
2. Damage to GPS hoses and/or Air-Gas Feedback hose;
3. Kink or restriction on rubber gas line;
4. GPS component failure;
5. Improper potentiometer adjustment;

165

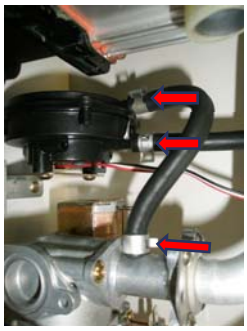
035E Gas Pressure Sensor Error:

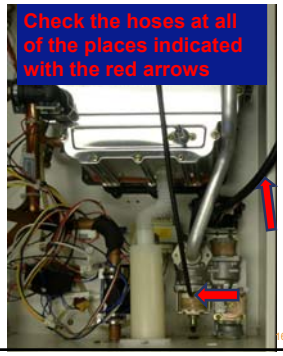
Possible Remedies:

1. Check to ensure all rubber hoses are securely attached at both ends to their appropriate components; Check all rubber tubing in the water heater for tears, cuts, cracking or any other such damage; in particular, check the 2 rubber gas line hoses supplying the GPS for damage to the hoses (see pictures on next slides);
2. Check GPS connection (CN7/F) at computer board to ensure it is securely connected and that there is no loose wiring, corrosion or water;
3. Ensure that plastic tie wraps are not pinching the rubber hoses;
4. Ensure Low Pressure and High pressure hoses are attached to the appropriate nipples on the GPS;



035E Gas Pressure Sensor Error:





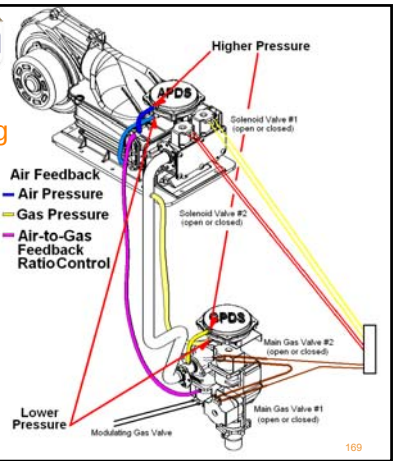
167

035E Gas Pressure Sensor Error:

Check the hoses at all of the places indicated with the red arrows

168

Understanding the Navien Combustion System Components



169

035E Gas Pressure Sensor Error:

Possible Remedies:

6. Remove hoses from the GPS and blow (and hold) and suck (and hold) through each nipple (H and L) to ensure that the diaphragm is moving and holding pressure (both high pressure and vacuum); you should hear a click each time;
7. Check the voltage between the black and red wires (input) of the GPS (CN7/F); the target voltage is DC 5V. If there is no voltage or if the voltage is not in the DC4.5~5.5V range, replace PCB;
8. Check the voltage between the black and white wires (output) while the unit is in standby mode (CN7/F); the target voltage range is DC 0.2~0.6V. If there is no voltage or if the voltage is not in the DC0.2~0.6V range, replace the GPS;

Gas Pressure Sensor			Target	Range
F	CN7	Black-Red (Input)	DC 5V	DC 4.5~5.5V
		Black-White (Output while in Standby)	DC 0.2~0.6V	DC 0.3~4.5V
		Black-White (Output while Operating)	DC 1~4V	DC 0.3~4.5V

035E Gas Pressure Sensor Error:

Possible Remedies:

9. Check the voltage between the black and white wires (output) while the unit is in operating mode (CN7/F); the target voltage range is DC 1~4V. If there is no voltage or if the voltage is not in the DC 1~4V range, replace the GPS;

Gas Pressure Sensor			Target	Range
F	CN7	Black-Red (Input)	DC 5V	DC 4.5~5.5V
		Black-White (Output while in Standby)	DC 0.2~0.6V	DC 0.3~4.5V
		Black-White (Output while Operating)	DC 1~4V	DC 0.3~4.5V

171

036E Multi Unit Communication Error:

Error Condition:

The Master unit is trying to communicate with one of the slave units and there is no response or an improper response;

Possible Causes:

1. Power is off to one of the units in the system;
2. Improper DIP switch settings on master and/or slave units;
3. Improper cascade initialization and/or set up;
4. Damaged or disconnected multi-unit communication cable;
5. Incompatible PCB software versions;

172

036E Multi Unit Communication Error:

Possible Remedies:

1. Check to ensure all units are plugged in and that the GFCI is in the ON position; the LEDs on the PCB on all boards in the system should light up;
2. Ensure that the system is communicating properly; stop all flow through the system and then adjust the temperature on the remote control that is attached to the master unit; the temperatures on all slave units should change to the same temperature as displayed on the master's remote control; if all temperatures change, the system is communicating properly; if all temperatures do not change, then you must reset the cascade (set next slides);
3. Check the software version of the PCB by turning the GFCI off and then on again. The software version will appear first and then the software release year and month:

173

037E Leak Detection Error:

Error Condition:

The 'normally open' leak detection circuit (DC 0V) (contacts attached to the legs of the computer board) has shorted (closed) indicating water collection in the bottom of the unit (DC 5V).

Possible Causes:

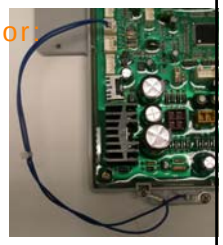
1. There is a leak within the unit and water is collecting in the bottom of the water heater;
2. Water has collected at C/CN11 and is shorting the circuit;
3. The two contacts are touching, shorting the circuit;
4. There is damage to the blue wires (cut) and they are shorting;

174

037E Leak Detection Error:

Possible Remedies:

1. Check the two contacts attached to the bottom left leg of the PCB to ensure there is no water collecting in the bottom of the case;
2. If there is no water at the bottom of the case, ensure that the two contacts are not inadvertently shorting, either by touching their contacts together or both touching the case;
3. Ensure there is no damage to the blue wiring causing the short;



175

038E Lack of Flow Error:

Error Condition:

On the Navien "A" models (that include a buffer tank and pump), the pump will come on when the faucet closes to reheat the buffer tank. When the pump comes on, the PCB looks for confirmation that the flow sensor to start spinning. If the PCB does not detect the flow sensor spinning for a minimum of 10 seconds, then 038E appears and the unit shuts down.

Possible Causes:

1. The flow sensor impeller is damaged or blocked and not spinning;
2. Pump is air-locked and not able to push water through;
3. The flow sensor feedback wire is not connected properly;
4. The pump power supply wire is not connected properly to either the PCB or to the pump contacts;
5. There is a blockage somewhere within the water circuit, including the recirculation line;
6. Three way valve is set to "OUT" but the recirculation inlet fitting is capped;
7. **Cross-over tees are being used at remote fixtures and closing while the pump is running**

176

038E Lack of Flow Error:

Possible Remedies:

1. Turn a faucet on to see if the unit turns on; if the unit turns on, the flow sensor is working and the 038E problem is likely with the pump; if the unit doesn't turn on, check the flow rate using the PCB LED; if the flow rate reads zero, there is likely a problem with the flow sensor;
2. Check the recirculation inlet filter for blockage;
3. Check to ensure both the flow sensor feedback wire (E/CN5) and the pump power supply wires (O/CN18) are connected to the PCB properly; also ensure that the connections to the pump are secure (see photo); ensure there is no damage to the wires (no corrosion, no water, no loose wires, etc.);

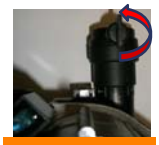
177

038E Lack of Flow Error:

Possible Remedies:

4. Open the pump air vent and then the bleed screw at the front of the pump to ensure all air is bled out; if the pump is coming on and off repeatedly, it is symptomatic of an airlock in the pump (see photos next slide);

038E Lack of Flow Error:



CCW to open;
CW to close

CCW to open;
CW to close

Bleeding Air From the Pump:

- To bleed air from the air vent, open the screw (CCW) to let any built-up air pressure escape; re-tighten cap;
- When bleeding air from the pump's front screw, open the screw slightly to let any built-up air pressure escape; when there is a clear stream of water coming from the pump, close the bleed screw;

179

038E Lack of Flow Error:

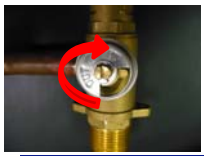
Possible Remedies:

5. When the faucet was turned on, if the unit did not come on and there was no flow registering on the PCB LED, remove the flow sensor and troubleshoot as described in the previous section;
6. If there is no external recirculation line, check to ensure the diverting valve is in the "IN" position; if it is in the "OUT" position, the pump will cavitate (see next slide);
7. If the water heater came on when you opened the faucet during the test in step 1, then there is no restriction within the heat exchanger of the water heater; if however, during recirculation only, there is no flow through the heater and all of the above conditions have been checked, there is likely a blockage in the external recirculation line or in the pump itself. You will need to disassemble the water ways to inspect;
8. If cross-over tees are being used at remote faucets, they may close thus restricting flow, causing the flow sensor to stop, while the pump is still running; a 038E will follow; once flow starts again, the unit will automatically try to restart (this is not a hard lockout error).

180

If there is no external recirculation line, ensure the pump is in the "IN"TERNAL RECIRCULATION position

- To switch from EXTERNAL to INTERNAL, rotate the valve ¼ turn clockwise;



Note: the brass tab does not move; the round stainless steel cover plate with "IN" and "OUT" indicated rotates; the brass tab is part of the casting and is fixed;

039E Cascade Flow Sensor Error:

Error Condition:

In a cascade installation (with multiple Navien water heaters operating as a system), when a unit is not required, it remains in standby mode with its Water Adjustment Valve (WAV) closed. When the demand for hot water increases in the building and subsequent units are required to assist, the master will command a unit to open its WAV. When that unit's WAV opens, cold water begins to flow through the heater, the flow sensor will see the flow and the unit will fire on and begin heating.

If that subsequent unit does not register any flow for a minimum of 10 seconds, then 039E appears and the unit shuts down.

Possible Causes:

1. The flow sensor impeller is damaged or blocked and not spinning;
2. The flow sensor feedback wire is not connected properly to PCB;
3. The WAV feedback sensor is damaged or not connected properly to PCB;
4. Improper cascade setup;

182

039E Cascade Flow Sensor Error:

Possible Remedies:

1. Check to ensure both the flow sensor feedback wire (E/CN5) and the WAV wires (D/CN22) are connected to the PCB properly; ensure there is no damage to the wires (no corrosion, no water, no loose wires, etc.);
2. Turn the power off to the water heater and remove the communication cable. Re-power the unit and the WAV should open fully; when water starts to flow through the heater, check the flow rate to see if the unit starts. If the PCB LED reads flow, the flow sensor and the unit fires on, the unit is not the problem; turn the power off, reinsert the communication cable and re-power. The unit should be online again;
3. If the unit operates individually (as in the above scenario), then the problem exists with the cascade setup. Follow the directions in the previous section regarding proper resetting of the cascade system.

183

048E Low Gas Pressure Error:

Error Condition:

If the GPS detects low gas pressure, the unit will automatically adjust the fan speed to balance the air-gas ratio to keep the unit running as normally as possible. Each time the unit re-ignites, the unit will revert to it normal settings;

When the burner ramps up into later 2nd stage and 3rd stage, if the fan speed required is outside the normal operating range of the APS and flame loss occurs 5 times (fan is blowing the flame out), the unit will lock out on a 048E error.

Possible Causes:

1. Improper DIP switch settings;
2. Inadequate gas supply pressure/volume;
3. Propane tank is empty;
4. Component error (fan, APS or GPS);
5. Damaged, disconnected or restricted Air-Gas Feedback hose (to modulating gas valve); also check all APS & GPS hoses;

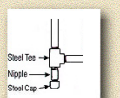
184

048E Low Gas Pressure Error:

Possible Remedies:

1. Improper DIP switch settings; check the DIP switches, especially the gas set of 6;
2. Check to ensure the manual shut off valve on the main gas line is fully open; if it is, take a reading of the gas line pressure at the dirt pocket to ensure the proper gas line pressures are maintained while the unit is operating at maximum fire;
3. Check the propane tank for volume and check the regulator for proper operation;
4. Check to ensure all rubber hoses are securely attached to their appropriate components (especially Air-Gas Feedback to modulating valve); check for disconnection, pinching, restrictions, tears, cuts, cracking or any other such damage;

Gas line Dirt Pocket



185

Determining Insufficient Temperature:

Error Condition:

Temperature at faucet is (significantly) below set point. No error code.

Possible Causes:

1. Insufficient gas supply (pipe diameter too small for length of pipe run); Is yellow light on board blinking slowly?
2. Improper DIP switch settings;
3. Cross piping.

186

Determining Insufficient Temperature:

Possible Remedies:

1. If the yellow light on the computer board is blinking slowly, the gas volume to the heater is low. Make note of the various pipe diameters and elbows you have in the gas line supplying the water heater (for example, 5 feet of 1"; 10' of ¾" with 4 90° elbows); cross reference that total length with the Gas Pipe Sizing Chart included in the Navien Installation Manual (blue)* to ensure the installed piping will deliver the BTUs required to run the heater at maximum fire;

- In the manual, we indicate the Navien unit can operate at lower gas pressures (down to 3.5" WC) but lower gas volumes equate to lower heat content delivery thus temperatures cannot be maintained if the water volume through the heater is higher than BTUs supplied.

* (or consult the National Fuel Gas Code (ANSI Z223.1/NFPA 54) in the USA or the Natural Gas and Propane Installation Code (CSA/CGA B149.1) in Canada)

187

Determining Insufficient Temperature:

Possible Remedies:

2. Check the settings of all DIP switches on the set of 6 switches to ensure they are set correctly. The set of 6 DIP switches controls the burner and BTUs. See the DIP switch setting section of this troubleshooting guide); also check switches #7 and #8 of the set of 8 DIP switches ofr proper temperature selection;
3. Check the set temperature of the remote control; disconnect the remote control and just use the DIP switches on the PCB for troubleshooting;
4. Check for Cross piping in the plumbing system or within the heater (see next slides).

188

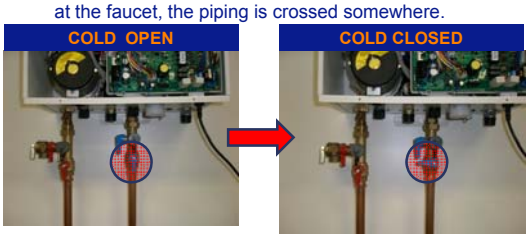
Determining Cross Piping:

Possible Remedies:

Step 1: Close the cold water supply to the water heater;

Step 2: Open any hot faucet (hot only);

IF after Steps 1 & 2 are completed, there is still water flowing at the faucet, the piping is crossed somewhere.



189

Determining Cross Piping:

Possible Remedies:

Step 3: Determine if the cross piping is within the water heater or external; the only place this crossing could take place within the heater is at the check valve; the check valve is located within the black tee attached to the bottom of the buffer tank;




Step 4: Move the 3-Way valve to the "IN" position (see next slide);

190

INTERNAL RECIRCULATION

• Valve should be in the vertical position for internal recirculation;

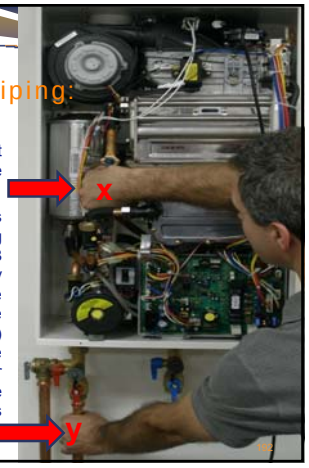
191

Determining Cross Piping:

Possible Remedies:

Step 5: Start water flow at a faucet and let the water heater operate normally.

Step 6: Once set temperature has been reached (verify by checking the HXXX number on the PCB LED), physically compare (by touching the pipe) the temperature of the pipe at the outlet of the heat exchanger (x) with the temperature of the pipe at the outlet of the water heater (y). If the two temperatures are significantly different, there is crossing at the check valve;

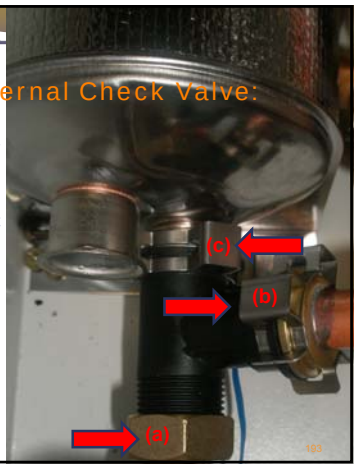


Removing the Internal Check Valve:

Step 7: If the crossing is internal, drain the water heater;

Step 8: Unscrew the brass nut **(a)** and remove the two retaining clips **(b)** and **(c)**; you should also remove the brass nut from the top of the pump that connects to **(a)**;

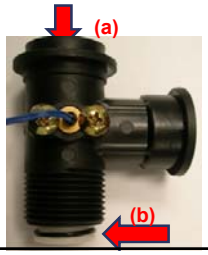
With these pieces removed, you will be able to remove the black tee which houses the check valve.



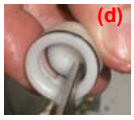
193

Cleaning the Internal Check Valve:

Using a thin, blunt object, gently push through the center of the tee **(a)** and the check valve will come out of the other end of the tee **(b)**;



Once the check valve is removed, inspect the check plate for debris (teflon tape, solder paste, PEX or copper filings, etc.) and proper seating in the valve **(d)**. Also check the spring **(e)** for proper expansion and contraction; if all looks proper, re-assemble.



194

Resetting the Cascade System:

Steps:

In a cascade system, ensure the units are communicating properly by shutting all water flow and then adjusting the temperature on the remote control attached to the master unit; if the temperature on the PCB LED of each unit adjusts with each change of temperature on the remote control, the cascade is set up properly. If not, then reset the cascade system;

1. To reset the cascade system, stop the flow and turn the power off to all units in the system; turn the existing master into a slave by moving DIP switch #1 on the set of 8 to the down position; select a new master unit and move DIP switch #1 on the set of 8 to the up position; you must remove the remote control wire from the old master and connect it to the new master;
2. Turn the power to the new master unit first and then to all other salves in the system one-by-one; H000 should appear in the PCB LED of the new master; S000 should appear in the PCB LED of all the slave units;
3. Select a slave unit; press and hold the two white buttons simultaneously (see next page); S001 will appear on the PCB LED of that unit; proceed to do the same for all slave units in the system.

195

Resetting the Cascade System:

KDC-321 Board

Resetting the Cascade System:

4. Using the same procedure, do the new master unit last; when you press and hold the two buttons, the PCB LED on the master unit will go blank and then reappear after a few seconds with the set temperature of the remote control.
5. At that time, all of the PCB LEDs in the system should then display the same set temperature that is indicated in the remote control attached to the master;
6. Test the cascade communication by adjusting the temperature on the remote control. Each time the temperature is changed on the remote control attached to the master, the temperature displayed on the PCB LEDs of all slave units should also change. If they all change, the cascade communication is set up properly; if any PCB LED did not change, it is not communicating properly and the re-set will have to be done again;
7. Retest to ensure 036E does not reappear.

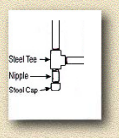
197

Adjusting the Manifold Pressure:

Note:

1. Before assuming the manifold pressure has to be adjusted, ensure the DIP switch settings, especially the gas set of 6, is set correctly;
2. Take a reading of the gas line pressure at the dirt pocket to ensure the proper gas line pressures are maintained while the unit is operating at maximum fire (open multiple faucets to start the unit and to ramp it up to maximum fire); to operate at it maximum BTU potential at maximum fire, the unit should have a minimum of 7" WC for Natural Gas and 11" WC for Propane;
3. If the line pressure while the unit is operating at maximum is less than the numbers listed above, you will experience lower hot water volumes and lower hot water temperatures than specified;
4. Adjusting the manifold pressure will not make up for a lack of gas volume coming into the heater.

Gas line Dirt Pocket

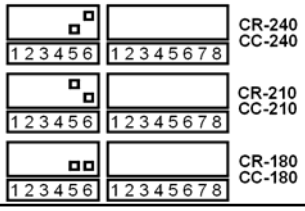


198

Adjusting the Manifold Pressure:
Set of 6 Dip Switches:

Confirm that you have the proper model selected on the set of 6 DIP switches (#5 & #6):

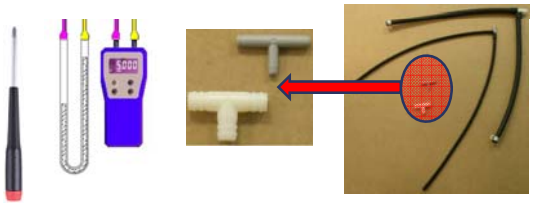
CR-CC Model/ BTU Settings



199

Adjusting the Manifold Pressure:

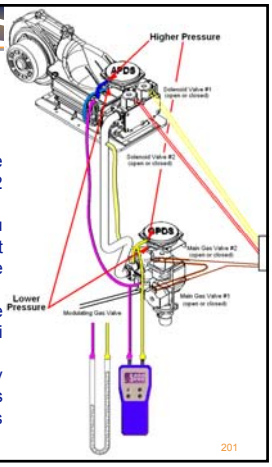
- To test and adjust the gas manifold pressure, you will require a differential pressure manometer (dual port), a Philips #2 screwdriver, 2 tees (available from Navien) and extra rubber hoses and a small (micro) Philips screwdriver;



200

Adjusting the Manifold Pressure:

- To measure the manifold pressure, we need to tee into the rubber hoses at 2 points;
- Do not cut the existing hoses as you will need to reattach them once the test is completed; as such, additional hose will be required to complete the test;
- Tee connection #1 (the larger white tee) is inserted between the gas venturi and high pressure port of the GPS;
- Tee connection #2 (the smaller gray tee) is inserted between the air-gas feedback nipple and the modulating gas valve;

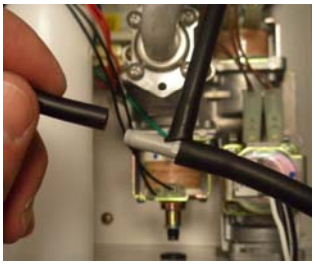


201

Adjusting the Manifold Pressure:

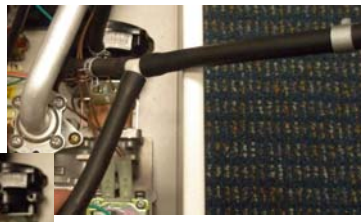
202

Adjusting the Manifold Pressure:



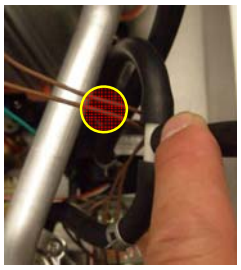
203

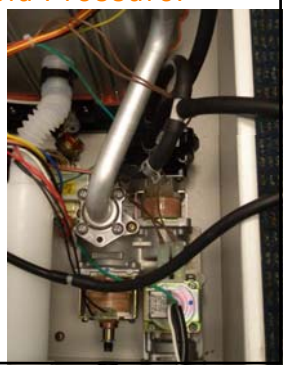
Adjusting the Manifold Pressure:



204

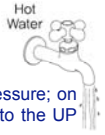
Adjusting the Manifold Pressure:





Adjusting the 3-Stage Minimum Manifold Pressure:

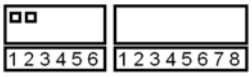
• Once the tees are in place and hooked up to the manometer, ensure the water heater is off and then set the manometer to zero;



• Turn on a faucet;

• We will first set the 3-stage minimum manifold pressure; on the set of 6 DIP switches, set switches #1 and #2 to the UP (ON) position;

MINIMUM FIRE
w/ 3-FRAMES OPEN
1 & 2 UP (ON)



• Now we are ready to adjust the minimum manifold pressure:

206

Adjusting the 3-Stage Minimum Manifold Pressure:

• Note the pressure indicated by the manometer; it should be with the following ranges. Be sure to note the proper model and proper gas type:

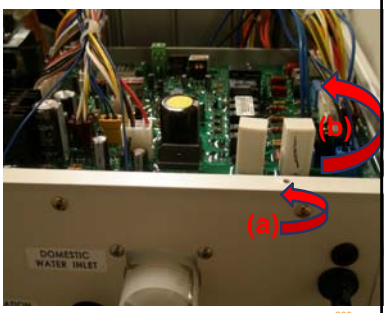
Model	Gas Type	Manifold Gas Pressure Settings	
		3 Stage Minimum Fire	Maximum Fire
CR-180, 180A / CC-180, 180A	NG	0.93 +/- 0.06" WC	2.72 +/- 0.08" WC
CR-210, 210A / CC-210, 210A	NG	0.67 +/- 0.06" WC	1.65 +/- 0.08" WC
CR-240, 240A / CC-240, 240A	NG	0.67 +/- 0.06" WC	2.20 +/- 0.08" WC
CR-180, 180A / CC-180, 180A	LP	1.73 +/- 0.08" WC	4.96 +/- 0.08" WC
CR-210, 210A / CC-210, 210A	LP	1.30 +/- 0.08" WC	3.19 +/- 0.08" WC
CR-240, 240A / CC-240, 240A	LP	1.30 +/- 0.08" WC	3.86 +/- 0.08" WC

• If the pressure is not in the above range, then adjustment will be required.

207

Accessing Behind the Computer Board:

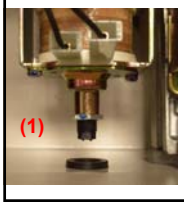
To access behind the board, remove the screw that attaches the right leg of the PCB to the bottom of the case (a). With that screw removed, the PCB will pivot out towards you to the left (b).

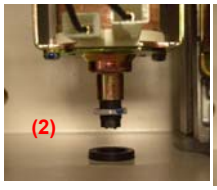


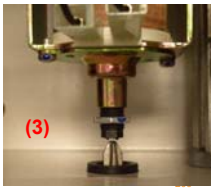
208

Adjusting the 3-Stage Minimum Manifold Pressure:

• Once the PCB is pivoted to the left, locate the black adjustment screw at the bottom of the modulating gas valve (1). Loosen the set screw by moving it clock wise (CW) (2). Once the set screw is loosened, from the bottom of the heater, insert a #2 Philips screw in into black adjustment screw (3); adjust the screwdriver according to the manometer to bring the value into the specified range:

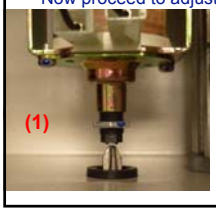


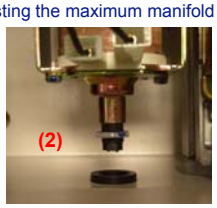


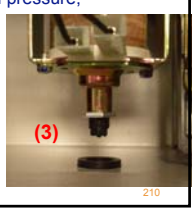


Adjusting the 3-Stage Minimum Manifold Pressure:

• Once the minimum manifold pressure reading on the manometer matches the target pressure outlined in the previous table, the minimum manifold pressure is the set properly.
• Tighten the set screw to secure that proper position by moving it counter clockwise (CCW);
• Now proceed to adjusting the maximum manifold pressure;







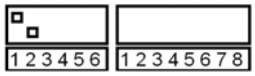
210

Adjusting the Maximum Manifold Pressure:

- Turn on multiple faucets;

- to set the maximum manifold pressure, in the set of 6 DIP switches, set switches #1 to the UP (ON) position (#2 is in the DOWN (OFF) position);

MAXIMUM FIRE:
1 UP & 2 DOWN



- Now we are ready to adjust the maximum manifold pressure:

211

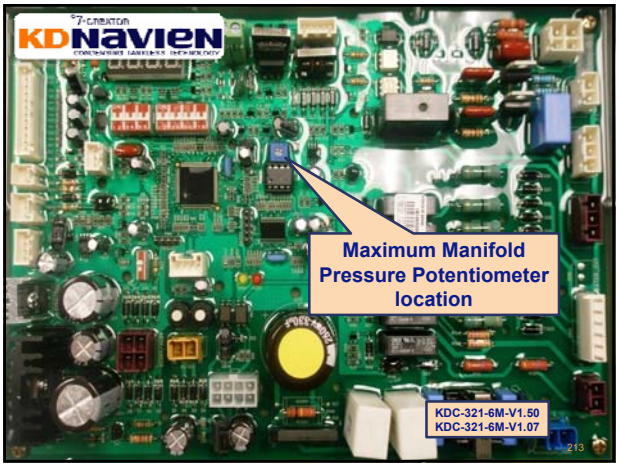
Adjusting the Maximum Manifold Pressure:

- Note the pressure indicated by the manometer; it should be with the following ranges. Be sure to note the proper model and proper gas type:

Model	Gas Type	Manifold Gas Pressure Settings	
		3 Stage Minimum Fire	Maximum Fire
CR-180, 180A / CC-180, 180A	NG	0.93 +/- 0.06" WC	2.72 +/- 0.08" WC
CR-210, 210A / CC-210, 210A	NG	0.67 +/- 0.06" WC	1.65 +/- 0.08" WC
CR-240, 240A / CC-240, 240A	NG	0.67 +/- 0.06" WC	2.20 +/- 0.08" WC
CR-180, 180A / CC-180, 180A	LP	1.73 +/- 0.08" WC	4.96 +/- 0.08" WC
CR-210, 210A / CC-210, 210A	LP	1.30 +/- 0.08" WC	3.19 +/- 0.08" WC
CR-240, 240A / CC-240, 240A	LP	1.30 +/- 0.08" WC	3.86 +/- 0.08" WC

- If the pressure is not in the above range, then adjustment will be required.

212



213

Potentiometer Settings:

- When burning at maximum fire, if the manifold pressure is not within its standard range, use the variable resistance potentiometer to bring the values into range (you will need a micro precision Philips screwdriver to adjust the potentiometer);
- Range is ¼" turn clockwise to increase and ¼" turn counterclockwise to decrease;

New Type

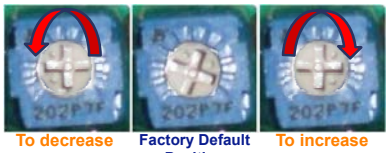
To decrease max. manifold pressure | **Factory Default Position (about 12:30 on clock)** | To increase max. manifold pressure

214

Potentiometer Settings:

- Over-firing (manifold gas pressure too high) could one possible cause of multiple error codes (001E, 003E, 012E, 016E and 030E);

- Old Potentiometer Type (KDC-320-1M boards):



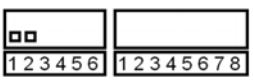
To decrease max. manifold pressure | **Factory Default Position (about 12:30 on clock)** | To increase max. manifold pressure

215

Adjusting the Maximum Manifold Pressure:

- Once the 3-stage minimum and maximum manifold pressures have been adjusted to their proper targets (as given in the tables), the setting of the manifold pressure is done;
- To complete the process, remove the tees and reattach the air-gas feedback tube (the thin tube running from the upper nipple at the burner plate to modulating gas valve) and the tube supplying the high pressure zone of the GPS;
- Readjust the DIP switch settings to their normal position (switches #1 & #2 in the DOWN (OFF) position:

NORMAL FIRE:
1 DOWN & 2 DOWN



- Open multiple faucets to run the water heater at maximum and then gradually reduce to minimum to ensure the proper burner operation.

216

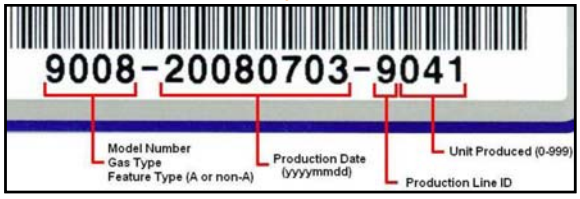
Navien Product Improvements:

• As Navien is dedicated to continuous product improvement, Navien reserves the right to change specifications as well as re-design and/or discontinue any model or feature without prior notice and without incurring obligations;

• Going forward, technical bulletins will be released to update the contractors of changes that are made to the water heaters;

•The serial number of the heater (outlined in the photo to the right) is the key to identifying which updates apply to which heaters;

Navien Product Improvements:



• When communicating with Navien Technical Support, when completing the warranty card or when referencing Technical bulletins, the serial number is essential. The serial number is located included in 2 places; one is on the right side of the water heater and the second is located on the back side of the front cover;
• As indicated in the photo above, the first 4 digits identify the model number and gas type and features ("A" model or not); the middle set of 8 digits represents the date in yyyymmdd format; the last 4 numbers indicate the production line used and the unit number for that line on that day (0-999 unit).

218

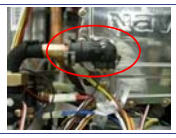
Improvements (1)

Model	OLDER CR/CC	NEWER CR/CC & NR/NP
Improvements Made Summary	-Impeller : PC(Polycarbonate) -Magnet : -Cold Inlet Filter : Plastic Filter	- Impeller Material : Nylon 66 -Magnet : Nickel Coating -Cold Inlet Filter : Stainless Steel Filter - Added Recirculation Inlet Filter : Stainless Steel Filter
Flow Sensor	impeller 	impeller 
Inlet Filters	Plastic Cold Water Inlet Filter 	Stainless Steel Cold Water Inlet Filter 
	 No Recirculation Inlet Filter	 Recirculation Inlet Filter

Improvements (2)

2nd/3rd/4th Stage Solenoid Valves		
Combustion Air Intake Duct Air-Gas Feedback Tube Nipple		

Improvements (3)

Water Pipe Adapter "A"	Color : Gray	Color : Black Rib for Reinforcement
		
Thermistor Wire	Wire with PVC	Wire with PVC and EVA
		

Product Improvements: Flow Sensor

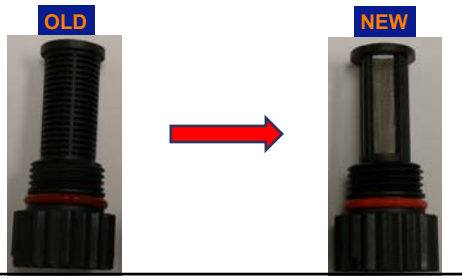
• If there is a flow sensor in the water heater has no date or if it is dated before 081025 (yymmdd) , then you may need to upgrade your flow sensor if the flow in the water heater becomes unstable or if there is any visible damage to the veins of the impeller or to the magnet (rusting, flaking, cracking);

•The new flow sensor has no filter screen in it so if you replace a flow sensor that had a screen with a new one that does not, it is best to also change the cold water inlet filter if it is made fully of black plastic (see next slide);

222

Product Improvements: Inlet Filter

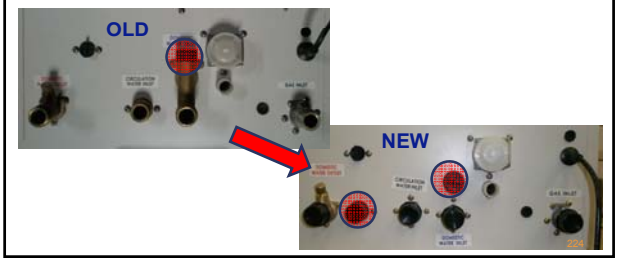
• If there is an old black plastic filter in your water heater and if you find that debris is often collecting in the flow sensor or in the flow sensor screen, changing to the newer inlet filter with the stainless steel screen will collect more debris but will collect it at the bottom of the heater which will be easier to remove and clean:



223

Product Improvements: Case

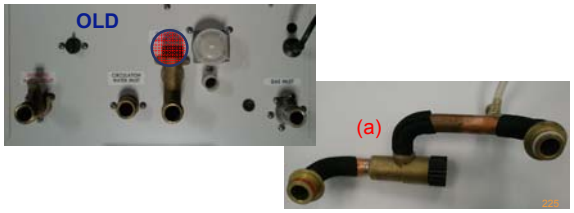
• In the original units, there was no filter for the recirculation line. As such, any debris left from the original install or that may develop over time, can collect in the flow sensor; the new case design eliminates this concern with the addition of a new recirculation inlet filter. It was added to the "A" model units in September '09



224

Product Improvements: Retrofit 2nd Filter

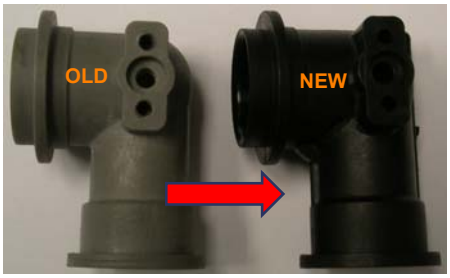
• For those that do have the older case but would like the second filter because they are often having to clean the flow sensor filter, Navien has designed a retrofit piece that installs between the outlet of the internal buffer tank and the flow sensor (see (a)). This filter has the new stainless steel filter built in and will be easier to service for the homeowner than the filter in the flow sensor; Once this filter is in place, it is safe to remove and discard the screen filter in the flow sensor.



225

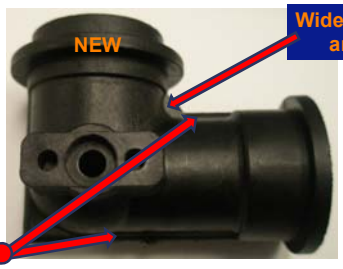
Product Improvements: Elbows

- If there are grey elbows on your water heater, they should be changed to the new black elbows with the seam ribbing and wider inside angle;



226

Product Improvements: Elbows



227

Product Improvements: Gas Line

- If there is thin gas line attached to the GPS of your heater, it is best to replace it with new thicker gas lines;

- This change affects units produced from 2008/01/01 to 2008/06/01. As this only affects older units, a change would only be required if you are called back to a jobsite with a 003E or 035E error code;

NOTE:
•This picture, when printed out is the actual diameter of the new pipe.

Navien Product Improvements Update Requirements:

Units Produced from:
XXXX-20080101-XXXX ~ XXXX-20080630-XXXX







Navien Product Improvements Update Requirements:

Units Produced from:
XXXX-20080701-XXXX ~ XXXX-20080920-XXXX





230

Navien Product Improvements Update Requirements:

Units Produced from:
XXXX-20080921-XXXX ~ XXXX-20081028-XXXX

- In some applications, software version V1.05 can result in a "burner off" condition during usage;
- Upgrade software or replace with a PCB having software version V1.07, 1.50, 1.51 or 1.52



231

Navien Product Improvements Update Requirements:

Units Produced from:
XXXX-20081101-XXXX ~ XXXX-20090101-XXXX

- In some applications, software version V1.05 can result in a "burner off" condition during usage;
- There are external issues that can cause these same issues but in the case where the end-user is running a shower (for example) with no other faucet (hot nor cold) being opened or closed, and after 5 or 10 minutes in the shower, the hot water is going very cold then hot again then cold again, this could be a software error and you will want to update the software or change the computer board with one that has a later software version;
- Upgrade software or replace with a PCB having software version V1.07, 1.50, 1.51 or 1.52

232

Navien Product Improvements Update Requirements:

Units Produced from:
XXXX-20090102-XXXX ~ present

- No known issues to date.

233

NAV-PK02

Navien's Wholesaler Product Upgrade Kit

Includes ground shipping across North America

Wholesaler Cost: US $300
Contractor Price: US $450

Pump
X 1

"A" Model Recirc Filter Adapter
X 1

Water Adjustment Valve
X 1

Inlet Filter
X 5

APS & GPS Hose Kit
X 2

APS & GPS
X 1 ea

Flow Sensor
X 10

90° Elbow Black
X 20

PCB 321-6M V1.52
X 2

O-Ring Set
X 2

234

Most Common Error Codes:

1. 10E
2. 3E
3. 15E
4. 16E
5. 35E
6. 39E
7. 48E
8. 34E
9. 38E

Customer service to pre-qualify calls for techs
Heat box combinations
Cross piping - check – gas -whole house vs 1 faucet

235

Things to add to presentation

- Descaling procedure set up;
- Plumbing example of time delay fahrhall
- Cascade
- New NCR and solutions for fluctuations
- Reverse flushing
- Symptoms anaylsis – for example if GFI trips, what to look for?
- Low gas pressure operation clarification – 3" does not mean unit will work well

236

Difference Between APS and GPS:

1. The shape and color of the APS and GPS are identical; to differentiate the two, Navien has placed different stickers on the units; 1 yellow dot sticker on the top identifies the APS; the 2 yellow dot stickers identifies the GPS;

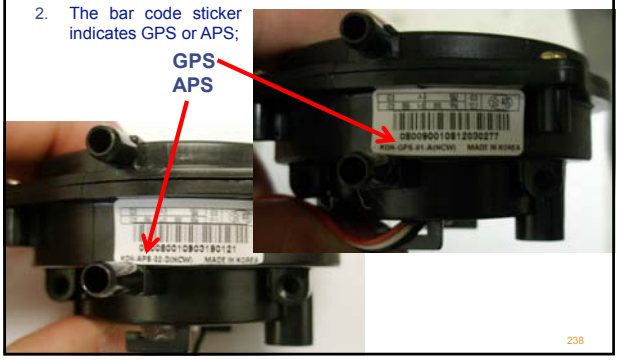
APS

GPS

237

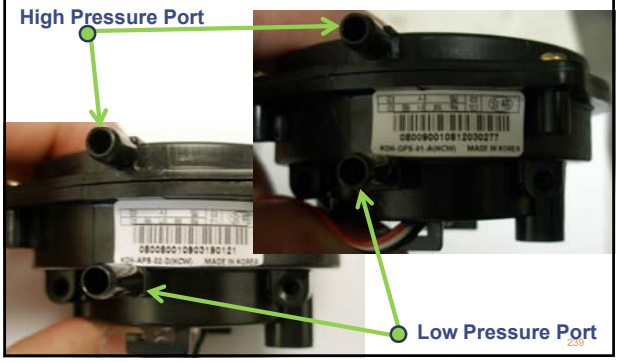
Difference Between APS and GPS:

2. The bar code sticker indicates GPS or APS;



238

Similarities Between APS and GPS:



239

Similarities Between APS and GPS:

240

Function Description(1)

1.Freeze Protection

When the outlet temperature sensor detects a temperature under 50 F, the circulation pump operate for 10 minutes then stop for 1 minute and re-check the temperature. If the temperature is still below 50 F it will then repeat the process. (Not Applicable to NON-A models)

When the outlet temperature sensor detects a temperature under 43 F, the unit will go into minimum burn stage until the outlet temperature detects a temperature of 70 F, the unit will then turn of the burners and begin "post purge"(Pump will stop); however, if there is any error codes displayed, the unit will then go into the "50F Freeze Protection Cycle" (Pump for 10 minutes and Stop for 1 minute then re-check temperature). (Not Applicable to NON-A models)

When the outlet temperature sensor detects a temperature under 35 F, the unit will go into minimum burn for 10 seconds, then every 4 hours the unit will check the outlet temperature. (For "A": When not detecting flow of water)

2.Unit Self Check: When unit has not been used in a long time

If the unit has not been in use for a long time, the unit will go through 2 self checking processes (During this self check, the burners will not fire):
1)PUMP – If the pump has not ran in 24 hours, the unit will activate the pump for 30 seconds and turn off to make sure the pump is functioning correctly. (Not Applicable to NON-A models)
2) WATER FLOW ADJUSTMENT VALVE (WAV)– If the "WAV" has not ran in 24 hours, the unit will then completely close (until F Value is at 220) and then re-open the valve. (IF the unit's pump activates, the unit will self-check when the pump cycle is FINISHED)

241

Function Description(2)

3. Recirculation: Internal

In order to provide heated water quickly, the unit will always keep the internal water heated.
When internally recirculated, the unit will turn ON or OFF the recirculation based on the temperatures displayed in the chart below. But, for initial recirculation, the unit will recirculate until the temperature reaches the "OFF" temperature.

Set - Temp		ON/OFF Temp	
		ON (Inlet Temp Senor on Heat Exchanger)	OFF (outlet temperature sensor)
CR	UNDER 126F (52℃) Recirculation matches Set Temp	Under Set Temp. – 15F (8℃)	Above Set Temp. – 6F (3℃)
	ABOVE 127 F (53℃) Recirculation matches ONLY 127 F	Under 113F (45℃)	Above 131F (55℃)
CC	All Temp Settings	Under Set Temp. – 15F (8℃)	Above Set Temp. – 6F (3℃)

<ON/OFF Internal Recirculation temp based on Set Temp>

4. Recirculation: External

In order to provide heated water quickly, the unit will keep the external water heated.
When externally recirculated the unit will turn ON or OFF the recirculation based on the temperatures displayed in the chart below. But, for initial recirculation, the unit will recirculate until the temperature reaches the "OFF" temperature. When the remote controller is disconnected from the unit, the unit will externally recirculate based on the chart on the next slide. When the remote controller IS CONNECTED to the unit, the unit will recirculate based on the chart within the timer setting.

242

Function Description(2)

Setting Temperature (SET-TEMP)		ON/OFF Temperature	
		ON (Inlet Temperature)	OFF(Outlet Temperature)
CR	UNDER 125 F: Recirculation matches Set Temp ABOVE 127 F: Recirculation matches ONLY 127 F	[Minimum temperature Drop for Circulation Based on Flow Amount] *UNDER 1GPM (3.5LPM) Recirc Flow : SET-TEMP. – 18 F (10℃) *UNDER 1.5GPM (5.5LPM) Recirc Flow : SET-TEMP. – 13 F (7℃) *UNDER 2.1GPM (5.5LPM) Recirc Flow : SET-TEMP. – 9 F (5℃) *Above 2.1GPM (5.5LPM) Recirc Flow : SET-TEMP. – 5 F (3℃)	*Inlet Temp. on Heat Exchanger < [Re-circulation ON Temp. – 9F (5℃)] SET-TEMP. + Above 5 F (3℃) *Inlet Temp. on Heat Exchanger < [Re-circulation ON Temp. – 5F (3℃)] Above SET-TEMP. *Inlet Temp. on Heat Exchanger < [Re-circulation ON Temp. – 9F (5℃)] SET-TEMP. - Above 2 F (1℃) *Inlet Temp. on Heat Exchanger < [Re-circulation ON Temp. – 9F (5℃)] SET-TEMP. - Above 4 F (2℃) *SET-TEMP ABOVE 131 F (55℃) Recirculation limited ONLY 131 F (Only CR Model)
CC	All Temp Settings		

< ON/OFF External Recirculation temp based on Set Temp >

Pump ON	Pump OFF
Inlet Temperature ≤ Re-Circulation ON TEMP. – 4F(2℃)	Inlet Temp. on Heat Exchanger ≥ Re-Circulation ON Temp.+ 1F(0.5℃)

<ON/OFF Pump Condition – External Recirculation>

243

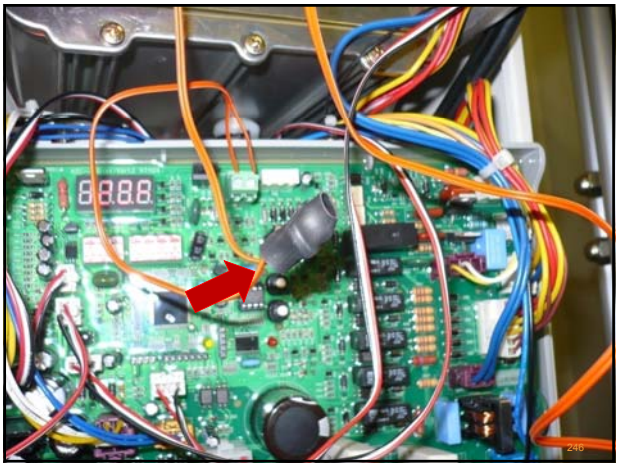
NAVIEN Condensing Freeze protection

Outlet water temperature	Model A	Non-A Model
45 F	Pump ON: 5 Min 3 min interval	
40 F	Pump ON with Flame Output sensor reach 70F automatically Stop	Heat Block ON
35 F	Flame ON 10 Sec with Minimum BTU Check every 4 Hour	Flame ON 10 Sec with Minimum BTU Check every 4 Hour

244

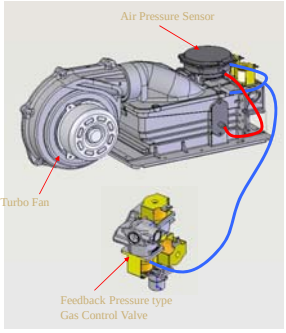
Remote Control

245



246

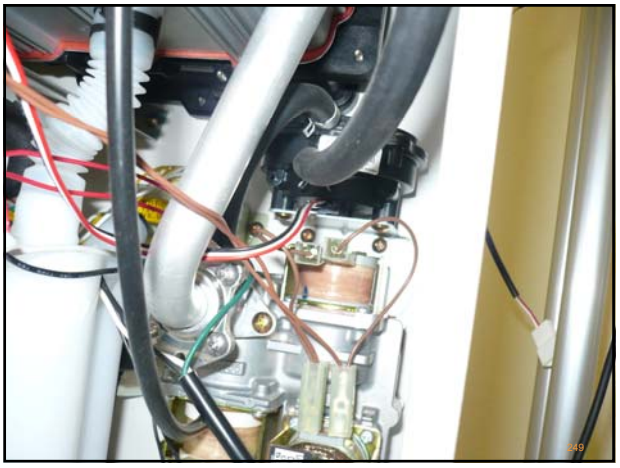
Burner Control System



- **Air Pressure Sensor (APS)**
  - maximizes combustion efficiency by sensing and controlling the air required for optimal combustion even in high wind locations or in installations with long vents.
- **Feedback Pressure type Gas Valve**
  - Adjusts gas volume based on air pressure.
- **High Velocity BLDC Motor & TurboFa**
  - Variable speed for better accuracy and control
  - Turbo Fan for quieter operation.

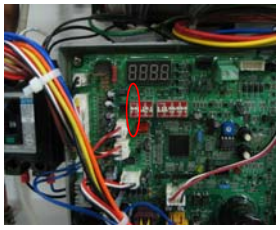
247

248



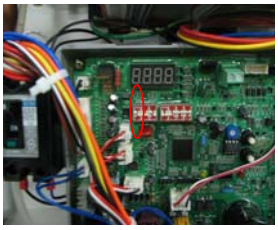
249

NAVIEN Condensing water heater APS & GPS Setting



<Pic 10>

For Minimum setting.
Dip switch # 1 and 2 : ON



<Pic 11>

For Maximum setting.
Dip switch # 1 ON, # 2 OFF

Minimum and Maximum check and adjust together. Cannot be individual setting.

250

NAVIEN Condensing water heater APS & GPS Setting

<Pic 5>

Using T fitting, connects GPS Venturi Pressure (Gas Pressure) and GPS high pressure port, then connect to Manometer positive port

<Pic 6>

251

NAVIEN Condensing water heater APS & GPS Setting

Gas Proportional feed back port

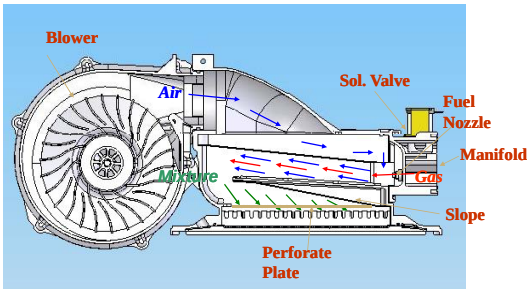
<Pic 7>

Pull out tube from Proportional feed back port at main Gas valve <Pic 7>.

<Pic 8>
Using T fitting and connect to Manometer negative port

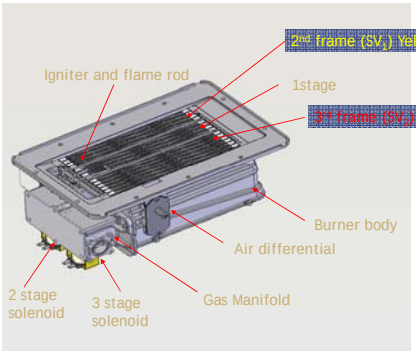
252

KD Premixing burner design



253

3 stage premixing burner



254

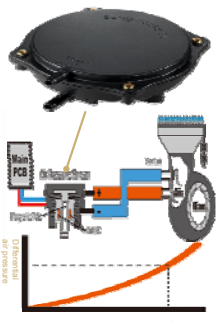
APS (Air Pressure Sensor) & GPS (Gas Pressure Sensor)

Working principal of APS

APS measures air flow velocity by sensing the difference of air pressure of two points in the conduit.

At any situations such as blocking flue, strong wind, it is possible to operate by supplying optimal amount of air.

Regardless of diameter, length and bend of flue, optimal combustion conditions is maintained by APS measuring the air flow rate.



255

APS (Air Pressure Sensor) & GPS (Gas Pressure Sensor)

Working principal of GPS

GPS measures gas flow velocity by sensing the difference of gas pressure of two points in the gas conduit.

Even if there is big fluctuation of gas supply, it is possible to operate optimally by measuring the exact gas flow rate.

Especially, in case of sudden drop of gas pressure like in the morning when people use lots of gas simultaneously,

GPS detects supplying gas pressure precisely.

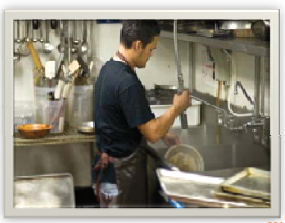
With GPS, regardless of any gas pressure, proper operation is secured.

256

Navien Condensate Trap

257

Applications to beware



258