This document is intended to be a supplement to product schematics and possessed knowledge of XLT products as well as possessed understanding of basic electrical theory and basic fuel systems. Utilize this document, in its entirety, at your own risk as Wolfe Electric Inc. (also known as XLT Ovens) assumes absolutely no liability from any person's use of this document under any circumstances.

This document was originally produced, primarily, for the North American market. International market integration is in development although many parts of this document may only cover the North American market.

Colloquially speaking: This document is to attempt to capture the majority of issues to arise and either provide resolution or direct you to the component to be checked, although it may not resolve every possible scenario.

Please advise XLT Ovens of any errors, omissions, needed updates or changes you may find.

Generally speaking:

- Visual Checks:
  - Controllers such as temperature and ignition controls will often have light indicators to communicate current status and fault conditions the controller has determined. These can be a useful place to start when troubleshooting.

- Electrical Checks:
  - Inputs:
    - If you can keep the device connected, check voltages connected
    - If you can't get the VOM probes on the terminal, then disconnect the device and check voltage at the wires
  - Outputs:
    - If you can keep the device connected, check voltages connected
    - If you can't get the VOM probes on the terminal or pin on the device

- Lighting Problems in Gas Ovens:
  - Remember, all we should need for combustion is fuel and spark, and then all should need for sustained combustion is flame sense. Some occurrences may arise where the nature of the airflow itself negatively impacts burner performance. Generally, a good place to start is: "Does the oven try to light, and if so what is the manifold gas pressure when it tries?" The answer to this line of questioning should lead you in the proper direction to troubleshoot the root cause of the issue.

Delta or Wye Configuration:

Two types of transformers are most commonly used: Delta or Wye. A Delta configuration has its phases wired in series to one another and will typically not include a neutral wire or be grounded. For example, in a 240V Delta configuration, line-to-line voltage will read 240V and line-to-neutral/line-to-ground voltage is not theoretically applicable in an ungrounded system.

A Wye configuration has one side of all three phases wired to a common neutral point and is commonly grounded. For example, in a 208V Wye configuration, line-to-line voltage will read 208V and line-to-neutral and line-to-ground voltage will read 120V. In a 400V Wye configuration, line-to-line voltage will read 400V and line-to-neutral voltage will read 230V.

Sometimes a Delta configuration will have one of its phases center tapped with a neutral wire. For example, in a 240V Delta configuration, the center-tapped neutral will produce a split-phase where either line-to-neutral will measure 120V. The line-to-line voltage would measure 240V. The remaining line would measure 208V as measured across the center-tapped neutral wire. Referred to as a "High-Leg Delta", "Stinger", etc. This configuration has its appeal from the varied available service voltages.

Phase voltage refers to voltage as measured across the load. Line voltage refers to voltage measured across any two line conductors from the transformer. Phase current refers to the current as measured at the load. Line current refers to the current as measured at a line conductor. In a Delta configuration, phase voltage and line voltage should always be the same where phase current and line current will differ by a factor of the square root of three (3). In a Wye configuration, phase current and line current should always be the same where phase voltage and line voltage will differ by a factor of the square root of three (3).

General electrical information:

Voltage, amperage, and resistance all have direct relationships with one another. Voltage applied to a resistor yields an amperage. Voltage being higher than expected yields an amperage higher than expected. Resistance being lower than expected also yields an amperage that is higher than expected. A circuit that contains a direct path to ground can be said to have virtually no resistance which yields very high amperage and therefore will blow fuses and trip circuit breakers.

Power, voltage, and amperage all have direct relationships with one another. If power is assumed to be the same, then the higher the voltage – the lower the amperage. Alternatively, if power is assumed to be the same, then the lower the voltage – the higher the amperage. XLT's current main fan motors are rated at 3/4 Horsepower and for use with either 120 or 208/240 VAC. Motors ran with 120 VAC yield a higher amp draw than motors ran with 240 VAC although it is important to note fan motor wiring would change for different voltage ratings (see Section 5.8). If the fan motor wiring is not correct, then for example, a fan motor wired for 120 VAC but connected to 208/240 VAC will draw a higher current than expected.

Special notes pertaining to our equipment and this troubleshooting guide:

- For our purposes, put simply: AC voltage contained on a single line conductor from transformer will be referred to as phase voltage whereas AC voltage measured across two line conductors from transformer will be referred to as line voltage.

Version Assumption:

Oven models will be assumed to be in reference to gas or electric ovens. Specialty ovens such as radiant and countertop ovens will be noted for each instance.

Table of Contents

1 Oven Troubleshooting

1.1 Oven Initial Symptoms

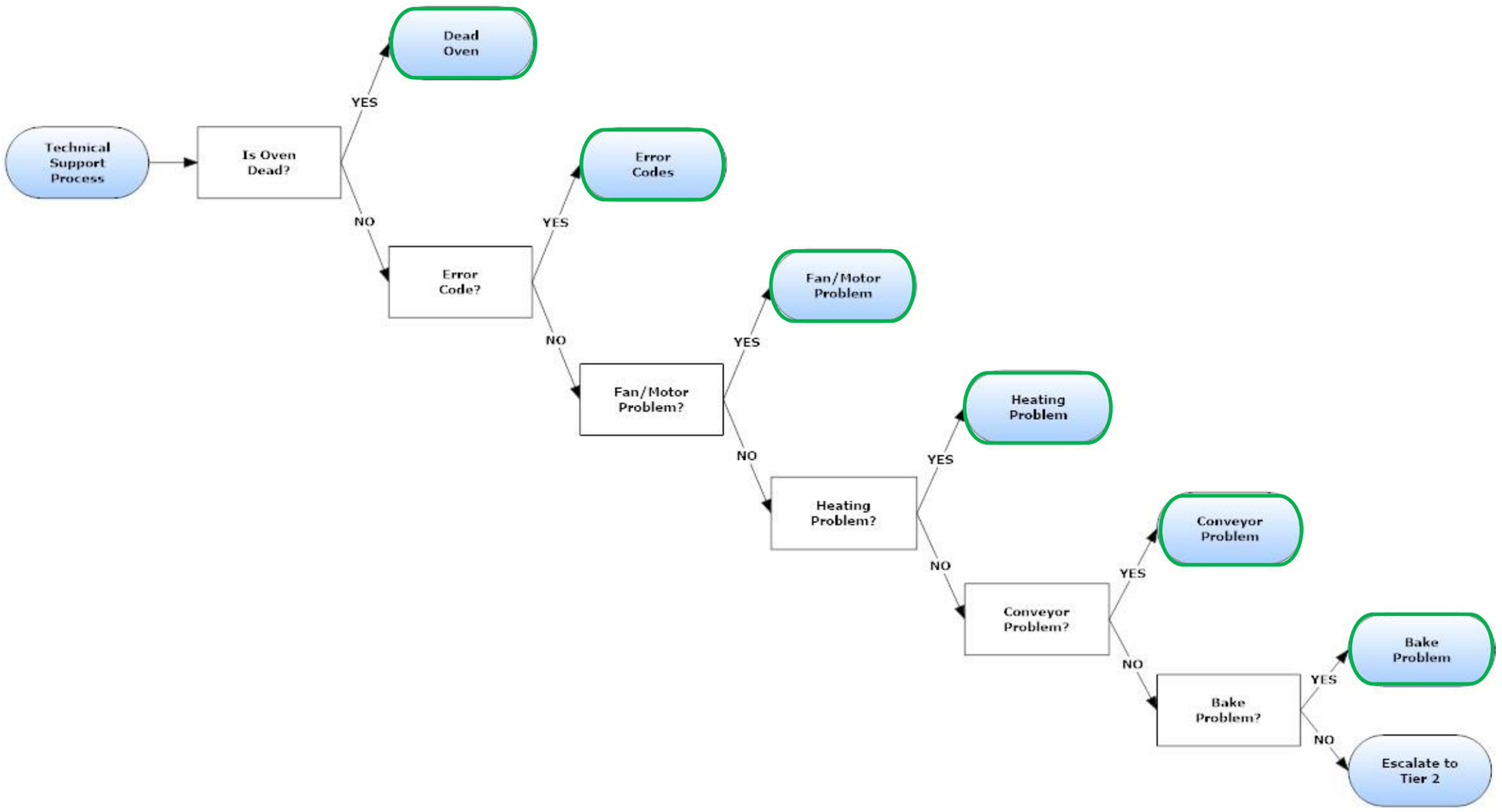


Figure 1 Initial Symptoms

1.2 Dead Oven

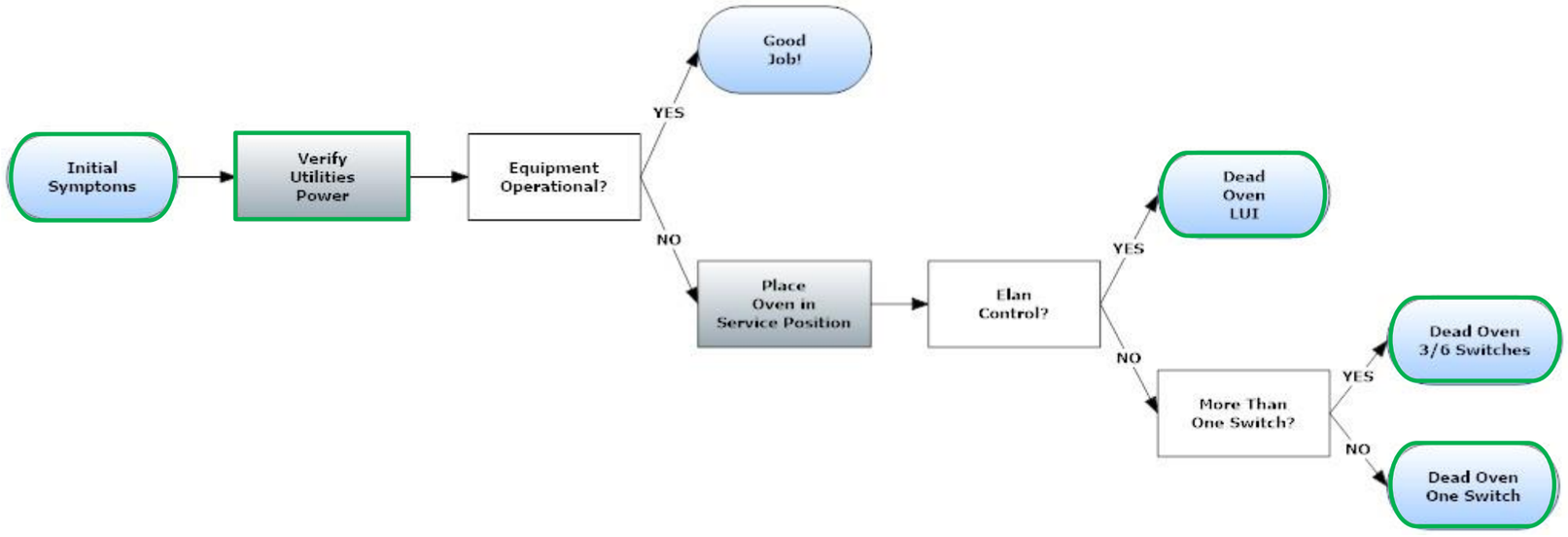
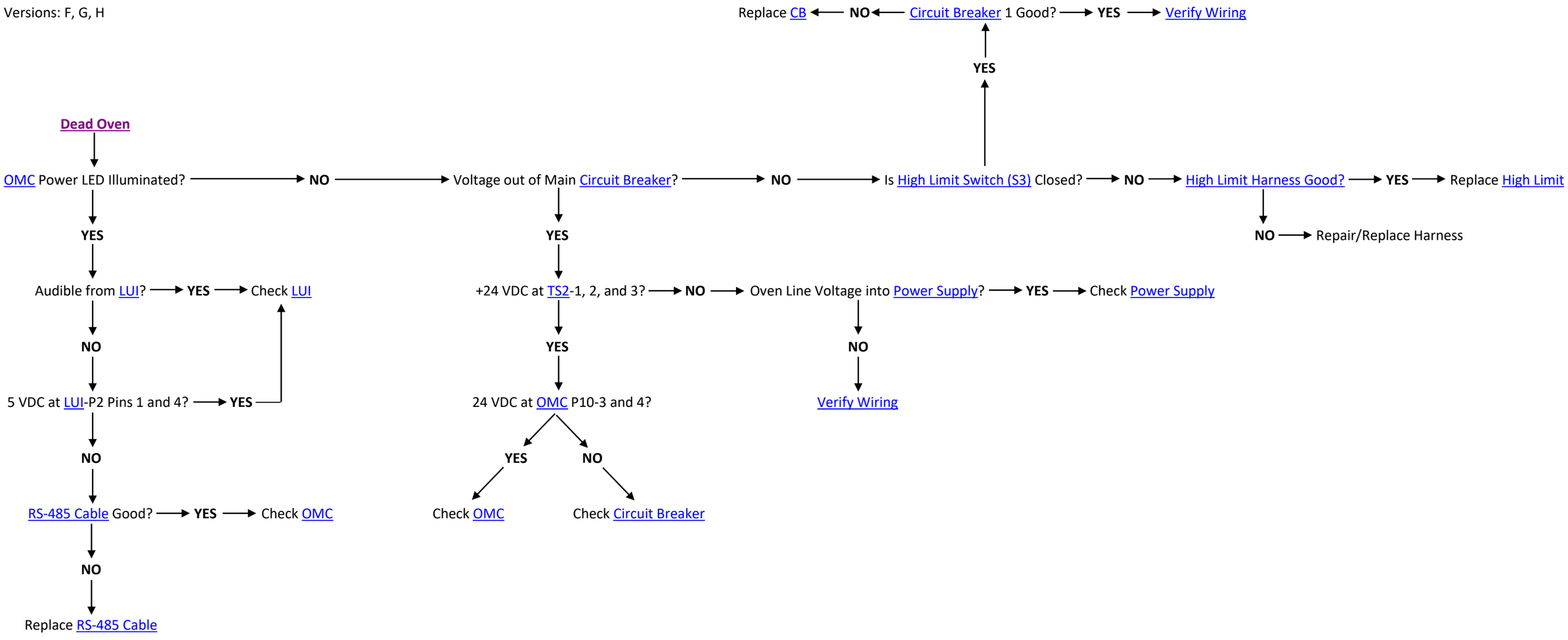


Figure 2 Dead Oven

1.2.1 Dead Oven – LUI

Versions: F, G, H



1.2.2 Dead Oven – 3/6 Switches

Versions: DS, TS, TS2

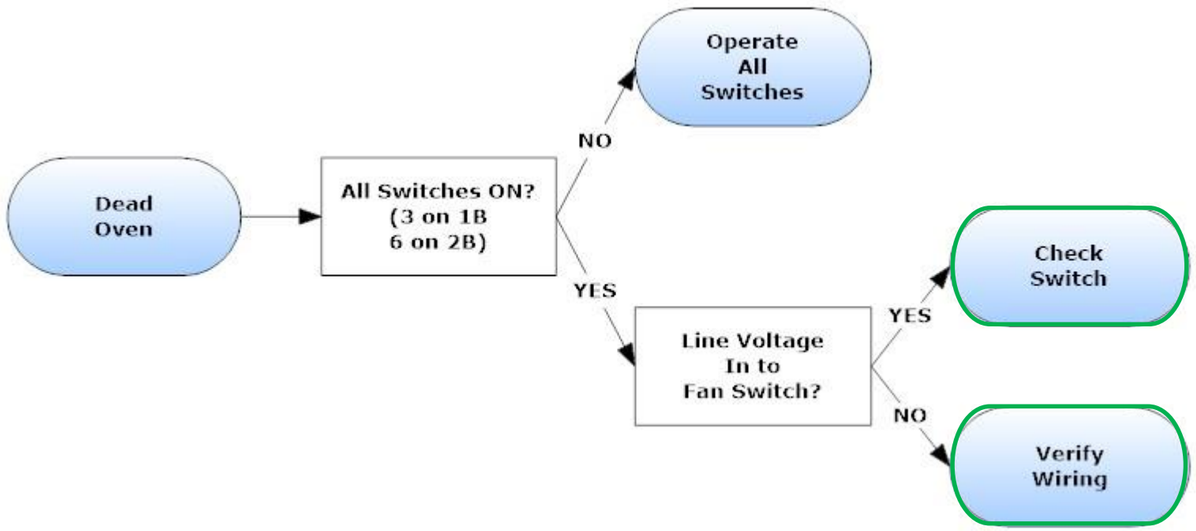
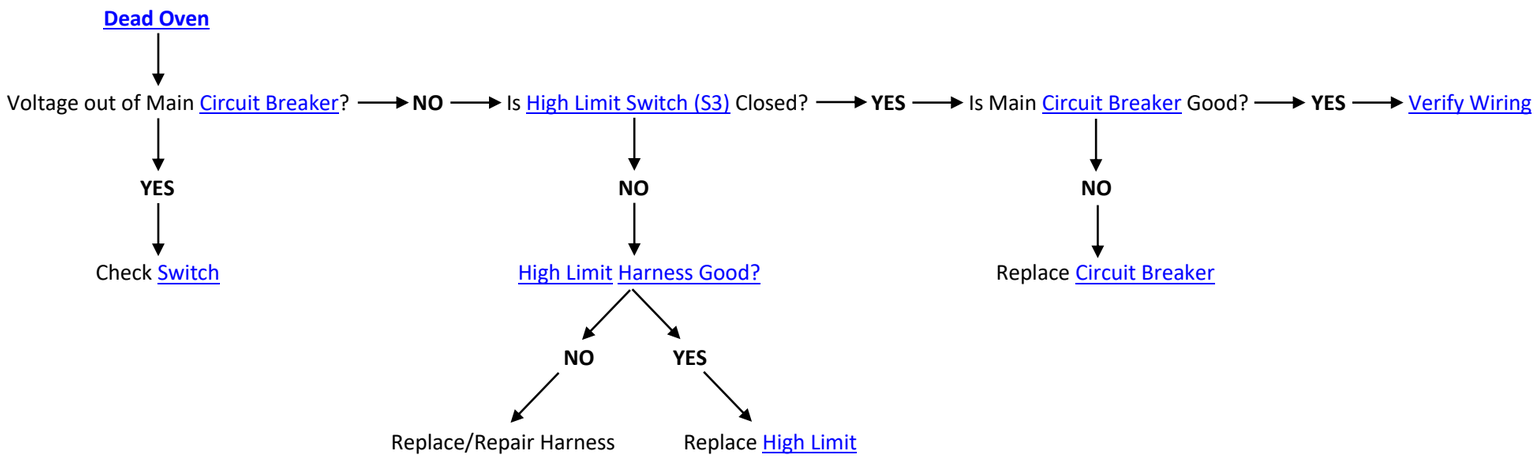


Figure 3 Dead Oven 3-6 Switches

Note: If a three switch oven is in a state where the only system that operates is the conveyor, then check the Cool-Down Timer (R1)

1.2.3 Dead Oven – 1 Switch

Versions: TS3, A, B, C, D, E, H



1.3 Error Codes

Back to Oven Initial Symptoms

1.3.1 Elan Error Codes, LUI

LUI ERROR CODES		
Error Code	**Problem**	**Corrective Action**
Oven Probe	Thermocouple Issue	See Thermocouple
Ignition Error	Failure to confirm at least a 25°F temperature rise within 3:00 minutes	See Square Burner On/Off Undertemp
Under Temp	After reaching Set-Point, actual temperature is more than 15°F below Set-Point for more than 30:00 minutes	See Square Burner On/Off Undertemp
Over Temp	Actual temperature is at least 50°F above Set-Point for more than 1:00 minute	See Square Burner On/Off Overtemp
Under Speed	Actual belt time is at least 0:30 seconds less than indicated belt time	See Conveyor Problem
Over Speed	Actual belt time is at least 0:30 seconds more than indicated belt time	See Conveyor Problem
Key Short	Interference with LUI buttons	See Key Short
Comm. Error	Communication problem between LUI and OMC	See Comm. Error, Replace Control if Error Persists
Main Fan Low Amp	Main Fan amperage draw has dropped below specified value for at least 0:10 seconds	See Fan/Motor Problem
Main Fan High Amp	Main Fan amperage draw has risen above specified value for at least 0:10 seconds	See Fan/Motor Problem
Belt Jam Check for Obstruction	Conveyor motor RPM is at least 25% less than the most recent motor speed	See Conveyor Problem

(Elan Error Codes: Cont…)

(Elan Error Codes: Continued)

Radiant LUI ERROR CODES		
Error	**Problem**	**Corrective Action**
TC1 Failure	Thermocouple Error, Open or Short, Over/Under Range	See Thermocouple
TC2 Failure	Thermocouple Error, Open or Short, Over/Under Range	See Thermocouple
TC3 Failure	Thermocouple Error, Open or Short, Over/Under Range	See Thermocouple
TC4 Failure	Thermocouple Error, Open or Short, Over/Under Range	See Thermocouple
PCB Temp Therm	Temp Sensor Error, Open or Short	See Thermocouple
U.L. Element Failure	Element Temp. Does Not Raise More Than 25°F in Four (4) Minutes	See Radiant Heating Problem
U.R. Element Failure	Element Temp. Does Not Raise More Than 25°F in Four (4) Minutes	See Radiant Heating Problem
L.L. Element Failure	Element Temp. Does Not Raise More Than 25°F in Four (4) Minutes	See Radiant Heating Problem
L.R. Element Failure	Element Temp. Does Not Raise More Than 25°F in Four (4) Minutes	See Radiant Heating Problem
U.L. Under Temp	Once Setpoint is Reached, Element Temp. Falls 15°F or More Below Setpoint	See Radiant Heating Problem
U.R. Under Temp	Once Setpoint is Reached, Element Temp. Falls 15°F or More Below Setpoint	See Radiant Heating Problem
L.L. Under Temp	Once Setpoint is Reached, Element Temp. Falls 15°F or More Below Setpoint	See Radiant Heating Problem
L.R. Under Temp	Once Setpoint is Reached, Element Temp. Falls 15°F or More Below Setpoint	See Radiant Heating Problem
U.L. Over Temp	Element Temp. 50°F Over Setpoint for Over One (1) Minute	See Radiant Heating Problem
U.R. Over Temp	Element Temp. 50°F Over Setpoint for Over One (1) Minute	See Radiant Heating Problem
L.L. Over Temp	Element Temp. 50°F Over Setpoint for Over One (1) Minute	See Radiant Heating Problem
L.R. Over Temp	Element Temp. 50°F Over Setpoint for Over One (1) Minute	See Radiant Heating Problem
Over Speed	Speed is Greater Than Thirty (30) Seconds Faster than Setpoint	See Conveyor Problem
Under Speed	Speed is Greater Than Thirty (30) Seconds Slower than Setpoint	See Conveyor Problem
Software Error	Internal Software Error	Soft Reset, Replace Control if Error Persists
EEPROM Error	Bad Checksum	Soft Reset, Replace Control if Error Persists
Key Short	Any Key Shorted for Greater Than One (1) Minute	See Keyshort Error
Comm. Error	Internal Software Error	See Comm. Error, Replace Control if Error Persists
U.L. Hi Alarm	Element High Temperature Alarm Setting Exceeded	See Radiant Heating Problem
U.R. Hi Alarm	Element High Temperature Alarm Setting Exceeded	See Radiant Heating Problem
L.L. Hi Alarm	Element High Temperature Alarm Setting Exceeded	See Radiant Heating Problem
L.R. Hi Alarm	Element High Temperature Alarm Setting Exceeded	See Radiant Heating Problem
Belt Jam	Current Motor Speed is Less Than 25% of Most Recent Motor Speed	See Conveyor Problem

1.3.1.1 Key Short

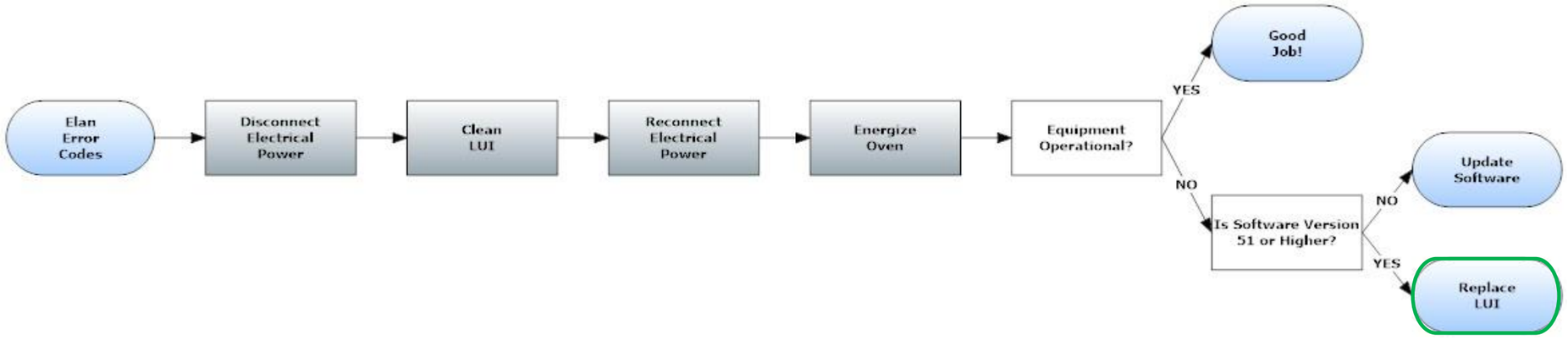


Figure 4 Key Short

1.3.1.2 Comm. Error

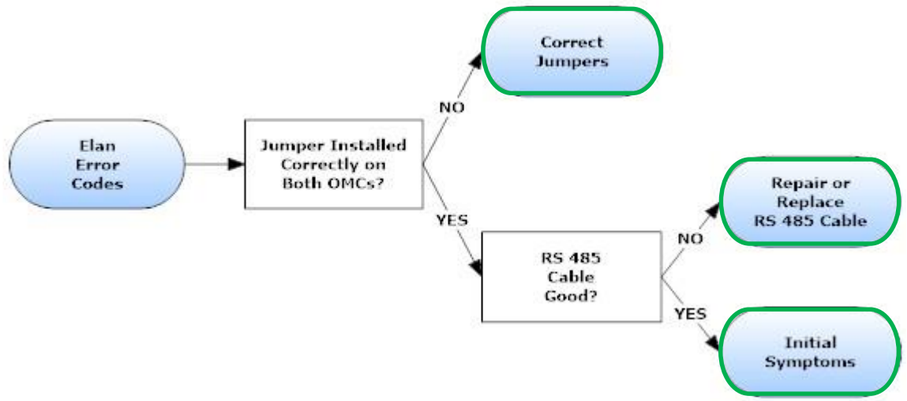


Figure 5 Comm. Error

1.3.2 Barber-Colman Error Codes

Barber-Colman Error Codes		
Error	**Problem**	**Corrective Action**
oooo	Thermocouple Over-Range	Check Thermocouple
_ooo	Thermocouple Under-Range	Check Thermocouple
SEr Err	Serial Interface Parameter Error	Load Default Parameters - Reprogram to XLT Spec. - If Error Persists Then Replace Control
100 Err	EEPROM Write Error	
150 Err	CPU Error	
200 Err	Attempt to Write to Protected Memory	
2xx Err	Configuration Parameter Error: The last two digits show the number of the wrong parameter	Verify Specific Parameter's Programming - If Error Persists Then Replace Control
299 Err	Error on Control Output Selection	Load Default Parameters - Reprogram to XLT Spec. - If Error Persists Then Replace Control
301 Err	Input Calibration Error	
307 Err	RJ Input Calibration Error	
320 Err	Analog Retransmission Calibration Error	
400 Err	Control Parameter Error	
500 Err	Auto-Zero Error	
502 Err	RJ Error	
510 Err	Calibration Error	

1.3.3 Eurotherm Error Codes

Eurotherm Error Codes		
Error	**Problem**	**Corrective Action**
S.br	Thermocouple input is open or out of range	Check thermocouple, verify programming
L.br	Thermocouple input is not reacting to control output	Verify programming, this alarm should be OFF
E.ConF	Programming issue	Verify programming
E.CAL		
E2.Er		
EE.Er		
E.Lin		
Emod		
E.tun	Auto-tune function was unsuccessful	Verify burner circuit operation and retry

1.3.4 Golander Error Codes

Golander Error Codes		
Error	**Problem**	**Corrective Action**
EEEE	Thermocouple input is open or out of range	Verify programming, check thermocouple

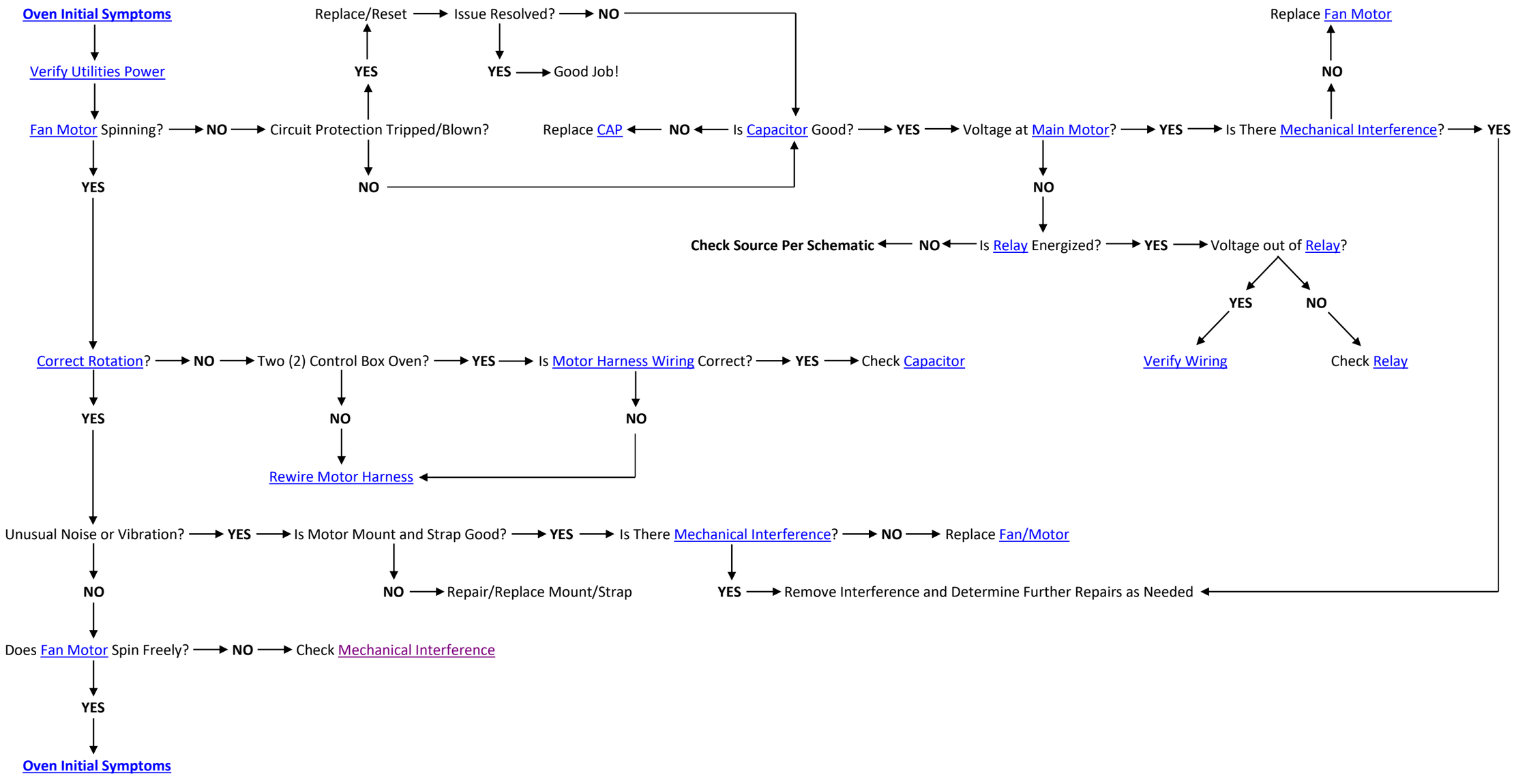
1.3.5 Omron Error Codes

Omron Error Codes		
Error	**Problem**	**Corrective Action**
FFF	Thermocouple input issue or out of range (high temperature)	Check thermocouple
---	Thermocouple input issue or out of range (low temperature)	Check thermocouple
E11	Memory Error	Perform Reset, Minimize Electrical Noise
<<<	This is not an error - This will display when the sensor input is within the control range but outside of the display range	Not Applicable
>>>		

1.3.6 Dart Error Codes

Dart Error Codes		
Error	**Problem**	**Corrective Action**
LF-L	AC line supplying power has too much noise (low frequencies)	Review routing of power wires to minimize electrical noise. Consider rerouting power wires, applying a power filter, using shielded cable, etc.
LF-H	AC line supplying power has too much noise (high frequencies)	

1.4 Fan/Motor Problem



1.5 Heating Problem

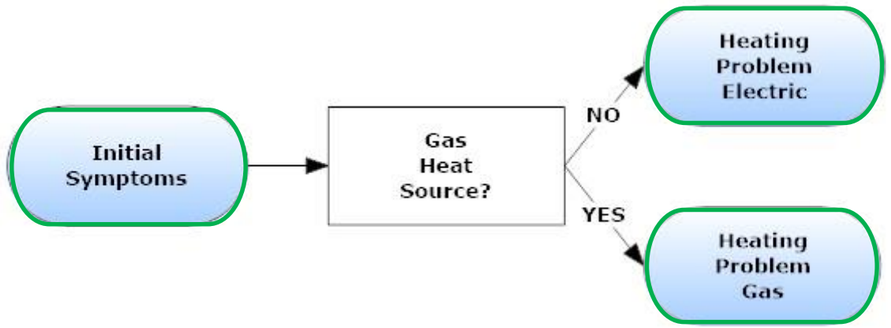


Figure 6 Heating Problem

1.5.1 Heating Problem Electric

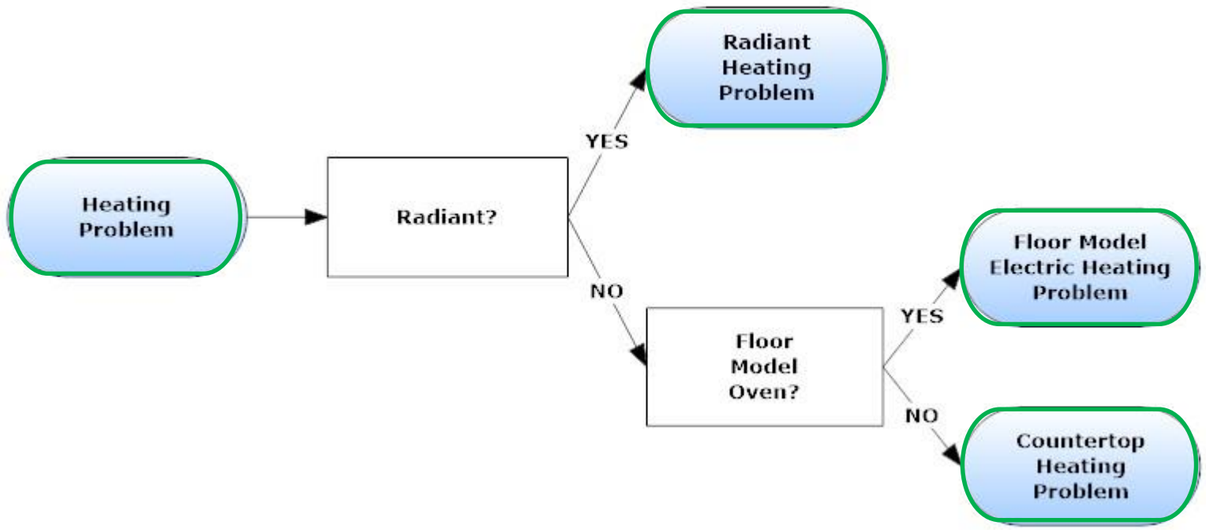
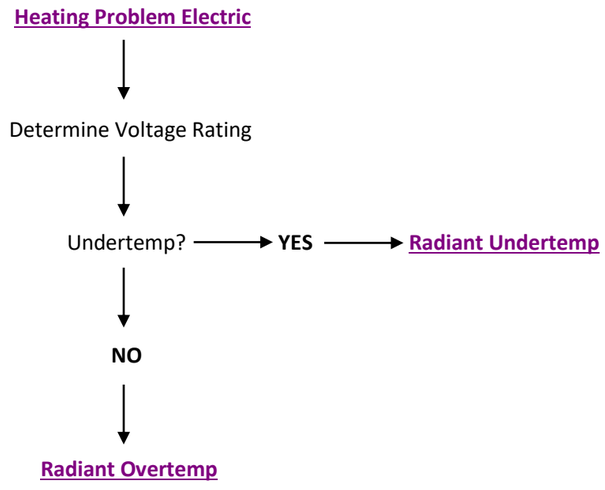


Figure 7 Heating Problem Electric

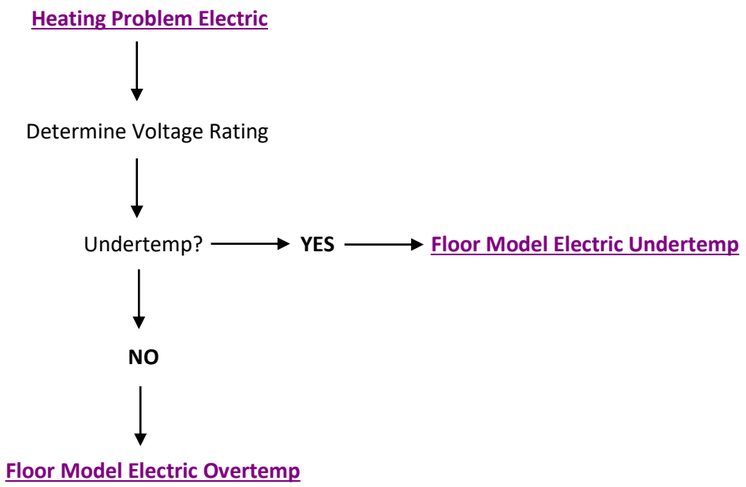
1.5.1.1 Radiant Heating Problem

Radiant Versions: A



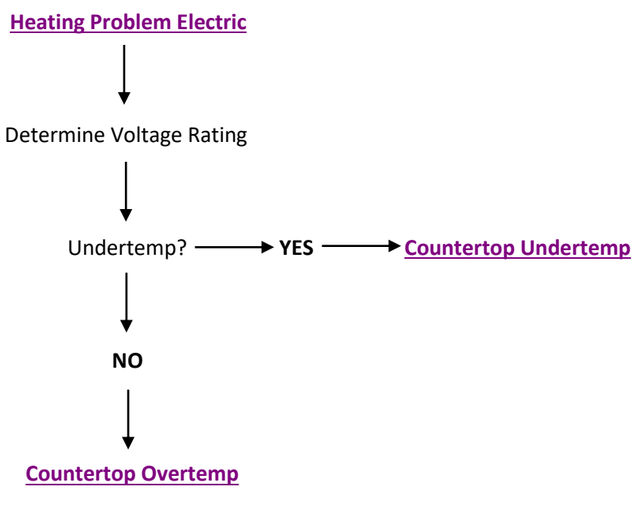
1.5.1.2 Floor Model Electric Heating Problem

Versions: TS, TS2, B, C, D, E, F, G, H

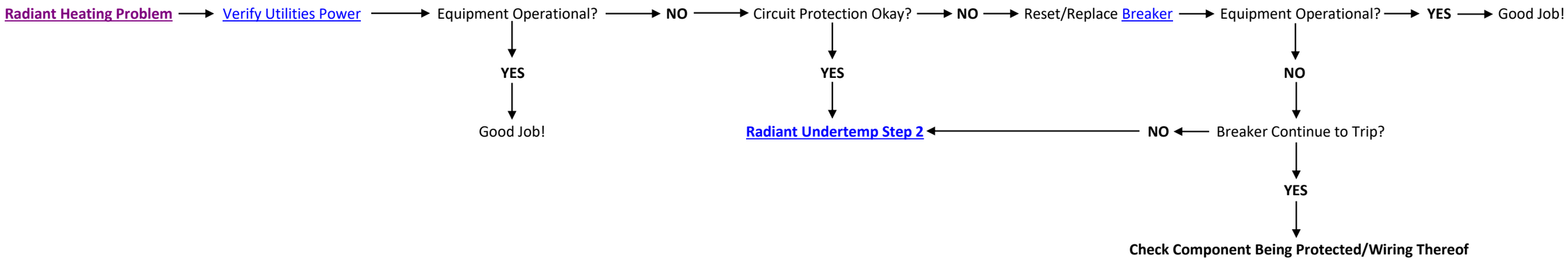


1.5.1.3 Countertop Heating Problem

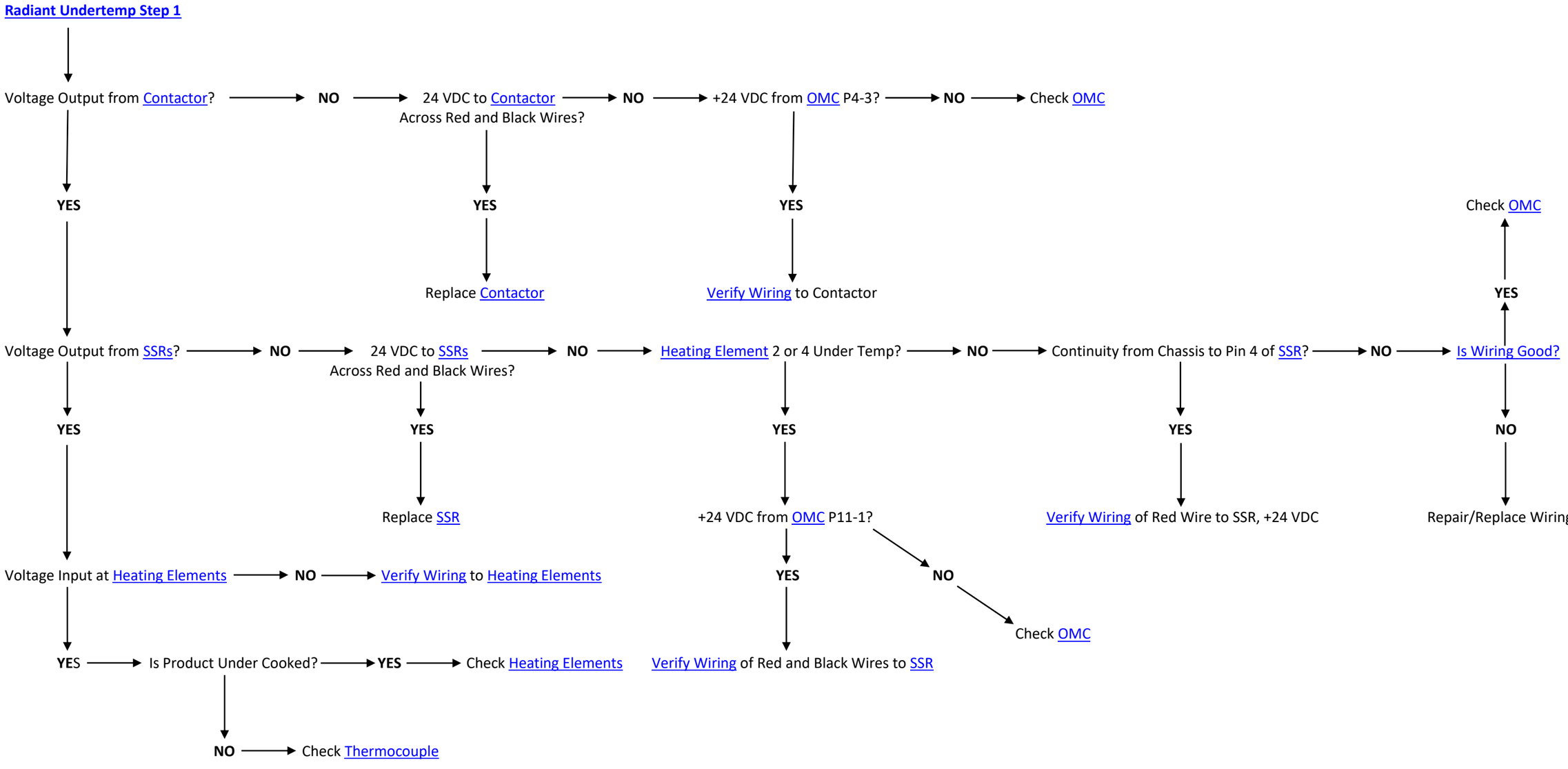
Countertop Versions: A



1.5.1.4 Radiant Undertemp Step 1

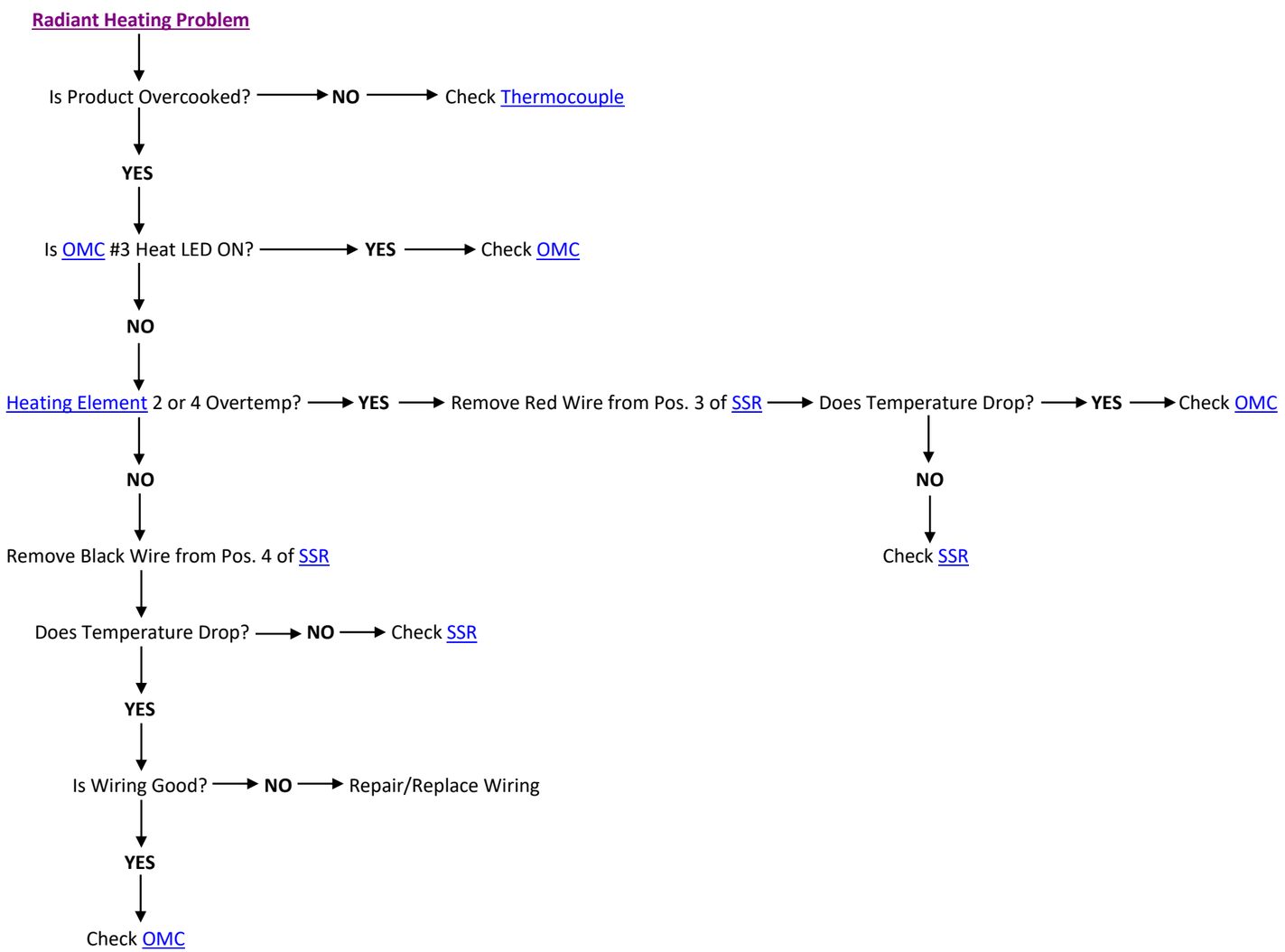


1.5.1.5 Radiant Undertemp Step 2



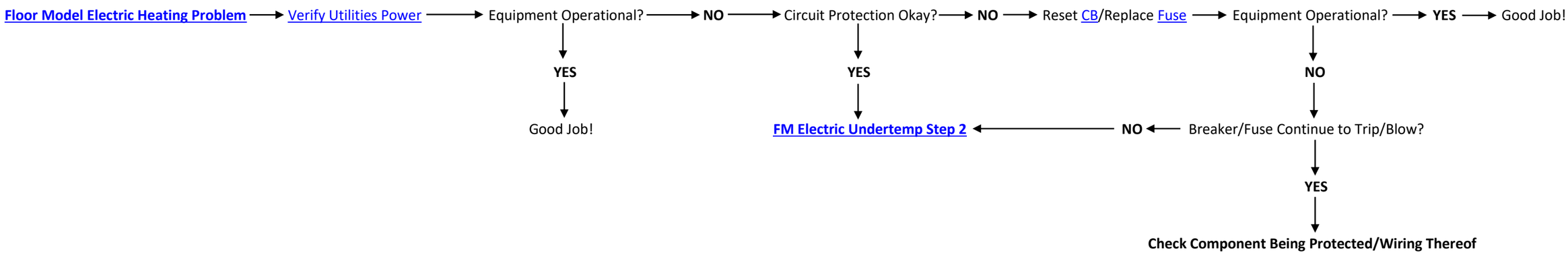
Note: OMC1 controls SSRs 1 and 2 while OMC2 controls SSRs 3 and 4. SSRs 2 and 4 are provided +24 VDC from the OMC while SSRs 1 and 3 are grounded by the OMC

1.5.1.6 Radiant Overtemp

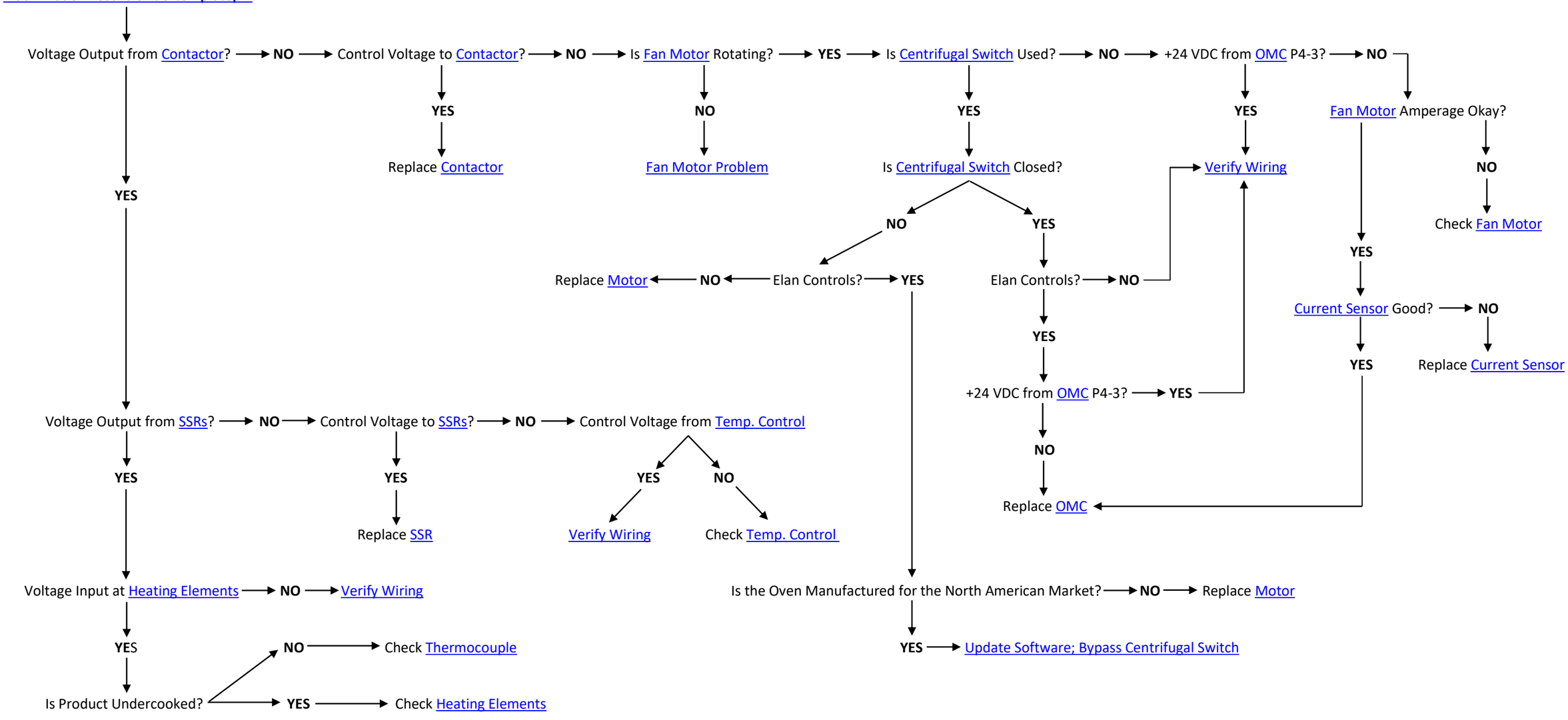


Note: OMC1 controls heating elements 1 and 2 while OMC2 controls heating elements 3 and 4. Heating elements 2 and 4 are provided +24 VDC from OMC while heating elements 1 and 3 are grounded by the OMC

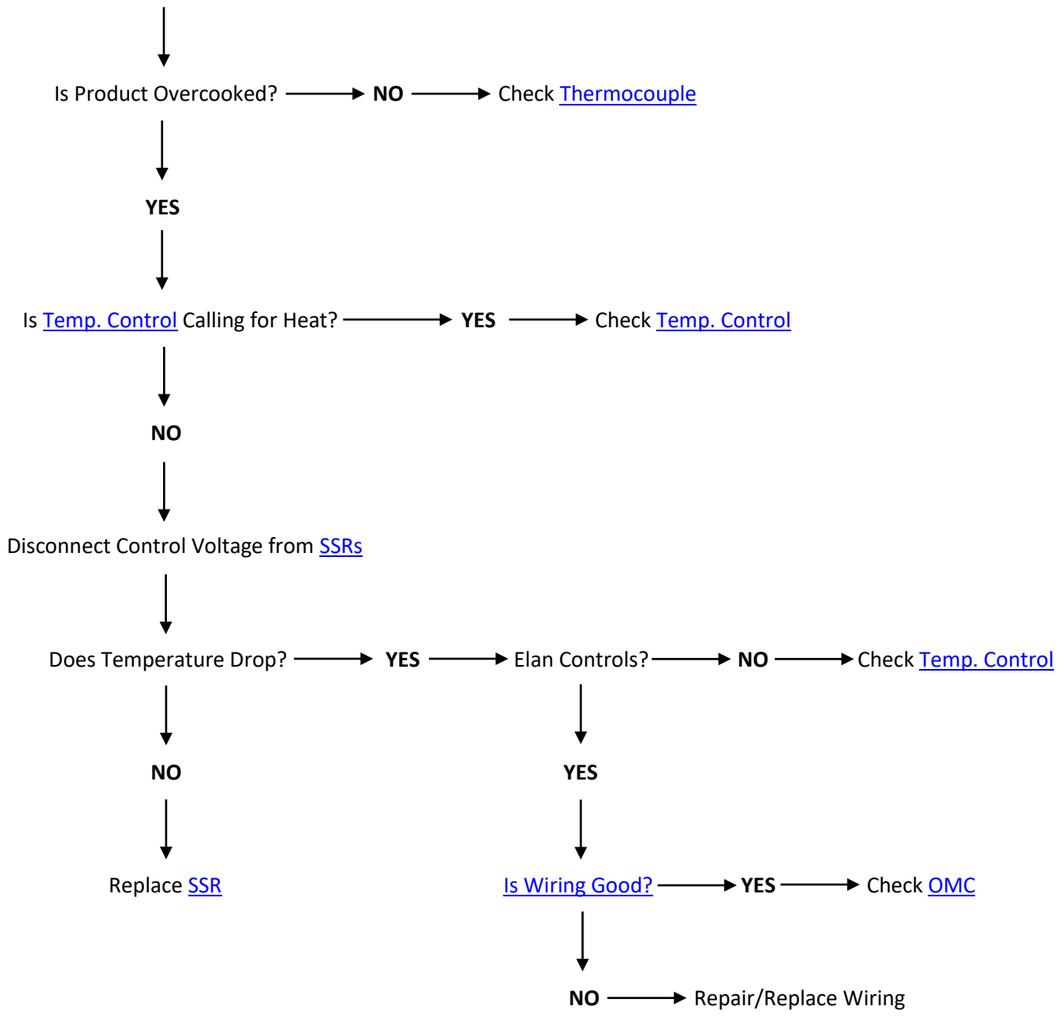
1.5.1.7 Floor Model Electric Undertemp Step 1



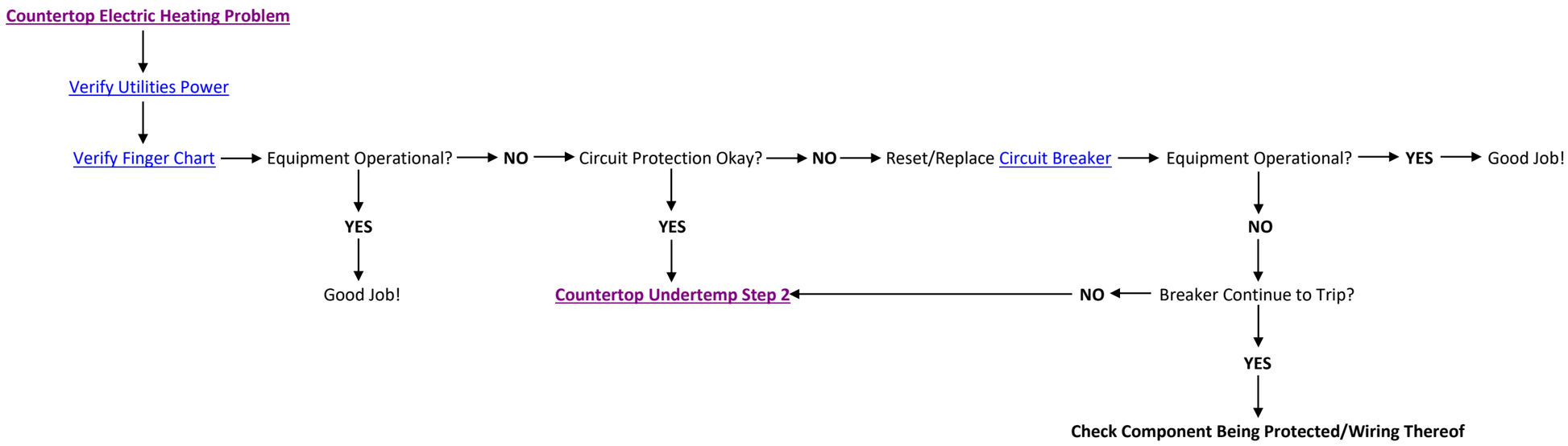
1.5.1.8 Floor Model Electric Undertemp Step 2



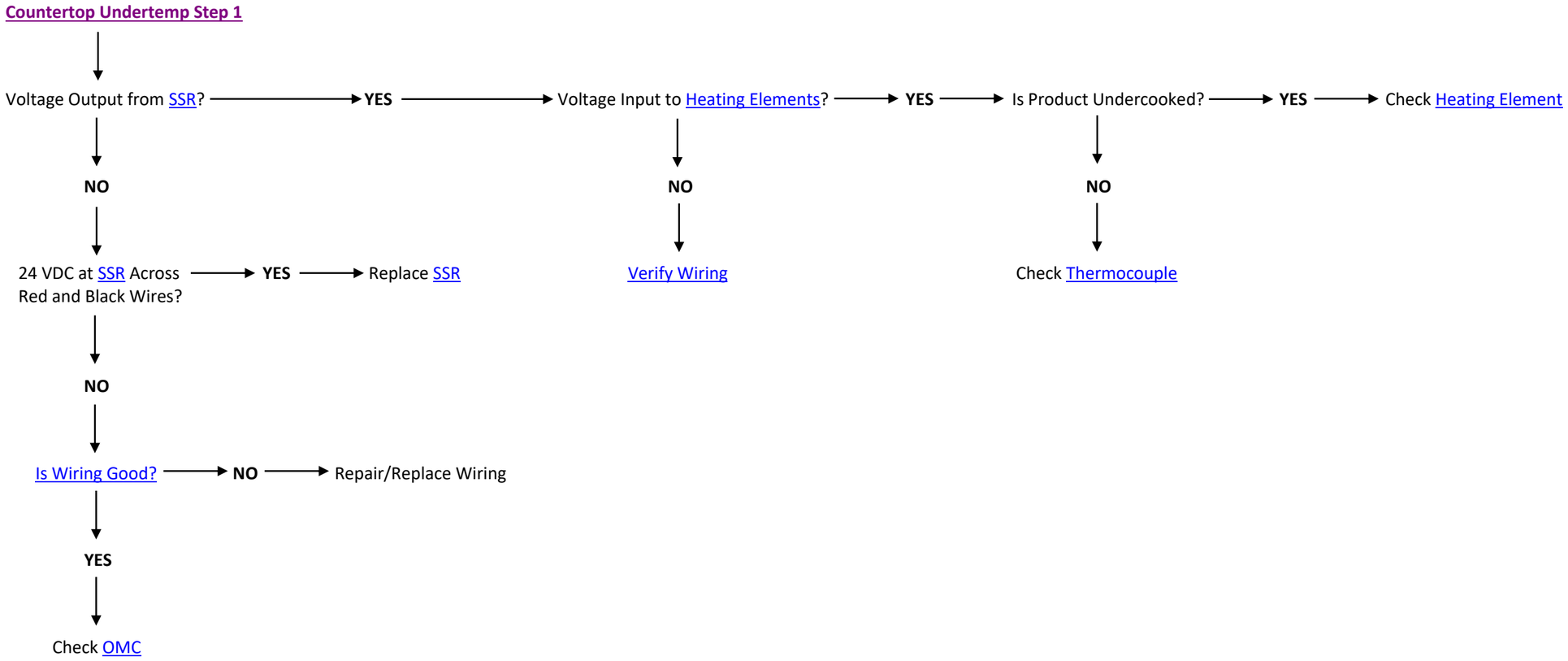
1.5.1.9 Floor Model Electric Overtemp



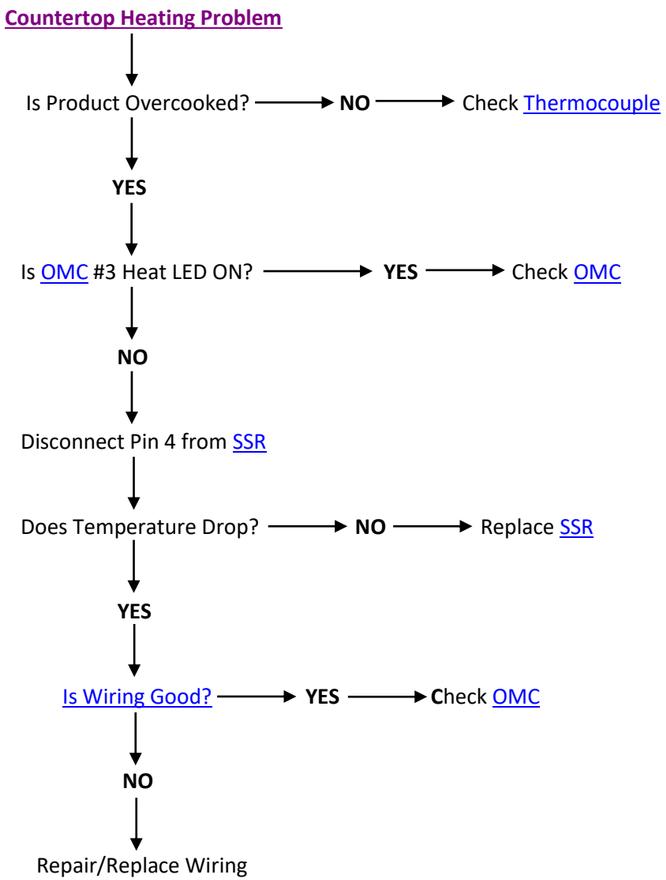
1.5.1.10 Countertop Undertemp Step 1



1.5.1.11 Countertop Undertemp Step 2



1.5.1.12 Countertop Overtemp



1.5.2 Heating Problem Gas

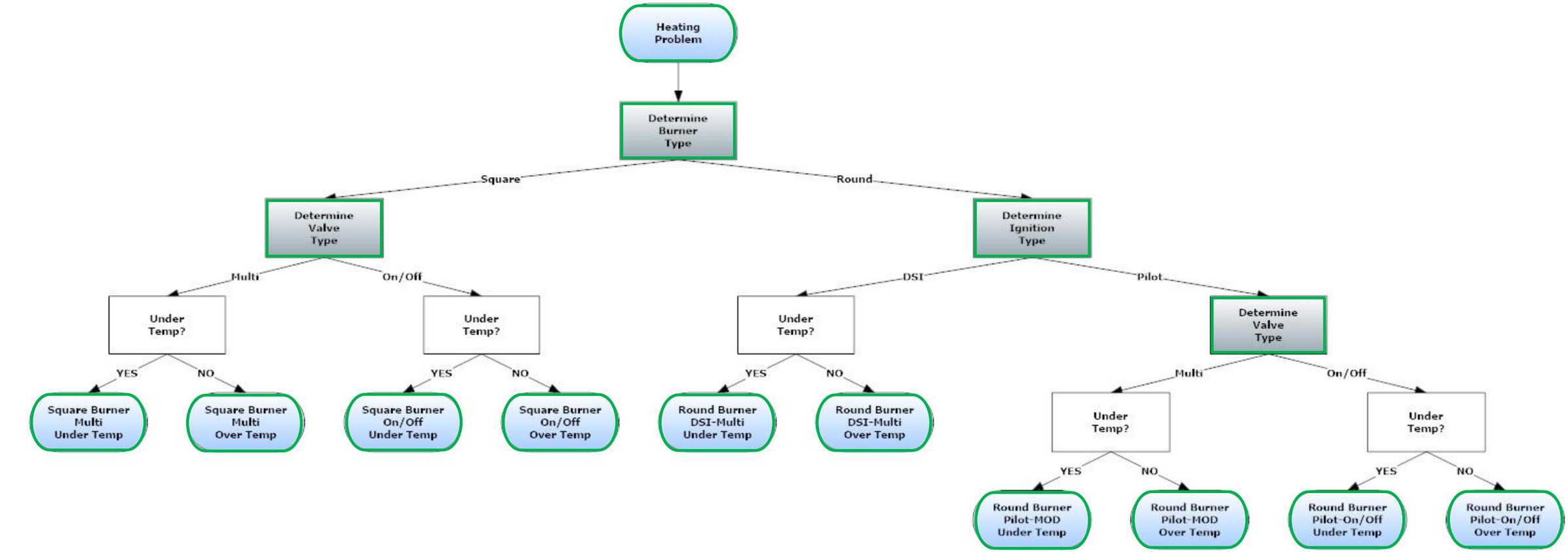


Figure 8 Heating Problem Gas

(Heating Problem Gas: Cont…)

(Heating Problem Gas: Continued)

Heating problems are either under temperature or over temperature. They can be either sustained or intermittent.

- Under Temperature scenarios include:
  - No ignition
  - Ignition for four seconds only
  - Low flame only
  - High flame, but still under temperature

- Over temperature scenarios include:
  - A gradual increase in temperature over time
    - Low flame/bypass
  - A runaway condition – Sustained high flame
    - Stuck Valve
    - Call for heat voltage

1.5.2.1 Determine Burner Type

Round Burner:

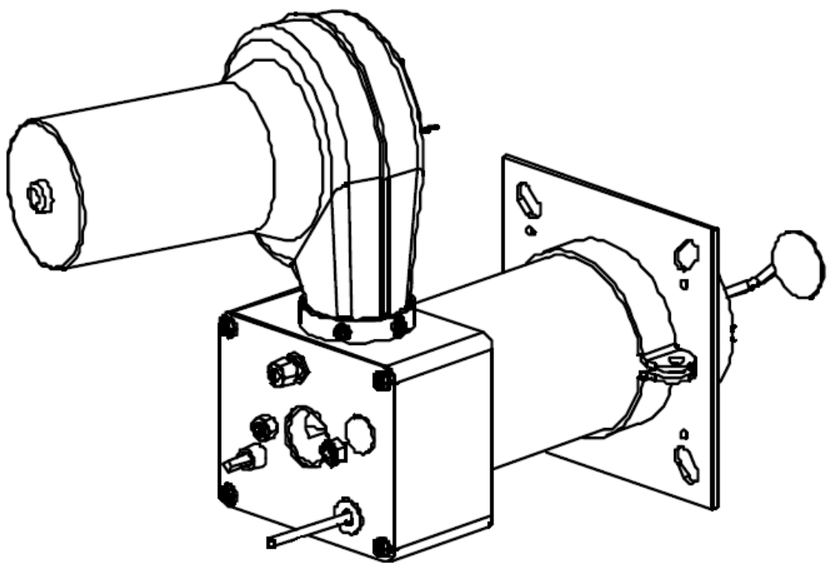
- Applicable versions: DS, TS, TS2, TS3, A
- Manufactured by Wayne Combustion Systems
- Utilizes a Burner Blower Motor mounted atop the burner

Square Burner:

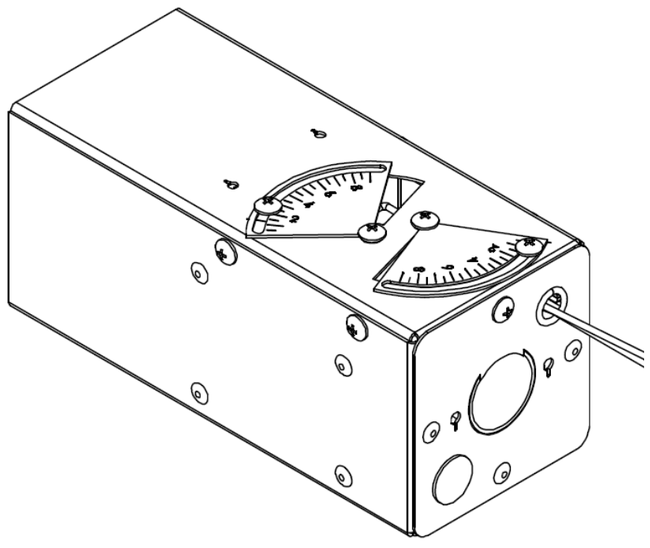
- Applicable versions: TS3, A, B, C, D, E, F, G, H
- Original design by XLT Ovens
- Originally referred to as a “Quiet Fire Burner”
- Constructed of stainless steel

Utilize the below images to further determine if your oven has a “round” or “square” burner:

Round Burner:



Square Burner:



Back to Heating Problem Gas

1.5.2.2 Determine Valve Type

Square or Round Burner Multi Valve:

- Applicable versions: TS, TS2, TS3, A, B, C, D, E
- Utilized with a square burner, or a round burner with a Direct Spark Ignition (DSI) system
- Manufactured by Honeywell

Square Burner On/Off Valve:

- Applicable versions: F, G, H
- Manufactured by BASO Gas Products

Piloted Oven Modulating (Multi) Valve:

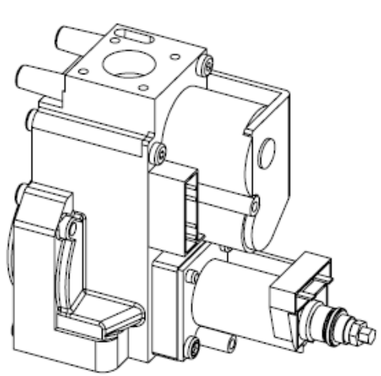
- Applicable versions: DS, TS, TS2
- Piloted Ovens will always have two distinct gas valves plumbed in series; the first being a Honeywell Combination Valve
- Manufactured by Maxitrol

Piloted Oven Solenoid (On/Off) Valve:

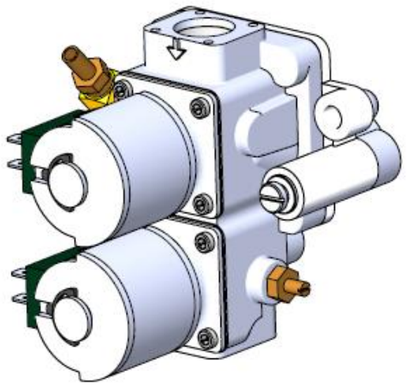
- Applicable versions: DS
- Piloted Ovens will always have two distinct gas valves plumbed in series; the first being a Honeywell Combination Valve
- XLT's least common burner system, utilizes the Omron Temperature Controller
- Manufactured by Johnson or ASCO

Utilize the below images to further determine your oven's valve type:

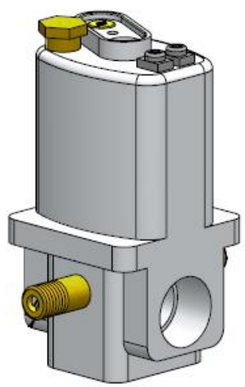
SQ or RO Multi:



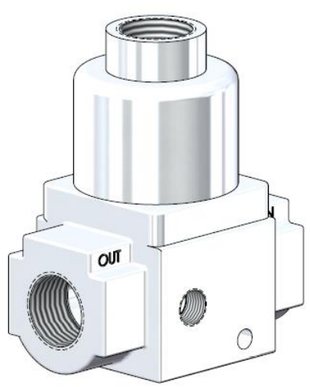
SQ On/Off:

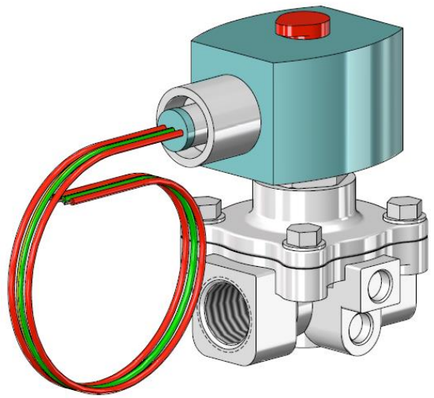


Piloted Multi:



Piloted On/Off:





Back to Heating Problem Gas

1.5.2.3 Determine Ignition Type

Piloted Oven:

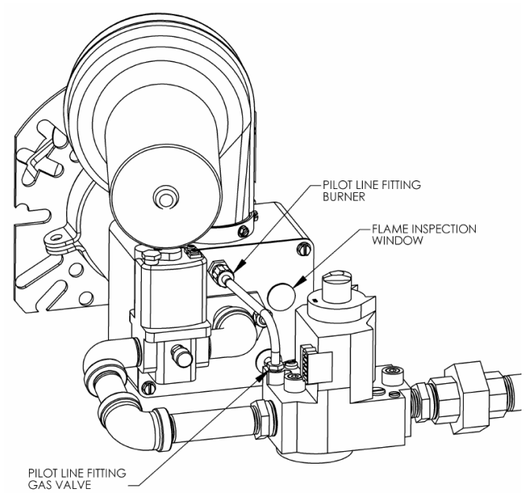
- Applicable Versions: DS, TS, TS2
- Fuse holders will be labeled for “Main Valve” and “Pilot Valve” on control panel
- Piloted Ovens will always have two distinct gas valves plumbed in series; the first being a Honeywell Combination Valve
- Oven will either utilize the Honeywell S8600H Burner Control or the Fenwal replacement Ignition Control
    - Honeywell is black in color while the Fenwal is gray in color
    - Both controls will have terminal positions labeled for Main Valve “MV” and Pilot Valve “PV”
    - Neither control has a separate flame sense terminal position (the spark wire transmits the flame sense signal)

Direct Spark Ignition (DSI):

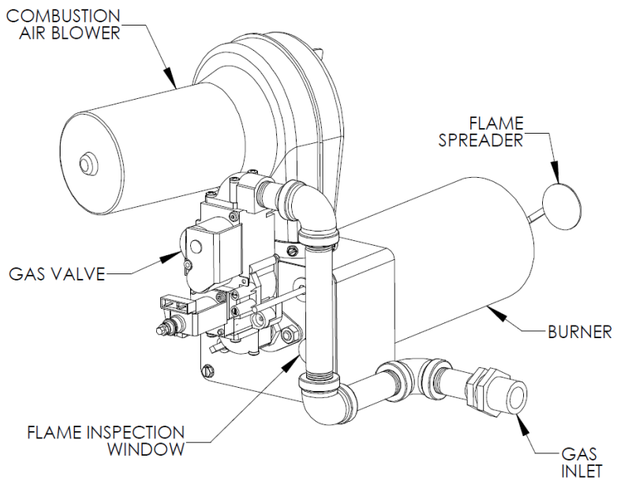
- Applicable Versions: TS, TS2, A, B (AE)
- Round Burner DSI Ovens will only have a single gas valve plumbed to the burner, and this will always be the Honeywell Multi Valve
- Oven will utilize a Fenwal Ignition Control
    - Control will have terminal positions labeled for “V1” and “V2”
    - Control will have a dedicated terminal position for flame sense labeled “S1”
    - Control will have a dedicated flame sense wire, blue in color, which will accompany the spark wire into the burner

Utilize the below images to further determine your oven’s ignition type:

Piloted Oven:



Direct Spark Ignition (DSI):



Back to Heating Problem Gas

1.5.2.4 Square Burner Multi Under Temp Step 1

Versions: TS3, A, B, C, D, E

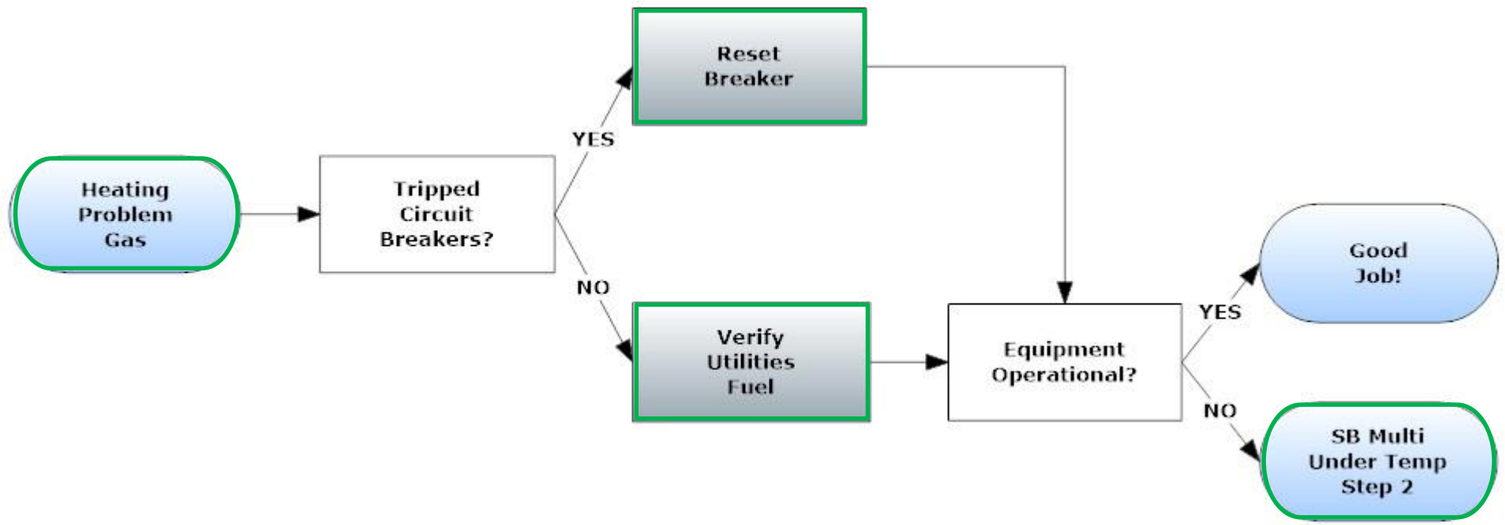


Figure 9 SB Multi Under Temp Step 1

1.5.2.4.1 Square Burner Multi Under Temp Step 2

Versions: TS3, A, B, C, D, E

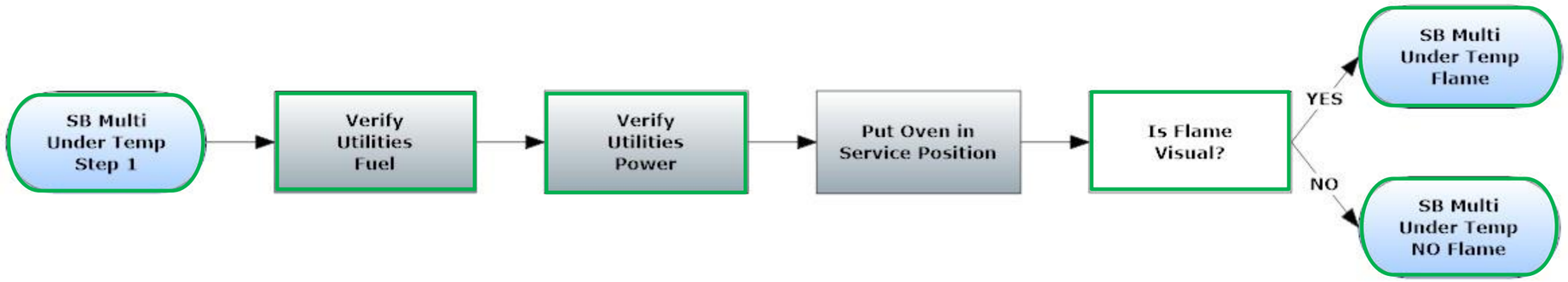


Figure 10 SB Multi Under Temp Step 2

1.5.2.4.2 Square Burner Multi Under Temp Flame

Versions: TS3, A, B, C, D, E

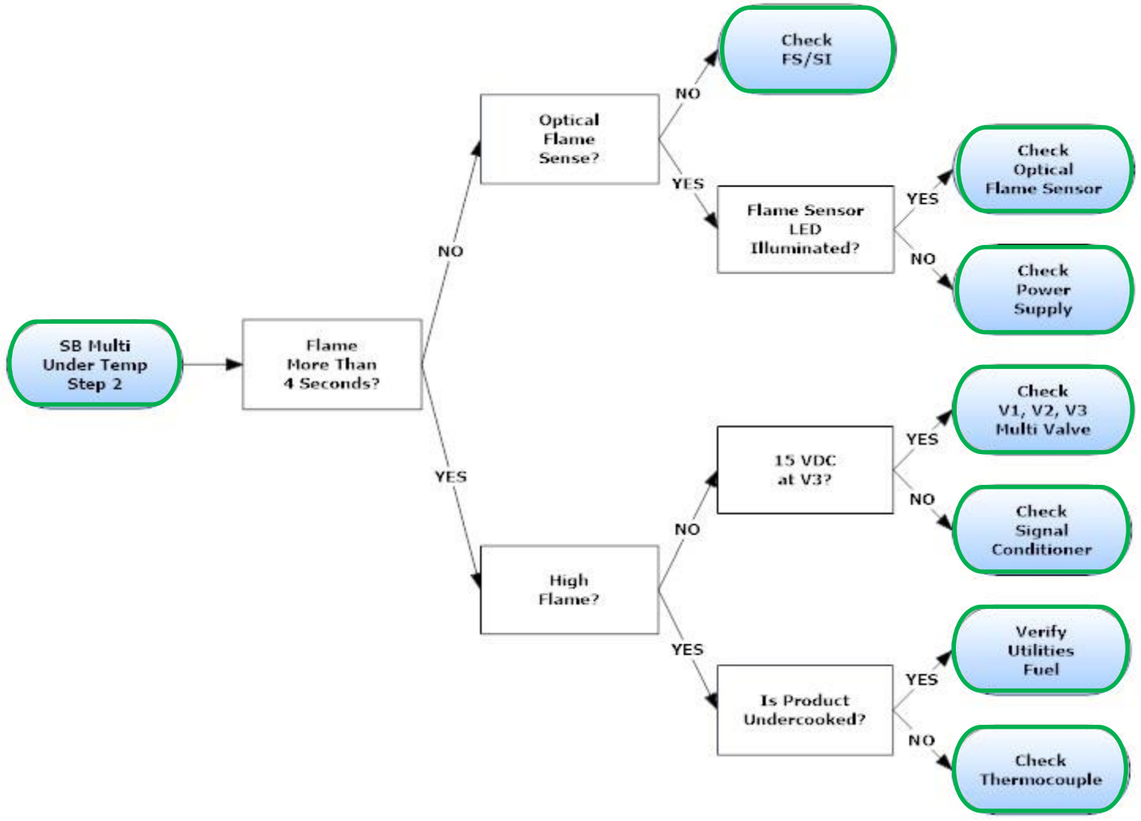


Figure 11 SB Multi Under Temp Flame

Note: If oven has been moved/recently installed, and you have verified fuel utilities to no resolution, then check the Main Orifice to be correct size for fuel used. This has been a previously observed issue. Main Orifice could contain debris/blockage limiting fuel flow as well

1.5.2.4.3 Square Burner Multi Under Temp NO Flame

Versions: TS3, A, B, C, D, E

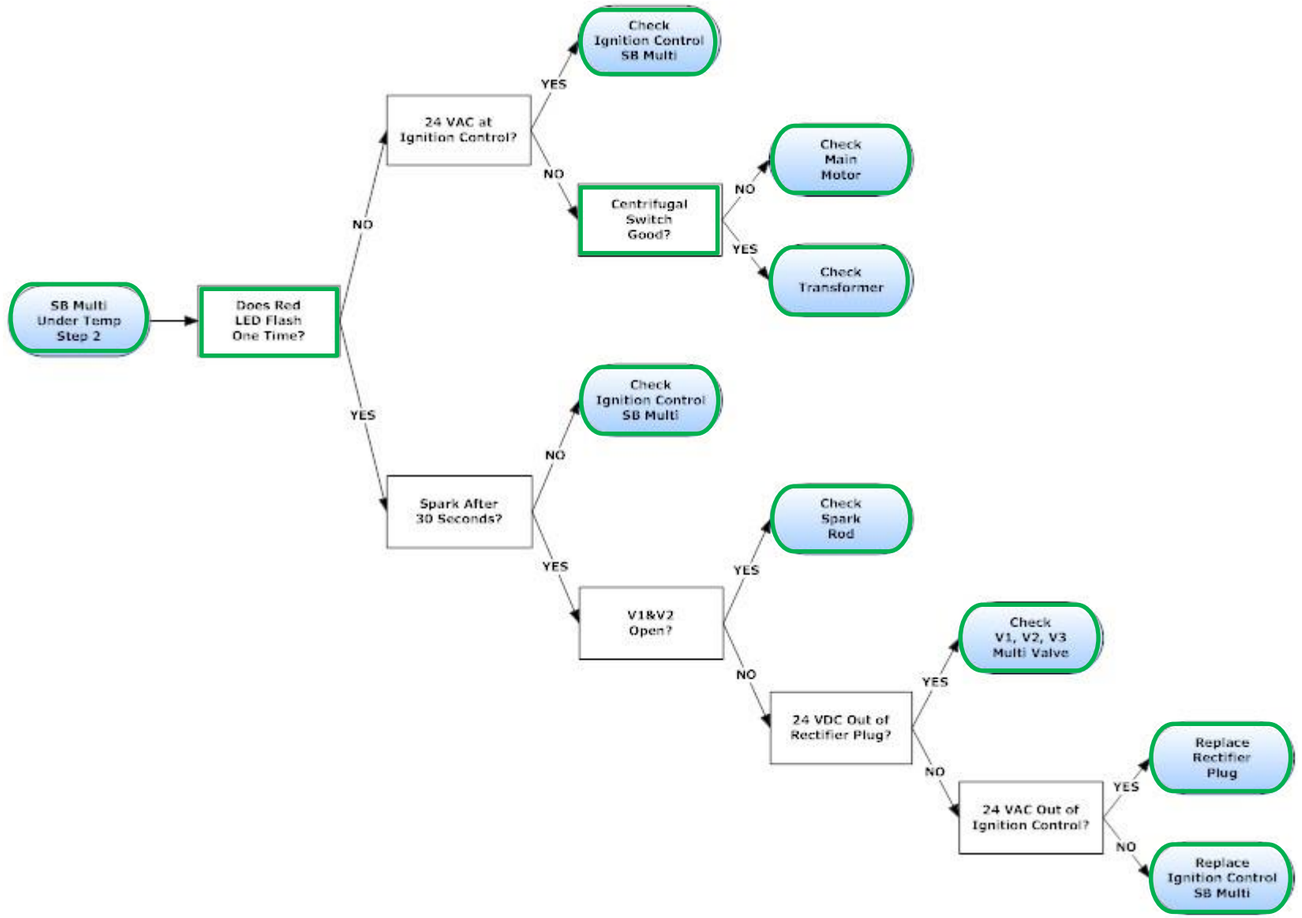


Figure 12 SB Multi Under Temp NO Flame

1.5.2.5 Square Burner Multi Over Temp

Versions: TS3, A, B, C, D, E

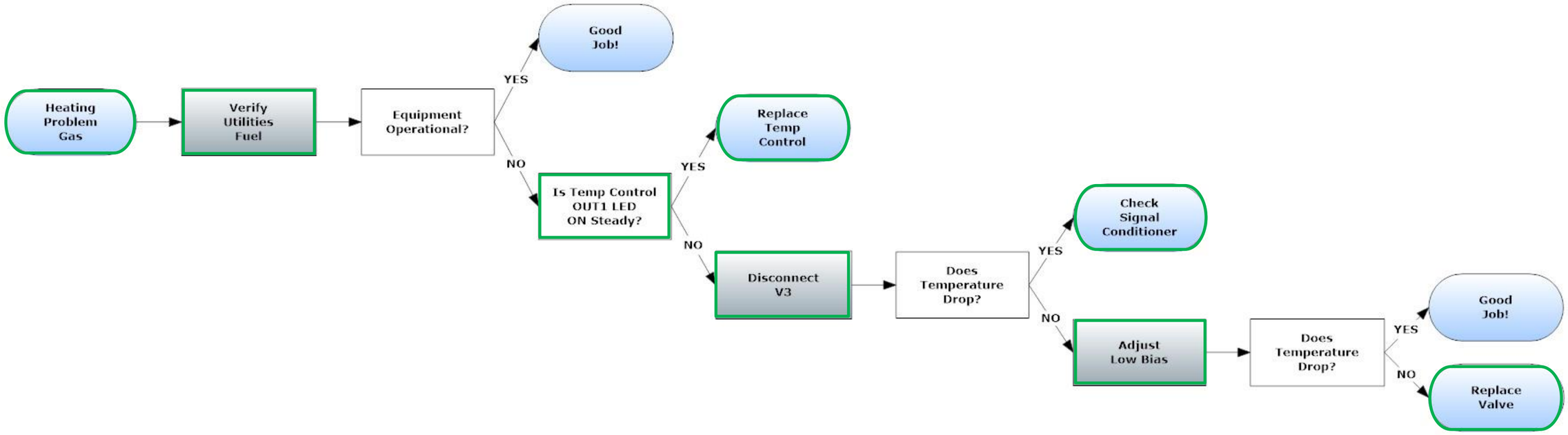


Figure 13 SB Multi Over Temp

Note: If product is not being overcooked, then check the Thermocouple

1.5.2.6 Square Burner On/Off Under Temp Step 1

Versions: F, G, H

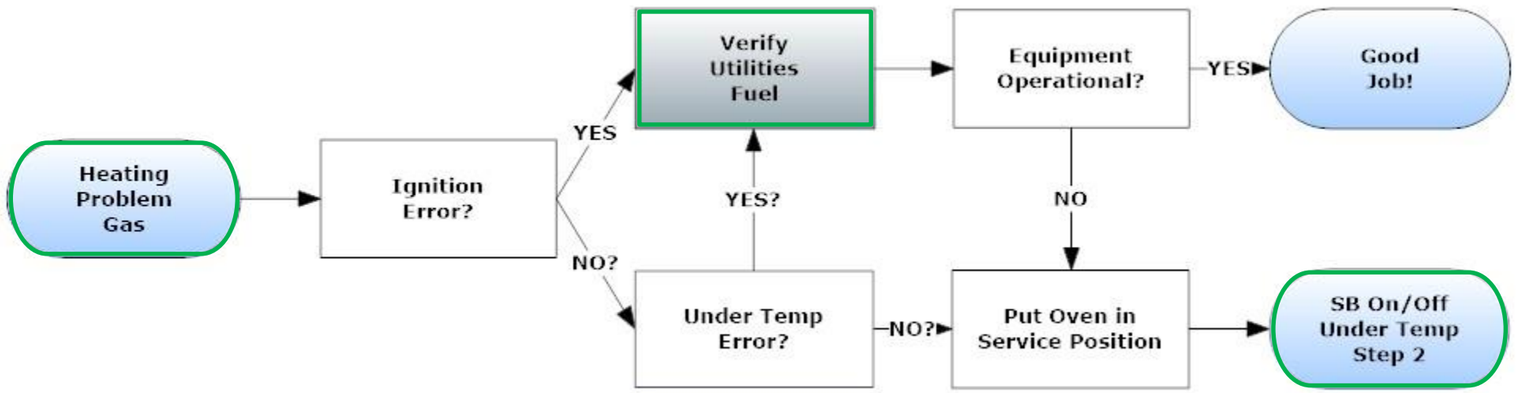


Figure 14 SB On/Off Under Temp Step 1

1.5.2.6.1 Square Burner On/Off Under Temp Step 2

Versions: F, G, H

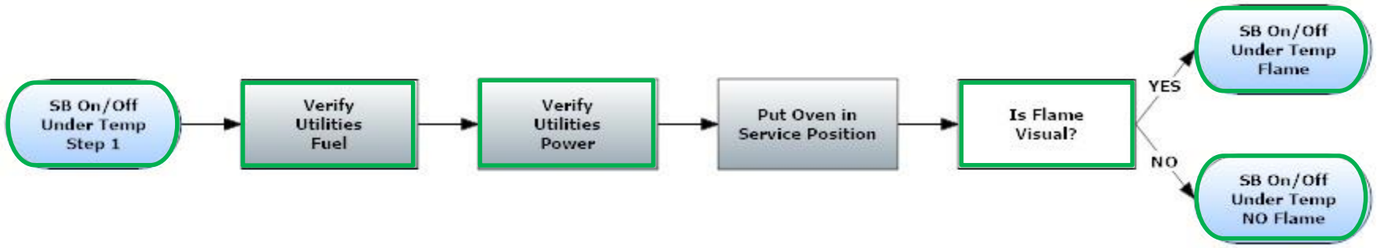
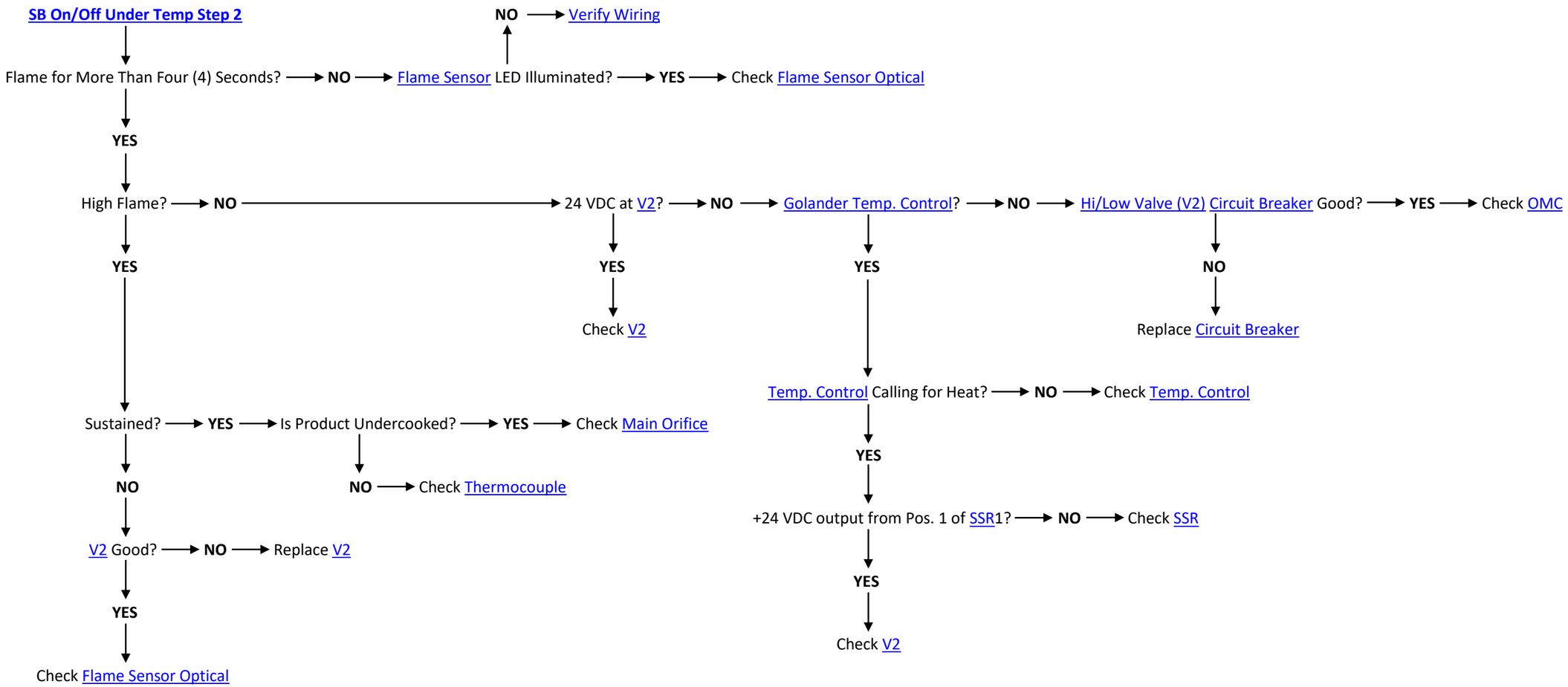


Figure 15 SB On/Off Under Temp Step 2

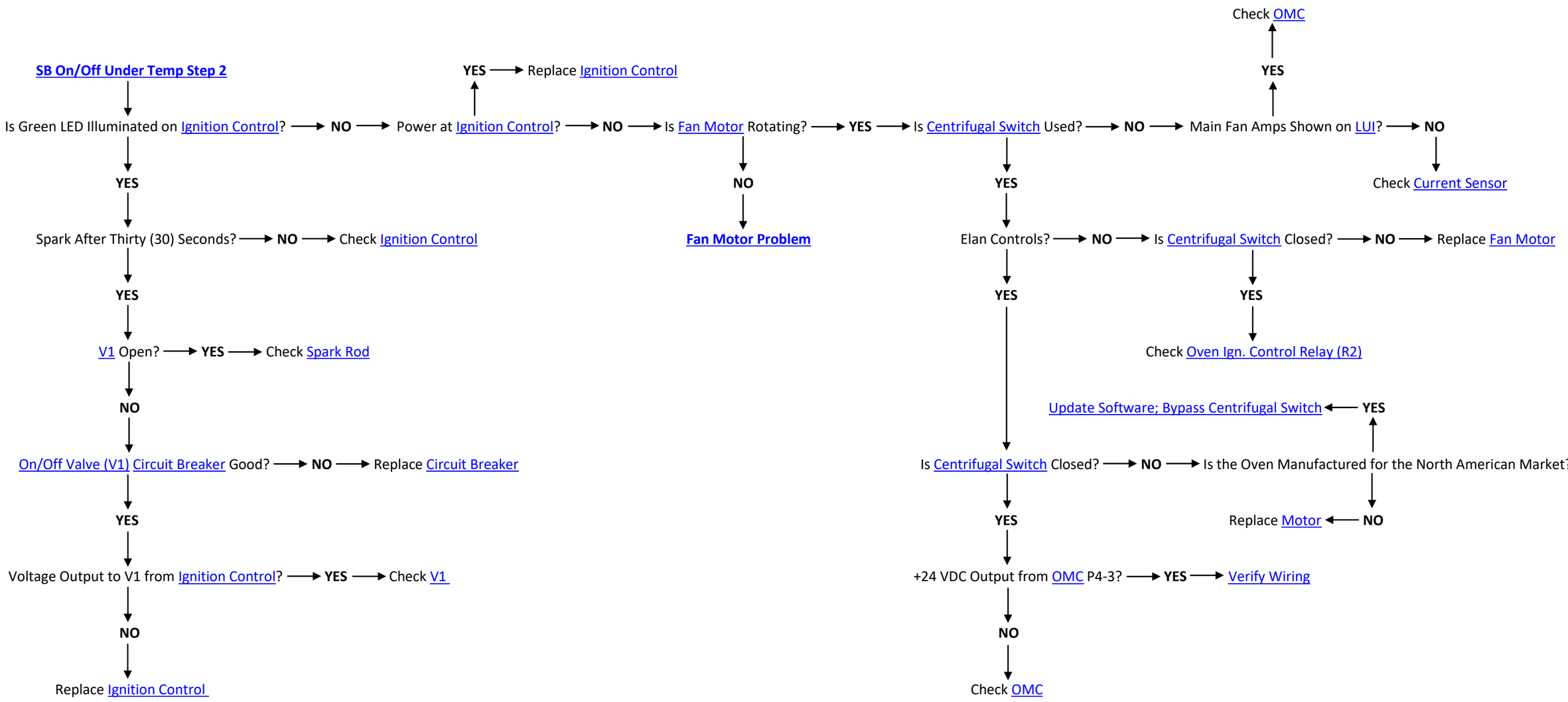
1.5.2.6.2 Square Burner On/Off Under Temp Flame

Versions: F, G, H



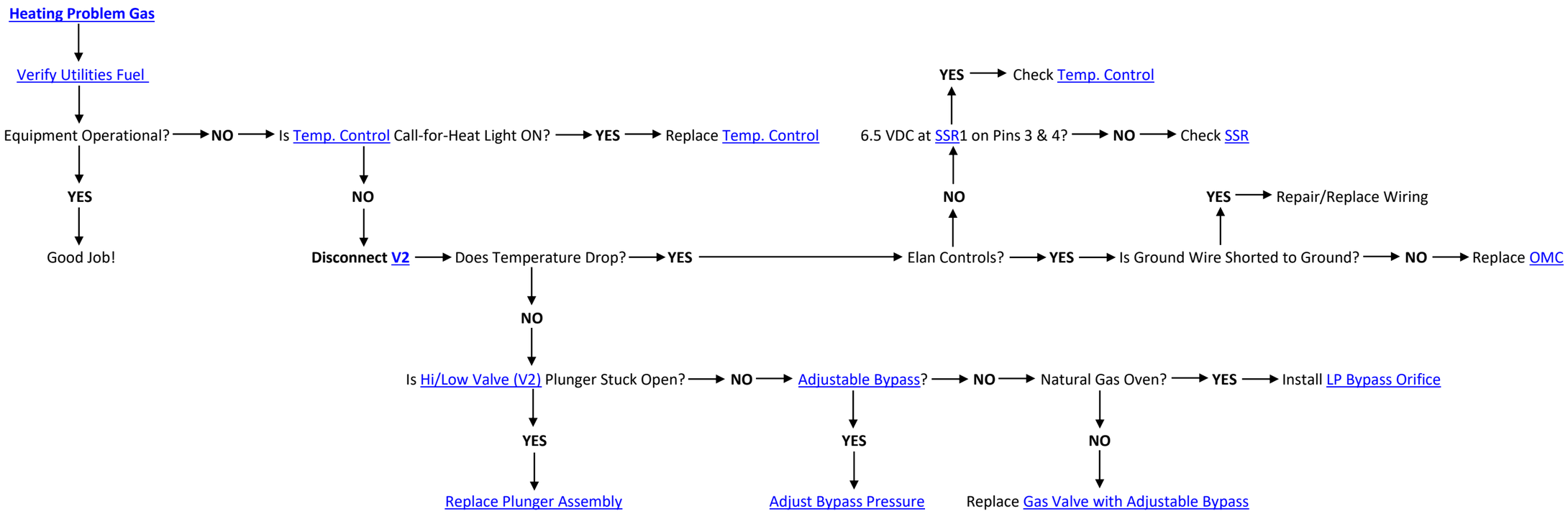
1.5.2.6.3 Square Burner On/Off Under Temp NO Flame

Versions: F, G, H



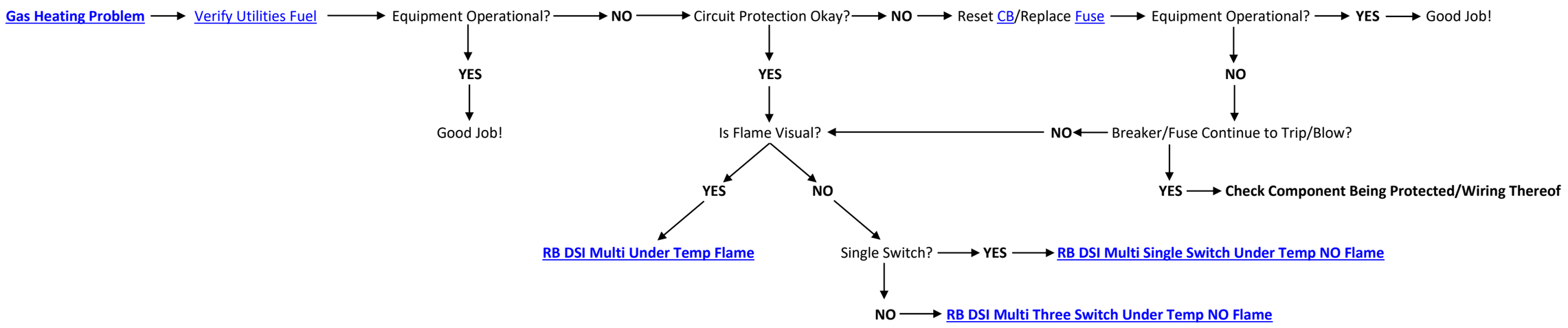
1.5.2.7 Square Burner On/Off Over Temp

Versions: F, G, H

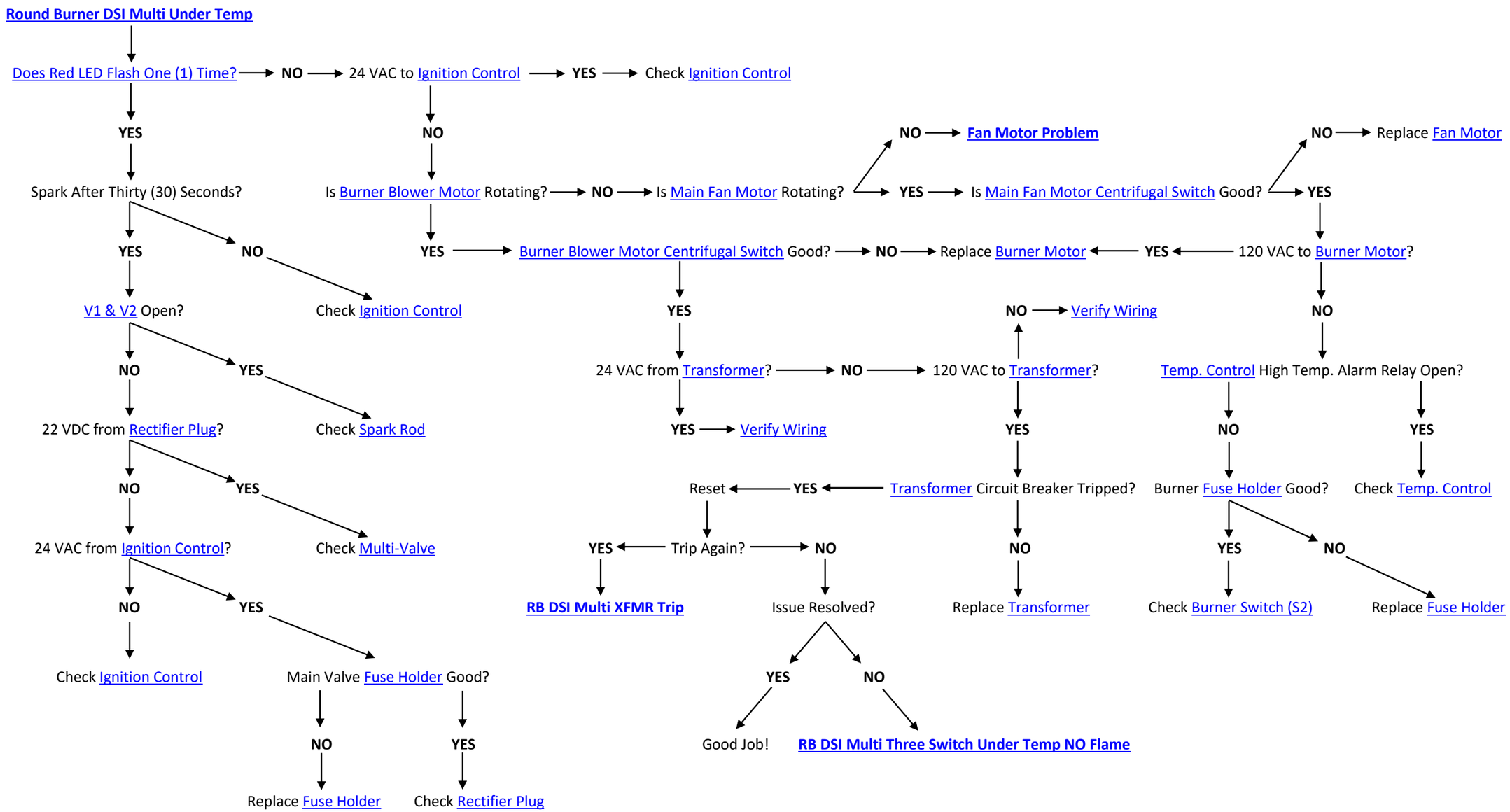


1.5.2.8 Round Burner DSI Multi Under Temp

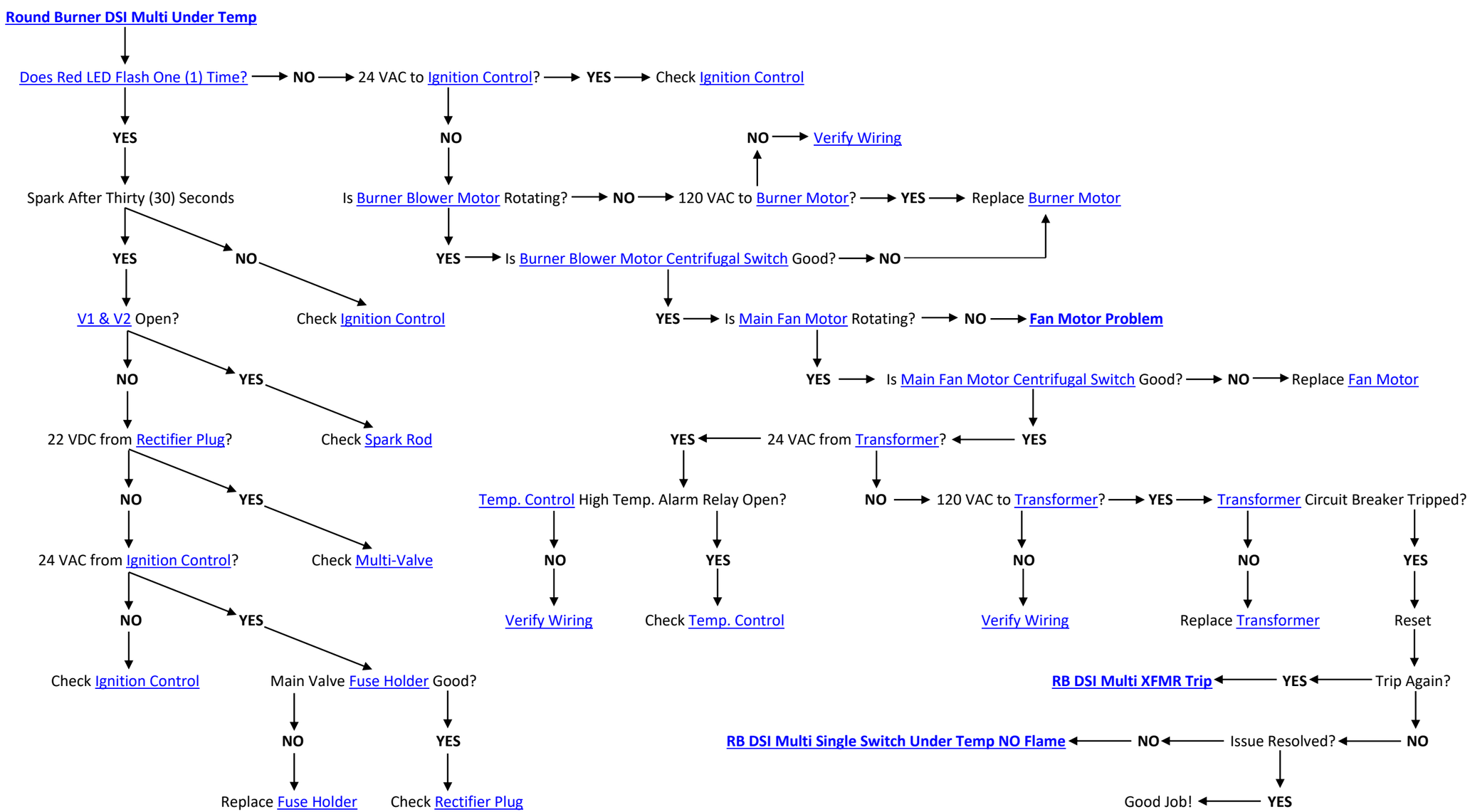
Versions: TS, TS2, TS3, A



1.5.2.8.1 Round Burner DSI Multi Three Switch Under Temp NO Flame



1.5.2.8.2 Round Burner DSI Multi Single Switch Under Temp NO Flame

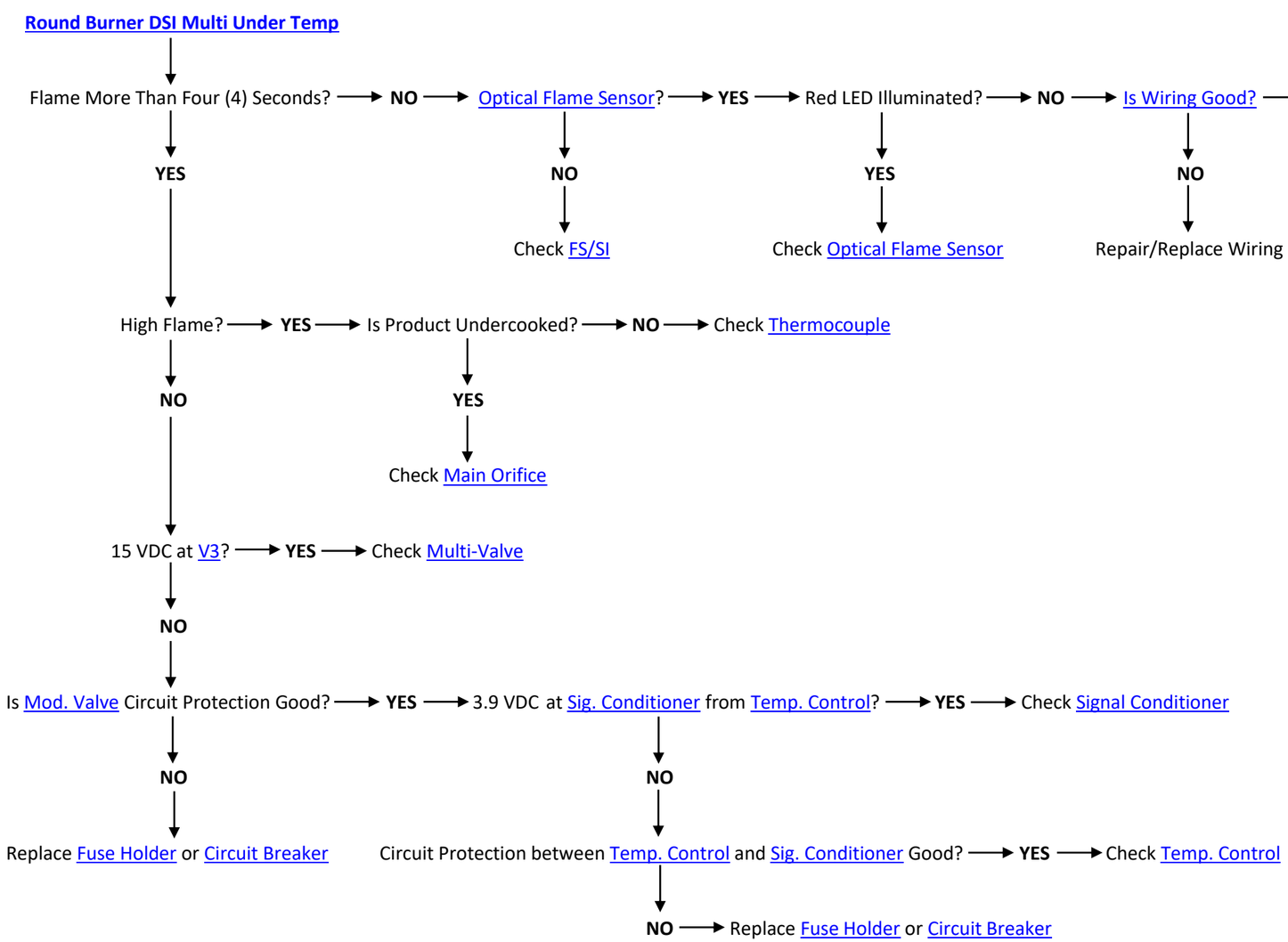


1.5.2.8.3 Round Burner DSI Multi Transformer Circuit Breaker Tripping

Versions: TS, TS2, TS3, A

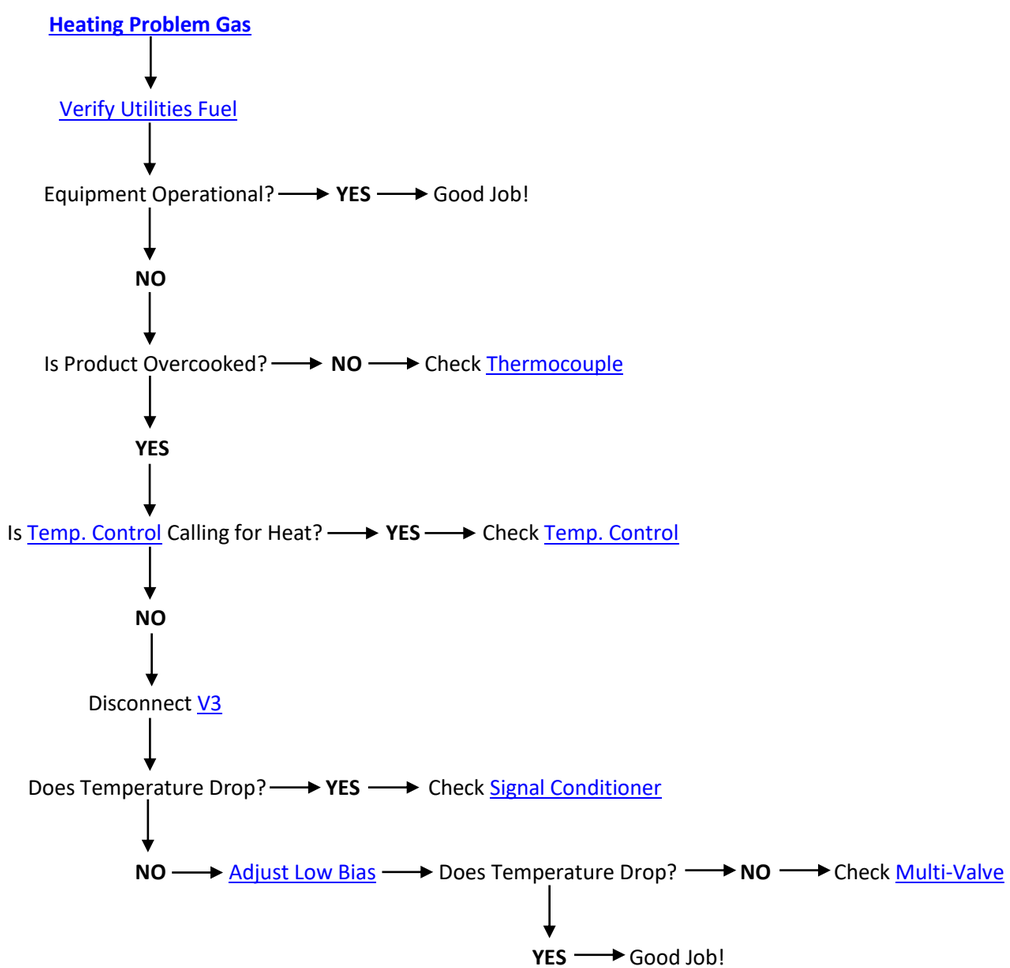
1.5.2.8.4 Round Burner DSI Multi Under Temp Flame

Versions: TS, TS2, TS3, A



1.5.2.9 Round Burner DSI Multi Over Temp

Versions: TS, TS2, TS3, A



1.5.2.10 Round Burner Pilot Mod. Under Temp

Versions: DS, TS, TS2

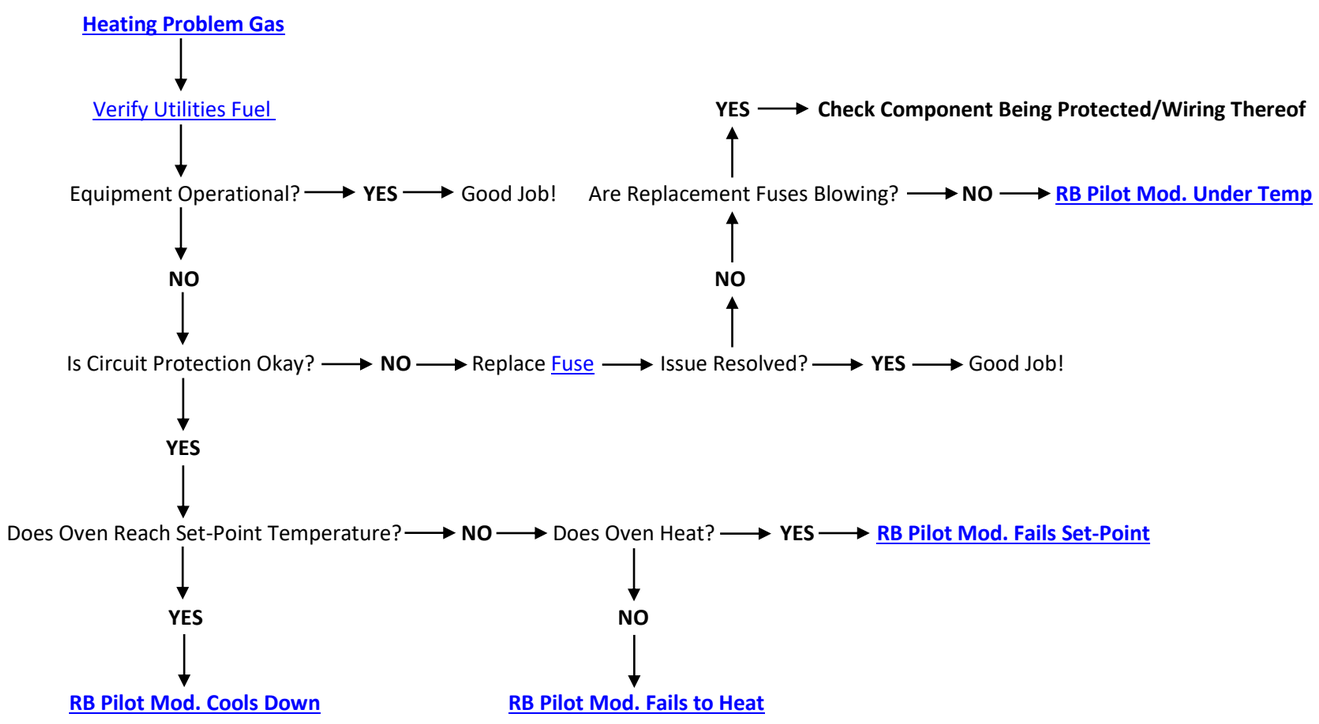
Information: Oven heating problems require careful observation and diagnosis to effectively solve the problem. Heating problems can be separated into several groups that each have their own symptoms and remedies:

- Oven fails to heat.
- Oven heats, but won't achieve set-point temperature.
- Oven reaches set-point temperature for a period of time, then cools down.
- Oven goes above set-point temperature.

There are two (2) reasons an oven won't heat up;

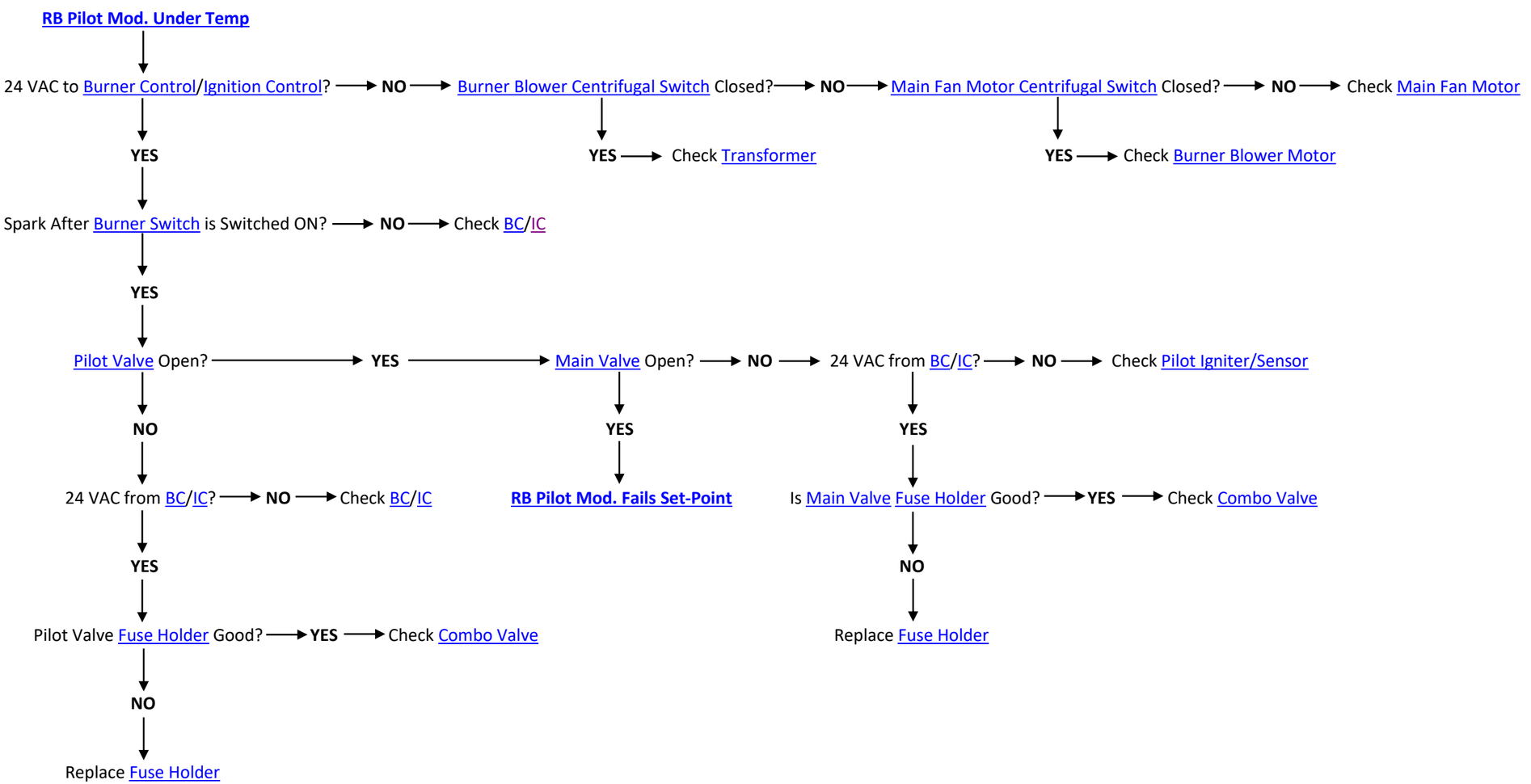
- It fails to light, OR
- It actually lights, but fails to stay lit.

These two problems may appear similar, but the identification and remedies are completely different. Once the proper diagnosis is made, effective problem-solving can occur.



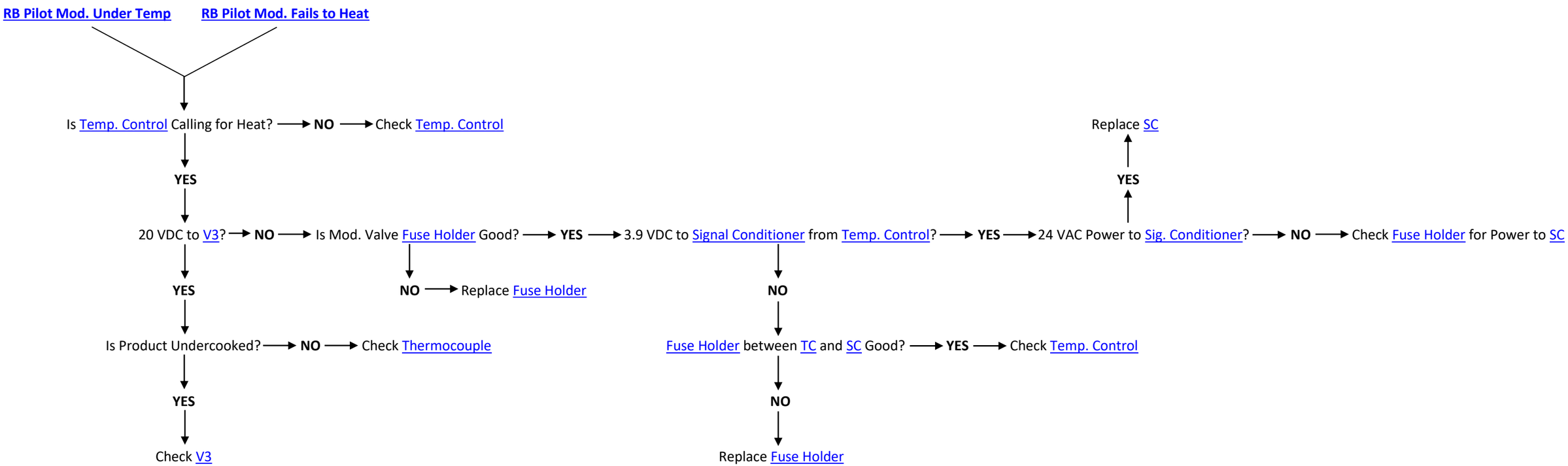
1.5.2.10.1 Round Burner Pilot Mod. Fails to Heat

Versions: DS, TS, TS2



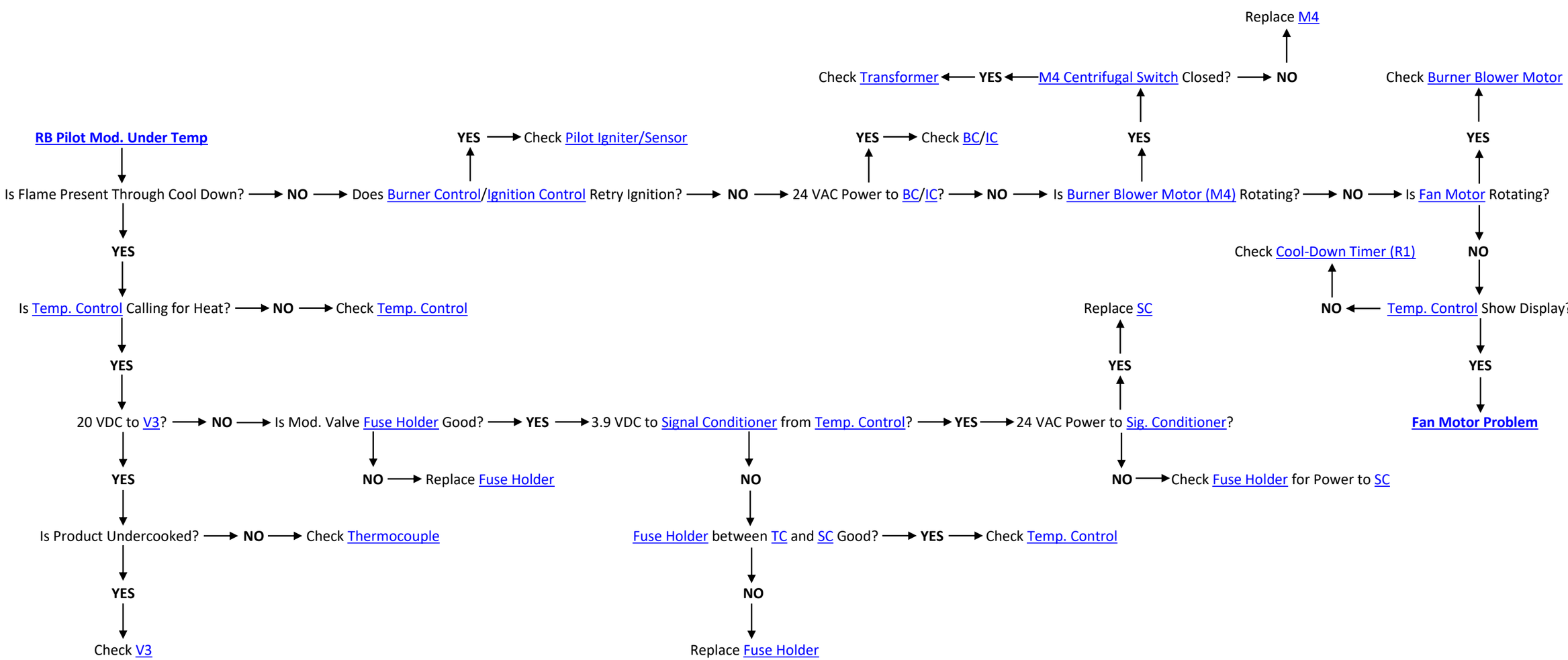
1.5.2.10.2 Round Burner Pilot Mod. Fails Set-Point

Versions: DS, TS, TS2



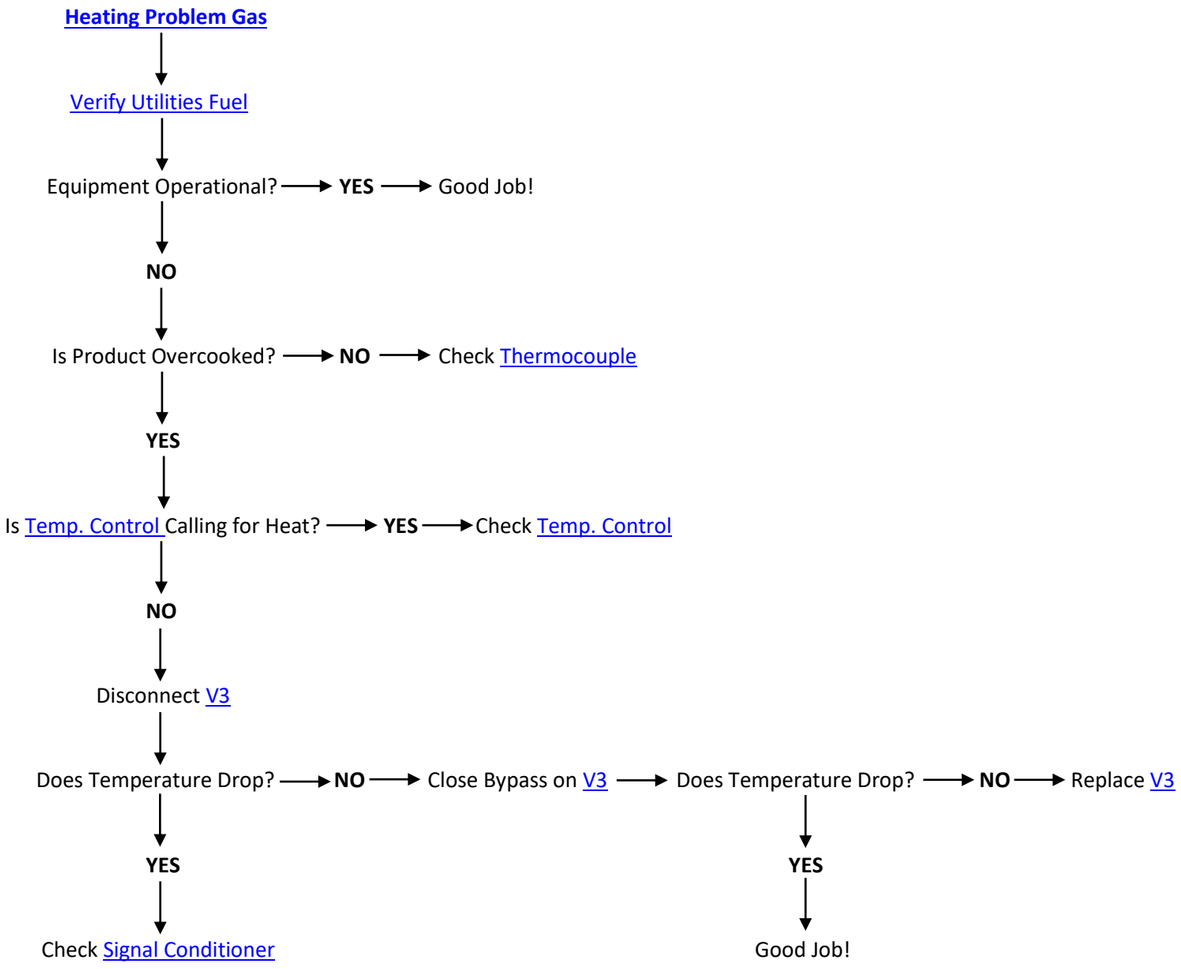
1.5.2.10.3 Round Burner Pilot Mod. Cools Down

Versions: DS, TS, TS2



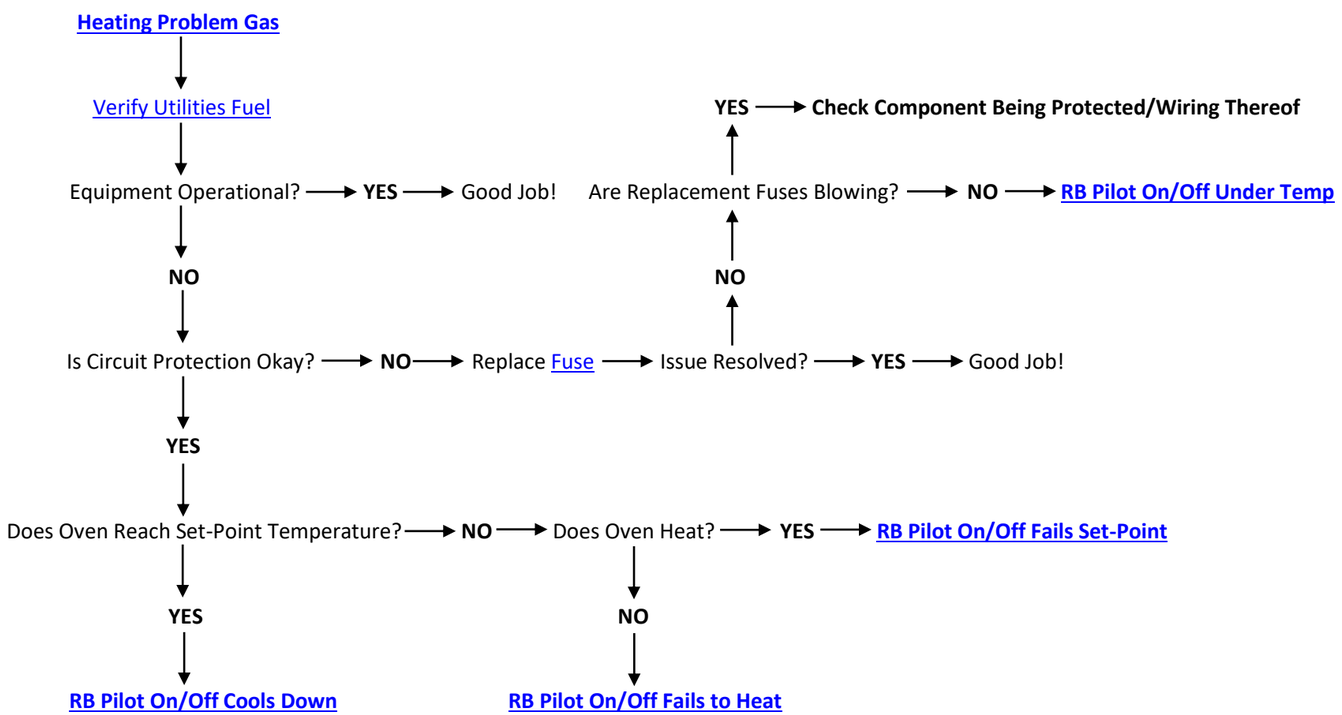
1.5.2.11 Round Burner Pilot Mod. Over Set-Point

Versions: DS, TS, TS2



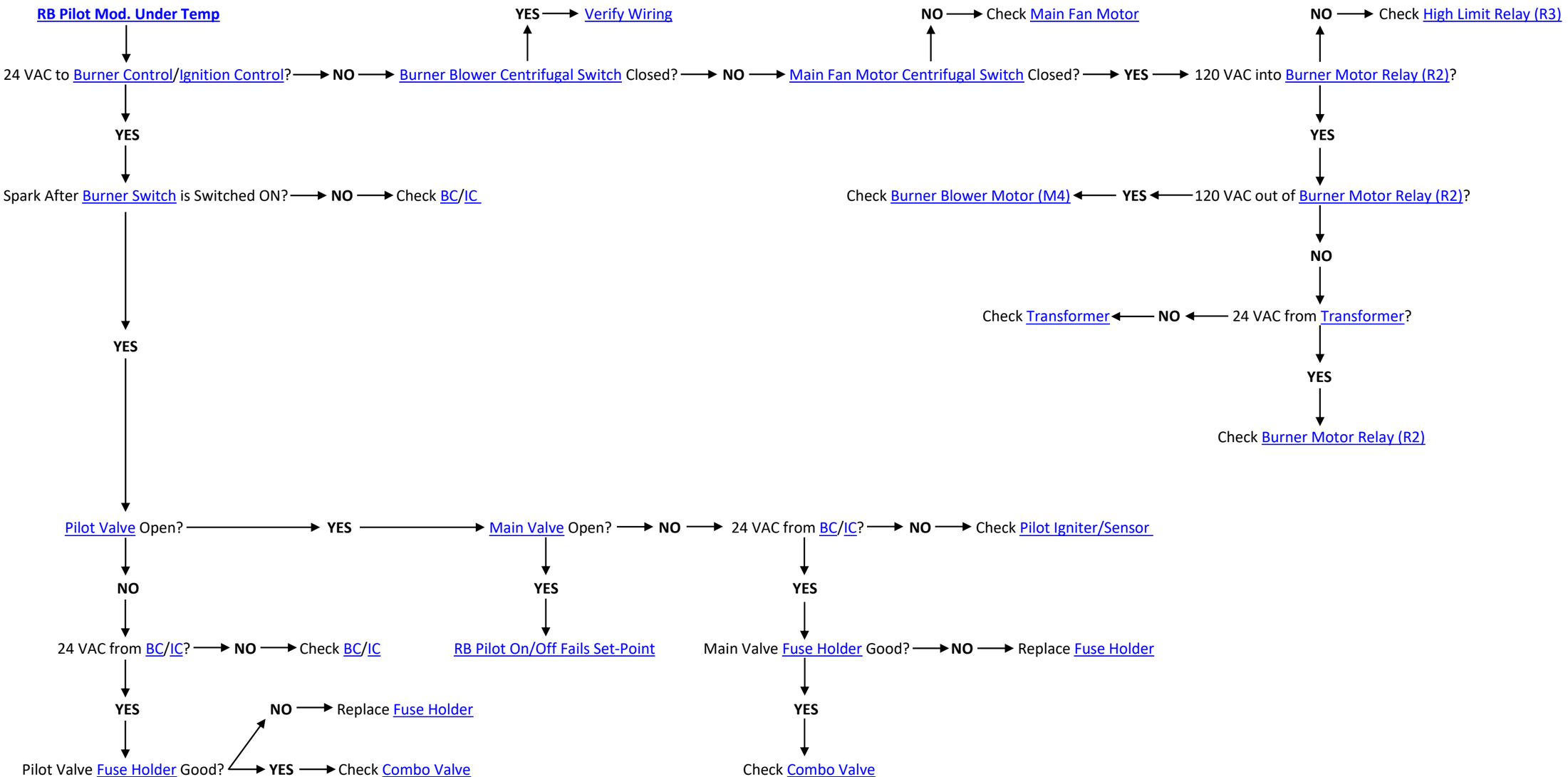
1.5.2.12 Round Burner Pilot On/Off Under Temp

Version: DS



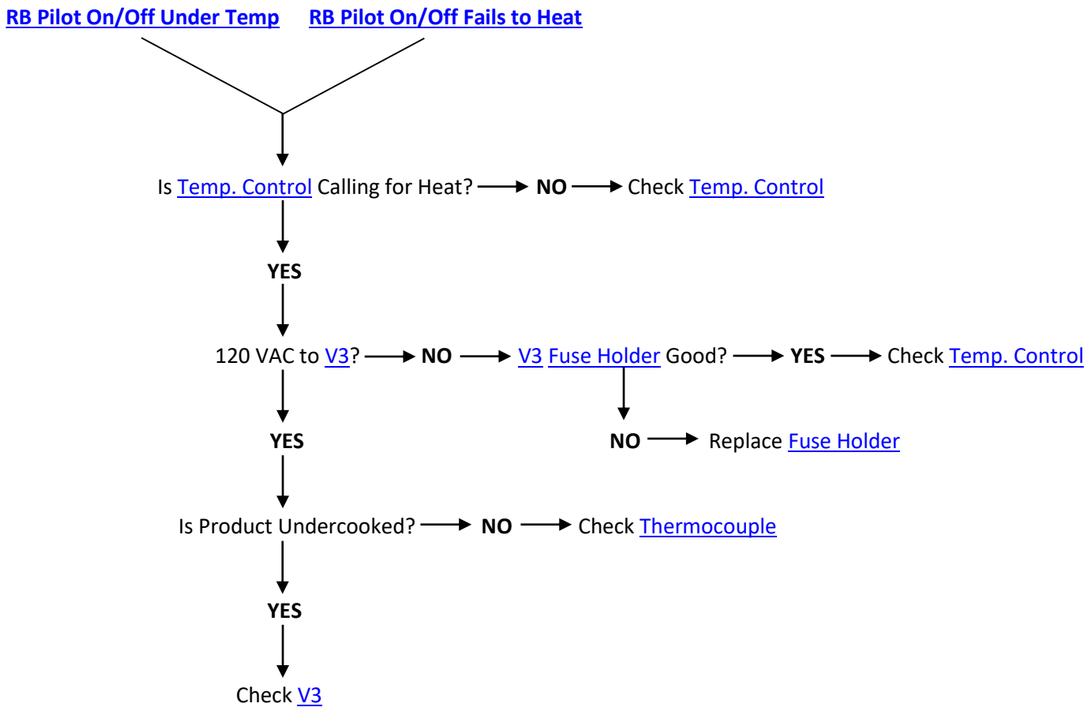
1.5.2.12.1 Round Burner Pilot On/Off Fails to Heat

Version: DS



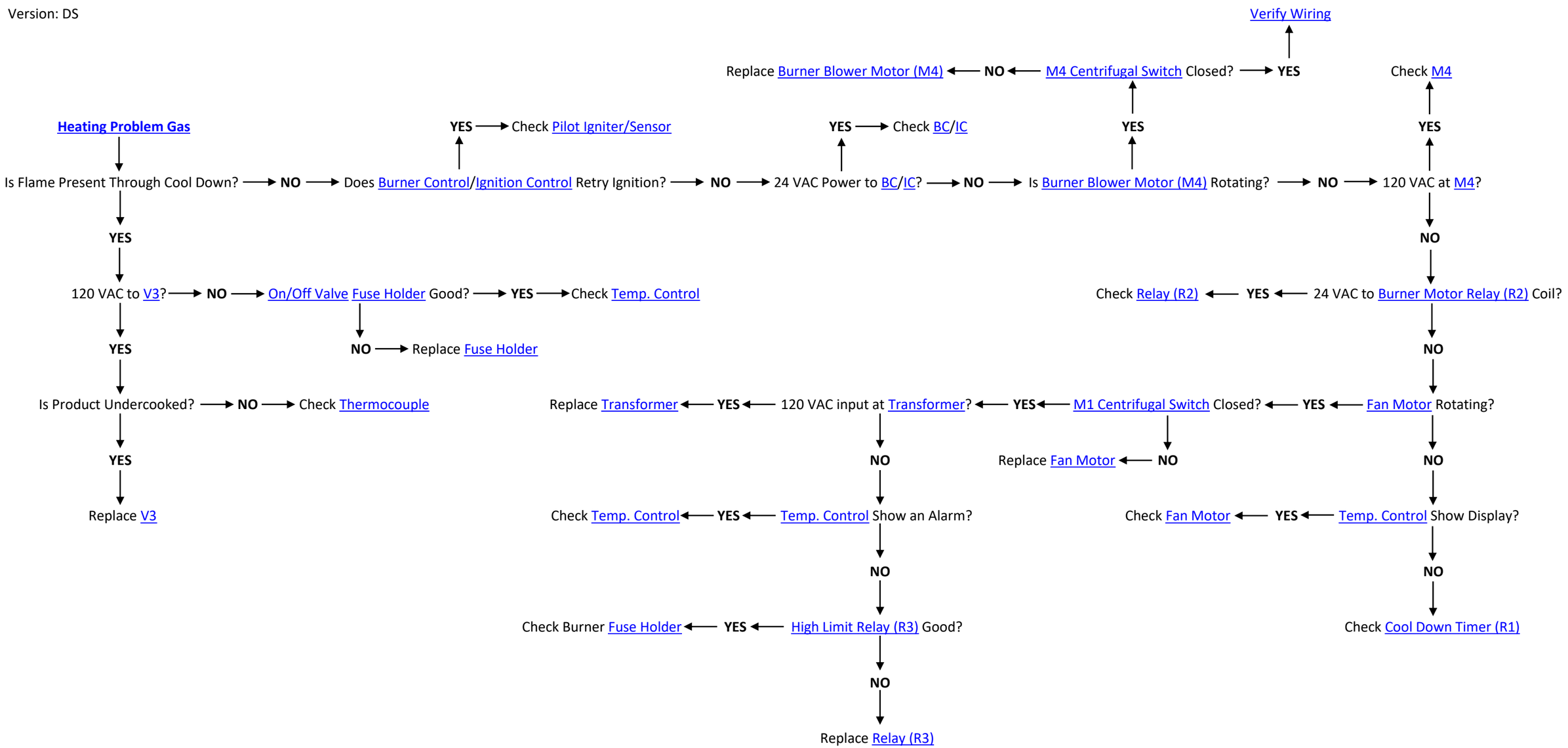
1.5.2.12.2 Round Burner Pilot On/Off Fails Set-Point

Version: DS



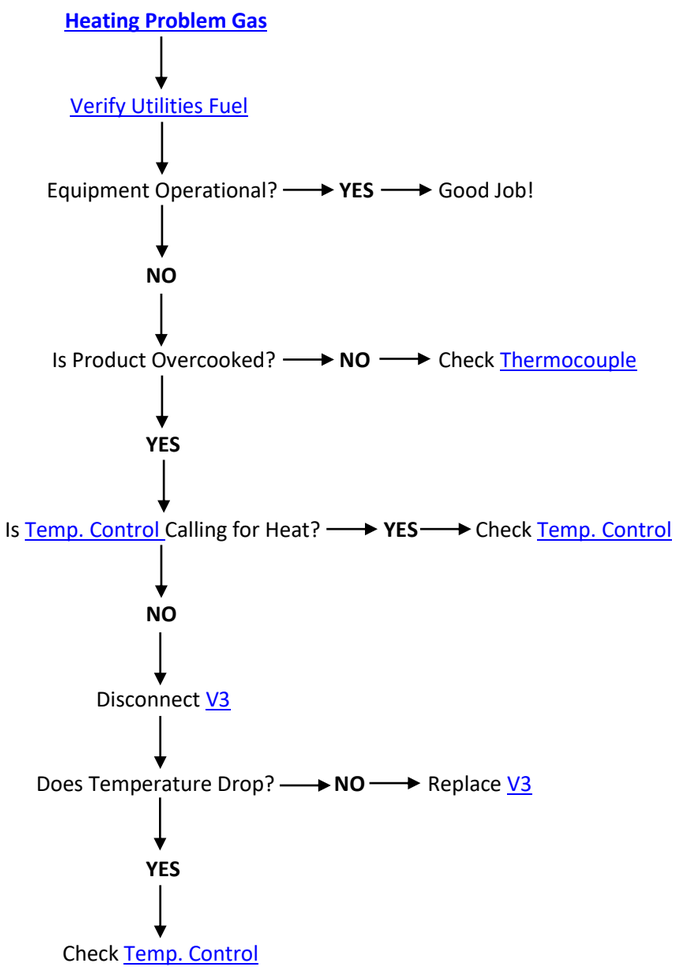
1.5.2.12.3 Round Burner Pilot On/Off Cools Down

Version: DS

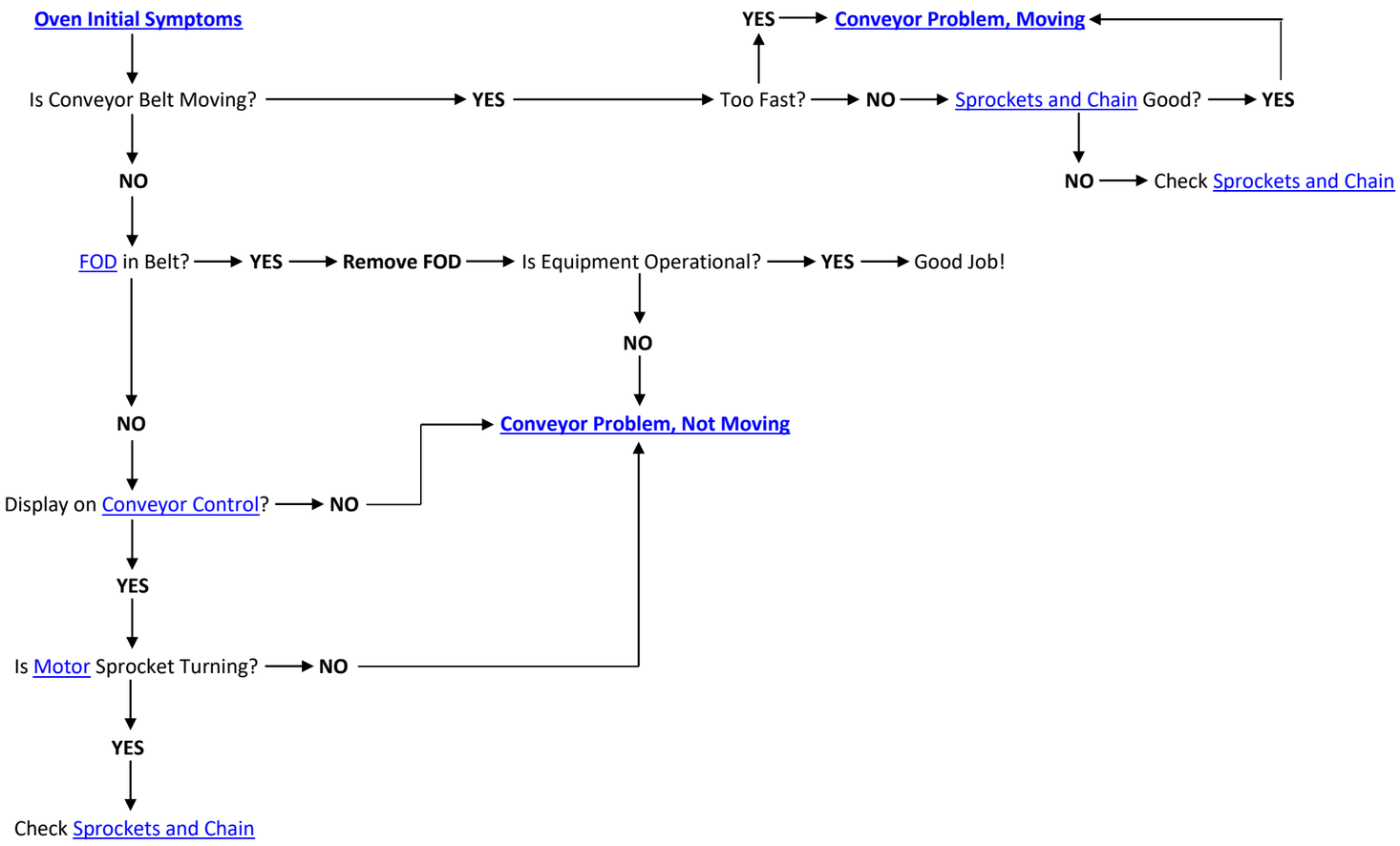


1.5.2.13 Round Burner Pilot On/Off Over Temp

Versions: DS



1.6 Conveyor Problem



1.6.1 Conveyor Problem, Moving

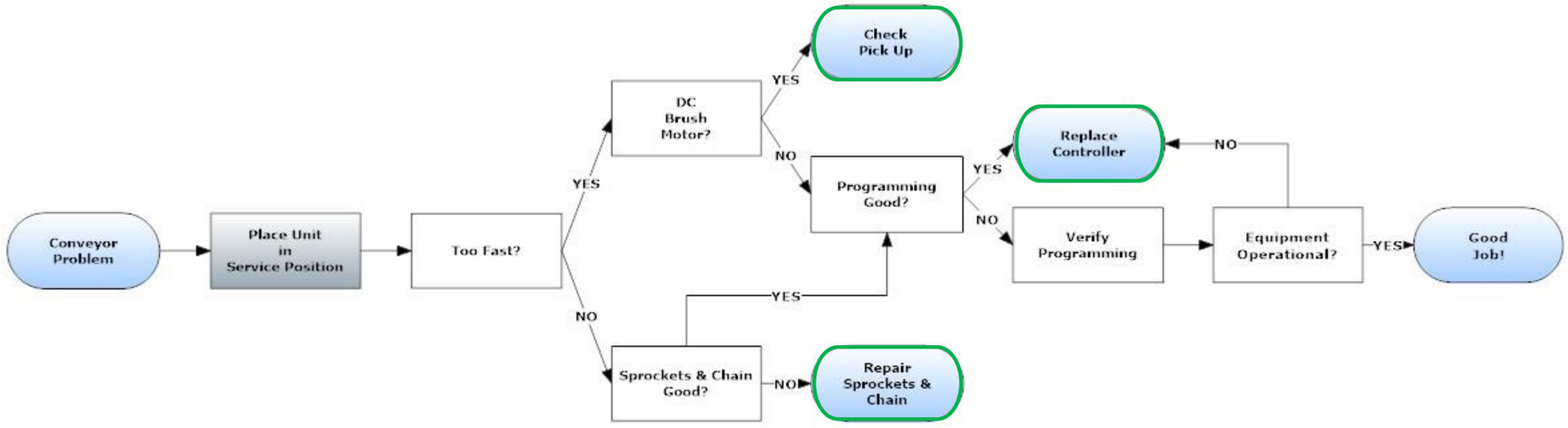
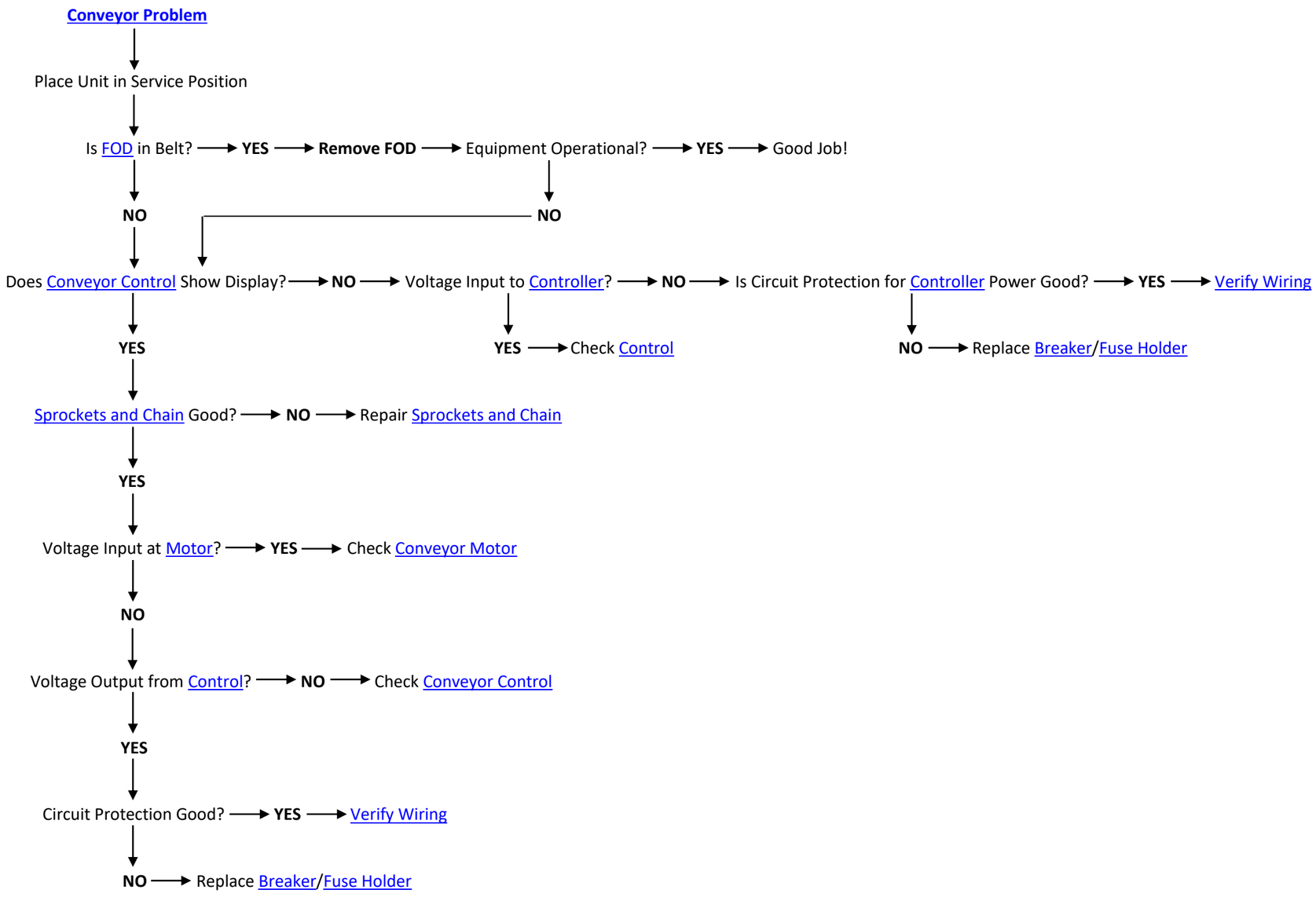


Figure 16 Conveyor Problem Moving

1.6.2 Conveyor Problem, Not Moving



1.6.3 Sprockets & Chain

The sprockets and chain will have to be observed to verify proper installation and operation. Remove Chain Guard and make the following observations:

Is the drive chain properly installed to sprockets?

- The sprocket teeth and chain pitches' interactions are one-for-one.

Is the drive chain needing lubricated?

- Remove drive chain, does it hinge on its pins freely?

Is the drive chain taut when installed? Not too loose or too tight?

- Chain tension is optimal with 1/2" of deflection while installed.

Are the sprockets aligned?

- Uniform distance between conveyor frame and chain, as well as between control box and chain? (See Drive Chain Alignment)

Are sprockets in good condition? Are the teeth worn down? Are teeth completely missing?

Are sprockets' set screws properly tightened to shafts? Flat side of shaft?

Figure 17 Drive Chain Alignment

1.6.4 FOD – Foreign Object Debris

Can it be removed by the store's oven operator?

Did it cause any damage needing addressed?

Is the conveyor clean?

1.7 Bake Problem

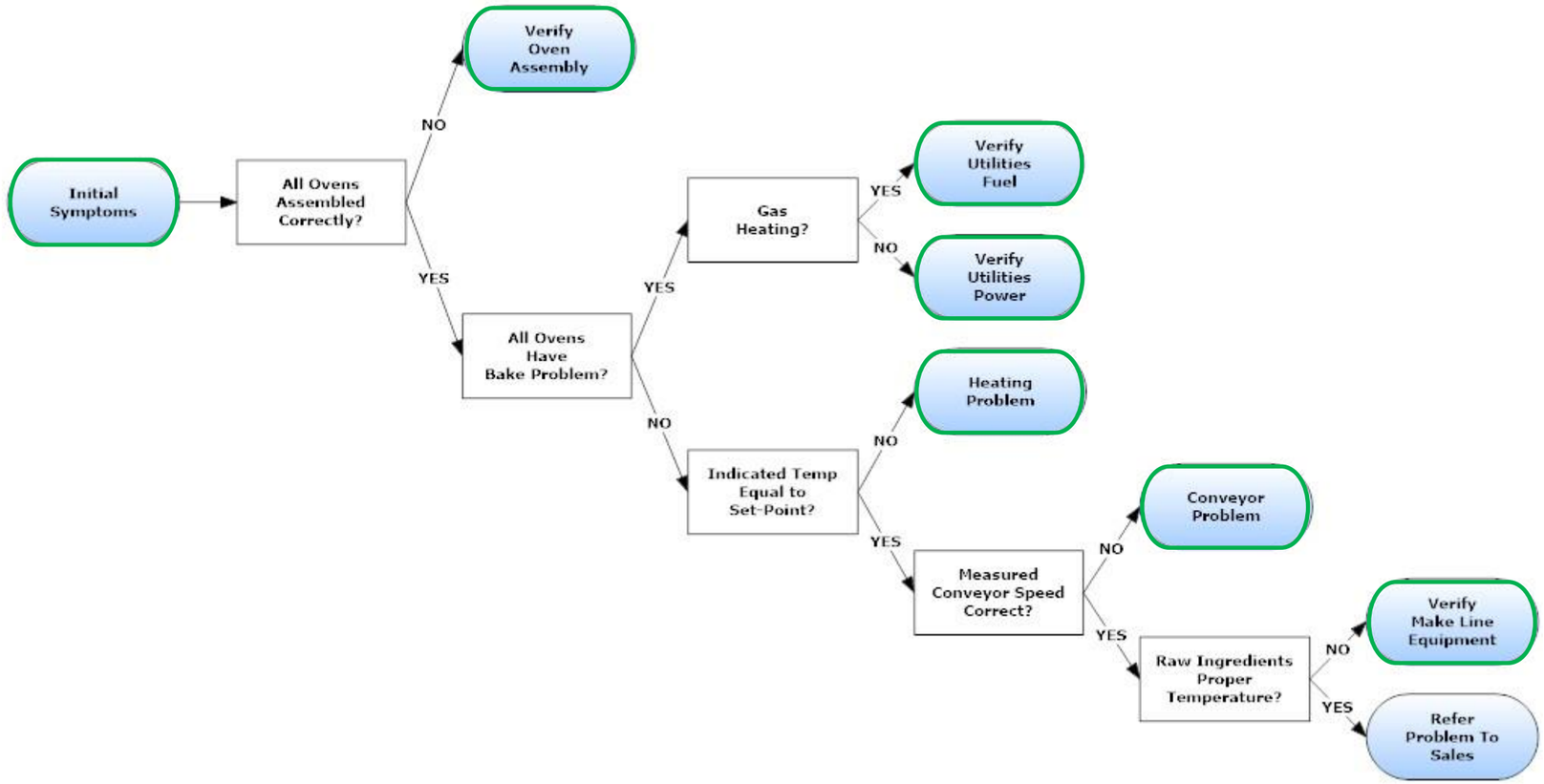
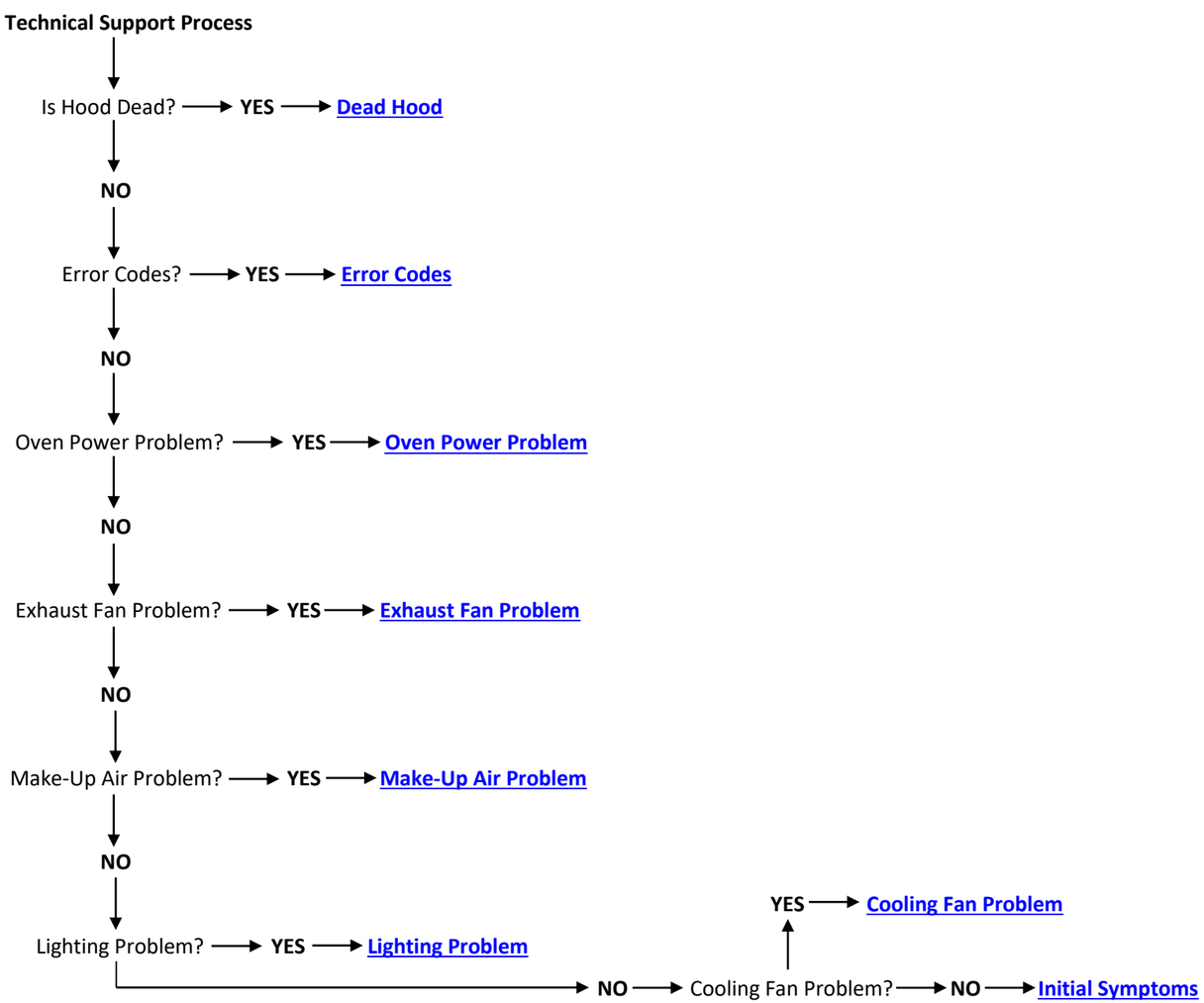


Figure 18 Bake Problem

Note: Thermocouple issues can be diagnosed as a bake problem

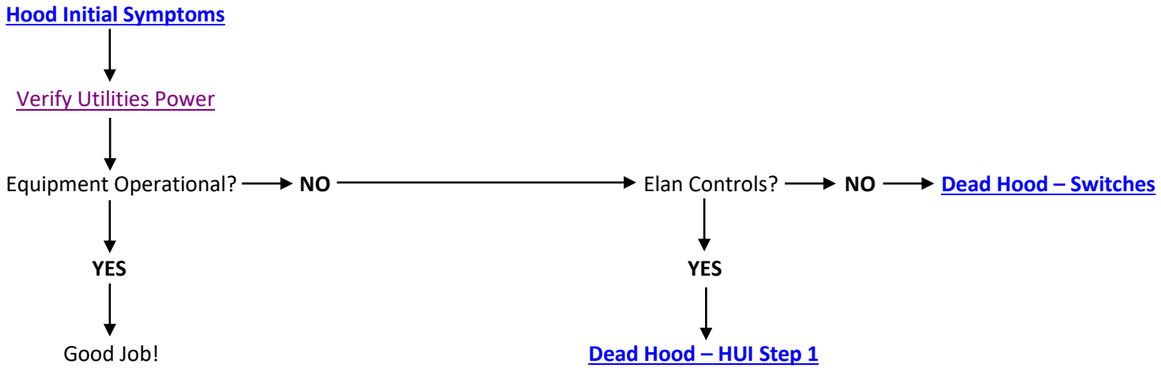
2 Hood Troubleshooting

2.1 Hood Initial Symptoms



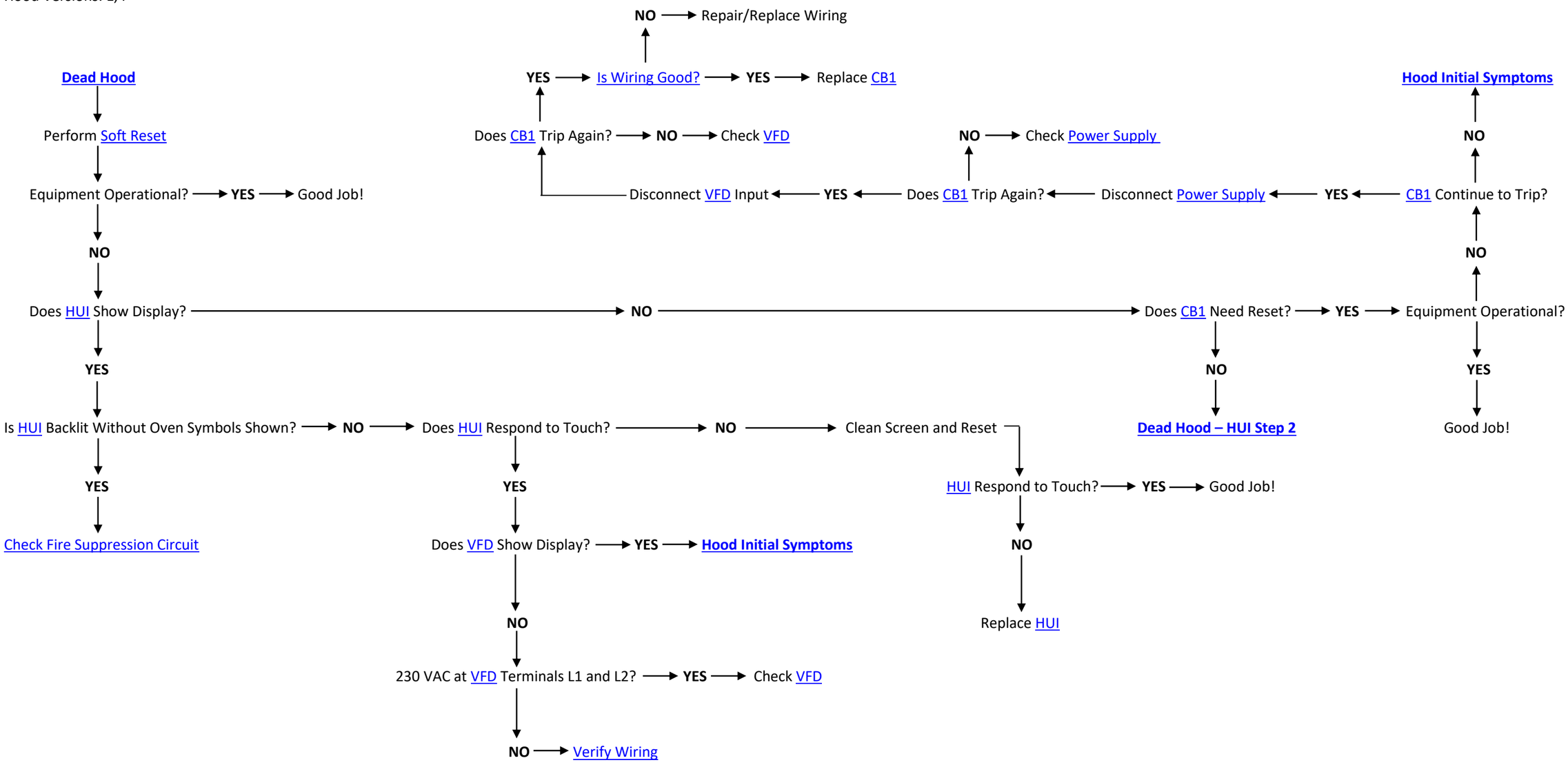
2.1.1 Dead Hood

Note: This section is designed to capture a range of complaints that indicate either the VFD or HUI do not show display or that the HUI is unresponsive to any and all user interaction.



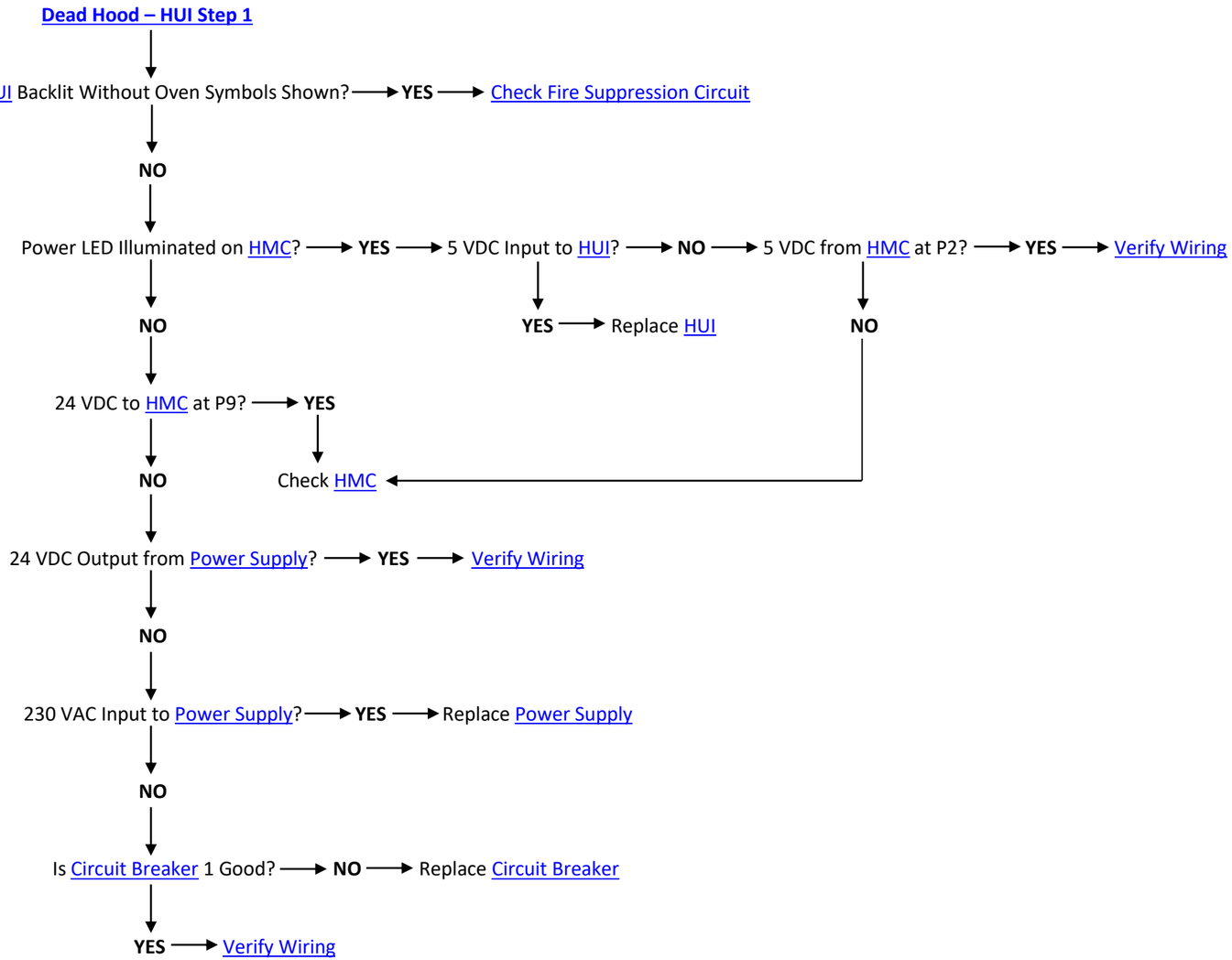
2.1.1.1 Dead Hood – HUI Step 1

Hood Versions: E, F



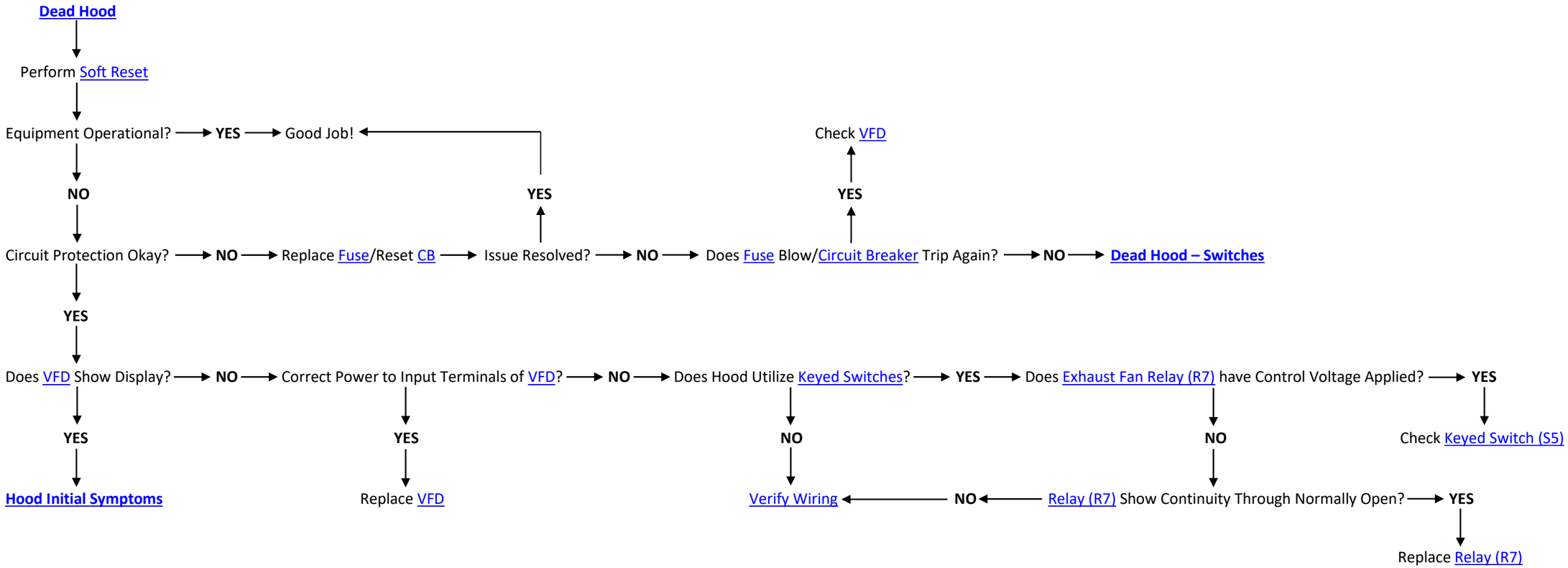
2.1.1.2 Dead Hood – HUI Step 2

Hood Versions: E, F



2.1.1.3 Dead Hood – Switches

Hood Versions: A, B, C, D



2.1.2 Error Codes

2.1.2.1 VFD Error Codes

2.1.2.1.1 ABB VFD Error Codes

Used in Hood Versions:

- Discontinued service part replacement for **VFD, Variable Frequency Drive, Hitachi** (applicable versions: C, D)

VFD, Variable Frequency Drive, ABB error codes are fully listed in the manual starting on page 320.

ABB VFD Error Codes		
Error	**Problem**	**Corrective Action**
0001 - OVERCURRENT	Output current has exceeded trip level	Check Exhaust Fan Motor and Motor Cable
0002 - DC OVERVOLT	DC bus voltage exceeded maximum value	Check Incoming AC Voltage
0003 - DEV OVERTEMP	Drive internal temperature exceeds 275°F	Clean Dirty Heat Sink Fins, Check Cooling Fan
0004 - SHORT CIRCUIT	Short circuit in motor wires or motor	Check Motor and External Wiring to the Drive Output Terminals for a Shorted Condition
0006 - DC UNDERVOLT	DC bus voltage fell below the minimum value	Check Incoming AC Voltage
0009 - MOTOR OVERTEMP	Motor temperature appears to be too high due to excessive load, insufficient power, or incorrect start-up motor data	Check Motor, Check VFD Output, Check VFD Programming for Motor
0010 - PANEL LOSS	Control panel has stopped communicating	Check Control Panel Connection
0012 - MOTOR STALL	An excessive motor load exists	Check Exhaust Fan Motor
0016 - EARTH FAULT	Drive has detected ground fault in motor or motor cable	Check Output Terminals of VFD, Motor and Motor Cables
0022 - SUPPLY PHASE	Missing input power line phase	Check Incoming AC Voltage/Circuit Protection
0034 - MOTOR PHASE	Missing motor output power line phase	Check Output Terminals of VFD, Motor and Motor Cables
0035 - OUTP WIRING	Incorrect input power and motor cable connection	Check Wiring for Input and Output of VFD

(VFD Error Codes: Cont…)

2.1.2.1.2 Allen-Bradley VFD Error Codes

Used in Hood Versions:

- E

VFD, Variable Frequency Drive, Allen-Bradley error codes are fully listed in the manual starting on page 4-3, or page 75.

Allen-Bradley VFD Error Codes		
Error	**Problem**	**Corrective Action**
F003 - Power Loss	Excessive DC bus voltage ripple	Check Incoming AC Voltage
F004 - Under Voltage	DC bus voltage fell below the minimum value	
F005 - Over Voltage	DC bus voltage exceeded maximum value	Check MC Software 14, Check Incoming AC Voltage
F007 - Motor Overload	An excessive motor load exists	Check Exhaust Fan Motor
F008 - Heatsink Overtemp	Heatsink temperature exceeded maximum allowed temperature	Clean Dirty Heat Sink Fins, Check Cooling Fan
F013 - Ground Fault	A ground fault has been detected between one or more of the drive output terminals	Check Motor and External Wiring to the Drive Output Terminals for Grounded Condition
F033 - Auto-Reset Tries	Drive unsuccessfully attempted to reset a fault and resume running for the allowed number of tries	Reset Hood and Observe Initial Fault Shown
F038 - Phase U to GND	A phase to ground fault has been detected between the drive and motor in the listed phase	Check Motor and External Wiring to the Drive Output Terminals for Grounded Condition
F039 - Phase V to GND		
F040 - Phase W to GND		
F041 - Phase UV Short	Excessive current has been detected between the two listed output terminals	Check Motor and External Wiring to the Drive Output Terminals for a Shorted Condition
F042 - Phase UW Short		
F043 - Phase VW Short		
F081 - Comm. Loss	RS-485 port stopped communicating	Check Comm. Wiring and Connection

(VFD Error Codes: Cont…)

2.1.2.1.3 Hitachi VFD Error Codes

Used in Hood Versions:

- A, B, C, D

VFD, Variable Frequency Drive, Hitachi error codes are fully listed in the manual starting on page 6-5, or page 224.

Hitachi VFD Error Codes		
Error	**Problem**	**Corrective Action**
E-01 - Over Current Event	The VFD has detected excessive current output	Check Exhaust Fan Motor to be Locked Up, Motor Cable for Short Circuit Conditions
E-02 - Over Current Event		
E-03 - Over Current Event		
E-04 - Over Current Event		
E-05 - Overload Protection	Motor Overload Detected by Electronic Thermal Function	Check Exhaust Fan Motor
E-07 - Over Voltage Protection	DC bus voltage exceeds threshold due to regenerative energy from motor	Check Incoming AC Voltage, Check Exhaust Fan Motor
E-08 - EEPROM Error	Built-In Memory has Problems due to Noise or Excessive Temperature	Clean Dirty Heat Sink Fans, Check Cooling Fan, and Check for External Power Causing Excessive Noise
E-09 - Under Voltage	DC bus voltage fell below the minimum value	Check Incoming AC Voltage
E-14 - Ground Fault	Drive has detected ground fault in motor or motor cable	Check Output Terminals of VFD, Motor and Motor Cables
E-15 - Input Over Voltage	After the VFD has been in Stop Mode for at least 100 seconds, the VFD has detected input over voltage	Check Incoming AC Voltage

(VFD Error Codes: Cont…)

2.1.2.1.4 Invertek VFD Error Codes

Used in Hood Versions:

- E, F

VFD, Variable Frequency Drive, Invertek error codes are fully listed in the manual starting on page 37.

Invertek VFD Error Codes		
Error	**Problem**	**Corrective Action**
0-1 (03): Output Over Current	Excessive load exists on output from VFD	Check Output Terminals of VFD, Check Exhaust Fan Motor and Cable, Check Motor Shaft to be Locked
O-Volt (06): Over Voltage	DC bus voltage exceeded maximum value	Check Incoming AC Voltage
U-Volt (07): Under Voltage	DC bus voltage fell below the minimum value	
O-t (08): Heatsink Overtemp	Heatsink temperature exceeded maximum allowed temperature	Clean Dirty Heat Sink Fans, Check Cooling Fan
U-t (09): Undertemp	Ambient temperature is less than 14°F	Raise Temperature of Drive
FLt-dc (13): DC Bus Ripple	Excessive DC bus voltage ripple	Check Incoming AC Voltage
P-LOSS (14): Input Phase Loss	Missing input power line phase	Check Incoming AC Voltage
h 0-1 (15): Output Over Current	Excessive load exists on output from VFD	Check Output Terminals of VFD, Check Exhaust Fan Motor and Cable for Shorted Condition
DATA-F (17): Internal Memory Fault	The VFD has detected a fault condition with internal memory	Press The STOP Key, If Fault Persists then Replace Drive
FAN-F (22): Cooling Fan Fault	The VFD has detected a fault condition with internal cooling fan	Check Cooling Fan
O-Heat (23): Overtemperature	Drive ambient temperature is too high	Clean Dirty Heat Sink Fans, Check Cooling Fan
Out-F (26): Output Fault	The VFD has detected a fault with drive output	Check Output Terminals of VFD, Check Exhaust Fan Motor and Motor Cable Connections
SC-F01 (50): Modbus Comm. Loss	Modbus communication is interrupted	Check Connection Cable and Source

(Error Codes: Cont…)

2.1.2.2 Elan Error Codes, HUI

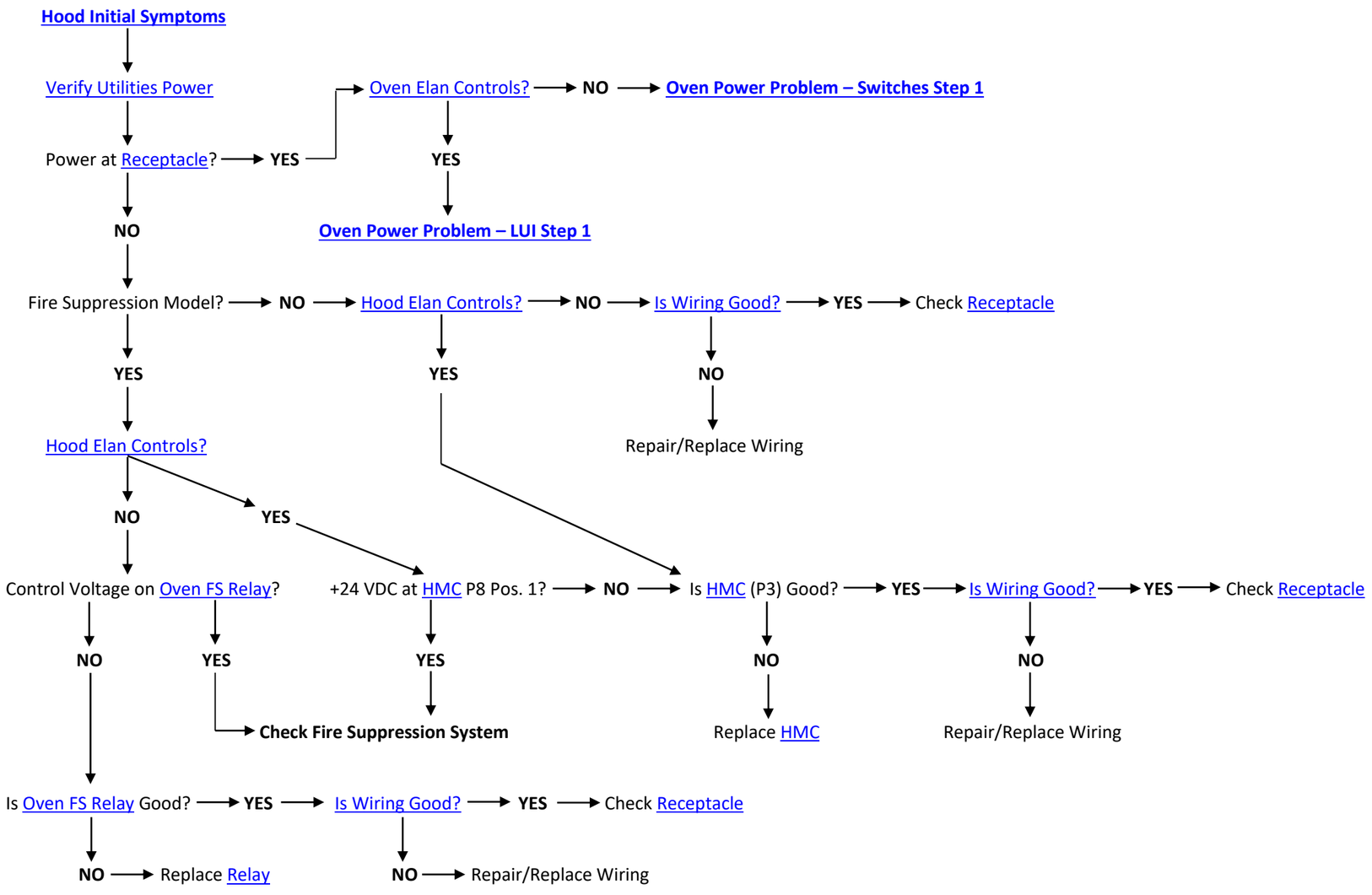
Used in Hood Versions:

- E, F

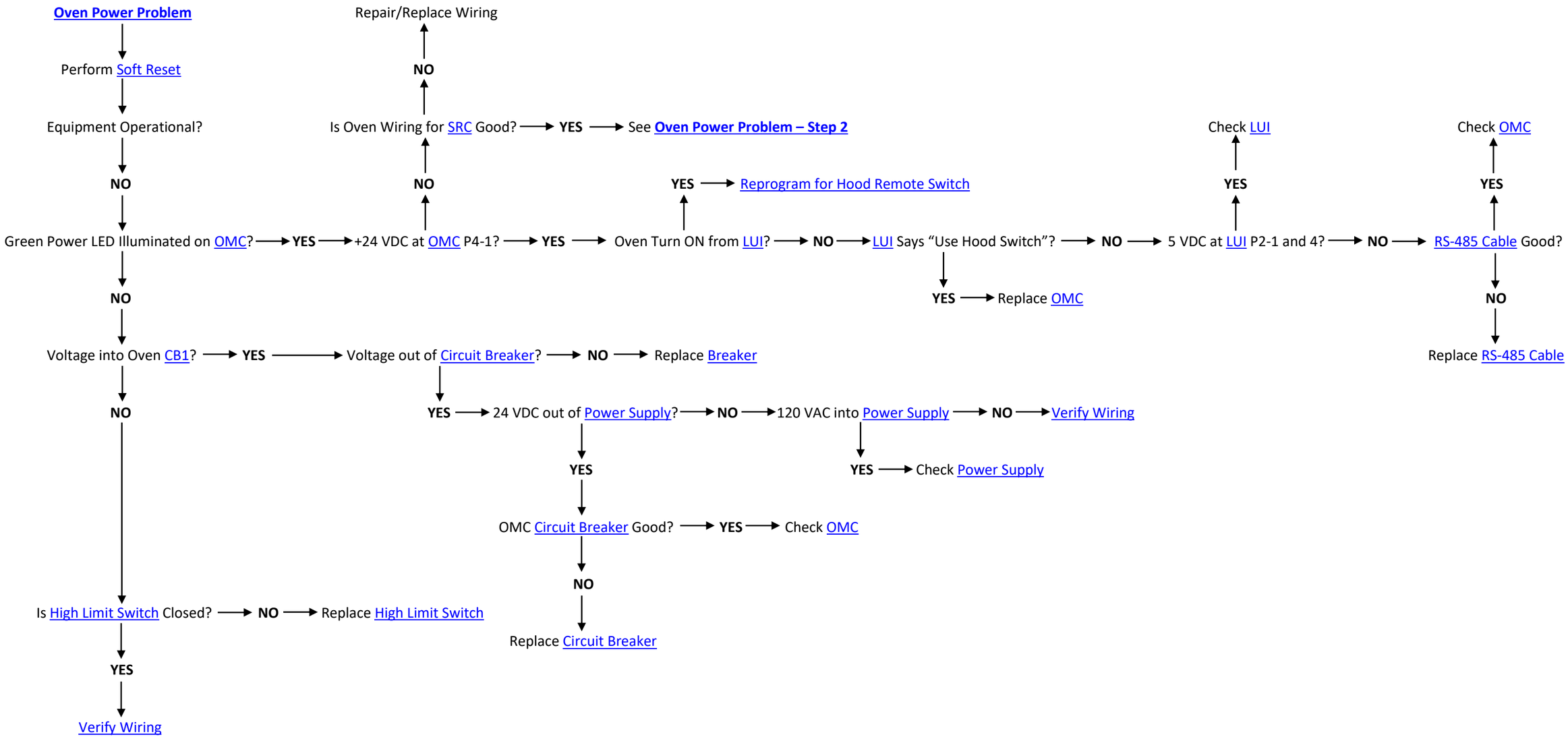
HUI ERROR CODES		
Error Code	**Problem**	**Corrective Action**
Blank Screen (Backlit Without Oven Symbols)	Fire suppression mode is active	Check Fire Suppression Circuit
MC Comm Error	No communication to MC	Check Communication Wiring
VFD No Rotation	VFD feedback 0%	Check VFD
VFD Underspeed	VFD feedback 5% lower than demand	Check VFD, Check Exhaust Fan and Wiring
VFD Overspeed	VFD feedback 5% higher than demand	Check Exhaust Fan
Check Plug on P20	MUA APS circuit is open	Check MUA APS jumpers and wiring
Check Plug on P13	Exhaust APS circuit is open	Check Exhaust jumpers and wiring
Makeup N/C (APS Installed)	Makeup N/C switch closed with N/O switch closed (While Exhaust and MUA ON)	Check Air-Proving Switch and Wiring
Makeup N/O (APS Installed)	Makeup N/O switch open with N/C switch open (While Exhaust and MUA ON)	Check Air-Proving Switch and Wiring
Exhaust N/O (APS Installed)	Exhaust N/O switch open (While Exhaust and MUA ON)	Check Air-Proving Switch and Wiring
Key Short	Any key shorted for greater than one (1) minute, interference with HUI buttons	Clean HUI and Reset, Remove Electromagnetic Interference

2.1.3 Oven Power Problem

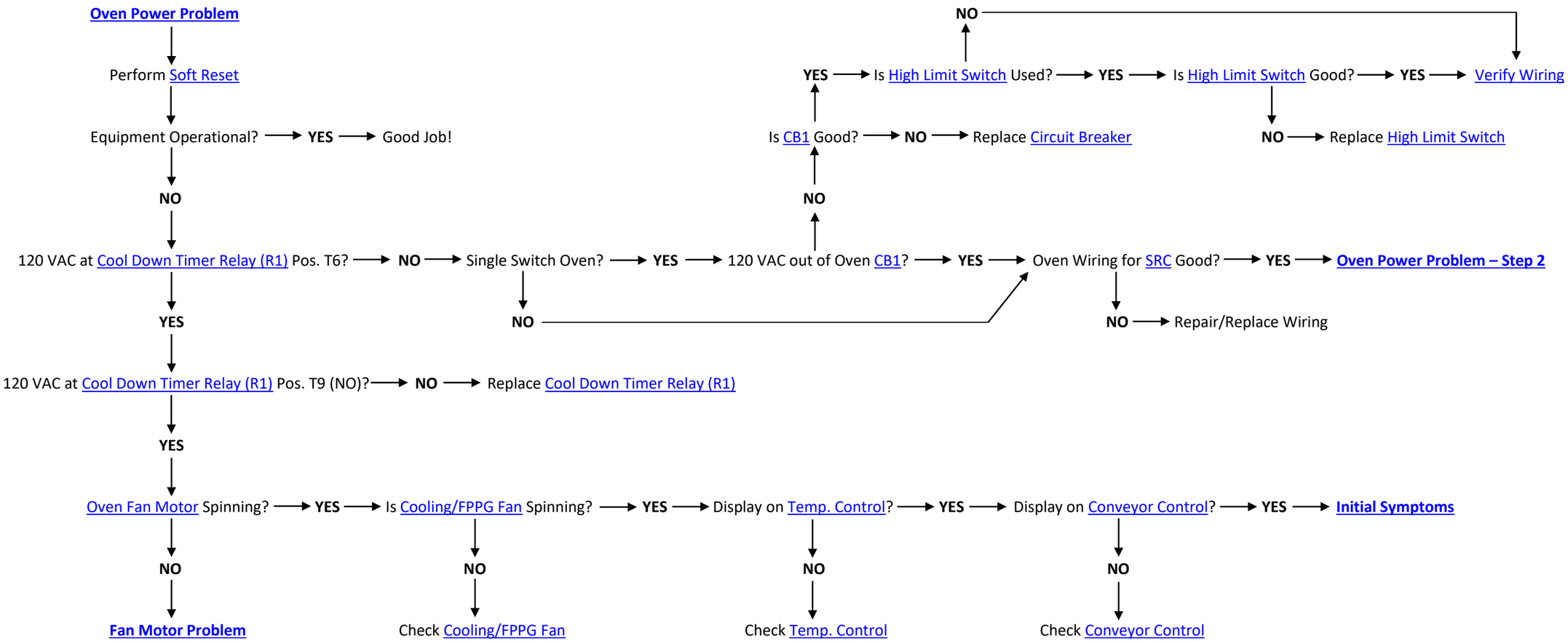
Note: This section is designed to capture a range of complaints that indicate that oven(s) do not turn on when activated via the hood. Troubleshooting is to be done with the oven in the ON position.



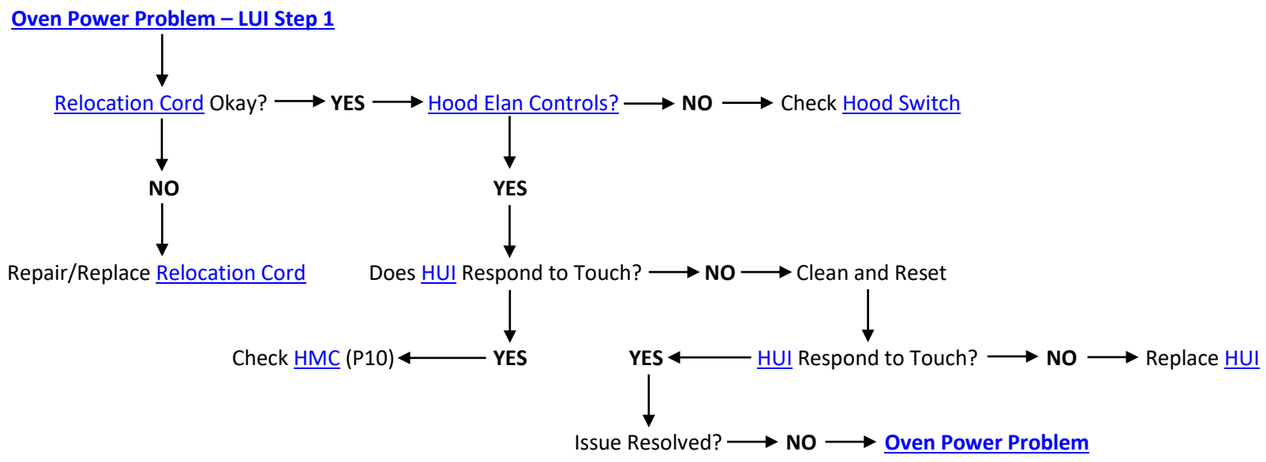
2.1.3.1 Oven Power Problem – LUI Step 1



2.1.3.2 Oven Power Problem – Switches Step 1

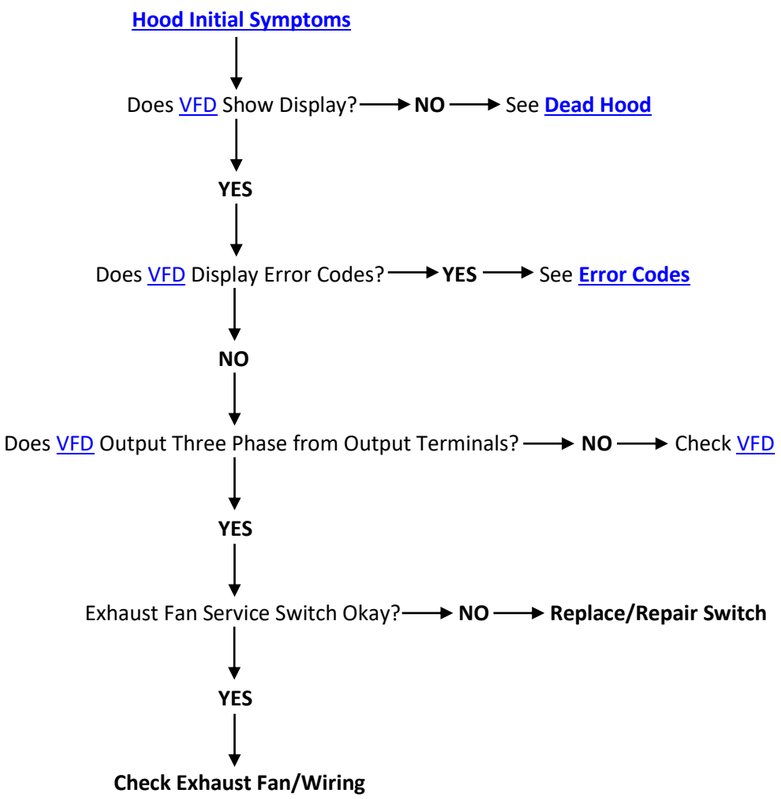


2.1.3.3 Oven Power Problem – Step 2



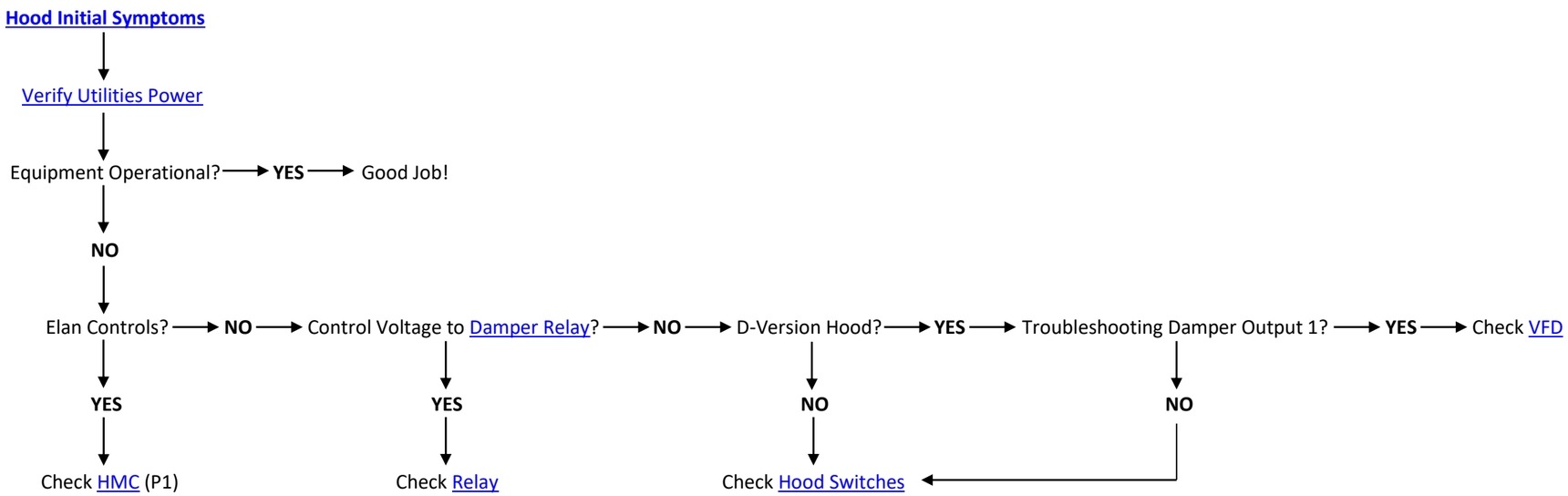
2.1.4 Exhaust Fan Problem

Note: This section is designed to capture a range of complaints that indicate that the exhaust fan does not seem to be in operation. Dirty/clogged grease filters can cause airflow issues. A quick way to try to determine if air is being evacuated is by holding a piece of paper up to the grease filters to check for suction. Troubleshooting is to be done with oven(s) turned ON.



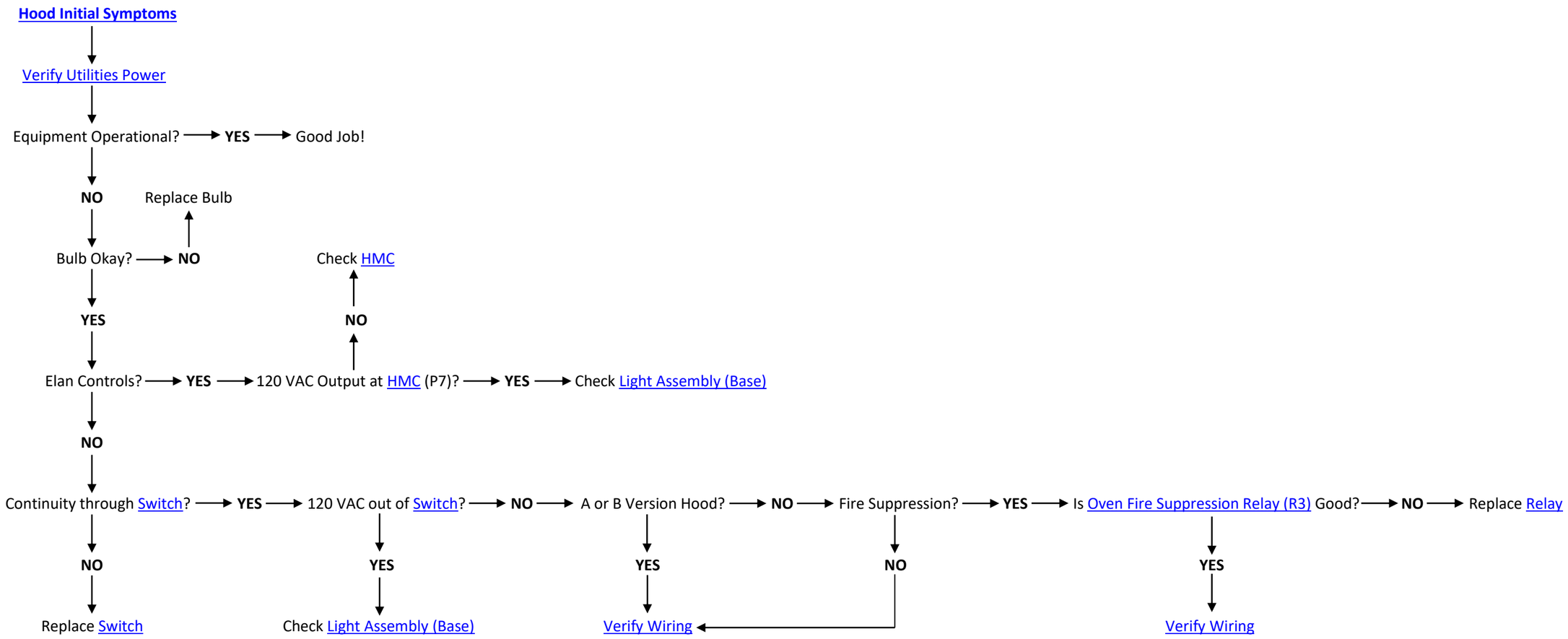
2.1.5 Make-Up Air Problem

Note: This section is designed to capture a range of complaints that indicate that a make-up air unit is not in operation. XLT Hoods will **only** handle either a signal voltage or the coil voltage of the relay that is used by the installer to release power to their make-up air unit. Troubleshooting is to be done with oven(s) turned ON.



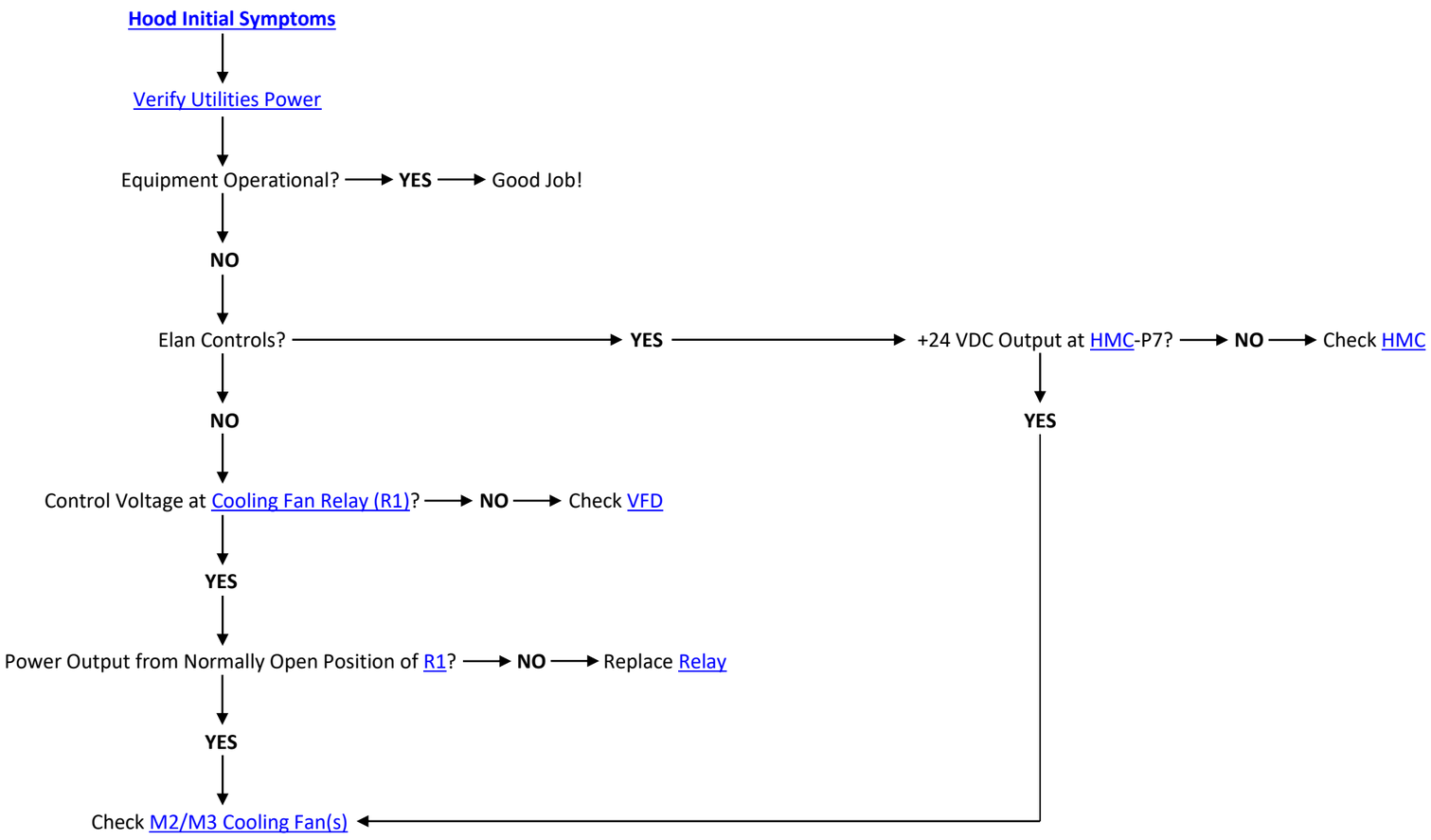
2.1.6 Lighting Problem

Note: This section is designed to capture a range of complaints that indicate that the light(s) will not operate.



2.1.7 Cooling Fan Problem

Note: This section is designed to capture a range of complaints that indicate that the cooling fan(s) will not operate. Troubleshooting is to be done with oven(s) turned ON.



3 Verifications

3.1 Verify Utilities Power

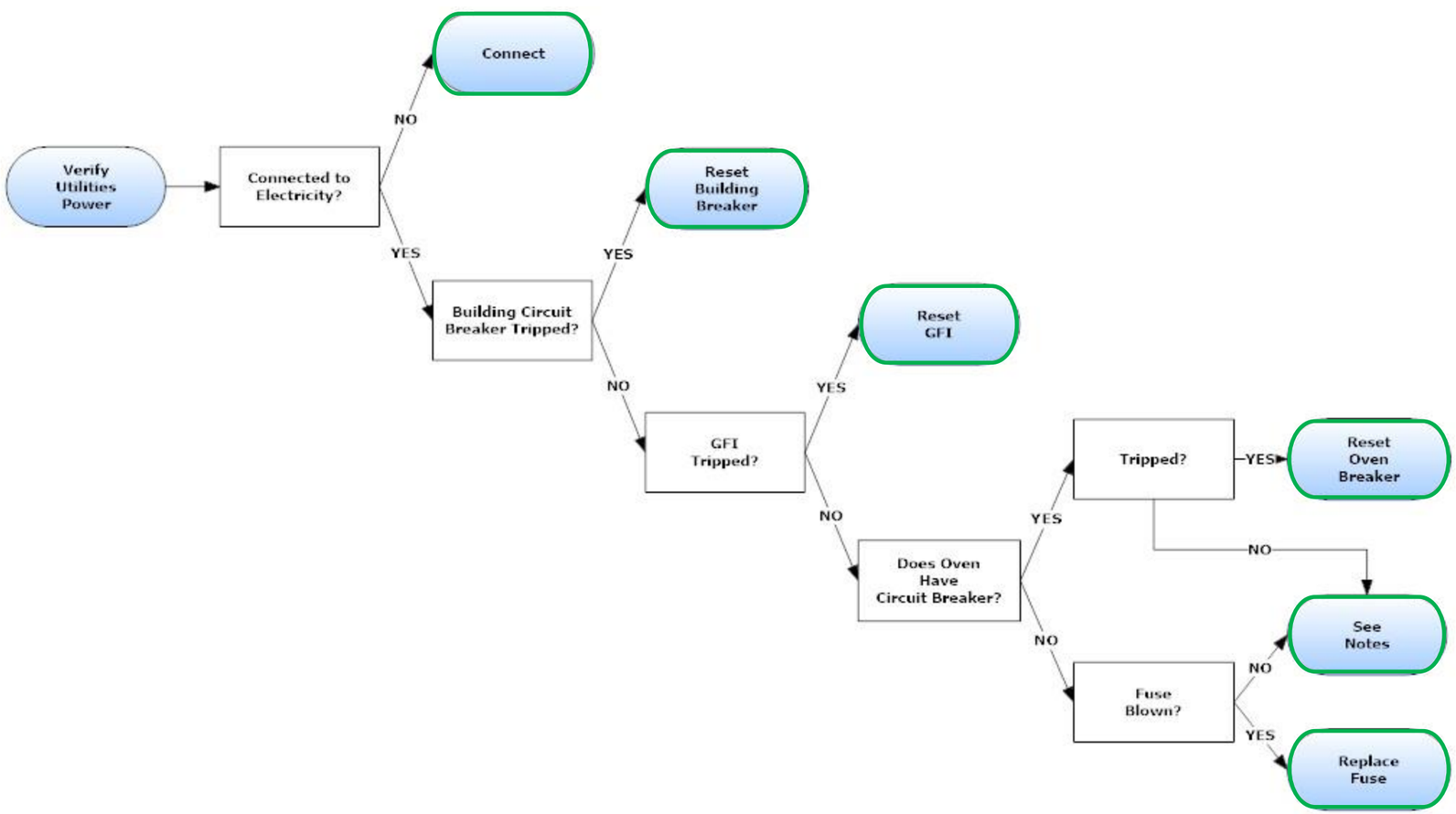


Figure 19 Verify Utilities Power

(Verify Utilities Power: Cont…)

3.1.1 Connect

A separate circuit breaker should be provided for each oven deck.

Electrical connections must be accessible when the ovens are in the installed position.

Electrical connections must meet all local code requirements.

Ensure ovens are grounded per local codes.

3.1.2 Reset Building Breaker

If electrical wiring in a building has too much current flowing through it, then these devices interrupt the circuit and therefore the current.

Sometimes store breakers can be tripped but NOT appear to be tripped to the equipment operator; verify by switching OFF and ON.

Is breaker and associated wire sized appropriately?

Is breaker worn out?

3.1.3 Reset GFI

GFI outlets are typically standard in kitchens and bathrooms. GFI outlets have a built-in circuit breaker.

GFI outlets shall have a black button and a red button. The black button can be used to test the outlet while the red button is used to reset the outlet if it were to trip.

(Verify Utilities Power: Cont…)

3.1.4 Reset Oven Breaker

See Circuit Breaker – Oven and Hood

3.1.5 Replace Fuse

See Fuse

3.1.6 Notes

Circuit protection can be open, or limiting voltage through the breaker, fuse or fuse holder without appearing tripped/blown.

Plug something else into the outlet to see if it has power.

Tanning beds next door can cause problems.

A transformer can be turned on by the electric utility at various times of the day.

(Verifications: Cont…)

3.2 Verify Utilities Fuel

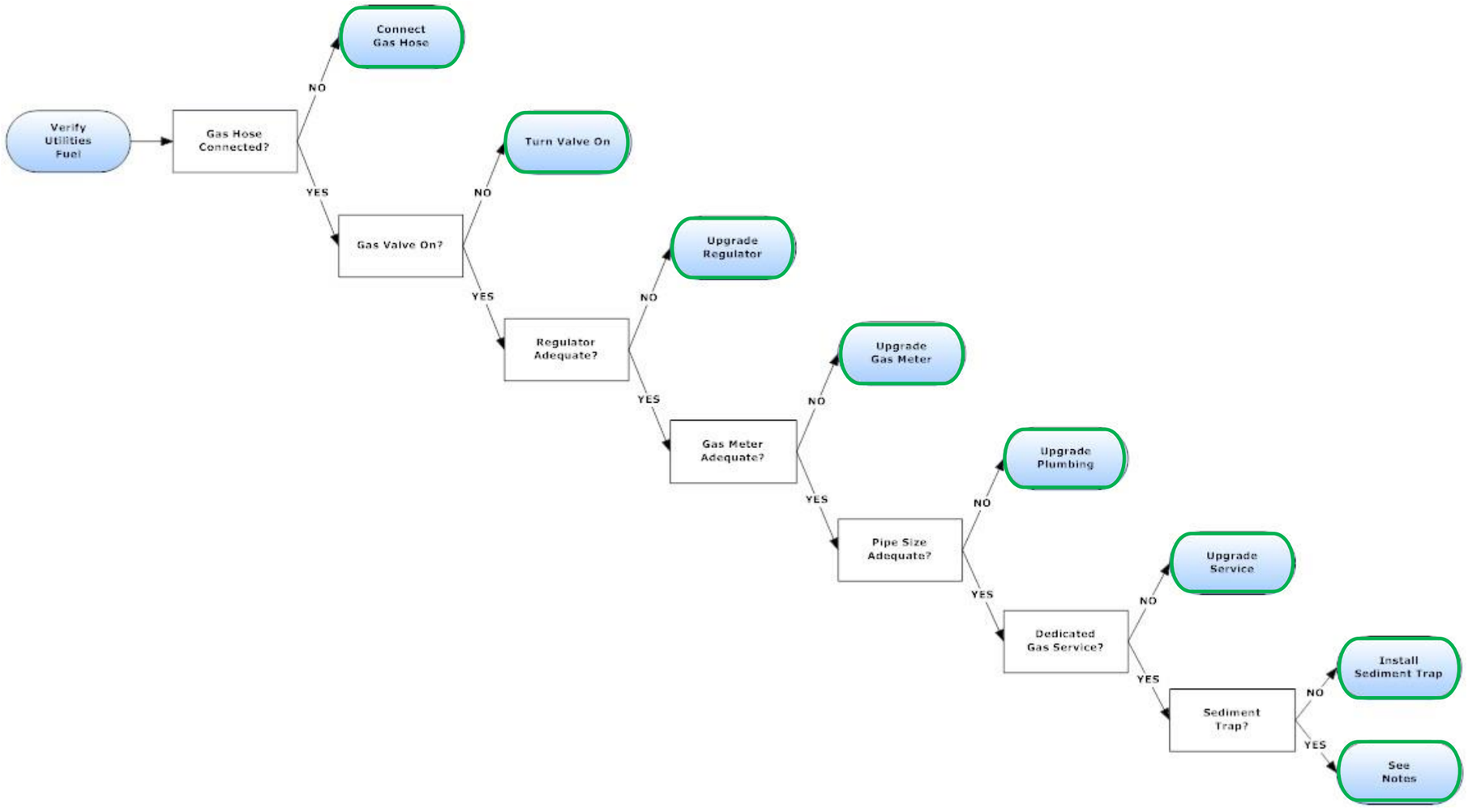


Figure 20 Verify Utilities Fuel

3.2.1 Connect Gas Hose

The quick disconnect coupling contains a thermal shutoff feature which is a polymer ring located inside the nipple that will melt and close the gas supply valve if the temperature rises above 350° F (177° C).

It also features a push to connect feature which allows the coupling's components to be joined quickly by simply pushing them together until they snap into place. There is no need to hold or slide the operating ring.

3.2.2 Turn Valve On

Valves can typically be visually verified to be open by the lever handle being in parallel orientation with the pipe it is in-line with.

3.2.3 Upgrade Regulator

Determine size or capacity, is there a data-plate or sticker?

3.2.4 Upgrade Gas Meter

Determine size or capacity, is there a data-plate or sticker?

3.2.5 Upgrade Plumbing

What diameter? XLT's minimum requirement is 1-1/2 inch.

How many elbows?

How long?

(Verify Utilities Fuel: Cont…)

3.2.6 Upgrade Service

If the restaurant is located in a strip mall, it is possible that only one gas pressure regulator services more than one suite. This can cause pressure fluctuations depending upon the nature of the neighboring business, such as those that require a high amount of fuel.

3.2.7 Install Sediment Trap

XLT supplies a sediment trap with every unit that goes out the door. Make sure it is installed and being utilized. This prevents sediment and debris from entering the oven gas valve and causing issues.

3.2.8 Notes

XLT Ovens utilize gas valves which allow the technician to connect a manometer to measure incoming gas pressure. Gas valves are typically mounted in a vertical orientation which positions the incoming pressure test port at the top of the valve. When the gas hose is connected and the gas supply is turned on, then this incoming test port should always show the supplied pressure.

A laundromat next door can impact gas pressures and volumes at various times throughout the day.

Gas meters and gas pressure regulators can cause problems.

New construction can have metal shavings in the gas lines.

Teflon tape can cause problems.

(Verifications: Cont…)

3.3 Verify Oven Assembly

- Fingers
  - Fingers should be oriented toward the conveyor belt, and fully seated on plenum flanges
  - Countertop fingers are clearly marked with their position when installed; visible after removing the front panel
- Return Air Plates, End-loss Plates
- Control Box Block-Off Plate
- Conveyor Frame
- Conveyor Drive Chain

3.4 Verify Wiring

- Cut wires
- Bare wires
- Bad crimps
- Loose connections
- Wired incorrectly – Wrong wire to wrong terminal
- Wire disconnected
- Molex pins pushed out
- If you've reached this point in your troubleshooting process and wiring is okay, then remember circuit protection can be open, or limiting voltage through the breaker, fuse or fuse holder without appearing tripped/blown.

3.5 Verify Make Line Equipment

- Proofer
- Retarder
- Make Table
- Walk-In Cooler/Freezer

(Verifications: Cont…)

3.6 Verify Flame

Look between the side panel and plenum as shown in the image below:

Look through sight glass or through air shutter of burner

Remove front panel – look under lower fingers

(Verify Flame: Cont…)

(Verify Flame: Continued)

Audible Flame – there is:

- a click from the gas valve,
- a ticking noise due to the spark, and
- you can hear the fuel combusting

3.7 Soft Reset

Unplug Oven, or turn store breaker OFF,

Wait 30 seconds,

Plug oven in, or turn store breaker ON

4 Components

4.1 Alarms

4.1.1 AL – Alarm, Ignition

Used in Oven Versions:

- F, G, H (AE and K)

PART NUMBER: HP-2063A

How it works: The Ignition Alarm is used on Australian and Korean models. The Alarm is wired for continuous +24 VDC to the Terminal Strip (TS) but the ground connection is wired to the Ignition Control (IC) onto pin 1. When the Ignition Control goes into ignition lockout then the Ignition Control grounds pin 1 and completes the circuit for the alarm to illuminate and emit an alarm sound.

Tools required:

- Multi-meter
- #2 Phillips Screwdriver

How to check: The Ignition Control must be in ignition lockout for the Alarm to be energized so this would either seem to be a secondary issue or the determination has been made to check the proper operation of the alarm. Forcing an ignition lockout can be achieved in multiple ways but one can simply shut off the gas supply to the oven and allow the Ignition Control to fail all trials for ignition (this should take approximately 1 ½ minutes).

- Visual/Audible
  - Force ignition lockout condition
  - Alarm should illuminate red and emit an alarm sound, if one exists without the other, then replace Alarm
- Electrical
  - Force ignition lockout condition
  - Measure voltage across screw terminals – Should be 24 VDC

(Alarms, Cont…)

4.1.2 AL – Alarm, Exhaust Fan

Used in Hood Versions:

- D

PART NUMBER: HP-2063 (Discontinued)

HP-2063A (Replacement)

How it works: The alarm will receive 24 VDC power with the +24 VDC coming from VFD terminal AL1 at any time the VFD has detected a fault. The common/ground will be supplied at all times from VFD terminal PCS.

Tools required:

- Multi-meter

How to check – VISUAL:

- Normal Operation
  - Alarm should not be illuminated red or emit an alarm sound
- VFD is showing a Fault
  - Alarm should illuminate red and emit an alarm sound, if one exists without the other, then replace Alarm

How to check – ELECTRIC:

- VFD is showing a fault
  - Measure voltage across screw terminals – Should be 24 VDC

4.2 BC – Burner Control

Used in Oven Versions:

- DS, TS, TS2

Original: Honeywell: S8600H

Replacement: SP-4705-EP-F (See IC – Ignition Control – Piloted)

How it works: The burner control receives 24 VAC from the Transformer (XFMR) via the Combustion Burner Blower Motor (M4) Centrifugal Switch (S4). If the Oven Fan Motor (M1) Centrifugal Switch (S5) does not engage, then the Combustion Burner Blower Motor will not receive power and the Combustion Blower Motor Centrifugal Switch will not send power to the Burner Control. In early DS ovens utilizing an On/Off Solenoid Valve, this circuit included a Burner Blower Motor Relay (R2). When the Burner Control receives power, the pilot valve is energized with 24 VAC and the spark generator operates. If the pilot flame lights; the Burner Control senses flame current through the spark wire, the spark generator then shuts off, and the main valve is energized with 24 VAC. If the pilot flame is not sensed in 90 seconds, the Burner Control locks out and must be reset by switching the Burner Switch off and then back on. If there is a pilot flame failure (flame sense is established and then lost), then the Burner Control starts trial for ignition again. If the power is interrupted, the Burner Control will restart when power is restored.

Tools required:

- Multi-meter
- Needle Nose Pliers

How to check:

- Electrical
  - Inputs
    - Turn Oven ON
    - Should be 24 VAC across 24V & 24V (GND) supplied by XFMR via the M4 centrifugal switch
    - Should be a minimum of 1.0 µA supplied by the flame sensor/spark ignitor rod and cable
  - Outputs
    - Should be approximately 10,000 volts out of SPARK during the 90 second trial for ignition.
    - Should be 24 VAC across PV & MV/PV from when the spark generator begins operation and as long as the Burner Control senses flame
    - Should be 24 VAC across MV & MV/PV from when pilot flame sense is established and the spark generator stops operation
- Visual
  - LED Indicators (see tables immediately following this section)
    - Status LED can be found underneath the SPARK terminal and will indicate system operation status and error conditions
    - Flame LED can be found directly next to the Status LED and will indicate flame signal presence and strength

(Burner Control: Cont…)

(Burner Control: Continued)

Table 8. Lockout Models B, H D, and J Only—Green LED Status Codes.

Green LED Flash Code (X + Y)[a]	Indicates	Next System Action	Recommended Service Action
OFF	No "Call for Heat"	Not applicable	None
Flash Fast	Startup - Flame sense calibration	Not applicable	None
Heartbeat	Normal operation	Not applicable	None
3	Recycle - Flame failed during run	Initiate new trial for ignition. Flash code will remain through the ignition trial until flame is proved.	If system fails to light on next trial for ignition, check gas supply, pilot burner, flame sense wiring, contamination of flame rod, burner ground connection.
4	Flame sensed out of sequence	If situation self corrects within 10 seconds, control returns to normal sequence. If flame out of sequence remains longer than 10 seconds, control goes to Flash code 6+4 (see below).	Check for pilot flame. Replace gas valve if pilot flame present. If no pilot flame, cycle "Call for Heat." If error repeats, replace control.
7	Flame sense leakage to ground	Control remains in wait mode. When the fault corrects, control resumes normal operation after a one minute delay.	Check flame sense lead wire for damage or shorting. Check that flame rod is in proper position.Check flame rod ceramic for cracks, damage or tracking.
8	Low secondary voltage supply - (below 15.5 Vac)	Control remains in wait mode. When the fault corrects, control resumes normal operation after a one minute delay.	Check transformer and AC line for proper input voltage to the control. Check with full system load on the transformer.
6+2	Failed trial for ignition resulting in lockout	Remain in lockout until "Call for Heat" is cycled.	Check gas supply, pilot burner, spark and flame sense wiring, flame rod contaminated or out of position, burner ground connection.
6+3	More than 5 flame failures during run on the same "Call for Heat" resulting in lockout	Remain in lockout until "Call for Heat" is cycled.	Check gas supply, pilot burner, flame sense wiring, contamination of flame rod, burner ground connection.
6+4	Flame sensed out of sequence - longer than 10 seconds	Control waits until flame is no longer sensed and then goes to soft lockout. Flash code continues. Control auto resets from soft lockout after one hour.	Check for pilot flame. Replace gas valve if pilot flame present. If no pilot flame, cycle "Call for Heat." If error repeats, replace control.
ON	Soft lockout due to error detected during self check sequences	Control auto resets from soft lockout after one hour.	Reset by cycling "Call for Heat." If error repeats, replace the control.

[a] Flash Code Descriptions:
- Flash Fast: rapid blinking.
- Heartbeat: Constant ½ second bright, ½ second dim cycles.
- A single flash code number signifies that the LED flashes X times at 2Hz, remains off for two seconds, and then repeats the sequence.
- X + Y flash codes signify that the LED flashes X times at 2Hz, remains off for two seconds, flashes Y times at 2Hz, remains off for three seconds, and then repeats the sequence.

Figure 21 S8600H LED Status Codes

Table 6. Yellow LED Flame Codes.

Yellow LED Flash Code[a]	Indicates	Recommended Service Action
Heartbeat	Normal Flame Signal	Not applicable
2	Weak Flame Signal—System will operate reliably but flame signal is less than desired. NOTE: This indication may flash temporarily during or shortly after lightoff on some applications.	Perform routine maintenance to assure optimum flame signal.
1	Marginal Flame Signal (less than 1.1μA)—System may not operate reliably over time. Service call recommended. NOTE: This indication may flash temporarily during or shortly after lightoff on some applications.	Check gas supply, pilot burner, flame sense wiring, contamination of flame rod, burner ground connection.
OFF	No Flame or Flame Signal below minimum threshold for system operation.	Not applicable

[a] Flash Code Descriptions:
- Heartbeat: Constant ½ second bright, ½ second dim cycles.
- The flash code number signifies that the LED flashes X times at 2Hz, remains off for two seconds, and then repeats the sequence.

Figure 22 S8600H LED Flame Codes

4.3 CAP (C1) – Capacitor

Used in Oven Versions:

- DS, TS, TS2, TS3, A, B, C, D, E, F, G, H
- A (Countertop)

PART NUMBER: XP-5014-30 (Used with 3/4 Horsepower Motors: SP-5009D-75 and SP-5016B-DS)

SP-5014-07.5 (Used with 1/3 Horsepower Motors)

96-4014A7.5 (Used in: A, Countertop)

How it works: A capacitor stores electric charge and is made up of one or more pairs of conductors separated by an insulator. XLT ovens utilize a permanent split capacitor in their fan motor systems where the capacitor is wired in series with the auxiliary winding and remains in the circuit through starting and running operation.

Tools required:

- Multi-meter
- Screwdriver (with insulated handle rated to protect against electric shock)

How to check:

- Visual
  - Signs the Capacitor may be bad:
    - Capacitor casing bulging from its original form
    - Capacitor leaking fluid
- Electrical
  - Pull capacitor boot and unplug wires from capacitor terminals
  - Use screwdriver to short terminals together to discharge Capacitor
  - Measure resistance across terminals. Should be infinite, if sustained continuity, replace capacitor.
  - Measure resistance between one terminal and Ground. Should be infinite. If any continuity, replace capacitor.
  - Measure resistance between other terminal and Ground. Should be infinite. If any continuity, replace capacitor.
  - Set multi-meter for capacitance, touch either probe to either terminal on capacitor, wait several seconds as multi-meter obtains reading, should be 30µf, 7.5µf, or 40µf depending on the rating printed on the data sticker on the capacitor

4.4 CB – Circuit Breaker

4.4.1 Building

How it works:

If electrical wiring in a building has too much current flowing through it, then these devices interrupt the circuit and therefore the current.

4.4.2 Oven and Hood

Used in Oven Versions:

- A, B, C, D, E, F, G, H
- A (Radiant)
- A (Countertop)

PART NUMBER: XP 4515-CB (Used in all Oven Versions listed above)

XP-4303A (Used in Oven Versions: G, H)

XP-4303 (Used in Oven Versions: B, C, D, E, F)

RP-4303A (Used in Radiant Oven Versions: A)

Used in Hood Versions:

- B, C, D, E, F

PART NUMBER: HP-2060A (Used in Hood Versions: D, E)

HP-2060-S (Used in Hood Versions: B, C)

XP 4515-CB (Used in Hood Versions: F)

(Circuit Breakers: Cont…)

(Circuit Breakers: Continued)

How to check:

- **XP-4515-CB** Visual Inspection
  - Compare it to the other breakers
    - Circuit protection can be open, or limiting voltage through the breaker, without appearing tripped.
  - If it is tripped, it will look different
  - The center section will be pushed out
  - The center section will be white in color
  - Sometimes the breaker may trip and not want to reset, allow the breaker to cool down for a little while and try again

- Electrical Inspection
  - Tools required:
    - VOM
  - Disconnect wires
  - Check for continuity

Why is the breaker tripped?

- Breakers very rarely fail on their own. Something in the circuit caused the breaker to trip:
  - Bad/Failed component
  - Bad/Failed wire that created a path to ground
  - Bad/Failed wire connection
  - Power surge

4.5 Contactors

Used in Oven Versions:

- TS, TS2, B, C, D, E, F, G, H
- A (Radiant)

PART NUMBER: XP-4306A-70 (Used in: G, H)

XP-4306A-50 (Used in: F)

XP-4306-50 (Used in: TS, TS2, B, C, D, E)

RP-4306A-50 (Used in: A, Radiant)

Used in Hood Version:

- A

How it works: A Contactor is an electrically controlled switch used for switching a power circuit. In Impingement ovens, the Contactor(s) will be switched using a control circuit which is supplied once Oven Fan Motor rotation is proven either through the Centrifugal Switch or via the OMC (version 38+) utilizing a Current Sensor to detect motor amperage. In Radiant ovens, the Contactor will be switched on about 0:30 seconds after the oven is switched on by +24 VDC from OMC P4-3. The Contactor will release three phase power to the Solid State Relays (SSRs) so that the Temperature Control (TC) can then control the power to the Heating Elements. A-version hoods have a contactor feeding oven receptacle power with the control circuit appearing to be wired from the fire suppression's micro-switch's normally closed (NC) position.

Tools required:

- Multi-meter
- #2 Phillips Screwdriver

How to check – ELECTRIC:

- Power Input
  - Check Oven Data-Plate for Voltage Rating
  - Turn Oven ON
  - Test voltage across terminals L1 and L2. Should be voltage as taken from data-plate.
  - Test voltage across terminals L2 and L3. Should be voltage as taken from data-plate.
  - Test voltage across terminals L1 and L3. Should be voltage as taken from data-plate.

(Contactors: Cont…)

(Contactors: Continued)

- Control Circuit
  - Can be 208/240 VAC or 24 VDC (Refer to schematic specific to the oven you are working on)
  - Test voltage across terminals A1 and A2. Should be voltage as determined above.
- Power Output
  - Output should be the same as the power input as tested above.
  - Test voltage across terminals T1 and T2. Should be voltage as taken from data-plate.
  - Test voltage across terminals T2 and T3. Should be voltage as taken from data-plate.
  - Test voltage across terminals T1 and T3. Should be voltage as taken from data-plate.

4.6 Conveyor Controls

4.6.1 CC – Conveyor Control, Dart

Used in Oven Versions:

- DS, TS, TS2, TS3

PART NUMBER: SP-4507

How it works: This Conveyor Control has line voltage applied to terminals 1 and 2. This Conveyor Control outputs 0-90 VDC to the conveyor motor; the +VDC is applied from terminal 4 while the –VDC is applied from terminal 3. A pulse generator will be mounted to the conveyor motor. The Conveyor Control applies +5 VDC to the pulse generator from terminal 6, with a common wire from terminal 5. The pulse generator sends the pulse signal via a white wire applied to terminal 7. The 0-90 VDC output to the motor will be based on the set-time and model of oven; regulated by the pulse signal it receives back.

Here's what it should look like:

Figure 23 Dart Display

Tools required:

- Multi-meter
- Stopwatch
- #2 Phillips Screwdriver
- Small Flathead Screwdriver

(Dart Control: Cont…)

(Dart Conveyor Control: Continued)

How to check:

- Electrical
  - Turn Fan Switch and Conveyor Switch on
  - Input – Line voltage should be measured across terminals 1 and 2
  - Output
    - Should be 0-90 VDC across terminals 3 and 4
    - Should be 5 VDC across terminals 5 and 6
- Mechanical
  - Perform pan test on conveyor belt (start timer when the leading-edge of pan enters bake chamber and stop timer when the same leading-edge exits the other side).
  - If pan test does not equal time displayed, then verify programming.
- Programming
  - Section 5.4

Note: Enter button may be used as a double-click on/off switch, see programming document linked above – Step 8, Parameter 38

(Conveyor Controls: Cont…)

4.6.2 CC – Conveyor Control, Anaheim

Used in Oven Versions:

- TS3, A, B, C, D, E, H

PART NUMBER: SP-4507-24-A

How it works: This Conveyor Control has +24 VDC applied to terminal 4, and -24 VDC applied to terminal 5. The 24 VDC is received from a Power Supply (PS) via circuit protection. This Conveyor Control outputs 18-24 VDC to the conveyor motor and is applied from terminals 1, 2, and 3. Each of these three wires will be energized in sequence to provide power to individual stator coils which provides motor rotation. The conveyor motor used with this control will have internal hall effect switches that transmit rotational position of the rotor to the control, and this is used to monitor and maintain proper rotational speed. The 18-24 VDC output to the motor will be based on the set-time and model of oven; regulated by the hall effect signal it receives back.

Here's what it should look like:

Figure 24 Anaheim Display

Tools required:

- Multi-meter
- Stopwatch
- #2 Phillips Screwdriver
- Small Flathead Screwdriver

How to check:

- Electrical
  - Turn Oven Switch on
  - Input – Should be 24 VDC across terminals 4 and 5
  - Output
    - Should be about 18-24 VDC as tested against chassis ground across terminals 1, 2, and 3
    - Should be about 6 VDC across terminals 6 and 10

(Anaheim Conveyor Control: Cont…)

(Anaheim Conveyor Control: Continued)

- Mechanical
  - Perform pan test on conveyor belt (start timer when the leading-edge of pan enters bake chamber and stop timer when the same leading-edge exits the other side).
  - If pan test does not equal time displayed, then verify programming.
- Programming
  - Section 5.1

(Conveyor Controls: Cont…)

4.6.3 CC – Conveyor Control, Elan

Used in Oven Versions:

- F, G, H

PART NUMBER: XP-4175A-MC

PART NUMBER: RP-4175A-MC (Radiant)

How it works: The Elan conveyor control is made up of the LUI and OMC. The LUI is the user interface for the oven operator to enter desired conveyor time while the OMC holds the logic to execute those commands. The OMC will send Conveyor Motor power through three (3) wires; 1) a black or "W" phase, 2) a white or "V" phase, and 3) a red or "U" phase. Each phase will carry between 0-24 VDC. Each wire is energized by the control in sequence to provide power to the individual stator coils which in turn provide motor rotation. An internal Pick-Up Sensor with three Hall Effect switches is utilized to determine rotor position from a magnetic disc mounted on the rotor assembly. The Hall Effect switches react to the presence of the magnetic field's North and South poles to determine rotor position. The motor will signal rotor position through three (3) wires; 1) an orange "U" phase pole signal output, 2) a green "V" phase pole signal output, and 3) a green/white "W" phase pole signal output. The Pick-Up sensor will receive power via a purple and gray wire. The purple wire is for voltage and the gray wire is for ground. The direction of motor rotation can be changed through the programming (factory tech mode).

The OMC's Alarm light will illuminate red when there is an error while the LUI displays an actual error message.

The OMC's Conveyor light will flash while the Alarm light is illuminated if the error is related to the conveyor system.

Tools required:

- Multi-meter
- #2 Phillips Screwdriver

How to check:

- See LUI
- See OMC

4.7 Current Sensor

Used in Oven Versions:

- F, G, H

PART NUMBER: XP-4310A

Used in Hood Versions:

- B, C

PART NUMBER: HP-2061

How it works: The Current Sensor detects electrical current (AC) in a wire and generates a signal proportional to it. In ovens, the current sensor is used to monitor the amperage of the Oven Fan Motor. In hoods, the current sensor is used to signify that the exhaust fan is running.

Tools required:

- Multi-meter

How to check – VISUAL:

- **OVEN –** Enter Factory Tech Mode in the Large User Interface (LUI) to view Main Fan Motor amperage as measured by the current sensor
- **HOOD –** Light from Current Sensor should illuminate when Exhaust Fan is running

How to check – ELECTRIC:

- **OVEN** – Measure resistance between white wire leads. Should be about 30 Ohms, +/- 10%. If infinite Ohms, replace sensor

4.8 Filters, Power

4.8.1 FLT1 – Power Filter, EMI

Used in Oven Versions:

- TS, TS2, TS3, A, B, C, D, E, F, G, H

How it works: This is an inline filter used in world ovens. The filter is placed in series with the line voltage being supplied to the oven. The filter is used to reduce electromagnetic interference (EMI). The EMI filter uses capacitors to inhibit direct current while permitting alternating current. These filters also use inductors which redirect high voltages and high frequencies by dissipating them to ground. These filters should always be grounded to the oven.

How to check:

- Electrical
    - Input voltage and output voltage should be the same, if output voltage does not match input voltage then replace Filter.

4.8.2 SC – Suppression Core

Used in Oven Versions:

- H

PART NUMBER: XP-9303A

How it works: The Suppression Core is placed around the incoming power wires after the Power Block and Heating Element Circuit Breaker on World Electric ovens and is used to reduce high frequency interference (25-300 MHz).

4.9 F – Fuse

Used in Oven Versions:

- DS, TS, TS2, TS3

PART NUMBER: SP-4110 (Fuse)

SP 4506 (Fuse)

SP 4505 (Fuse Holder)

Used in Hood Version:

- A

PART NUMBER: SP-4110-MDL-10

How it works: The essential component of a fuse is a metal wire or strip of material that melts when too much current flows through it. AGC fuse types are fast-acting glass tube fuses, which upon overload will almost immediately sever the power connection. MDL fuse types have a slower interrupt speed which allow for minor and short fluctuations in amperage without allowing the fuse to break. All fuses will be wired in series, to the circuit of the component it is meant to protect, utilizing a fuse holder.

Tools required:

- Multi-meter
- Flathead Screwdriver

How to check:

- Visual – Remove Fuse from Fuse Holder
  - Check for evidence of burning (black marks), if present then replace Fuse
  - Check for the metal wire to be broken inside of the glass tube, if broken then replace Fuse
- Electric
  - Remove Fuse from Fuse Holder
  - Check for continuity, if continuity is not present, then replace Fuse
  - Re-insert good/new Fuse into Fuse Holder
  - Disconnect wires from Fuse Holder for better access to terminals
  - Check for continuity through Fuse Holder, if continuity is not present, then replace Fuse Holder

(Fuses: Cont…)

(Fuses: Continued)

Why is the fuse blown?

- Bad/Failed component
- Bad/Failed wire that created a path to ground
- Bad/Failed wire connection
- Power surge

Note: Refer to the appropriate Service Manual for replacement fuse values

4.10 Flame Sensors

4.10.1 FS – Flame Sensor – Optical

Used in Oven Versions:

- D, E, F, G, H

PART NUMBER: XP-4210-UV-DC

NOTE: Some versions utilize a mirror-mount – more often this mirror is the issue (see Section 4.10.2)

How it works: The Flame Sensor consists of a plastic housing and a flame sensor mount. The FS utilizes 24 volts. When flame is present, a blue wire sends a 6.75 µA signal from the connector to the Ignition Control. The minimum flame sensitivity signal to maintain operation is 0.7 µA. The sensor visually looks at the flicker rate and the UV characteristics of the flame. If either of these do not appear the sensor will not send current to the Ignition Control. The Flame Sensor is equipped with an operating indicator LED. The following operating conditions are indicated by the LED:

LED Status	Meaning
OFF	No Power
Blinking	No flame detected
ON	Flame detected

Tools required:

- VOM
- Lighter (flame source)

How to Check:

- Incoming Power
  - Unplug unit
  - Measure voltage at harness – Should be 24 VDC
- Function
  - Plug sensor in
  - Remove Sensor from mount
  - Hold a lighter 2-3” away from the lens end

(Optical Flame Sense: Cont…)

(Optical Flame Sense: Continued)

- Output
  - When flame is present, a 6.75 µA signal is generated and sent to the Ignition Control

How to clean: For maintenance of the sight glass, use a clean and lint-free cloth. Do not use any kind of cleaning sprays or liquids.

(Flame Sense: Cont…)

4.10.2 FS – Flame Sensor – Optical - Mirror

Used in Oven Versions:

- D, E

PART NUMBER: XP-4213 (Mirror Mount)

How it works: The optical flame sensor mirror is a piece of plastic that has a reflective coating or material that allows the flame sensor to be mounted in a vertical orientation while looking horizontally down the burner. If/when the reflective material or coating degrades, or gets dirty, the flame sensor loses sight of the flame.

Tools required:

- #2 Phillips Screwdriver

How to check:

- Visual inspection – no debris – no scratches

How to clean:

- Similar to eye glasses
- Mild detergent
- lint-free cloth
- No abrasive cleaners
- No paper towels

How to install: Orientated correctly with reflective surface aimed towards flame.

NOTES:

1. HVAC tape can be applied over the original reflective sticker as a quick in-field test/repair before the mirror can be properly replaced.

2. An upgrade kit is available that converts the flame sensor mounting orientation from vertical to horizontal that eliminates the need for a mirror.

(Flame Sense: Cont…)

4.10.3 FS/SI – Flame Sensor/Spark Igniter – DI

Used in Oven Versions:

- TS, TS2, TS3, A, B, C

PART NUMBER: SP-4203-DI-RO Kit (Used in Oven Versions: TS, TS2, TS3, A)

SP-4203-DI-SQ-Kit (Used in Oven Versions: TS3, A, B, C)

How it works: The Flame Sensor/Spark Igniter consists of a copper-clad metal mounting plate, a ground electrode, and two additional electrodes encapsulated in ceramic insulators. One of the insulated electrodes has a 1/4" male spade welded to it while the other insulated electrode has a 3/16" male spade welded to it. The rod with the 1/4" spade connects to the Spark Terminal on the Ignition Control (IC) via a spark wire. The end of this rod is positioned near the ground electrode in such a way so as to create a small gap. When the high-voltage signal from the IC reaches the gap, it is forced to jump the gap resulting in a spark.

Flame has the unique ability to rectify AC voltage and current into DC voltage and current. The electrode with the 3/16" spade is positioned in such a way so that the electrode is inside the flame envelope. A wire connects this electrode to Terminal S1 on the IC. A green ground wire is attached to the copper-clad mounting plate, and connected to chassis ground inside the control box. When flame is present, a DC current flow is detected by the IC. The amount of current flow is determined by the position of the flame sensor and the size of the flame. The minimum current flow to maintain operation is 0.7 µA.

Tools required:

- Multi-meter

How to check:

- Spark
  - Visual
    - Gap – Should be 3/16" +/- 1/32". Too small or too big will cause problems.
    - Ceramic – Should have no cracks or dirt. Cracks and dirt can cause the spark to take a different route to ground.
  - Electrical
    - Plug Wire – Should have no cracks or splits. Should have tight connections. Should have continuity from Ignition Control terminal to the tip of the Spark Rod.
- Flame Sense
  - Visual
    - Corrosion – Corrosion can inhibit electrical flow. Clean the Flame Sensor using fine steel wool, emery cloth, or a scotch-brite pad.
    - Position – Must be in the flame in order to sense flame.
  - Electrical
    - Ammeter – Connect an ammeter up to the two terminals on the Ignition Control. The minimum current flow to maintain operation is 0.7 µA.

(DI Flame Sense: Cont…)

(DI Flame Sense: Continued)

- Both Spark and Flame Sense
    - Ground – Must have a good connection. If no ground wire exists, then add one.

NOTE: An upgrade kit (SP-4200E and SP-4210A) is available that converts spark rod flame sense to optical flame sense.

(Flame Sense: Cont…)

4.10.4 FS/SI – Flame Sensor/Spark Igniter – Piloted

Used in Oven Versions:

- DS, TS, TS2

PART NUMBER: SP-4227A (Natural Gas)

SP-4228A (Propane)

How it works: When the Burner Control (BC) is energized, voltage is applied to the igniter/sensor and sparking occurs between the insulated rod and the ground strap. At the same time, the burner control sends 24 VAC to the pilot valve for gas to flow over the spark. When the spark ignites the pilot gas, then the gas molecules between the flame rod and the ground strap become ionized and are able to conduct an electrical current. Current through the flame results in pulsating direct current. The Flame Sensor/Spark Igniter will contain a pilot orifice specific to the type of fuel being used; BCR-18 with Propane, and BCR-24 with Natural Gas.

Tools required:

- Multi-meter

How to check:

- Spark
  - Visual
    - Gap – Should be 3/16” +/- 1/32”. Too small or too big will cause problems.
    - Ceramic – Should have no cracks or dirt. Cracks and dirt can cause the spark to take a different route to ground.
  - Electrical
    - Plug Wire – Should have no cracks or splits. Should have tight connections. Should have continuity from Ignition Control terminal to the tip of the Spark Rod.
- Flame Sense
  - Visual
    - Corrosion – Corrosion can inhibit electrical flow. Clean the Igniter/Flame Sensor using fine steel wool, emery cloth, or a scotch-brite pad.
    - Position – Must be in the flame in order to sense flame.
  - Electrical
    - Using an ammeter, measure DC micro-amps.
      - If a Honeywell S8600H is being used, hook an ammeter up in series with the spark wire to the Ignition Control. The minimum current flow to maintain operation is 1.0 µA.
      - If a Fenwal (SP-4705-EP-F) is being used, hook an ammeter up to the two terminals on the Ignition Control. The minimum current flow to maintain operation is 0.7 µA.
- Both Spark and Flame Sense
  - Ground – Must have a good connection. If no ground wire exists, then add one.

(Piloted Spark Igniter/Flame Sensor: Cont…)

(Piloted Spark Igniter/Flame Sensor: Continued)

- Gas Pressure Setting and Adjustment
  - Please See V1/V2 Gas Valve Combination Main/Pilot

Note: The burner's venturi this igniter/sensor would be mounted to should have a flame retention ring mounted in the flame-end of the venturi. This flame retention ring will have a break in it that can be situated toward the pilot ignitor and can funnel air toward the pilot flame and cause it to have trouble staying lit. See flame retention ring shown in burner exploded view below.

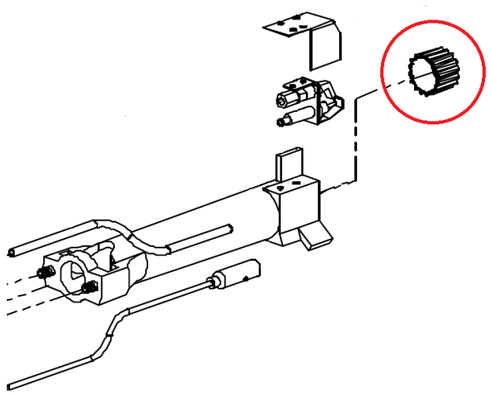


Figure 25 Flame Retention Ring

4.11 Heating Elements

4.11.1 Heating Elements, Electric Impingement

Used in Oven Versions:

- TS, TS2, B, C, D, E, F, G, H

PART NUMBER: XP-5201A-XXX-4.5

XP-5202A-XXX-5.3

How it works:

- The Heating Element will convert electrical energy into heat. The electrical current that will flow through the Heating Element will encounter resistance thus resulting in heating of the element. 208/240V electric ovens have their Heating Elements wired in a Delta configuration while 380/415V electric ovens have their Heating Elements wired in a Wye configuration. Electric ovens that contain six (6) heating elements will have two sets of three heating elements wired in parallel from incoming power.
- The Heating Element will either be rated for 208 Volts (V) or for 240V, check the Data-Plate on the oven you are working on.
    - Ovens rated for 380/415V and 480V will utilize 240V rated heating elements.
- The Heating Element will either be rated for 4500 Watts (W) or for 5300W.
- The Heating Element's resistance will differ depending on Voltage and Wattage ratings as follows:
    - XP-5201A-208-4.5 (208V, 4500W)
        - 9.61 Ohms
    - XP-5201A-240-4.5 (240V, 4500W)
        - 12.8 Ohms
    - XP-5202A-208-5.3 (208V, 5300W)
        - 8.16 Ohms
    - XP-5202A-240-5.3 (240V, 5300W)
        - 10.87 Ohms

How to check – ELECTRIC:

- Resistance
    - Shut off Circuit Breaker(s) to Oven
    - Remove Electrical Cover from Back of Oven
    - Remove Wires from Heating Elements
    - Test resistance across terminals. Should be one of the values listed above, +/- 10%. If infinite Ohms, then replace Heating Element

(Impingement Heating Elements: Cont…)

(Impingement Heating Elements: Continued)

- Power Input
  - Remove Electrical Cover from Back of Oven
  - Turn Oven ON
  - Test voltage across terminals. Should match the voltage rating as listed on the Oven's Data-Plate
- Current
  - Refer to rating shown on Oven's Data-Plate or refer to version-specific Installation and Operation manual for electrical requirements
  - See a more in-depth look at current calculations of heating elements for 208/240V Ovens at Section 5.10 (example shown is a 240V oven utilizing 5300W elements in a Delta configuration)

(Heating Elements: Cont…)

4.11.1.1 Heating Elements, Countertop

Used in Oven Versions:

- A (Countertop)

PART NUMBER: 96-5201A2800-208

96-5201A3000-240

How it works:

- The Heating Element will convert electrical energy into heat. The electrical current that will flow through the Heating Element will encounter resistance thus resulting in heating of the element.
- The Heating Element will either be rated for 208 Volts (V) or for 240V, check the Data-Plate on the oven you are working on.
- The Heating Element will either be rated for 2800 Watts (W) or for 3000W.
- The Heating Element's resistance will differ depending on Voltage and Wattage ratings as follows:
    - 96-5201A2800-208 (208V, 2800W)
        - 15.45 Ohms
    - 96-5201A3000-240 (240V, 3000W)
        - 19.20 Ohms

How to check – ELECTRIC:

- Resistance
    - Unplug Oven
    - Remove Electrical Cover from Back of Oven
    - Remove Wires from Heating Elements
    - Test resistance across terminals. Should be one of the values listed above, +/- 10%. If infinite Ohms, then replace Heating Element
- Power Input
    - Remove Electrical Cover from Back of Oven
    - Turn Oven ON
    - Test voltage across terminals. Should match the voltage rating as listed on the Oven's Data-Plate
- Current
    - Refer to rating shown on Oven's Data-Plate or refer to version-specific Installation and Operation manual for electrical requirements

(Heating Elements: Cont…)

4.11.2 Heating Elements, Electric Radiant

Used in Oven Versions:

- A (Radiant)

PART NUMBER: RA-5100A-TLBR-208

RA-5100A-TRBL-208

RA-5100A-TLBR-240

RA-5100A-TRBL-240

How it works:

- The Heating Element will convert electrical energy into heat. The electrical current that will flow through the Heating Element will encounter resistance thus resulting in heating of the element.
- The Heating Element will either be rated for 208 Volts (V) or for 240V, check the Data-Plate on the oven you are working on.
- The Heating Element will be rated for 2400 Watts (W).
- The Heating Element's resistance will differ depending on Voltage ratings as follows:
    - RA-5100A-TLBR-208 (208V, 2400W)
    - RA-5100A-TRBL-208
        - 17.50 Ohms
    - RA-5100A-TLBR-240 (240V, 2400W)
    - RA-5100A-TRBL-240
        - 23.30 Ohms

How to check – ELECTRIC:

- Resistance
    - Unplug Oven
    - Remove Electrical Cover from Back of Oven
    - Remove Wires from Heating Elements
    - Test resistance across terminals. Should be one of the values listed above, +/- 10%. If infinite Ohms, then replace Heating Element
- Power Input
    - Remove Electrical Cover from Back of Oven
    - Turn Oven ON
    - Test voltage across terminals. Should match the voltage rating as listed on the Oven's Data-Plate

(Heating Elements: Cont…)

(Heating Elements: Continued)

- Current
  - Refer to rating shown on Oven's Data-Plate or refer to version-specific Installation and Operation manual for electrical requirements

4.12 HMC – Hood Machine Control

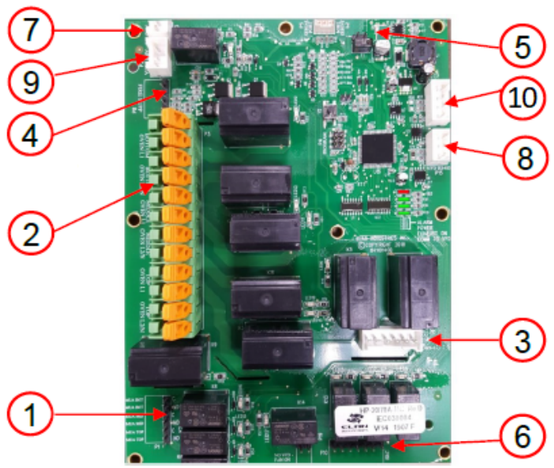
Used in Hood Versions:

- E, F

PART NUMBER: SP-2070A-MC

How it works: The Hood Machine Control is a printed circuit board that has all of the relays and logic to control the following functions: switch ovens on and off, activate make-up air, activate VFD, monitor air-proving switches, and energize the lights. The Hood Machine Control reads selections or parameters from the Hood User Interface (HUI) as entered by the equipment operator. There are four LED indicators located on the HMC directly below the P15 – VFD connection that will tell you current operating status of the hood system. There is a button located directly below the P9 – Power connection that is a manual reset of the HMC; this button is labeled S1. Electric ovens will not have their three phase power routed through the hood, instead a single phase circuit of 120 VAC will be wired to the hood specifically to power the lights.

Here's what it should look like:



1) P1- Dampers
   1) MUA Top
   2) Not Used
   3) MUA Middle
   4) Not Used
   5) MUA Bottom
   6) Common
2) P3- Oven Power
   1) Bottom Oven L1
   2) Not Used
   3) Bottom Oven L2/N
   4) Not Used
   5) Middle Oven L1
   6) Not Used
   7) Middle Oven L2/N
   8) Not Used
   9) Top Oven L1
   10) Not Used
   11) Top Oven L2/N
   12) Not Used
3) P7-Lights/Cooling Fans
   1) By Installer
   2) Light 1
   3) Light 2
   4) To PS CN2-3
   5) +24 VDC To Cooling Fan
   6) +24 VDC To Cooling Fan
4) P8- Fire Suppression
   1) To TS1-10L
   2) To R1-1
   3) Not Used
   4) Not Used
   5) Not Used
5) P9- Power
   1) +24 VDC Power Supply CN2-1
   2) -24 VDC Power Supply CN2-4
6) P10- Switch Relocation Cord
   1) Bottom Oven
   2) Bottom Oven
   3) Middle Oven
   4) Middle Oven
   5) Top Oven
   6) Top Oven
   7) Not Used
7) P13- APS Ex
   1) TS2-4R
   2) TS2-5R
8) P15- VFD
   1) TB2
   2) TB1
   3) Not Used
9) P20- APS MUA
   1) TS2-3R
   2) TS2-2R
   3) TS2-1R
10) P2 - RS-485
   1) Black
   2) Green
   3) White
   4) Red

(HMC: Cont…)

Figure 26 HMC Connections

(HMC – Hood Machine Control: Continued)

Tools required:

- Multi-meter
- Small Flathead Screwdriver
- #2 Phillips Screwdriver

How to check – VISUAL:

- LED Indicators
  - Status LEDs
    - Alarm – Should illuminate red when the HMC has detected an error in its operation. This should be accompanied by an error message on the Hood User Interface (HUI) – See HUI Error Codes
    - Power – Should illuminate green when the HMC has power. This should be illuminated at all times under normal operating conditions
    - Exhaust On – Should illuminate green when the exhaust fan is running
    - Comm. To VFD – Should illuminate green when the HMC is communicating with the VFD
  - Relays – Each relay on the circuit board should have a designated LED that will illuminate to signify the relay is energized

How to check – ELECTRIC:

- **Input**
  - **Power** – At P9, should be 24 VDC across terminals 1 and 2
  - **Cooling Fan Power** – At P7, should be 24 VDC across terminal 4 and chassis ground
  - **Oven Power** – Depends on the Quantity of Ovens Stacked Under the Hood
    - Single Stack (Top Oven)
      - At P3, should be 120 VAC across terminals 9 and 11 with terminal 11 being the neutral line
    - Double Stack (Bottom Oven)
      - At P3, should be 120 VAC across terminals 1 and 3 with terminal 3 being the neutral line
    - Triple Stack (Middle Oven)
      - At P3, should be 120 VAC across terminals 5 and 7 with terminal 7 being the neutral line

(HMC: Cont…)

(HMC – Hood Machine Control: Continued)

- **Switch Relocation Cords** – Depends on the Quantity and Versions of Ovens Stacked Under the Hood (NOTE: Refer to schematic specific to the version of oven you are working on)
  - Single Stack (Top Oven)
    - With +24 DC voltage: At P10, should be +24 VDC at terminal 5 as measured against chassis ground
    - With 120 AC voltage: At P10, should be 120 VAC at terminal 6 as measured against chassis ground
  - Double Stack (Bottom Oven)
    - With +24 VDC voltage: At P10, should be +24 VDC at terminal 1 as measured against chassis ground
    - With 120 AC voltage: At P10, should be 120 VAC at terminal 2 as measured against chassis ground
  - Triple Stack (Middle Oven)
    - With +24 VDC voltage: At P10, should be +24 VDC at terminal 3 as measured against chassis ground
    - With 120 AC voltage: At P10, should be 120 VAC at terminal 4 as measured against chassis ground
- **Signal**
  - VFD – At P15, pins 1 and 2 are ModBus communications with the VFD
  - HUI – At P2, pins 2 and 3 are CANBUS communications with the HUI
- **Lights**
  - At P7, should be 120 VAC applied to terminal 1 originating from Top Oven Power (from P3, terminal 9)
  - **Make-Up Air Relay Control/Signal Voltage** – At P1, should be a maximum of 240 VAC and 7 Amperes at terminal 6 as measured against chassis ground
  - **Fire Suppression –** At P8, should be +24 VDC at terminal 1 anytime the fire suppression system is activated

- **Output**
  - **Cooling Fan Power** – At P7, should be +24 VDC at terminals 5 and 6 individually as measured against chassis ground
  - **Oven Power** – Depends on the Quantity of Ovens Stacked Under the Hood
    - Single Stack (Top Oven)
      - At P3, should be 120 VAC across terminals 10 and 12 with terminal 12 being the neutral line
    - Double Stack (Bottom Oven)
      - At P3, should be 120 VAC across terminals 2 and 4 with terminal 4 being the neutral line
    - Triple Stack (Middle Oven)
      - At P3, should be 120 VAC across terminals 6 and 8 with terminal 8 being the neutral line

(HMC: Cont…)

(HMC – Hood Machine Control: Continued)

- **Switch Relocation Cords** – Depends on the Quantity and Versions of Ovens Stacked Under the Hood (NOTE: Refer to schematic specific to the version of oven you are working on)
  - Single Stack (Top Oven)
    - With +24 DC voltage: At P10, should be +24 VDC at terminal 6 as measured against chassis ground
    - With 120 AC voltage: At P10, should be 120 VAC at terminal 5 as measured against chassis ground
  - Double Stack (Bottom Oven)
    - With +24 VDC voltage: At P10, should be +24 VDC at terminal 2 as measured against chassis ground
    - With 120 AC voltage: At P10, should be 120 VAC at terminal 1 as measured against chassis ground
  - Triple Stack (Middle Oven)
    - With +24 VDC voltage: At P10, should be +24 VDC at terminal 4 as measured against chassis ground
    - With 120 AC voltage: At P10, should be 120 VAC at terminal 3 as measured against chassis ground
- **Signal**
  - VFD – At P15, pins 1 and 2 are ModBus communications with the VFD
  - HUI – At P2, pins 2 and 3 are CANBUS communications with the HUI
- **Lights**
  - At P7, should be 120 VAC at terminal 2 and 3 individually as measured against chassis ground anytime the Lights button is pressed ON
- **Make-Up Air Relay Control/Signal Voltage** – Depends on HUI being programmed for Make-Up Air Mode to either be ‘Common’ or ‘Per Oven’
  - Common
    - At P1, should be a maximum of 120 VAC at terminals 1, 3, and 5 any time any oven is turned on
  - Per Oven – Depends on the Quantity of Ovens Stacked Under the Hood
    - Single Stack (Top Oven)
      - At P1, should be a maximum of 120 VAC at terminal 1 as measured against chassis ground any time the Top Oven is turned on
    - Double Stack (Bottom Oven)
      - At P1, should be a maximum of 120 VAC at terminal 5 as measured against chassis ground any time the Bottom Oven is turned on
    - Triple Stack (Middle Oven)
      - At P1, should be a maximum of 120 VAV at terminal 3 as measured against chassis ground any time the Middle Oven is turned on
- **Fire Suppression –** At P8, should be +24 VDC at terminal 2 anytime the fire suppression system is activated

(HMC: Cont…)

(HMC – Hood Machine Control: Continued)

- **Air-Proving Switches (APS) –** APS are utilized simply on the principle of open or closed circuits
  - Continuity
    - Oven(s) OFF, Exhaust OFF, MUA OFF
      - At P13, should not have continuity between terminals 1 and 2
      - At P20, should not have continuity between terminals 2 and 3
      - At P20, should have continuity between terminals 1 and 3
    - Oven(s) ON, Exhaust ON, MUA ON
      - At P13, should have continuity between terminals 1 and 2
      - At P20, should have continuity between terminals 2 and 3
      - At P20, should not have continuity between terminals 1 and 3

4.13 HUI – Hood User Interface

Used in Hood Versions:

- E, F

PART NUMBER: HP-2071A-UI

How it works: The Hood User Interface (HUI) is powered by the Hood Machine Control (HMC) via the RS485 twisted cable. The interface has seven capacitive touch buttons for user input. The HUI is to contain factory settings so that the VFD will run the exhaust fan at the correct frequency for the intended quantity and size of ovens. The HUI also contains parameters to select a VFD or non-VFD hood, type of Make-Up Air activation, and whether air-proving switches are being used. Any error messages will display at the top of the screen. Touching the "i" button will give a brief description of how to correct the error.

Here's what it should look like:

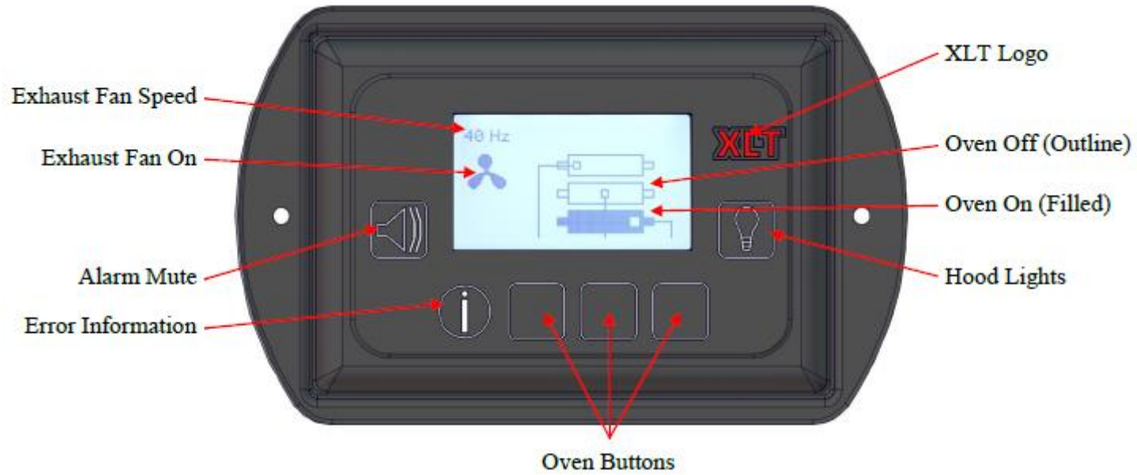
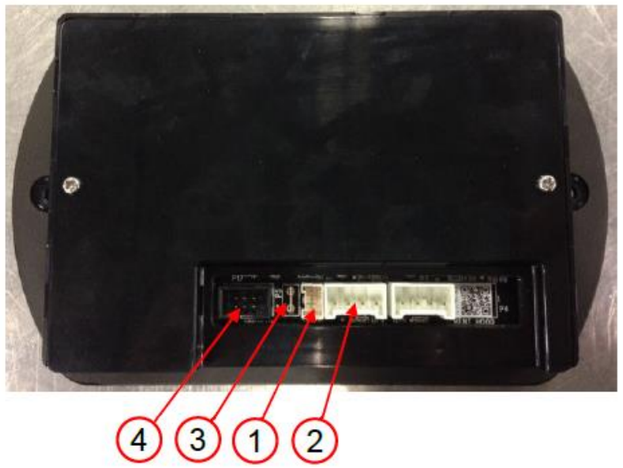


Figure 27 HUI Display



1) P1- Not Used
2) P2- RS-485 Cable To HMC
   1) +5V
   2) 485-
   3) 485+
   4) Ground
3) P5- Ground
4) P17- Elan Programming

Figure 28 HUI Connections

(HUI: Cont…)

(HUI – Hood User Interface: Continued)

Tools required:

- Multi-meter
- #2 Phillips Screwdriver

How to check:

- Visual
  - The screen should be free of dust, dirt, and grease as these can cause issues (see Keyshort)
  - Error messages will display at the top of the screen (See HUI Errors)
  - Oven symbols should be filled in when oven is turned ON
  - Hertz display should match what is shown on VFD
  - Brightness/Contrast - If display seems to be too dim or hard to read
    - Press ‘Error Information’ and ‘Top Oven’ keys together for 3 seconds to enter adjustment display
    - Options listed will include ‘Backlight’ and ‘Contrast’
    - Enter to make selection for adjustment, use up and down buttons to adjust, and press enter to save
- Electrical
  - Power – At P2, should be 5 VDC across pins 1 and 4
  - HMC Communication – At P2, pins 2 and 3 are CANBUS communications with the Hood Machine Control (HMC)
  - Ground – At P5, should be a wire connected to chassis ground

4.14 Ignition Controls

4.14.1 IC – Square Burner – Multi

Used in Oven Versions:

- TS, TS2, TS3, A, B, C, D, E

PART NUMBER: XP-4705-DI

How it works: The Ignition Control (IC) is powered by 24 VAC from the Transformer (XFMR). Incoming power will be interrupted by Centrifugal Switch (S2) mounted in the Fan Motor (M1). When the IC receives power, it initiates a pre-purge lighting sequence. A red LED will blink once after about 2-3 seconds to give notification that the lighting sequence has started. After about 30 seconds, two events occur; 1) a high-voltage electrical signal will be sent to the Spark Igniter (SI) from the Spark Terminal, and 2) a 24 VAC signal will be generated across Terminals V1 & V2. The high voltage jumps across a gap in the SI creating a spark that can be heard, although the IC only produces this spark for four (4) seconds. One end of the Rectifier Plug is connected to Terminals V1 & V2 through a Circuit Breaker (CB5). The Rectifier Plug rectifies the 24 VAC to 22 VDC. The other end of the Rectifier Plug is connected to Terminals 1 & 5 of the Main Valve (V1-V2). The V1-V2 valve will open, allowing fuel to flow into the burner. When the two simultaneous events occur, fuel flow and spark, ignition should occur. When flame is sensed by the Flame Sensor (FS), a DC signal is sent to Terminal S1 of the IC. The IC uses this DC current to prove ignition. A minimum of 0.7 µA is required to maintain operation. If the Burner lights, the LED will not flash. If the Burner fails to light, the LED will flash three (3) times, repeatedly, and the IC will not attempt to re-light.

Here's what it should look like:

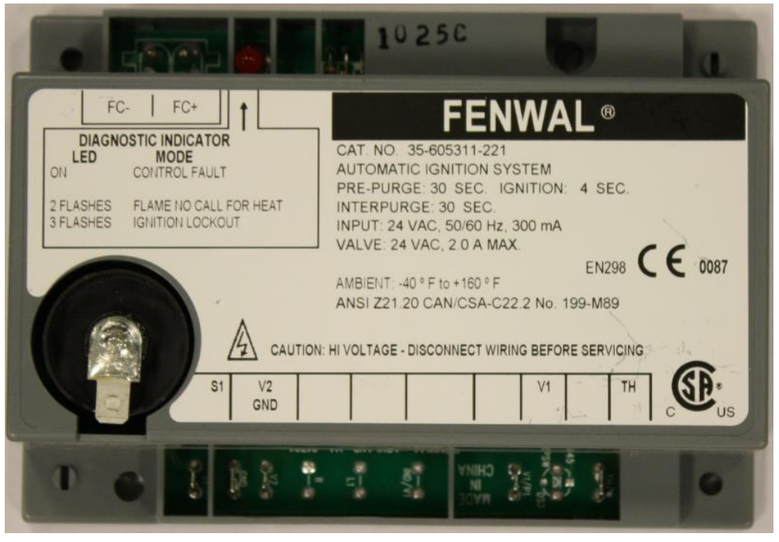


Figure 29 DSI Multi Ignition Control

(Multi SQ IC: Cont…)

(Multi SQ IC: Continued)

Tools required:

- Multi-meter

How to check:

- Visual
  - When it receives power, the red LED will blink once after about 2-3 seconds to give notification that the lighting sequence has started.
  - If the Burner fails to light, the LED will flash three (3) times, repeatedly, indicating the Ignition Control is in ignition lockout, and the IC will not attempt to re-light.
  - If the red LED is illuminated steady, the Ignition Control has an internal control failure.
  - If the red LED flashes two (2) times, repeatedly, then the Ignition Control received a flame sense signal without completing its ignition sequence.
- Electrical
  - Inputs
    - Power – Should be 24 VAC across TH & Ground supplied by XFMR via the M1 centrifugal switch
    - Flame Sense – Should be a minimum of 0.7 µA supplied by the flame sensor applied to S1
  - Outputs
    - Valve 1 & 2 – Should be 24 VAC across terminals V1 & V2 to the rectifier plug as long as the IC is sensing flame
    - Spark – Should be approximately 10,000 volts out of SPARK during the 0:04 seconds trial for ignition

(Ignition Controls: Cont…)

4.14.2 IC – Square Burner – On/Off – Fenwal

Used in Oven Versions:

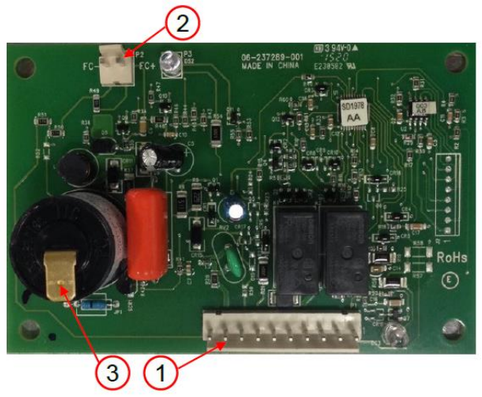
- F, G, H

PART NUMBER: XP-4705A-DI-24

How it works: Once the oven is switched on then the OMC will supply power to the ignition control after fan rotation is proven. North American ovens will either utilize a current sensor to detect fan amperage, or will have the call for heat signal routed through a centrifugal switch in the fan motor. International ovens may utilize both the centrifugal switch and current sense, but should always contain the centrifugal switch in the circuit.

- For ovens utilizing a **current sensor:** As long as the fan current is within range, then the OMC will supply +24 VDC to TS2 to energize Flame Sensor, FPPG Fan, and Ignition Control. The Ignition Control receives this +24 VDC power on positions 2 and 4. Receiving +24 VDC on position 2 will cause a red LED to blink once to give notification that the ignition control has power. Receiving +24 VDC on position 4 will turn a green LED on continuously which indicates IC has power and a call for heat.
- For ovens utilizing a **centrifugal switch:** When the oven is switched on then the OMC should release +24 VDC onto position 2 of the IC via TS2. A red LED will blink once about two (2) or three (3) seconds after the oven is switched on to give notification that the ignition control has power. It also receives a +24 VDC call for heat signal from the OMC via the centrifugal switch (S2) which is mounted in the Main Fan Motor (M1). This will turn a green LED on continuously indicating the IC has power and a call for heat.

When the IC receives a call for heat, it initiates a pre-purge lighting sequence. After about thirty (30) seconds, two (2) events occur; 1) a high-voltage electrical signal will be sent to the Spark Rod (SR) from the Spark Terminal. The high voltage jumps across a gap in the SR creating a spark that can be heard, although the IC only produces this spark for four (4) seconds. 2) A VDC (+) will be sent from terminal IC6 to Gas Valve V1-V2 via CB2 and CB3. The V1-V2 valve will open, allowing fuel to flow into the burner. When the two events occur, spark and fuel flow, then ignition will occur. When flame is sensed by the FS, a DC micro-amp signal is sent to position 10. The IC uses this DC current to prove ignition. A minimum of 0.7 µA DC is required to maintain operation. If the Burner fails to light, the IC will reattempt ignition two (2) more times before the red LED will flash three (3) times, repeatedly, having gone into lockout. The LED flashes two (2) times when the Ignition Control is receiving a flame sense signal without completing its ignition sequence.



1) P1
   1) Alarm (Australian and Korean models only)
   2) +24 VDC In
   3) Not Used-Manual Reset
   4) Call For Heat
   5) Ground In
   6) +24 VDC Sent To V1
   7) Not Used-Digital Output
   8) Not Used
   9) Burner Ground
   10) Signal Wire To Flame Sensor
2) P2- Not Used
3) Spark Terminal

Figure 30 Fenwal 24 VDC Ignition Control

(On/Off IC – Fenwal: Cont…)

(On/Off IC – Fenwal: Continued)

Tools required:

- VOM
- Needle Nose Pliers

How to check – VISUAL:

- LED Indicator
  - When it receives power, the red LED will blink once after about 2-3 seconds to give notification that it has received power.
  - When it receives the call for heat signal voltage, the green LED should be steadily illuminated.
  - If the Burner fails to light, the LED will flash three (3) times, repeatedly, indicating the Ignition Control is in ignition lockout, and the IC will not attempt to re-light.
  - If the red LED is illuminated steady, the Ignition Control has an internal control failure.
  - If the red LED flashes two (2) times, repeatedly, then the Ignition Control received a flame sense signal without completing its ignition sequence.
- LED Indicator under Normal Operation
  - Red system diagnostic LED should flash one time
  - Green power LED should steadily illuminate proving fan rotation

How to check – ELECTRIC:

- Inputs
  - Power Input
    - At P1, across pins 2 & 5 should be 24 VDC about 0:03 seconds after the oven is turned ON
  - Signal Inputs
    - Call for Heat – At P1, across pins 4 & 5 should be 24 VDC after fan rotation is proven
    - Flame Sense – At P1, pin 10 should have a minimum of 0.7 µA current flow (tested in series with this wire, or measure across FC+ and FC- terminals on IC)
- Outputs
  - Electrical
    - Valve 1 & 2 – At P1, pin 6 to ground should be 24 VDC after 0:30 seconds for a duration of 0:04 seconds. This will sustain if flame is detected.
    - Spark – At spark terminal, a high voltage will be generated for 0:04 seconds.

(Ignition Controls: Cont…)

4.14.3 IC – Square Burner – On/Off – Capable Controls

Used in Oven Versions:

- H

PART NUMBER: XP-4705A-DI-120

How it works:

- After the oven is switched ON, then the power supply generates 24 VDC to be supplied to Terminal Strip 2 (TS2). This 24 VDC will be used to power the Golander Temperature Controller, while +24 VDC is routed to the Temperature Controller's alarm relay to then supply +24 VDC to the Oven Ignition Control Relay (R2). When the Oven Ignition Relay (R2) receives the +24 VDC onto its coil it will then send 120 VAC phase voltage from its Normally Open (NO) contact to provide power to the ignition control and begin the pre-purge sequence. As long as the indicated temperature, as shown on the Temperature Controller, is below the high alarm setting then the Temp. Control alarm relay will supply +24 VDC to the Oven Ignition Control Relay (R2).
- The Capable Controls ignition control will have a LED indicator to show current status as well as fault conditions. When the IC receives power, it initiates a pre-purge lighting sequence and the green LED should blink rapidly.
- After about thirty (30) seconds, two (2) events occur; 1) a high-voltage electrical signal will be sent to the Spark Rod (SR) from the Spark Terminal. The high voltage jumps across a gap between the SR and the burner tube creating a spark that can be heard, although the IC only produces this spark for four (4) seconds. 2) 120 VAC will be sent from terminal 5 to V1 via CB3. The V1 valve will open, allowing fuel to flow into V2. When the two events occur, spark and fuel flow, then ignition will occur.
- When flame is sensed by the FS, a DC micro-amp signal is sent to position 8. The IC uses this DC current to prove ignition and the green LED should be steadily illuminated while flame is sensed and the main valve is energized. A minimum of 0.7 µA DC is required to maintain operation.
- If the Burner fails to light, the IC will reattempt ignition two (2) more times before the red LED will flash one (1) time, signifying that the control did not sense flame through its trial for ignition. The LED flashes two (2) times when the Ignition Control is receiving a flame sense signal without completing its ignition sequence.

Here's what it should look like:

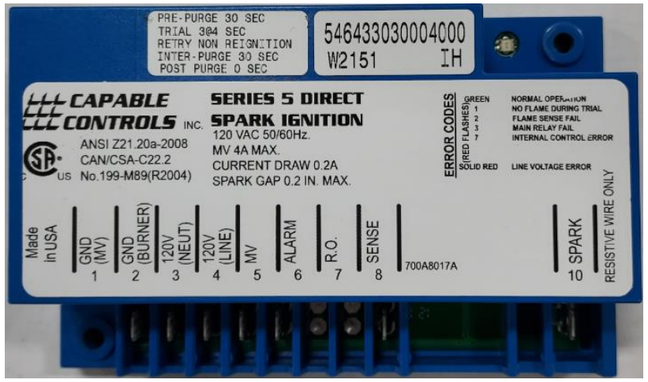


Figure 31 Capable Controls Ignition Control

(On/Off IC – Capable: Cont…)

(On/Off IC – Capable Controls: Continued)

Tools required:

- Multi-meter
- #2 Phillips Screwdriver

How to check – VISUAL:

- LED Indicators
  - When the ignition control starts the pre-purge sequence then the LED should rapidly flash a green light
  - When the ignition control receives a flame sense signal after its ignition sequence then the LED should steadily illuminate a green light
  - When the ignition control fails to receive a flame sense signal through its trials for ignition then the LED should flash a red light one (1) time continuously – signifying a lockout condition
  - When the ignition control receives a flame sense signal prior to its ignition sequence then the LED should flash a red light two (2) times continuously – signifying a lockout condition
  - If the LED flashes a red light three (3) times, then the ignition control has detected a failure of its main valve relay – signifying a lockout condition
  - If the LED flashes a red light seven (7) times, then the ignition control has detected an internal fault – signifying a lockout condition
  - If the LED is steadily illuminating a red light, then the ignition control has detected an issue with line voltage applied for power – signifying a lockout condition

How to check – ELECTRIC:

- Inputs
  - Power Input – Should be 120 VAC measured across terminals 3 and 4 with terminal 3 being neutral
  - Flame Sense – Should be a DC micro-amp signal received on terminal 8
  - Burner Ground – There is an additional ground wire from terminal 2 to the burner body
- Outputs
  - Spark – At spark terminal, a high voltage will be generated for four (4) seconds
  - Valve 1 – Should be 120 VAC measured across terminals 1 and 5 with terminal 1 being ground, after 0:30 seconds for a duration of 0:04 seconds. This will sustain if flame is detected.

(Ignition Controls: Cont…)

4.14.4 IC – Ignition Control – Piloted Part 1

Used in Oven Versions:

- DS, TS, TS2

PART NUMBER: SP-4705-EP-F (Fenwal, Service Part Replacement for Honeywell Burner Control)

Catalog number: 35-630200-007

How it works:

- In DS ovens specifically, the Burner Blower Motor is supplied 120 VAC from the Burner Motor Relay (R2). Ignition Control power will always route through the Burner Motor Centrifugal Switch (S4). The IND/MV1 terminal is connected via a Fuse to the Main Valve (V1). The V1/PV1 terminal is connected via a Fuse to the Pilot Valve (V2). The V2/GND terminal is a common ground connected to both V1 and V2. The Spark terminal is connected to the Flame Sensor/Spark Igniter.
- The Ignition Control has a Red LED indicator. It will flash one (1) time about 2-3 seconds after the Main Switch is turned ON, then a high voltage spark will occur, lasting for ninety (90) seconds.
- During the ninety (90) seconds of spark 24 VAC will be sent to the Pilot Valve (V2) via a Fuse from Terminals V1/PV1 & V2/GND on IC. The pilot valve should open and release fuel over the spark gap.
- If pilot flame sense is established, then 24 VAC will be sent to the Main Valve (V1) via a Fuse from Terminals IND/MV1 & V2/GND on IC.
- If the Burner lights, the LED will not flash.
- If the Burner fails to light, the LED will flash three (3) times, repeatedly. The Ignition Control will not attempt to re-light.
- If the Burner lights, and subsequently the flame goes out, then the Ignition Control will attempt another trial for ignition. If the Burner lights again, the LED will not flash. If the Burner fails to light, the LED will flash three (3) times, repeatedly and not try again.
- If the Ignition Control has a solid red LED, then the control is in "control fault". The control will go into "control fault" when there is an internal failure of the control, or when the control's power has been interrupted by voltage irregularities and/or frequency noise from external sources. The "control fault" will often appear intermittently, and will likely operate correctly, although momentarily, if the oven switch is cycled OFF and then back ON. The best practice is to remove the control box lid and check for the solid red light immediately upon ignition failure.

How to check:

- Electrical
  - Inputs
    - Turn Oven ON
    - Power – Should be 24 VAC across TH/W and GND supplied by Transformer (XFMR) via the M4 centrifugal switch
    - Flame Sense – Should be a minimum of 0.7 µA supplied by the flame sensor/spark igniter rod and cable
  - Outputs
    - Spark – Should be approximately 10,000 volts out of SPARK after oven is switched ON for 90 seconds
    - Pilot Valve – Should be 24 VAC across terminals V1/PV1 and V2 GND from when the spark generator begins operation and as long as the Ignition Control senses flame
    - Main Valve – Should be 24 VAC across IND/MV1 and V2 GND from when pilot flame sense is established and the spark generator stops operation

(Ignition Controls: Cont…)

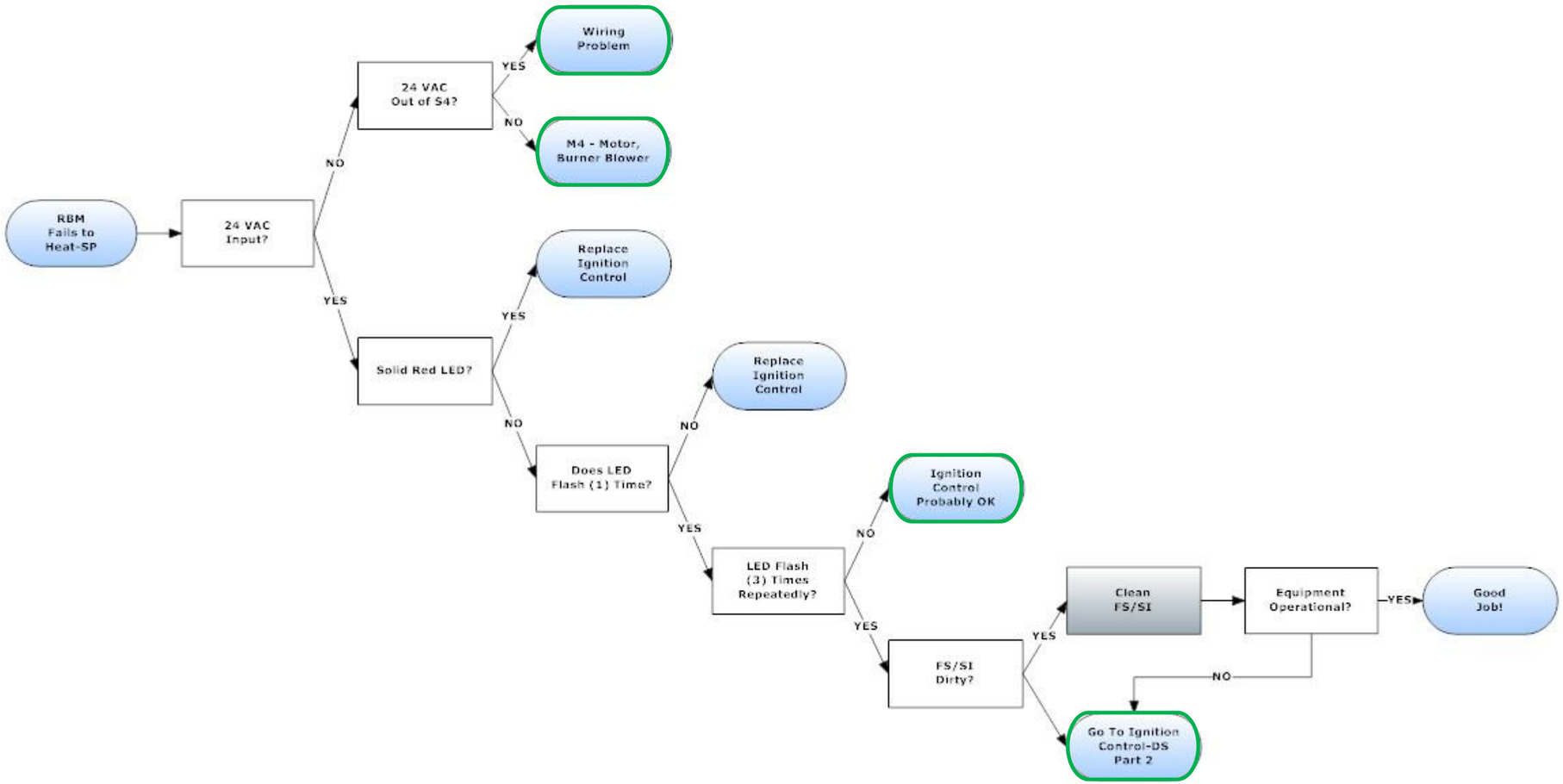


Figure 32 Ignition Control-DS Part 1

(Ignition Controls: Cont…)

4.14.5 IC – Ignition Control – Piloted Part 2

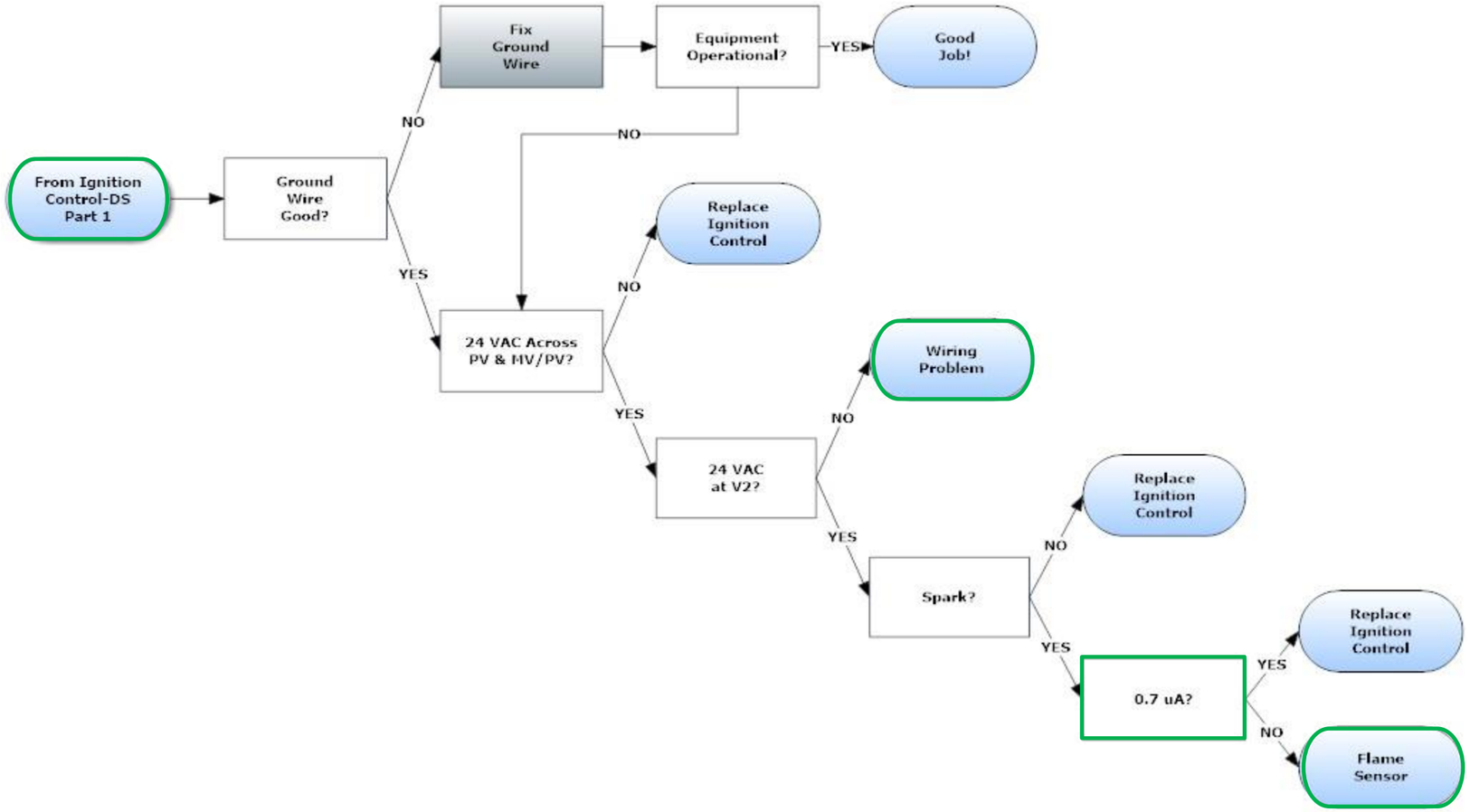


Figure 33 Ignition Control-DS Part 2

(Ignition Controls: Cont…)

0.7 µA:

The Ignition Control has 2 test ports located on the upper left hand side. You can use your volt meter set at micro amps and connect your leads to the terminals. If flame is present you should get a 0.7 or higher signal. If you have low micro-amps, then I would suggest replacing flame sensor after you have verified that you have a good ground.

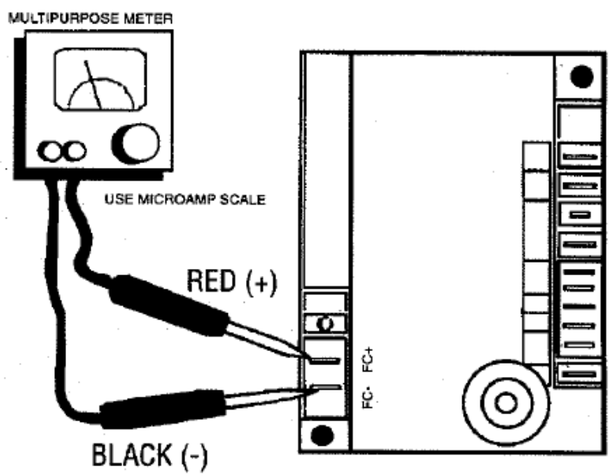


Figure 34 Ignition Control Flame Sense Check

4.15 Lights

4.15.1 L – Lamp, Main Valve

Used in Oven Versions:

- DS

How it works: The lamp was used as indication that the burner is in operation. The lamp is wired parallel to the main valve so that when pilot flame sense is established then the lamp receives power along with the main valve to give external indication that flame has been proven and the oven burner is in operation.

Tools required:

- Multi-meter

How to check:

- Visual
  - Turn Oven Switch(es) ON
  - When the burner lights then the Lamp should illuminate, if Lamp does not illuminate, verify burner operation
- Electrical
  - Turn Oven Switches ON
  - Allow the burner to light
  - Should be 24 VAC across red and white wire leads

(Lights: Cont…)

4.15.2 LT1/LT2 – Lamp, Hood

Used in Hood Versions:

- A, B, C, D, E

PART NUMBER: HP-1251-Base

HP-1251-Globe

How it works: The light assemblies used in the hoods will be powered by 120 VAC and activated either via the Light Switch or via the light button on the Hood User Interface (HUI). The light assembly will accept a three-wire service: line conductor, neutral line, and ground. The light assembly will be accompanied by a temperature-resistant and shock-resistant globe to protect the light bulb. Light assembly accepts standard 60-100 Watt A19 bulbs.

Tools required:

- Multi-meter

How to check:

- **Visual**
  - Switch lights ON
  - If a light does not illuminate, check the bulb's filament
- **Electrical**
  - Should be 120 VAC input to the light assembly any time the Light Switch or Light Button is switched ON

(Lights: Cont…)

4.15.3 LT3 – LED, Fan Indicator

Used in Hood Versions:

- B, C

How it works: The LED fan indicator is used in conjunction with the Current Sensor (CS) to signify that the exhaust fan is running.

How to check – VISUAL:

- LED should illuminate any time the exhaust fan is in operation. If not, verify wiring

4.16 LUI – Large User Interface

4.16.1 Impingement Ovens – Gas and Electric

Used in Oven Versions:

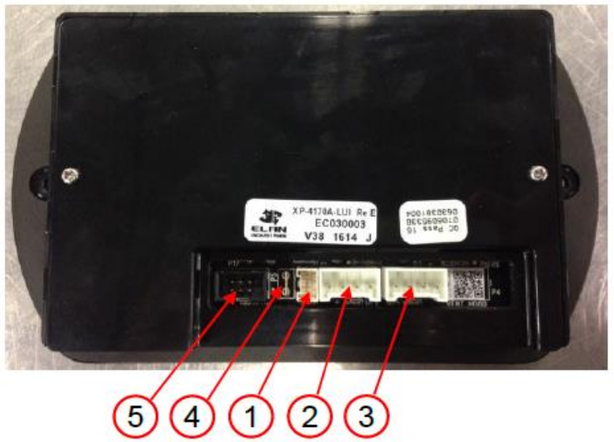
- F, G, H
- A (Countertop)

PART NUMBER: XP-4170A-LUI

How it works: The Large User Interface is powered by the OMC via the RS-485 twisted cable. The interface has eight capacitive touch buttons for user input. The conveyor(s) and temperature of the oven is controlled through the LUI. The LUI will display error messages and maintenance alarms.

Here's what it should look like:

Figure 35 LUI Display



1) P1- Not Used
2) P2- RS-485 Cable To OMC1
    1) +5V
    2) 485-
    3) 485+
    4) Ground
3) P3- RS-485 Cable To OMC2
    1) +5V
    2) 485-
    3) 485+
    4) Ground
4) P5- Ground
5) P17- Elan Programming

Figure 36 LUI Connections

Tools Required:

- Multi-meter
- #2 Phillips Screwdriver

(Impingement LUI: Cont…)

(Impingement LUI: Continued)

How to check:

- Electrical
  - Input Power
    - OMC1 – At P2, across pins 1 and 4, should be 5 VDC with pin 1 being positive when the oven is plugged in
    - OMC2 – If oven is dual burner or split-belt, then at P3, across pins 1 and 4, should be 5 VDC with pin 1 being positive when the oven is plugged in
    - Ground – P5 should contain a wire attached to the chassis of the oven
  - Signal
    - At P2, pins 2 & 3 are CANBUS communications with the OMC
    - If oven is dual burner or split-belt, then at P3, pins 2 & 3 are CANBUS communications with the OMC
- Visual
  - Brightness/Contrast - If display seems to be too dim or hard to read
    - Press 'Temp' and 'Time' keys together for 3 seconds to enter adjustment display
    - Options listed will include 'Backlight' and 'Contrast'
    - Enter to make selection for adjustment, use up and down buttons to adjust, and press enter to save
- Version
  - Observe LUI while powering oven on
  - Factory Tech Mode
- Parameters
  - Factory Tech Mode

4.16.2 Radiant Ovens – Electric

Used in Oven Versions:

- A (Radiant)

PART NUMBER: RP-4170A-LUI

How it works: The Large User Interface is powered by the OMC via the RS485 twisted cable. The interface has nine capacitive touch buttons for user input. The conveyor(s) and temperature of the oven is controlled through the LUI. The LUI will display error messages and maintenance alarms. The Radiant LUI will connect to the Thermocouple Module (TCM) as well as OMC2, while OMC1 is connected to the TCM. The left-hand temperature display will show bottom heating elements' temperature while the right-hand temperature display will show top heating elements' temperature. This wiring interconnects the LUI with both OMCs as well as the TCM. The Radiant LUI will include a Self-Clean button to raise the temperature of the heating elements to burn off any food particles that may be left behind.

Here's what it should look like:

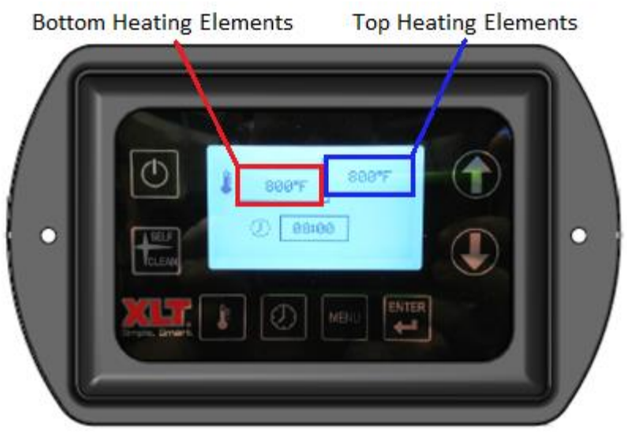


Figure 37 Radiant LUI Display

1) P1- Not Used
2) P2- RS-485 Cable To OMC1
   1) +5V
   2) 485-
   3) 485+
   4) Ground
3) P3- RS-485 Cable To OMC2
   1) +5V
   2) 485-
   3) 485+
   4) Ground
4) P5- Ground
5) P17- Not Used

Figure 38 Radiant LUI Connections

Tools Required:

- Multi-meter
- #2 Phillips Screwdriver

(Radiant LUI: Cont…)

(Radiant LUI: Continued)

How to check:

- Electrical
  - Input Power
    - At P2, across pins 1 and 4, should be 5 VDC with pin 1 being positive when the oven is plugged in
    - At P3, across pins 1 and 4, should be 5 VDC with pin 1 being positive when the oven is plugged in
    - P5 should contain a wire attached to the chassis of the oven
  - Signal
    - At P2, pins 2 and 3 are CANBUS communications with the TCM/OMC1
    - At P3, pins 2 and 3 are CANBUS communications with the OMC2
- Visual
  - Brightness/Contrast - If display seems to be too dim or hard to read
    - Press 'Temp' and 'Time' keys together for 3 seconds to enter adjustment display
    - Options listed will include 'Backlight' and 'Contrast'
    - Enter to make selection for adjustment, use up and down buttons to adjust, and press enter to save
- Version
  - Observe LUI while powering oven on
  - Factory Tech Mode
- Parameters
  - Factory Tech Mode

4.17 Motor, Oven Fan

Used in Oven Versions:

- DS, TS, TS2, TS3, A, B, C, D, E, F, G, H
- A (Countertop)

PART NUMBER: SP-5009D-75 (Used in: TS3, A, B, C, D, E, F, G, H)

SP-5016B-DS (Used in: DS, TS, TS2, TS3, A)

05-2-5016A34501.2-2 (Used in: A, Countertop)

How it works:

- The Main Motor for ovens without the variable frequency drive (VFD) option is a permanent split capacitor (PSC), single phase, dual voltage, capacitor run motor.
- The Main Motor for ovens with the VFD option is a 3 phase inverter rated motor.
- Both motors have an internal centrifugal switch, are thermally protected, and rotation is reversible. Both motors will continue to operate for approximately 30 minutes or until the oven temperature is less than 225 degrees Fahrenheit after the oven is turned off. There are no user serviceable parts in the motor, and the bearings are permanently lubricated.
- The Main Motor for **countertop** ovens will not utilize a centrifugal switch.

How to clean-replace-adjust-install:

Dust and debris will collect in the end bells of the motors, thereby reducing the air flow inside the motor. This will cause the motor to operate at a higher temperature, resulting in shorter life. As a good practice, any time anybody performs any work on the main motor, the end bells should be cleaned. The best method is by using compressed air. If compressed air is not available, then use a rag, brush, toothpick or something similar to remove the debris. Liquids should never be used.

Single Phase:

- When the capacitor fails during operation, the motor will continue to run. Current draw will be approximately 50% higher.
- On single fan units, when the capacitor fails before start-up, the motor will not spin. Current draw will be locked rotor amperage. The circuit breaker will likely trip.
- On 2 box units, if one capacitor fails the air pressure from the properly functioning fan can cause the failed motor to rotate in the wrong rotation.

(Fan Motor: Cont…)

(Fan Motor: Continued)

Three Phase:

- If one leg drops out during operation, the motor will continue to run. Current draw will be approximately 50% higher.
- On single fan units, when the leg drops out before start-up, the motor will not spin. Current draw will be locked rotor amperage. The circuit breaker will likely trip.
- On 2 box units, if one leg drops out the air pressure from the properly functioning fan can cause the failed motor to rotate in the wrong rotation.

4.17.1 Input Power

Tools required:

- VOM
- #2 Phillips Screwdriver
- Schematics Note: Refer to correct versions of schematics
    - Fan Motor Wiring Diagram
    - Oven Schematic

How to check:

- De-energize oven
- Remove Motor Cover
- Unplug Molex connector
- Place VOM leads on proper terminals
- Energize oven
- Record readings

(Fan Motor: Cont…)

(Fan Motor: Continued)

4.17.2 Motor Rotation

Rotation is determined by viewing the motor from the shaft end. If viewed from the opposite end, rotation will be opposite. The sticker placed above the fan motor on the backwall is only for reference while behind the oven.

How to check rotation:

- Tools required:
  - Zip Tie or Tie-Strap
- Remove motor cover
- Energize oven
- Slowly insert cable-tie through end bell until cable-tie contacts the motor's internal cooling fan
- Observe deflection

How to reverse rotation:

- Single Phase: Rewire per the Fan Motor Wiring Diagram
- Three Phase: Swap any two phases at the VFD

4.17.3 Mechanical Interference

Mechanical interference, noise, and/or vibration can be caused by multiple issues:

- Motor:
  - Worn Bearings
- Fan Blade:
  - Out of alignment
  - Out of balance

(Fan Motor: Cont…)

(Fan Motor: Continued)

- Foreign objects:
  - Return air plate
  - Shipping clip
  - Hand tools
- Fan Collar:
  - Not round
  - Floor not level
- Motor Mount:
  - Broken rivet
  - Loose or broken hose clamp

Noise and/or vibration can be apparent at start-up, or it can become apparent depending upon temperature. The Air Distorter in the plenum could be vibrating/rattling.

How to check for mechanical interference:

Note: Remove the Front Panel and a Finger to gain access to the fan blade if getting behind the oven is not possible

- Listen – Noise can be difficult to describe, and can be described in many different ways:
  - Growling
  - Squeaking
  - Loud banging
  - Rumbling
- Visual Inspection
  - Impact marks
  - Damaged surfaces or edges
  - Burrs
  - Remove Front Panel and lower Finger to gain access if getting behind the oven is not possible
- Flathead screwdriver in back of motor – should spin and coast freely

(Fan Motor: Cont…)

(Fan Motor: Continued)

How to fix mechanical interference:

- Worn bearings – Replace Motor
- Out of alignment – Shim Motor into position
- Out of balance – Replace Motor and Fan Blade
- Foreign Objects – Remove FOD and determine if further repair is needed
- Fan Collar is not round – Can Fan Collar be reformed whilst in the oven or does it need replaced
- Floor not level – Install ovens on level floor
- Motor Mount rivet broken – Replace rivets as needed
- Loose or broken hose clamp – Tighten or replace

(Fan Motor: Cont…)

4.17.4 Check Motor Windings

Applicable P/N: SP-5009D-75, and SP-5016B-DS

Tools required:

- Multi-meter

How to check:

- Remove all motor wires from crimp nuts
- Measure resistance between motor wires (between separate windings)
  - Wires 1 and 3 should not have continuity with infinite resistance. If continuity is shown, then replace motor.
  - Wires 1 and 5 should not have continuity with infinite resistance. If continuity is shown, then replace motor.
  - Wires 3 and 5 should not have continuity with infinite resistance. If continuity is shown, then replace motor.
  - All wires should not have continuity to the chassis of the motor or ground, and should have infinite resistance. If continuity is shown, then replace motor.
  - Wires 1 and 2 should have continuity with **varied** resistance. If resistance is infinite, then replace motor.
  - Wires 3 and 4 should have continuity with **varied** resistance. If resistance is infinite, then replace motor.
  - Wires 5 and C should have continuity with **varied** resistance. If resistance is infinite, then replace motor.

See drawing below of how the windings are wired:

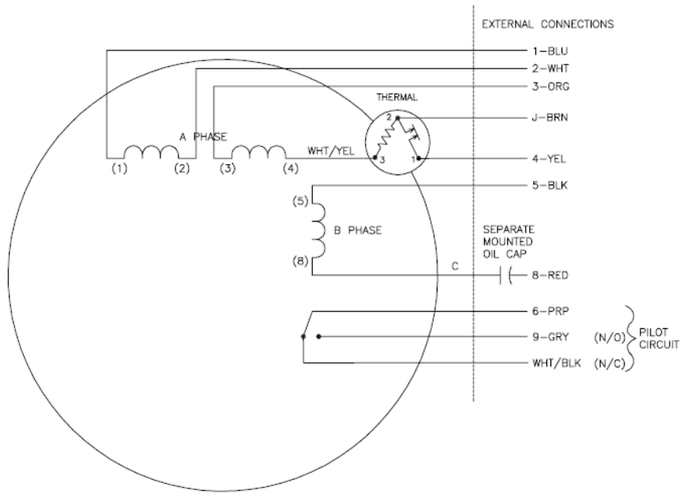


Figure 39 Motor Windings

4.18 Motor, Cooling Fan/FPPG

4.18.1 Hoods and Impingement Ovens, Gas

4.18.1.1 M2 – Motor – Cooling Fan

Note: This 120 VAC Cooling Fan may also be identified as "M2 - Motor – FPPG", "M3 - Motor – FPPG", or "M3 – Motor – Cooling Fan" per schematic

Used in Oven Versions:

- DS, TS, TS3, A, B, C, D, E

Used in Hood Versions:

- C, D

PART NUMBER: XP-4501-S

How it works: In ovens, the M2 Cooling Fan will be supplied 120 VAC via the Normally Open (NO) contact of the Cool Down Timer Relay (R1), while the neutral line is wired straight from incoming power via a Terminal Strip (TS). The Cooling Fan should run whenever the oven is switched on as well as for thirty minutes after the oven is switched off (see R1 – Cool Down Timer Relay). The Cooling Fan supplies the control box and its components with cool air, in turn providing combustion air for the burner.

In hoods, whenever an oven is switched ON and the VFD begins to run, the VFD will either send a control voltage or supply the common/ground to the cooling fan relay to switch to Normally Open (NO) and supply phase voltage to the cooling fans. Neutral voltage will be wired directly to the cooling fans from incoming power.

Tools required:

- Multi-meter

How to check:

- Visual/Audible
  - Damaged or Broken Wires
  - Damaged Fan Blades
  - Damaged Housing
  - Excessive Vibration
  - Ticking Noise

(Cooling Fan: Cont…)

(Hood and Impingement Gas Ovens Cooling Fan: Continued)

- Electrical – Refer to schematic specific to your version and model of oven or hood
  - Turn Fan/Oven Switch On
  - Should be 120 VAC across black wire leads

(Cooling/FPPG Fan: Cont…)

4.18.1.2 M3 – Motor, FPPG

Note: This 24 VDC FPPG Fan may also be identified as "M2 - Motor – Cooling Fan", "M3 – Motor – Cooling Fan" per schematic

Used in Oven Versions:

- F, G, H

Used in Hood Versions:

- E

PART NUMBER: XP-4501A-GA

How it works: In ovens, the FPPG Fan (M3) will be supplied with 24 VDC from the Power Supply (PS). The red wire lead from this FPPG Fan will be supplied +24 VDC from the Terminal Strip (TS) via the OMC. The black wire lead will tie into the -24VDC output side of the Power Supply via a Terminal Strip and thus connected to chassis ground.

In hoods, the Hood Machine Control (HMC) will output +24 VDC to the cooling fans any time an oven is turned ON and the VFD receives its MODBUS communication to run the exhaust fan.

Tools required:

- Multi-meter

How to check:

- Visual/Audible
  - Damaged or Broken Wire Leads
  - Damaged Fan Blades
  - Damaged Housing
  - Excessive Vibration
  - Ticking Noise
- Electrical
  - Turn Oven On
  - Should be 24 VDC across red and black wire leads

(Cooling/FPPG Fan: Cont…)

4.18.2 Impingement and Radiant Ovens, Electric

4.18.2.1 M2 – Motor – Cooling Fan

Note: This 208/240 VAC Cooling Fan may also be identified as "M3 - Motor – Cooling" per schematic

Used in Oven Versions:

- TS, TS2, A, B, C, D, E

PART NUMBER: XP-4501-EL

How it works: Electric ovens will **always** have two Cooling Fans. The M2 Cooling Fans will be supplied oven line voltage with one line wired from the Normally Open (NO) contact of the Cool Down Timer Relay (R1), while the other line is wired straight from incoming power via a Terminal Strip (TS). The Cooling Fan should run whenever the oven is switched on as well as for thirty minutes after the oven is switched off (see R1 – Cool Down Timer Relay). The Cooling Fan supplies the control box and its components with cool air, in turn providing combustion air for the burner.

Tools required:

- Multi-meter

How to check:

- Visual/Audible
  - Damaged or Broken Wire Leads
  - Damaged Fan Blades
  - Damaged Housing
  - Excessive Vibration
  - Ticking Noise
- Electrical
  - Turn Oven On
  - Should be 208/240 VAC across black wire leads (NOTE: Refer to Oven's data-plate for rated oven voltage)

(Cooling/FPPG Fan: Cont…)

4.18.2.2 M3 – Motor – Cooling Fan

Used in Oven Versions:

- F, G, H
- A (Radiant)

Used in Hood Versions:

- F

PART NUMBER: XP-4501B-EL (Used in Oven Versions: F)

XP-4501C-EL (Used in Oven Versions: G, H and A, Radiant and Hood Versions: F)

How it works: Electric ovens will **always** have two Cooling Fans. The Cooling Fan (M3) will be supplied with 24 VDC from the Power Supply (PS). The red wire lead from this FPPG Fan will be supplied +24 VDC from the Terminal Strip (TS) via the OMC. The black wire lead will tie into the -24VDC output side of the Power Supply via a Terminal Strip and thus connected to chassis ground. Hoods utilizing this component will provide power via HMC (P7) while ovens and exhaust fan are in operation.

Tools required:

- Multi-meter

How to check:

- Visual/Audible
  - Damaged or Broken Wire Leads
  - Damaged Fan Blades
  - Damaged Housing
  - Excessive Vibration
  - Ticking Noise
- Electrical
  - Turn Oven On
  - Should be 24 VDC across red and black wire leads

Note: There are retro-fit kits available to use the XP-4501C-EL fans in an F-version Electric oven (SP 4500D). The XP-4501C-EL is bigger than the XP-4501B-EL.

4.19 Conveyor Motors

4.19.1 M2 - Motor, Conveyor

Used in Oven Versions:

- TS3, A, B, C, D, E, F, G, H
- A (Radiant)
- A (Countertop)

PART NUMBER: SP-4117-12.5 RPM STD (Used in Oven Versions: TS3, A, B, C, D, E, H with Anaheim Conveyor Control)

XA-4117A-12.5 RPM STD (Used in Oven Versions: F, G, H with OMC)

05-2-4117A-25W-AA (Used in Oven Versions: A, Countertop with OMC)

Note: For our purposes, the Countertop conveyor motor is functionally identical to the conveyor motor used in larger oven models. The countertop motor will differ in size, shape, wattage rating, etc.

How it works: This Conveyor Motor is a brushless 24 VDC gear motor. The motor receives current from the Conveyor Control (CC) or Oven Machine Control (OMC) through three (3) wires; 1) a black or "W" phase, 2) a white or "V" phase, and 3) a red or "U" phase. Each phase will carry between 0-24 VDC. Each wire is energized by the control in sequence to provide power to the individual stator coils which in turn provide motor rotation. An internal Pick-Up Sensor with three Hall Effect switches is utilized to determine rotor position from a magnetic disc mounted on the rotor assembly. The Hall Effect switches react to the presence of the magnetic field's North and South poles to determine rotor position. The motor will signal rotor position through three (3) wires; 1) an orange "U" phase pole signal output, 2) a green "V" phase pole signal output, and 3) a green/white "W" phase pole signal output. The Pick-Up sensor will receive power via a purple and gray wire. The purple wire is for voltage and the gray wire is for ground. The direction of motor rotation can be changed through the programming of the controller being used.

Tools required:

- Multi-meter
- #2 Phillips Screwdriver

How to check:

- Visual
  - If motor is leaking oil/lubricant, then replace motor

(M2 – Conveyor Motor: Cont…)

(M2 – Conveyor Motor: Continued)

- Electrical
  - Turn oven ON
  - Voltage Input - Should be a low DC voltage measured from each power wire to chassis ground
    - Ovens utilizing an OMC will need to be tested prior to a Belt Jam Error state as this will shut off voltage output to the motor
    - Voltage reading should be consistent with all three power wires
  - DC Amperage – Should be **0.1A - 0.2A** measured from each power wire individually
    - If amperage is measured to be any higher (ex. **0.3A - 0.7A**), then remove drive chain and test again. If amperage remains high, then replace motor
    - If amperage drops to where it should be without the drive chain installed, then the conveyor belt may require maintenance, adjustment, or repair

(Conveyor Motors: Cont…)

4.19.2 M3 – Motor, Conveyor

Used in Oven Versions:

- DS, TS, TS2, TS3

PART NUMBER: SP-4117-05

SP-4117-19

How it works: This conveyor motor is powered with 0-90 VDC from the Conveyor Control. Changing motor rotation will be done by switching polarity to the motor, and XLT has facilitated this by supplying two connectors wired in parallel to each other and having the positive and negative DC voltage wired in opposite orientation from one another. A pulse generator will be mounted to the conveyor motor. The Pulse Generator receives +5 VDC from terminal 6 of the Conveyor Control, with a common wire from terminal 5. The pulse generator sends the pulse signal via a white wire applied to terminal 7 of the Conveyor Control. The 0-90 VDC output to the motor will be based on the set-time and model of oven; regulated by the pulse signal the controller receives back.

Tools required:

- Multi-meter

How to check:

- Visual
  - Motor
    - If motor is leaking oil/lubricant, then replace motor
    - If motor does not rotate, then tap on the sides of the motor. If this causes rotation of the motor, then check the brushes
  - Brushes
    - New brushes are approximately 9/16” long (SP-4118-Dayton-2)
    - Some brushes may show a brush wear indicator to show maximum allowable brush wear
    - Generally, if a brush is worn down to 1/4 of its original length, then replace the brush
    - Brushes should be free of burrs as these can restrict contact with the motor’s commutator, either file burrs off or replace brush
    - Brushes found to have chips broken off may indicate internal wear or damage of the motor’s commutator, in this case the motor may need to be replaced
  - Pulse Generator
- Electric
  - Turn Fan and Conveyor Switch On
  - Should be 0-90 VDC across red and black motor wire leads, polarity will depend upon desired motor rotation

4.20 M4 – Motor, Burner Blower

Used in Oven Versions:

- DS, TS, TS2, TS3, A, B (AE)

PART NUMBER: SP-4205A

How it works: The Burner Blower Motor (or **Combustion Blower Motor**) will receive 120 VAC with phase voltage passing through the Oven Fan Motor (M1) Centrifugal Switch (S5), while neutral voltage is wired straight from incoming power via a Terminal Strip (TS). The Burner Blower Motor provides air for combustion and generates a flow-path for the flame and heat into the back-wall cavity for the Oven Fan Motor to then distribute into the bake chamber. The Burner Blower Motor will utilize two circuits, the first already being described for incoming power, and the second being the internal centrifugal switch. The ignition control would have its incoming power routed through the Burner Blower Motor's Centrifugal Switch (S4) to prove rotation before allowing the burner to try to light. In early DS ovens utilizing an On/Off Solenoid Valve, this circuit included a Burner Blower Motor Relay (R2).

Tools required:

- Multi-meter
- #2 Phillips Screwdriver
- Flathead Screwdriver

How to check:

- Visual
  - Turn Fan and Burner Switch ON
  - Should observe motor rotation either through air shutter or air vents
  - Air shutter is typically set at 2 for all oven models, except for double-burner ovens (xx70) where the shutter was set at 1-3/4 on either side
- Electrical
  - Incoming Power – Should be 120 VAC across black and white motor wire leads
  - Centrifugal Switch – Should be the same voltage measured on either of the red motor wire leads to ground **(Note: Refer to the schematic for each incident)**
    - Voltage should be 24 VAC

4.21 OMC – Oven Machine Control

4.21.1 Impingement Ovens, Gas and Electric

4.21.1.1 OMC1 – Oven Machine Control, Main

Used in Oven Versions:

- F, G, H

PART NUMBER: XP-4175A-MC

How it works: The Oven Machine Control reads selections or parameters from the LUI. It holds the logic for the conveyor controls and the temperature controls. The OMC will either turn the gas valve (V2) on/off or turn the Solid State Relays (SSRs) on/off via P11-2, start and stop M1, send the call for heat signal, and read the thermocouple.

Note: Software version 38 or newer will monitor Main Fan Motor amperage from the Current Sensor (CS) to be within range before it will sustain +24 VDC from P4-3.

Here's what it should look like:

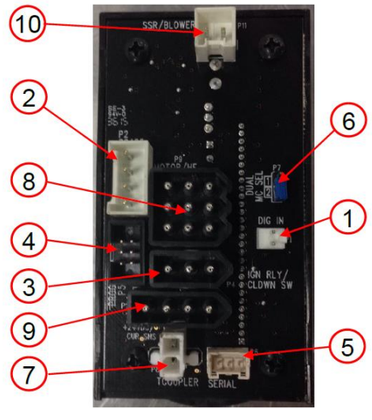
Oven Machine Control LED's

LED's Status

1. Power - Green (Illuminated when oven has power)
2. Conveyor - Green (Illuminated when conveyors are active)
3. Heat - Green (Illuminated when the gas valve receives power)
4. Main Fan - Green (Illuminated when fan is spinning)
5. Cool Down - Green (Illuminated when oven is in cool down mode)
6. Alarm - Red (Illuminated when an alarm is tripped)

(All LED's on for reference)

Figure 40 OMC LEDs



1) P1- Not Used - Digital Input
2) P2- RS-485 Cable To LUI
   1) +5V
   2) 485-
   3) 485+
   4) Ground
3) P4-Molex provided with harness
   1) +24 Remote Switch
   2) +24 Power (In) Switch
   3) Relay +24 Switched (Out)
4) P5- Elan Programming
5) P6- Elan Serial Port
6) P7- Jumper For OMC 1 or 2
7) P8- Thermocouples
   1) Red (-)
   2) Yellow (+)
8) P9- Conveyor Motor
   1) Motor SA
   2) Motor SB
   3) Motor SC
   4) Hall +5V
   5) Hall HC+
   6) Hall HB+
   7) Hall HA+
   8) Ground
   9) Not Used
9) P10-Molex provided with harness
   1) Current Sensor
   2) Current Sensor
   3) 24 VDC(-) Main Power
   4) 24 VDC(+) Main Power
10) P11-Molex provided with harness
   1) +24 VDC To R1/VFD
   2) -24 VDC Ground to Gas Valve V2

Figure 41 OMC Connections

(Impingement OMC: Cont…)

(Impingement OMC: Continued)

Tools required:

- VOM

How to check:

- ELECTRICAL FUNCTION
  - Inputs
    - Power Inputs
      - **WITHOUT HOOD:** SRC Signal Voltage – At P4, pin 1 to ground should be 24 VDC when the oven is plugged in
      - Ignition Relay COM – At P4, pin 2 to ground should be 24 VDC when the oven is plugged in
      - At P10, across pins 3 & 4, should be 24 VDC with pin 4 being positive when the oven is plugged in
    - Signal Inputs
      - At P2, pins 2 & 3 are CANBUS communications from the LUI
      - **WITH HOOD** – Oven ON Signal – At P4, pin 1 to ground should be 24 VDC when the oven is switched on via hood
      - Thermocouple – At P8, across pins 1 & 2, should be a varying DC millivolt signal from the thermocouple – See Thermocouple Chart
      - Conveyor Motor Speed – At P9, across pins 5, 6, & 7, should be Hall Effect signals from the conveyor motor pickup sensors
      - Fan Motor Amperage – At P10, across pins 1 & 2, should be a signal from the current sensor
  - Outputs
    - Power Outputs
      - LUI Power – At P2, across pins 1 & 4, should be 5 VDC with pin 1 being positive when the oven is plugged in
      - Ignition Relay NO – At P4, pin 3 to ground should be 24 VDC about 0:03 seconds after oven is turned on, **OR** once the Fan Motor Amperage is established and within range – Check for software version 38 or newer
      - Conveyor Motor Power – At P9, across pins 1, 2, & 3 should be a varying voltage and varying frequency three-phase power out to the conveyor motor
      - Pick-Up Power – At P9, pin 4 to ground should be 5 VDC when the oven is turned on
      - Fan Motor Relay Control Voltage – At P11, pin 1 to ground should be 24 VDC when the oven is turned on
    - Signal Outputs
      - At P2, across pins 2 & 3 are CANBUS communications to the LUI
      - At P11, pin 2 to TS2-3 (Terminal Strip 2, position 3)
        - Should read 24 VDC when #3 heat LED is ON
        - Should read 0 VDC when #3 heat LED is OFF

(Impingement OMC: Cont…)

(Impingement OMC: Continued)

- VERSION
  - Factory Tech Mode
- PARAMETERS
  - Factory Tech Mode

4.21.1.2 OMC2 – Oven Machine Control, Split-Belt and 2nd Burner

Used in Oven Versions:

- F, G, H

How it works: OMC2 will function just as OMC1 but will only be used in models of oven that either have two burners or a split belt utilizing two conveyor motors. The OMC is designated as being either OMC1 or OMC2 by the P7 jumper located on the back of the control. The P7 jumper is blue in color and will have only two positions available to be installed across three contact pins. The P7 jumper being installed across the top two pins will designate it as MC1, while being installed across the bottom two pins will designate it as MC2 (see image below).

Figure 42 OMC P7 Jumper

Tools required:

- Multi-meter

How to check:

- Electrical **(Double Burner and Split-Belt)**
  - All checks will be the same as OMC1, see above

- Electrical **(Split-Belt only)**
  - Input
    - Power
      - **WITHOUT HOOD** – At P4, pin 1 to ground should be 24 VDC when the oven is plugged in
      - At P10, across pins 3 & 4, should be 24 VDC with pin 4 being positive when the oven is plugged in
    - Signal
      - At P2, pins 2 & 3 are CANBUS communications to the LUI
      - **WITH HOOD** – At P4, pin 1 to ground should be 24 VDC when the oven is switched on via hood
      - At P9, across pins 5, 6, & 7, should be Hall Effect signals from the conveyor motor pickup sensor

(Impingement OMC: Cont…)

(Impingement OMC: Continued)

- Output
  - Power
    - At P2, across pins 1 & 4, should be 5 VDC with pin 1 being positive when the oven is plugged in
    - At P9, across pins 1, 2, & 3 should be a varying voltage and varying frequency three-phase power out to the conveyor motor
  - Signal
    - At P2, across pins 2 & 3 are CANBUS communications to the LUI

- Electrical **(Double Burner only)**
  - Inputs
    - Power Inputs
      - **WITHOUT HOOD** – At P4, pin 1 to ground should be 24 VDC when the oven is plugged in
      - At P4, pin 2 to ground should be 24 VDC when the oven is plugged in
      - At P10, across pins 3 & 4, should be 24 VDC with pin 4 being positive when the oven is plugged in
    - Signal Inputs
      - At P2, pins 2 & 3 are CANBUS communications to the LUI
      - WITH HOOD – At P4, pin 1 to ground should be 24 VDC when the oven is switched on via hood
      - At P8, across pins 1 & 2, should be a varying DC millivolt signal from the thermocouple – See Thermocouple Chart
      - At P10, across pins 1 & 2, should be a signal from the current sensor
  - Outputs
    - Power Outputs
      - At P2, across pins 1 & 4, should be 5 VDC with pin 1 being positive when the oven is plugged in
      - At P4, pin 3 to ground should be 24 VDC about 0:03 seconds after oven is turned on, **OR** once the Fan Motor Amperage is established and within range , check for software version 38 or newer
      - At P9, pin 4 to ground should be 5 VDC when the oven is turned on
      - At P11, pin 1 to ground should be 24 VDC when the oven is turned on
    - Signal Outputs
      - At P2, across pins 2 & 3 are CANBUS communications to the LUI
      - At P11, pin 2 to TS2-3 (Terminal Strip 2, position 3)
        - Should read 24 VDC when #3 heat LED is ON
        - Should read 0 VDC when #3 heat LED is OFF

(Impingement OMC: Cont…)

(Impingement OMC: Continued)

- VERSION
  - Factory Tech Mode
- PARAMETERS
  - Factory Tech Mode

Note: If an OMC was just replaced and the oven displays a Comm. Error, check the P7 jumper

(OMC: Cont…)

4.21.2 Radiant Ovens, Electric

Used in Oven Versions:

- A (Radiant)

PART NUMBER: RP-4175A-MC

How it works: Radiant ovens **always** utilize two (2) Oven Machine Controls (OMCs). OMC1 and OMC2 will be designated by the P7 jumper (see Figure 42). The Oven Machine Control reads selections or parameters from the LUI. It holds the logic for the conveyor controls and the temperature controls. OMC1 controls the oven's top Heating Elements while OMC2 controls the oven's bottom Heating Elements. The OMCs control the Heating Elements with a 24 VDC control voltage it delivers to the Solid State Relays (SSRs). Upon turning the oven on, OMC1 will simultaneously send +24 VDC to SSR2 and ground SSR1 from P11 (see Figure 44). OMC2 will simultaneously send +24 VDC to SSR4 and ground SSR3 from P11. Each heating element will have its own Thermocouple (T/C) connected to a Thermocouple Module (TCM). The TCM will interconnect with the LUI and OMCs via RS-485 cables to communicate the temperatures of the Heating Elements for the LUI to display.

Here's what it should look like:

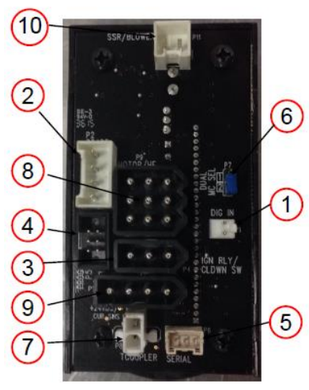
Oven Control LED's

LED's Status:

1. Power - Green (Illuminated when oven has power)
2. Conveyor - Green (Illuminated when conveyors are active)
3. Heat - Green (Illuminated when the SSR receives power)
4. Self Clean - Green (Illuminated when oven is in self cleaning mode)
5. Cool Down - Green (Illuminated when oven is in cool down mode)
6. Alarm - Red (Illuminated when an alarm is tripped)

(All LED's on for reference)

Figure 43 OMC LEDs (Radiant)



1) P1- Not Used - Digital Input
2) P2- RS-485 Cable To LUI
   1) +5V
   2) 485-
   3) 485+
   4) Ground
3) P4-Molex Provided With Harness
   1) +24 Remote Switch
   2) +24 Power (In) Switch
   3) Relay +24 Switched (Out)
4) P5- Elan Programming
5) P6- Elan Serial Port
6) P7- Jumper For OMC 1 or 2
7) P8- Not Used—Thermocouples
8) P9- Conveyor Motor
   1) Motor SA
   2) Motor SB
   3) Motor SC
   4) Hall +5V
   5) Hall HC+
   6) Hall HB+
   7) Hall HA+
   8) Ground
   9) Not Used
9) P10- Molex Provided With Harness
   1) Not Used
   2) Not Used
   3) 24 VDC(-) Main Power
   4) 24 VDC(+) Main Power
10) P11- JST Provided With Harness
   1) +24 VDC To SSR
   2) -24 VDC Ground To SSR

Figure 44 OMC Connections (Radiant)

4.21.2.1 OMC1 – Oven Machine Control, Main

Tools required:

- Multi-meter

(Radiant OMC: Cont…)

(Radiant OMC: Continued)

How to check:

- ELECTRICAL FUNCTION
  - Inputs
    - Power Inputs
      - At P4, pin 1 to ground should be 24 VDC when the oven is plugged in
      - At P4, pin 2 to ground should be 24 VDC when the oven is plugged in
      - At P10, across pins 3 & 4, should be 24 VDC with pin 4 being positive when the oven is plugged in
    - Signal Inputs
      - At P2, pins 2 and 3 are CANBUS communications to the Thermocouple Module (TCM) and Large User Interface (LUI)
      - At P9, across pins 5, 6, and 7, should be Hall Effect signals from the conveyor motor pickup sensors
  - Outputs
    - Power Outputs
      - At P2, across pins 1 and 4, should be 5 VDC with pin 1 being positive when the oven is plugged in
      - At P4, pin 3 to ground should be 24 VDC about 0:03 seconds after oven is turned on
      - At P9, across pins 1, 2, and 3 should be a varying voltage and varying frequency three-phase power out to the conveyor motor
      - At P9, pin 4 to ground should be 5 VDC when the oven is turned on
    - Signal Outputs
      - At P2, across pins 2 & 3 are CANBUS communications to the Thermocouple Module and Large User Interface
      - At P11, pin 2 to TS1-1 (Terminal Strip 1, position 1)
        - Should read 24 VDC when #3 heat LED is ON
        - Should read 0 VDC when #3 heat LED is OFF
      - At P11, pin 1 to ground
        - Should read 24 VDC when #3 heat LED is ON
        - Should read 0 VDC when #3 heat LED is OFF
- VERSION
  - Factory Tech Mode
- PARAMETERS
  - Factory Tech Mode

(Radiant OMC: Cont…)

4.21.2.2 OMC2 – Oven Machine Control, Auxiliary and Optional Split-Belt

Tools required:

- Multi-meter

How to check:

- ELECTRICAL FUNCTION
  - Inputs
    - Power Inputs
      - At P4, pin 1 to ground should be 24 VDC when the oven is plugged in
      - At P10, across pins 3 & 4, should be 24 VDC with pin 4 being positive when the oven is plugged in
    - Signal Inputs
      - At P2, pins 2 and 3 are CANBUS communications to the Thermocouple Module (TCM) and Large User Interface (LUI)
      - WITH SPLIT-BELT – At P9, across pins 5, 6, and 7, should be Hall Effect signals from the conveyor motor pickup sensors
  - Outputs
    - Power Outputs
      - At P2, across pins 1 and 4, should be 5 VDC with pin 1 being positive when the oven is plugged in
      - WITH SPLIT-BELT – At P9, across pins 1, 2, and 3 should be a varying voltage and varying frequency three-phase power out to the conveyor motor
      - WITH SPLIT-BELT – At P9, pin 4 to ground should be 5 VDC when the oven is turned on
    - Signal Outputs
      - At P2, across pins 2 & 3 are CANBUS communications to the Thermocouple Module and Large User Interface
      - At P11, pin 2 to TS1-1 (Terminal Strip 1, position 1)
        - Should read 24 VDC when #3 heat LED is ON
        - Should read 0 VDC when #3 heat LED is OFF
      - At P11, pin 1 to ground
        - Should read 24 VDC when #3 heat LED is ON
        - Should read 0 VDC when #3 heat LED is OFF
- VERSION
  - Factory Tech Mode
- PARAMETERS
  - Factory Tech Mode

4.22 Orifice

Used in Oven Versions:

- DS, TS, TS2, TS3, A, B, C, D, E, F, G, H

How it works: Orifices are used in gas applications to control how much fuel is allowed to flow to the flame. These orifices will vary in appearance depending upon the application they are used for. The actual orifice size will depend on the version and model of oven they are to be used in as well as the intended fuel. One cubic foot of Natural Gas will generate about 1,012 BTUs where one cubic foot of Propane will generate about 2,520 BTUs. Simply put, propane burns hotter than natural gas. Knowing this, it can be safe to assume all Propane orifices to be smaller in size in contrast to the Natural Gas orifices. See the varied applications below.

Note: If the wrong orifices sizes are used with the wrong fuel you can experience either over temp or under temp scenarios.

4.22.1 Bypass Orifice

Used in Oven Versions:

- F, G, H

PART NUMBER: XP-4216A-N (Natural Gas)
XP-4216A-P (Propane)

How it works:

- When the burner reaches the set point temperature, the OMC will drop the gas valve into its low flame output state. The V2 plunger closes the main outlet of the valve and forces fuel to flow through the Bypass Orifice.
- The Bypass Orifice is mounted internal to the valve body opposite of the lower pressure testing port. This controls the amount of fuel allowed to flow through the burner while the valve is in its low flame output state.
- There is either **A.)** a threaded bypass orifice under a cap on the opposite side of the bottom pressure testing port, or **B.)** a threaded stem with a flathead end to adjust bypass pressure (see V1/V2 On/Off Gas Valve)

A.)

Figure 45 Bypass Orifice

B.)

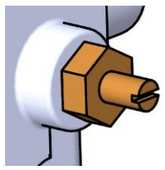


Figure 46 Adjustable Bypass

- The Adjustable Bypass can NOT be retro-fit in gas valves that utilize a Bypass Orifice

(Orifices: Cont…)

(Bypass Orifice: Continued)

Previously Observed New Install Issue:

- If burner flame is consistently lost when reaching set-point, check Bypass Orifice to be clogged **OR** check Adjustable Bypass to need adjusted (See Gas Valve On/Off)

Note: If the wrong orifice sizes are used with the wrong fuel you can experience either over temp or under temp scenarios.

4.22.2 Main Orifice

Used in Oven Versions:

- DS, TS, TS2, TS3, A, B, C, D, E, F, G, H

PART NUMBER: XP-4209-XXXX-SQ

How it works: The Main Orifice is mounted on the outlet side of the gas valve or at the burner end of the gas train on applicable version (DS, TS-Piloted). The Main Orifice is specific to the model (size) of oven as well as the type of fuel to be used, and this controls the amount of fuel allowed to flow to the burner. Refer to the Installation & Operation manual specific to the version of oven you are working on.

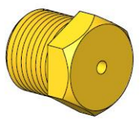


Figure 47 Main Orifice

Previously Observed New Installation Issue:

- If burner reaches set point temperature but takes longer than it should, or has trouble maintaining temperature while baking product, then check Main Orifice to be correct size (refer to Installation and Operation Manual)

(Orifices: Cont…)

4.22.3 Pilot Orifice

Used in Oven Versions:

- DS, TS, TS2

PART NUMBER: SP-4227A (Natural Gas)

SP-4228A (Propane)

How it works: The pilot orifice will be found in the Flame Sensor/Spark Igniter (FS/SI) behind the pilot gas line fitting. The Pilot Orifice will control the volume of fuel allowed to the pilot flame. The Pilot Orifice will have a specific size for use with natural gas versus propane. The natural gas igniter will use a BCR-24 orifice size. The propane igniter will use a BCR-18 orifice size. The Pilot Orifice would be included in the Flame Sensor/Spark Igniter (FS/SI), and not sold separately.

4.23 Plug, Switch Relocation Cord

Used in Oven Versions:

- TS, TS2, TS3, A, B, C, D, E, F, G, H

Used in Hood Versions:

- A, B, C, D, E

PART NUMBER: XW-1135 (Plug)

XW-1113 (Socket Terminal)

How it works: The Switch Relocation Cord (SRC) will include a plug to connect to the hood system. The plug is a keyed twist-lock plug that can only be installed one way. Sometimes after repeatedly being removed and re-installed the Molex terminals can be pushed back in the connector and fail to make contact, resulting in an interruption in the circuit.

How to check – VISUAL:

- Turn Equipment OFF
- Turn plug's outer shell counter-clockwise until released
- Observe terminals being flush to the end of the connection side of the plug

4.24 PS – Power Supply

Used in Oven Versions:

- TS3, A, B, C, D, E, F, G, H

PART NUMBER: SP-4717A

Note: The original Power Supply, shown below, has been discontinued and is no longer available. The kit listed above (SP-4717A) includes a mount and harness needed to install current power supply.

Here's how it should look like:

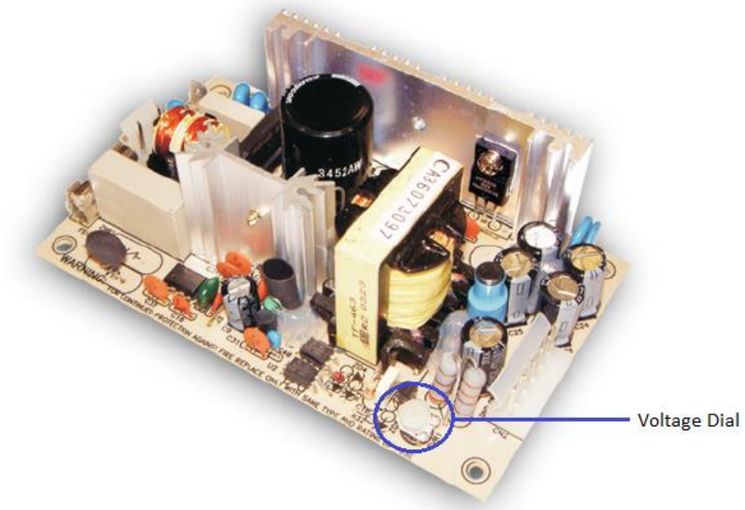


Figure 48 Power Supply

How it works: The Power Supply rectifies line voltage to 24 VDC, and supplies power to all 24 VDC components. Depending upon version, a 4-amp fuse may or may not be included to provide over current protection, which is mounted on the PS itself. The PS also has internal current limiting on the output side. There is a dial on the output side of the board to regulate DC voltage output as well.

(PS – Power Supply: Cont…)

(PS – Power Supply: Continued)

Tools required:

- VOM

How to check:

- Visual
  - Voltage Dial mounted on Power Supply (PS) board varies output voltage between 21-28 VDC (See Figure 48)
    - To increase, CW
    - To decrease, CCW
- Inputs
  - Disconnect wires
  - Measure voltage at plug, should be Oven Line Voltage
- Outputs
  - Disconnect wires
  - Measure voltage at terminals, should be 24 VDC

4.25 PU – Pick Up

Used in Oven Versions:

- TS3, A, B, C, D, E, F, G, H
- A (Radiant)
- A (Countertop)

PART NUMBER: See M2 – Motor, Conveyor

How it works: An internally mounted Pick-Up Sensor with three Hall Effect switches is utilized to determine rotor position from a magnetic disc mounted on the rotor assembly. The Hall Effect switches react to the presence of the magnetic field's North and South poles to determine rotor position. The motor will signal rotor position through three (3) wires; 1) an orange "U" phase pole signal output, 2) a green "V" phase pole signal output, and 3) a green/white "W" phase pole signal output. The Pick-Up sensor will receive power via a purple and gray wire. The purple wire is for voltage and the gray wire is for ground.

How to check – ELECTRIC:

- Input
  - Turn oven ON
  - Should be about 5 VDC as measured across purple and gray wire leads

4.26 PU – Pulse Generator

Note: May be referred to as a Pick Up.

Used in Oven Versions:

- DS, TS, TS2, TS3

PART NUMBER: SP-4120

How it works: The Pulse Generator utilizes a Hall-Effect transistor mounted in place while a magnet moves with the rotation of the motor. As the magnet's north-pole crosses the Hall-effect transistor, then it gives a high signal. As the magnet's south-pole crosses the Hall-effect transistor, then the signal is switched off. The result is a square wave whose frequency is proportional to the speed of the shaft that the Pulse Generator is mounted to. The PU will receive +5 VDC via a red wire, and will have a black wire for common or ground. The pulse signal is transmitted via a white wire.

How to check:

- **Visual**
    - Blue housing should rotate freely around its bearing and motor shaft it is mounted to
        - Mounting screw must not be over-tightened
        - Mounting screw must not be too loose
        - If conveyor seems to run at one speed, or runs at full speed, then check that your mounting screw is snug but not too tight or loose
            - Compare to another oven in operation if needed and applicable
- **Electric**
    - Power – Should be 5 VDC across red and black wire leads, supplied from Dart Conveyor Control
    - Pulse Signal – Should be around 3 VDC pulsating as measured across the white and black wire leads

4.27 REC – Receptacle, Power

Used in Hood Versions:

- A, B, C, D, E

PART NUMBER: HP-2054

How it works: The power receptacle is a NEMA 5-20R which includes a T-shaped neutral hole to accept either 5-15P or 5-20P plugs. The power plug utilized in domestic gas ovens would be a NEMA 5-15P plug. The receptacle is rated for 125 VAC and 20 Amps, and will specifically be used with domestic gas ovens. The receptacle will be factory-wired to the Terminal Strip (TS) of the hood for ease of installation.

How to check – ELECTRIC:

- **Continuity**
  - All three holes of the plug should not contain continuity between one another
  - Check bottom hole (ground hole) to have continuity to the chassis of the hood
- **Voltage** – Under Normal Operation
  - Should be 120 VAC across the two top rectangular holes

4.28 REC – Receptacle, Switch Relocation Cord

Used in Hood Versions:

- A, B, C, D, E

PART NUMBER: SP-1115 (Includes Wiring)

How it works: The Switch Relocation Cord Plug is to be installed to the Switch Relocation Cord Receptacle. The receptacle is keyed and the plug can only be installed one way.

How to check – ELECTRIC:

- Turn corresponding oven switch ON, or turn corresponding Hood User Interface (HUI) button ON
  - A – D Version Hoods
    - Should have continuity between pins 1 and 2
    - Should have continuity between pins 1 and 4
  - E Version Hood
    - Should have continuity between pins 1 and 4

4.29 Relays

4.29.1 R1 – Relay, Cool Down Timer

Used in Oven Versions:

- DS, TS, TS2, TS3, A, B, C, D, E, H

PART NUMBER: XP-4704-120 Volt

XP-4704-230 Volt

How it works: In Domestic Gas ovens, the Cool Down Timer Relay will receive 120 VAC power with phase voltage wired to terminal T11, while neutral voltage is wired to terminal T3. Domestic Electric ovens will have two phases of a 208/240 VAC three phase supply wired across T11 and T3. Terminal T6 acts as an initiate switch to change the relay from the normally closed (NC) position to the normally open (NO) position. The oven's Fan Switch or Main Switch, when turned on, will supply phase voltage to terminal T6 to then send phase voltage through the normally open position to energize the Oven Fan Motor (M1) and Cooling/FPPG Fan. Early DS and TS ovens will also have the Temperature Control (TC) wired for phase voltage power from the normally open (NO) position (refer to schematic specific to version and model of oven you are working on). When the oven is switched off then T6 will no longer have phase voltage supplied to it and this will start the thirty-minute timer for the relay to switch from normally open (NO) to normally closed (NC). This function acts as a cool down function to keep the Oven Fan Motor and Cooling/FPPG Fan running after the oven is switched off.

Here's what it should look like:

Figure 49 Cool Down Timer

(Cool Down Relay: Cont…)

(Cool Down Relay: Continued)

Tools required:

- Multi-meter
- #2 Phillips Screwdriver

How to check:

- Electrical
  - Oven Switch OFF (Fan or Main)
    - Power – Should be 120 VAC or 208/240 VAC across terminals T11 and T3
    - (NC) Output – Should be 120 VAC or 208/240 VAC across terminals T8 (NC) to T3
  - Oven Switch ON (Fan or Main)
    - Power – Should be 120 VAC or 208/240 VAC across terminals T11 and T3
    - Control Voltage – Should be 120 VAC or 208/240 VAC across terminals T6 to T3
    - (NO) Output – Should be 120 VAC or 208/240 VAC across terminals T9 (NO) to T3
- Failure Conditions/Observations
  - The oven's Conveyor Control illuminates and the Conveyor Motor turns but no other components come on after the oven is switched on (and sometimes the Temperature Control; refer to schematic specific to the oven you are working on)
    - Turn Oven Switch(es) OFF
    - Unplug Oven from Outlet
    - Change wires on R1 from terminal T9 (NO) to terminal T8 (NC)
    - Plug Oven into Outlet
    - When the oven is plugged in, the Oven Fan Motor and Cooling/FPPG Fan should come on without turning the Oven Switch ON (and sometimes the Temperature Control)
    - If so, replace the Cool Down Timer Relay
  - There is a delay for the Oven Fan Motor **and** Cooling/FPPG Fan to come on after the oven is switched on (and sometimes the Temperature Control)
  - The Oven Fan Motor **and** Cooling/FPPG Fan do not stay on for thirty minutes after the oven is switched off

(Relays: Cont…)

4.29.2 R1 – Relay, Cooling Fans

Used in Hood Versions:

- C

PART NUMBER: HP-2056A

How it works: Any time the VFD is running the exhaust fan it will output 120 VAC phase voltage from terminal AL1 to the Cooling Fan Relay to then supply 120 VAC phase voltage to the Cooling Fans.

Tools required:

- Multi-meter
- #2 Phillips Screwdriver

How to check – ELECTRIC:

- Continuity
  - Remove wires from terminals Common (COM) and Normally Open (NO)
  - Should have continuity between COM and NC any time the VFD and exhaust fan are at rest
  - Turn an oven ON
  - Should have continuity between COM and NO any time the VFD is running the exhaust fan
- Control Voltage
  - Turn an oven ON
  - Should be 120 VAC across terminals A and B any time the VFD is running the exhaust fan (See VFDs)

(Relays: Cont…)

4.29.3 R1 – Relay, Cooling Fans/MUA

Used in Hood Versions:

- D

PART NUMBER: HP-2067A-24VDC

How it works: Any time the VFD is running the exhaust fan the VFD will supply a common/ground from terminal 11 to the Cooling Fan Relay to switch to its Normally Open (NO) contacts to then supply 120 VAC phase voltage to the Cooling Fans. At the same time, R1 will send a Damper Output for Make-up Air (MUA) activation. Additional MUA would be wired to the middle and bottom oven switches in this case.

How to check – ELECTRIC:

- Continuity
  - Remove wires from terminals 6 and 8, as well as 2 and 4
  - Should have continuity between terminals 7 and 8, as well as terminals 3 and 4 any time the VFD and exhaust fan are at rest
  - Turn an oven ON
  - Should have continuity between terminals 6 and 8, as well as 2 and 4 any time the VFD is running the exhaust fan
- Control Voltage
  - Turn an oven ON
  - Should be 24 VDC across terminals A and B any time the VFD is running the exhaust fan (See VFDs)

(Relays: Cont…)

4.29.4 R1 – Relay, Fire Suppression Relay

Used in Hood Versions:

- E

PART NUMBER: HP-2067A-24VDC

How it works: The R1 relay's coil will be wired for +24 VDC from the Fire Suppression system's micro-switch's Normally Open (NO) contact while the other contact of the coil is wired directly to the ground bar. Receiving 24 VDC to the relay's coil will switch the relay to its Normally Open (NO) contacts, thus sending +24 VDC to terminal 5 of the VFD via the Time Delay Relay (R2) which will run the exhaust fan at 60 Hertz.

Tools required:

- Multi-meter
- #2 Phillips Screwdriver

How to check – ELECTRIC:

- Normal Operation
  - Continuity
    - Check for continuity across terminals 7 and 8. Should have continuity any time under normal operation
    - Check for continuity across terminals 3 and 4. Should have continuity any time under normal operation
  - Voltage
    - Should be +24 VDC at terminal 8 as measured against chassis ground
    - Should be +24 VDC at terminal 7 as measured against chassis ground
- Fire Suppression is Activated
  - Continuity
    - Check for continuity across terminals 6 and 8. Should have continuity any time the Fire Suppression system is activated
    - Check for continuity across terminals 2 and 4. Should have continuity any time the Fire Suppression system is activated
  - Voltage
    - Should be 24 VDC across terminals 0 and 1
    - Should be +24 VDC at terminal 8 as measured against chassis ground
    - Should be +24 VDC at terminal 6 as measured against chassis ground

(Relays: Cont…)

4.29.5 R1 – Relay, Oven Fan Motor

Used in Oven Versions:

- F, G, H

PART NUMBER: HP-2067A-24VDC

How it works: Phase voltage for the Oven Fan Motor will be wired through the Oven Fan Motor Relay's normally open (NO) contact. This relay is activated by 24 VDC with the +24 VDC being wired from OMC P11-1 while the -24VDC is wired straight from the Terminal Strip (TS). The OMC will release the +24 VDC control voltage any time the oven is switched on and until the oven reaches the factory-set cool-down temperature of 225°F upon being switched off. The Oven Fan Motor Relay has two sets of contacts, so if one fails, the other can be utilized in lieu of a replacement.

Tools required:

- Multi-meter
- #2 Phillips Screwdriver

How to check – ELECTRIC:

- Continuity
  - Check for continuity across terminals 3 and 4. Should have continuity any time the oven is switched off and has completed its cool-down function
  - Turn Oven ON
  - Check for continuity across terminals 2 and 4. Should have continuity any time the oven is switched on as well as throughout its cool-down function
- Control Voltage
  - Turn Oven ON
  - Should be 24 VDC across terminals 0 and 1

(Relays: Cont…)

4.29.6 R1/R2/R3 – Relay, Damper

Note: The Damper Relays may be labeled as "R4 – Relay, Damper", "R5 – Relay, Damper", and "R6 – Relay, Damper".

Used in Hood Versions:

- A, B, C, D

PART NUMBER: HP-2056B-120VAC

How it works: The damper relays will be supplied 120 VAC to their coil once their corresponding oven switch has been turned ON. The 120 VAC being present across terminals A and B will switch the relay contact to its normally open (NO) position, and consequently send the Damper Outputs. The neutral line would be wired directly from incoming power to the other contact of the coils.

Tools Required:

- Multi-meter

How to check – ELECTRIC:

- Oven(s) OFF
  - Should have continuity across terminals Common (COM) and Normally Closed (NC)
- Oven(s) ON
  - Should have 120 VAC across terminals A and B
  - Should have continuity across terminals COM and Normally Open (NO)

(Relays: Cont…)

4.29.7 R2 – Relay, Burner Motor

Used in Oven Versions:

- DS

How it works: The relay receives 24 VAC directly from the Transformer (XFMR), upon receiving this voltage the relay will engage to supply 120 VAC phase voltage to the Burner Blower Motor from this relay's normally open (NO) contact.

Tools Required:

- Multi-meter

How to check - ELECTRIC:

- Input
  - Ensure all oven switches are ON
  - Should be 24 VAC across yellow wires
  - Should be 120 VAC across one orange wire to chassis ground
- Output
  - Ensure all oven switches are ON
  - Should be 120 VAC across the other orange wire to chassis ground

(Relays: Cont…)

4.29.8 R2 – Relay, Fire Suppression, Exhaust Fan

Used in Hood Versions:

- C, D

PART NUMBER: HP-2056A (Used in Oven Version: C)

HP-2056B-120VAC (Used in Oven Version: D)

How it works: The R2 relay's coil will be wired for 120 VAC phase voltage from the Fire Suppression system's micro-switch's Normally Open (NO) contact while neutral voltage will be directly wired from incoming power. When the relay's coil is energized then the relay will switch to its Normally Open (NO) contact to then supply a +24 VDC voltage to the VFD signaling it to run the exhaust fan at full speed.

Tools required:

- Multi-meter

How to check – ELECTRIC:

- Normal Operation – when the Fire Suppression System is not activated
  - Should have continuity across terminals Common (COM) and Normally Closed (NC)
  - Should not have 120 VAC across terminals A and B
- Fire Suppression is activated
  - Should have continuity across terminals COM and Normally Open (NO)
  - Should be 120 VAC across terminals A and B

(Relays: Cont…)

4.29.9 R2 – Relay, Oven Ignition Control

Used in Oven Versions:

- H

PART NUMBER: HP-2067A-24VDC

How it works: The Oven Ignition Control Relay (R2) will accept 24 VDC onto its coil from the Golander Temperature Control as long as the actual temperature is below the high alarm setting, and once this is received the relay will switch to its Normally Open (NO) contact to send 120 VAC phase voltage to the Ignition Control to begin the pre-purge/ignition sequence.

How to check – ELECTRIC:

- Input
  - Should be 24 VDC across terminals 0 and 1 with terminal 1 being +24 VDC
  - At terminal 2, should be 120 VAC as measured against chassis ground or neutral
- Output
  - At terminal 4, should be 120 VAC as measured against chassis ground or neutral anytime the oven is under 600°F

(Relays: Cont…)

4.29.10 R3 – Relay, Fire Suppression, Ovens

Used in Hood Versions:

- C, D

PART NUMBER: HP-2055B-120VAC

How it works: The R2 relay's coil will be wired for 120 VAC phase voltage from the Fire Suppression system's micro-switch's Normally Open (NO) contact while neutral voltage will be directly wired from incoming power. When the relay's coil is energized then the relay will switch to its Normally Open (NO) contacts to interrupt oven power.

Tools required:

- Multi-meter

How to check – ELECTRIC:

- Under Normal Operation
  - Should have continuity across terminals:
    - 1 and 7
    - 2 and 8
    - 3 and 9
  - Should not have 120 VAC across terminals A and B
- Fire Suppression is activated
  - Should have continuity across terminals:
    - 4 and 7
    - 5 and 8
    - 6 and 9
  - Should have 120 VAC across terminals A and B

(Relays: Cont…)

4.29.11 R3 – Relay, High Limit

Used in Oven Versions:

- DS

How it works: The High Limit Relay (R3) will receive 120 VAC power with phase voltage supplied to terminal B, while neutral voltage is wired to terminal A. The phase voltage is supplied from the Omron Temperature Control (TC) when it enters a High Temperature Alarm state. Phase voltage for the burner system circuit is then wired through the normally closed (NC) contacts of this relay immediately following the Burner Switch (S2). When the Temperature Control goes into a High Temperature Alarm state then the Temperature Control energizes this relay and it will switch to its normally open (NO) contacts and the burner system circuit would be interrupted.

Tools Required:

- Multi-meter
- #2 Phillips Screwdriver

How to check – ELECTRIC:

- **Normal Oven Operation**
  - Input
    - Ensure all oven switches are turned ON
    - Should be 120 VAC across terminals 1 and A
  - Output
    - Ensure all oven switches are turned ON
    - Should be 120 VAC across terminals 1 and A
- **Temperature Control is in High Temperature Alarm**
  - Input
    - Should be 120 VAC across terminals A and B
    - Should be 120 VAC across terminals 7 and A

(Relays: Cont…)

4.29.12 R4 – Relay, Fire Suppression

Used in Hood Versions:

- B

PART NUMBER: HP-2056A

How it works: The fire suppression relay will be supplied 120 VAC to its coil once the fire suppression system is activated. The 120 VAC being present across terminals A and B will switch the relay contact to its normally open (NO) position, and consequently send +24 VDC to terminal 4 of the VFD. The neutral line would be wired directly to the other contact of the coil from incoming power.

Tools required:

- Multi-meter

How to check – ELECTRIC:

- Normal Operation – when the Fire Suppression System is not activated
  - Should have continuity across terminals Common (COM) and Normally Closed (NC)
  - Should not have 120 VAC across terminals A and B
- Fire Suppression is activated
  - Should have continuity across terminals COM and Normally Open (NO)
  - Should be 120 VAC across terminals A and B

(Relays: Cont…)

4.29.13 R5/R6/R7 – Relay, Exhaust Fan

Used in Hood Versions:

- B

PART NUMBER: HP-2055A-S

How it works: The exhaust fan relays were used in conjunction with Keyed Switch Operators (S5/S6) to reroute the incoming three phase power, that would be supplied to the VFD input, directly to the exhaust fan. The 120 VAC single phase power supplied for the Hood Lights (L1/L2) would be wired in parallel with the Keyed Switch Operators, and then lead to the coils of the relays. The neutral line would be wired directly to the other contact of the coils and should always be present. When Keyed Switch (S5) is turned ON then the 120 VAC would be supplied onto terminal B of Relay (R6) and Relay (R7). The contacts in R6 and R7 would then switch to normally open (NO) interrupting input power to the VFD and instead send it to R5, as well as interrupt VFD output power to the exhaust fan motor. When Keyed Switch (S6) is turned ON then 120 VAC would be supplied to terminal B of R5 in turn switching its contacts to their normally open (NO) position and allowing the three phase power supplied from R7 to flow directly to the exhaust fan.

Tools required:

- Multi-meter

How to check – ELECTRIC:

- When the Keyed Switch Operators are turned ON
  - Should be 120 VAC measured across terminals A and B
  - Should have continuity across Normally Open (NO) terminals:
    - 6 and 9
    - 5 and 8
    - 4 and 7
- When they Keyed Switch Operators are turned OFF
  - Should have continuity across Normally Closed (NC) terminals:
    - 3 and 9
    - 2 and 8
    - 1 and 7
  - Should <u>not</u> have 120 VAC measured across terminals A and B

(Relays: Cont…)

4.29.14 R8 – Relay, Fire Suppression

Used in Hood Versions:

- B

PART NUMBER: HP-2055A-S

How it works: The fire suppression relay will be supplied 120 VAC to its coil once the fire suppression system is activated. The 120 VAC being present across terminals A and B will switch the relay contacts to their normally open (NO) position, and consequently interrupt power to the Oven Power Receptacles. The neutral line would be wired directly from incoming power to the other contact of the coils.

Tools required:

- Multi-meter

How to check - ELECTRIC:

- Normal Operation – when the Fire Suppression System is not activated
  - Should have continuity across terminals:
    - 1 and 7
    - 2 and 8
    - 3 and 9
  - Should not have 120 VAC measured across terminals A and B
- Fire Suppression is activated
  - Should be 120 VAC measured across terminals A and B
  - Should have continuity across terminals:
    - 4 and 7
    - 5 and 8
    - 6 and 9

(Relays: Cont…)

4.29.15 SSR – Relay, Solid State

Used in Oven Versions:

- TS, TS2, B, C, D, E, F, G, H
- A (Radiant)
- A (Countertop)

PART NUMBER: XP-4305A-90 (Used in: G, H) (Used in: A, Countertop)

XP-4305-50 (Used in: C, D, E, F)

XP-4305 (Used in: TS, B)

RP-4305A-25 (Used in: A, Radiant)

XP-4305A-10 (Used in: H)

Note: The SSR used in H ovens with the Discrete Control Package is specially provided by Golander. The positions of the wires for the Hi/Low solenoid are specific and need to match the schematic exactly

How it works: A Solid State Relay is an electronic switching device which receives a small control voltage from the Temperature Control (TC) which in turn controls power output to the Heating Elements, or to the High/Low Valve (V2) in H01-version ovens. You will have to either verify with the technician onsite or refer to the schematic specific to the oven you are working on for properly notated terminal positions. Earlier versions had A1, A2, L1, and T1 terminal labels, while later versions have 1, 2, 3, and 4 terminal labels.

Tools required:

- Multi-meter
- #2 Phillips Screwdriver

How to check – ELECTRIC:

- Control Circuit
  - Turn Oven ON
  - Should be 6-24 VDC across terminals A1 and A2 (or terminals 3 and 4)
- Continuity
  - Turn Oven ON
  - Verify control voltage is present
  - Test for continuity across terminals L1 and T1 (or terminals 1 and 2)

4.30 RP – Rectifier Plug

Used in Oven Versions:

- TS, TS2, TS3, A, B, C, D, E

PART NUMBER: XH-4235

How it works: The Rectifier Plug has an integrated full-wave bridge rectifier circuit. It converts 24 VAC from the Ignition Control (IC) into 22 VDC that is sent to the Multi-Valve (V1-V2).

Tools required:

- Multi-meter
- #2 Phillips head screwdriver
- 2 Paperclips

How to check:

- Visual - None
- Electrical
  - Inputs – Should be 24 VAC
  - Outputs – Should be 22 VDC (Note: Use straightened paperclips as probes)

4.31 RS-485 Cable

Used in Oven Versions:

- F, G, H
- A (Radiant)
- A (Countertop)

Used in Hood Versions:

- E

PART NUMBER: XP-4175A-MC (Cable is included with OMC)

How it works: The RS-485 cable is utilized for communication and to power the User Interface (UI). Pins 2 and 3 are CANBUS communications. Pins 1 and 4 are 5 VDC power with pin 1 being +5 VDC and pin 4 being -5 VDC.

Tools required:

- Multi-meter

How to check:

- Electrical
  - Should be 5 VDC across pins 1 and 4
  - Should be CANBUS communication from pins 2 and 3

4.32 RTD – Resistive Thermocouple Detector

Used in Oven Versions:

- A (Radiant)

PART NUMBER: RP-2110A

How it works: The RTD monitors the air temperature inside of the bake chamber. The RTD wire is a pure material which is typically either platinum, nickel, or copper. The material has an accurate resistance/temperature relationship which is used to provide an indication of temperature. The RTD is to be wired to the High Limit Switch (S3) used in radiant ovens.

Tools required:

- Multi-meter

How to check:

- Resistance – the resistance measured across the two red wire leads will differ depending on temperature (see table below)

			TOLERANCE		
TEMP.(°F)	TEMP.(°C)	RESISTANCE (OHMS)	OHMS	°F	°C
32	0	1000	±4.0	±2.0	±1.1
100	37.7	1143	±5.5	±2.7	±1.5
200	93.3	1350	±7.5	±3.6	±2.0
300	148.8	1554	±9.6	±4.9	±2.7
400	204.4	1754	±11.9	±5.9	±3.3
500	260.0	1950	±14.2	±7.2	±4.0
600	315.5	2142	±16.6	±8.8	±4.9
700	371.1	2331	±19.1	±10.3	±5.7
800	426.6	2516	±21.7	±11.9	±6.6
900	482.2	2697	±24.2	±13.5	±7.5
1000	537.7	2875	±26.8	±15.3	±8.5

Figure 50 RTD Resistance Table

4.33 Signal Conditioners

4.33.1 SC – Signal Conditioner – Elan

Used in Oven Versions:

- TS, TS2, TS3, A, B, C, D, E

PART NUMBER: SP 4710A-DI

How it works: The Signal Conditioner is powered by 24 VAC from the Transformer (XFMR) via the Main Motor Centrifugal Switch (S2). Incoming power will be interrupted by the Main Fan Motor if it stops rotating. The function of the SC is to convert a 4-20 mA signal into 0-15 VDC. This voltage is applied to the Multi Valve (V3) via a Circuit Breaker. This in turn modulates the valve to allow an appropriate amount of fuel to control temperature.

Here's what it should look like:

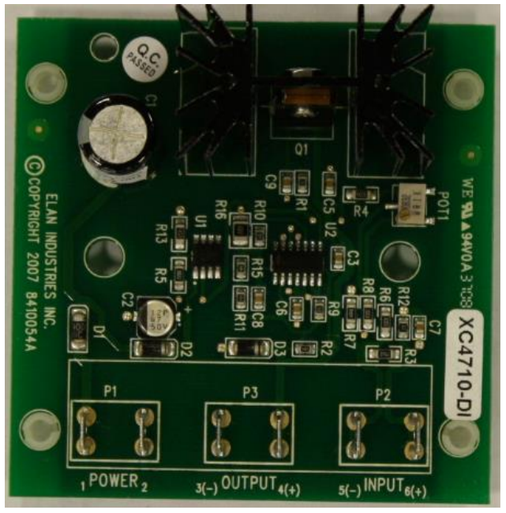


Figure 51 DI Signal Conditioner

Tools required:

- VOM
- Needle Nose Pliers

(SC – Signal Conditioner – Elan: Cont…)

(SC – Signal Conditioner – Elan: Continued)

How to check:

- Incoming Power
  - Should be 24 VAC across Pins 1 & 2
- Inputs
  - Leave wires connected to Pins 5 & 6
  - Turn oven ON
  - Adjust Set-Point value to at least 100° MORE than indicated temperature
  - Measure voltage across Pins 6 & 7 on Temperature Control – Should be 3.9 VDC – NOTE: Testing here is easier, but it assumes that the Circuit Breaker and the wires are functional.
  - Adjust Set-Point value to at least 100° LESS than indicated temperature
  - Measure voltage across Pins 6 & 7 on Temperature Control – Should be 0.78 VDC
- Outputs
  - Disconnect wires at V3 – NOTE: Testing here is easier, but it assumes that the Circuit Breaker and the wires are functional.
  - Turn oven ON
  - Adjust Set-Point value to at least 100° more than indicated temperature
  - Measure voltage at wires – Should be 0.0 VDC
  - Adjust Set-Point value to at least 100° less than indicated temperature
  - Measure voltage at wires – Should be 15 VDC

(Signal Conditioners: Cont…)

4.33.2 SC – Signal Conditioner – Maxitrol

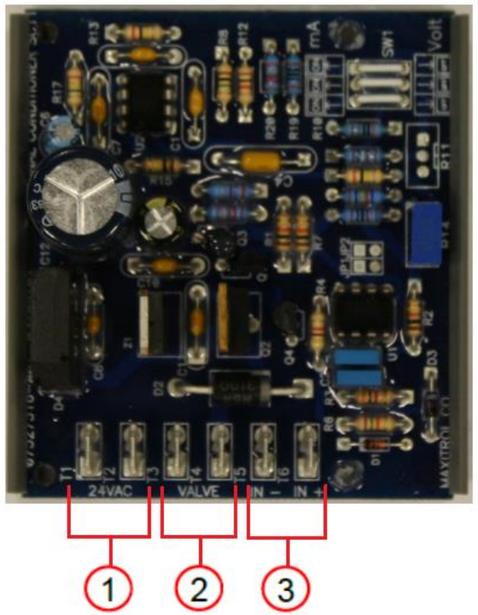
Used in Oven Versions:

- DS, TS, TS2

PART NUMBER: SP 4710

How it works: The Signal Conditioner is powered by 24 VAC from the Transformer (XFMR) via the Temperature Control (TC) high alarm relay. The function of the SC is to convert a 4-20 mA signal into 0-20 VDC. This voltage is applied to the Modulating Valve (V3) via a Fuse. This in turn modulates the valve to allow an appropriate amount of fuel to control temperature.

Here's what it should look like:



1) Input Power

2) Signal to Valve

3) Signal from Temp. Control

Figure 52 Pilot Signal Conditioner

(SC – Signal Conditioner – Maxitrol: Cont…)

(SC – Signal Conditioner – Maxitrol: Continued)

Tools required:

- VOM
- Needle Nose Pliers

How to check:

- Incoming Power
  - Should be 24 VAC across Pins 1 & 2
- Inputs
  - Leave wires connected to Pins 5 & 6
  - Turn oven ON
  - Adjust Set-Point value to at least 100° MORE than indicated temperature
  - Measure voltage across Pins 6 & 7 on Temperature Control – Should be 3.9 VDC (NOTE: Testing here is easier, but it assumes that the Fuse and the wires are functional)
  - Adjust Set-Point value to at least 100° LESS than indicated temperature
  - Measure voltage across Pins 6 & 7 on Temperature Control – Should be 0.78 VDC
- Outputs
  - Disconnect wires at V3 (NOTE: Testing here is easier, but it assumes that the fuse and the wires are functional)
  - Turn oven ON
  - Adjust Set-Point value to at least 100° more than indicated temperature
  - Measure voltage at wires – Should be 20 VDC
  - Adjust Set-Point value to at least 100° less than indicated temperature
  - Measure voltage at wires – Should be 0.0 VDC

4.34 Switches

4.34.1 Switches, Oven Operator

Used in Oven Versions:

- DS, TS, TS2, TS3, A, B, C, D, E, H

PART NUMBER: XP-4101 (Switch Operator)

XP-4102 (Contact Block w/ Mount)

How it works: In most cases, incoming power phase voltage is routed through the switch prior to most of the other electrical components of the oven to give on/off capability to the operator. With early XLT ovens, subsystems were designated with each subsystem having its own switch and thus its own on/off capability. These subsystems were the fan circuit, the burner circuit, and the conveyor circuit while being labeled S1, S2, and S3 respectively. The Fan Switch (S1) would supply phase voltage to the Burner Switch (S2) and the Conveyor Switch (S3), and thus S2 and S3 will only have phase voltage applied to them as long as S1 is switched on.

Tools Required:

- Multi-meter
- #2 Phillips Screwdriver

How to check – ELECTRIC:

- Continuity
  - Turn oven switch OFF
  - Unplug oven from outlet
  - Remove wires from the switch
  - Measure resistance between the two terminals. Should be infinite. If any continuity, then replace switch
  - Turn oven switch ON
  - Measure resistance between the two terminals. Should have continuity. If there is not continuity, then replace switch
- Voltage
  - Turn oven switch ON
  - Should be phase voltage as measured against chassis ground, or neutral, on either terminal

(Switches: Cont…)

4.34.1.1 S1 – Switch, Main

Used in Oven Versions:

- TS3, A, B, C, D, E, H

How it works: Phase voltage from the oven's incoming power will route through the Oven Main Switch (S1) to give the oven operator on/off capability. The only components to precede the Main Switch in receiving phase voltage will include a Circuit Breaker (CB), the Cool Down Timer Relay (R1), and sometimes a High Temperature Limit Switch (S3). When switched ON, this switch should supply phase voltage to the Cool Down Timer Relay to switch from normally closed (NC) to normally open (NO), to the Transformer (XMFR), to the Power Supply (PS), and to the Temperature Control (TC). Refer to the schematic specific to the oven you are working on.

4.34.1.2 S1 – Switch, Oven Fan

Used in Oven Versions:

- DS, TS, TS2

How it works: Phase voltage from the oven's incoming power will route through the Oven Fan Switch (S1) to give the oven operator on/off capability of the oven's fan subsystem. The only component to precede the Fan Switch in receiving phase voltage will be the Cool Down Timer Relay (R1). When switched ON, this switch will supply phase voltage to the Cool Down Timer Relay to switch from normally closed (NC) to normally open (NO), to the Burner Switch (S2), and to the Conveyor Switch (S3).

4.34.1.3 S2 – Switch, Burner

Used in Oven Versions:

- DS, TS, TS2

How it works: Phase voltage from the Oven Fan Switch (S1) will route through the Oven Burner Switch (S2) to give the oven operator on/off capability of the oven's burner subsystem. The Oven Fan Switch must be switched ON for the Oven Burner Switch to receive phase voltage. When switched ON, this switch will supply phase voltage to the Transformer (XFMR) via the Temperature Control (TC) high temperature alarm relay, and to the Burner Blower Motor (M4) via the Oven Fan Motor (M1) Centrifugal Switch (S5).

(Switches: Cont…)

4.34.1.4 S3 – Switch, Conveyor

Used in Oven Versions:

- DS, TS, TS2

How it works: Phase voltage from the Oven Fan Switch (S1) will route through the Oven Conveyor Switch (S3) to give the oven operator on/off capability of the oven's conveyor subsystem. The Oven Fan Switch must be switched ON for the Oven Conveyor Switch to receive phase voltage. When switched ON, this switch will supply phase voltage to the Conveyor Control (CC).

(Switches: Cont…)

4.34.2 Switches, Hood Operator

Used in Hood Versions:

- A, B, C, D, E

PART NUMBER: XP-4101 (Switch Operator)

XP-4102 (Contact Block w/ Mount)

XP-4102-C (Contact Block)

How it works: The switches on the hood when used in conjunction with the Switch Relocation Cord (SRC) will move the on/off capability of the ovens to the hood. Each oven switch on the hood will be labeled for their intended corresponding oven as with the power receptacles and the switch receptacles. In A – C Version Hoods, when the oven switches are switched ON they will energize the damper relays for make-up air activation as well as send the +24 VDC signal to the VFD so it knows to run the exhaust fan at the programmed frequency. In D Version Hoods, whenever the VFD is running the exhaust fan then the VFD will energize the Cooling Fan/MUA relay coil to send Damper Output 1 instead of the top oven switch as in previous versions. The middle and bottom oven switches will still be wired to the additional make-up air relays for damper outputs 2 and 3. E Version Hoods that do not include Fire Suppression connections or a Variable Frequency Drive will have switches that only control the on/off function of the ovens. There will also be a hood light switch to supply 120 VAC to the hood lights.

Note: F, G, and H Version Ovens send a +24 VDC signal via the SRC whereas TS – E Version Ovens will send 120 VAC or phase voltage via the SRC

Tools Required:

- Multi-meter
- #2 Phillips Screwdriver

How to check – ELECTRIC:

- Continuity
  - Turn oven switch OFF
  - Unplug oven from outlet
  - Remove wires from the switch
  - Measure resistance between the two terminals of each contact block. Should be infinite. If the terminals show continuity across a contact block, then replace the contact block
  - Turn oven switch ON
  - Measure resistance between the two terminals of each contact block. Should have continuity. If there is not continuity, then replace the contact block

(Switches: Cont…)

(Hood Operator Switches: Continued)

- Voltage
  - Reconnect wires
  - Plug oven into outlet
  - Turn oven switch ON
  - Should be phase voltage as measured against chassis ground, or neutral, on either terminal of the first contact block
  - **OVEN SWITCHES ONLY** – Should be +24 VDC as measured against chassis ground on either terminal of the second contact block

4.34.2.1 S1 – Switch, Lights

Used in Hood Versions:

- A, B, C, D, E

How it works: The lights will be powered with 120 VAC and the phase voltage will be wired through the Light Switch while neutral voltage is wired directly to the lights from incoming power.

4.34.2.2 S2/S3/S4 – Switch, Top/Middle/Bottom Oven

Used in Hood Versions:

- A, B, C, D, E

How it works: When used in conjunction with the Switch Relocation Cord (SRC) the Oven Switch changes on/off capability from the oven to the hood. A – D Version Hoods will utilize two contact blocks; one to send oven phase voltage back to the oven as well as sending oven phase voltage to the damper relays to activate make-up air while the other contact block is to send a +24 VDC signal to the VFD to notify it that the oven is on and needs to run at the programmed frequency. In D Version Hoods the top oven switch would not be wired for damper output 1 as this would come from the Cooling Fan/MUA Relay. E Version Hoods utilizing operator switches will only be equipped to send the voltage back to the oven via a single contact block.

4.34.2.3 S5/S6 – Switch, Manual Mode, Keyed

Used in Hood Versions:

- B

How it works: The Keyed Manual Mode Switches are used to divert three phase power from the input terminals of the VFD directly to the exhaust fan. These switches are functionally the same as normal operator switches except that they utilize a key to be switched on/off to prevent tampering. The S5 and S6 switches will supply 120 VAC phase voltage to the coils of relays R5, R6, and R7 when switched ON as the neutral voltage will be directly wired from incoming power.

(Switches: Cont…)

4.34.3 Switches, Centrifugal

Used in Oven Versions:

- DS, TS, TS2, TS3, A, B, C, D, E, F, G, H

How it works:

A centrifugal switch is an electric switch that operates using the centrifugal force created from a rotating shaft. The switch is designed to engage and disengage as a result of the rotational speed of the shaft.

Tools required:

- Multi-meter

How to check:

- Visual
  - No visual inspection
- Electrical
  - The main motor must be rotating at least 1300 RPM in order to check the centrifugal switch
  - Inputs
    - Refer to the schematic for each incident. The voltage could be either:
      - 120 VAC
      - 24 VAC
      - 24 VDC
  - Outputs
    - Refer to the schematic for each incident. The output voltages should be the same as the input voltage
    - Check voltage at the terminal strip.

How to replace:

- Replace the motor

(Switches: Cont…)

4.34.3.1 S4 – Switch, Burner Blower Motor, Centrifugal

Used in Oven Versions:

- DS, TS, TS2, TS3, A, B (AE)

How it works: The centrifugal switch, as named, utilizes the centrifugal force caused by the Burner Blower Motor (M4) rotation to engage the switch to its normally open (NO) position. The centrifugal switch should be switched to normally closed (NC) while at rest. This switch is used a safety feature to prove motor rotation prior to the burner being allowed to light. As stated in the above overview: output voltage should match input voltage per the schematic specific to the version of oven you are working on.

Tools required:

- Multi-meter

How to check:

- Audible – A "click" can be heard when the centrifugal switch engages
- Electrical – Input and Output
  - Turn Oven ON
  - Test voltage to ground into Centrifugal Switch, should be 24 VAC
  - Test voltage to ground out of Centrifugal Switch, should be 24 VAC

4.34.3.2 S5 – Switch, Oven Fan Motor, Centrifugal

Note: This centrifugal switch may also be identified as "(S1) Switch – M1 – Centrifugal", or "(S2) Switch – M1 – Centrifugal", or "(S3) Switch – M1 – Centrifugal" please refer to schematic specific to your version and model of oven.

Used in Oven Versions:

- DS, TS, TS2, TS3, A, B, C, D, E, F, G, H

How it works: The centrifugal switch, as named, utilizes the centrifugal force caused by the Oven Fan Motor rotation to engage the switch to its normally open (NO) position. The motor must spin at 1300 RPM or greater for the switch to engage. The centrifugal switch should be switched to normally closed (NC) while at rest. This switch is used a safety feature to prove motor rotation prior to the burner being allowed to light. As stated in the above overview: output voltage should match input voltage per the schematic specific to the version of oven you are working on. Ovens which utilize an LUI and OMC controllers may have the Oven Fan Motor Centrifugal Switch bypassed, check for software versions 53 and 38 or newer on the LUI and OMC, respectively. This software monitors Oven Fan Motor amperage to be within a set-range rather than using the Centrifugal Switch.

Tools required:

- Multi-meter

(Switches: Cont…)

(S5 – Switch, Oven Fan Motor, Centrifugal: Continued)

How to check:

- Audible – A “click” can be heard when the centrifugal switch engages
- Electrical – Input and Output – (Note: It may be easier to test wiring in the Control Box rather than at the Motor but this assumes wires are functional)
    - Can be +24 VDC, 24 VAC, or 120 VAC - Refer to schematic specific to version and model of oven you are working on
    - Turn Oven ON
    - Test voltage to ground into Centrifugal Switch
    - Test voltage to ground out of Centrifugal Switch

4.34.4 S3 – Switch, High Limit

4.34.4.1 Impingement Ovens, Gas and Electric

Used in Oven Versions:

- TS3, A, B, C, D, E, F, G, H

PART NUMBER: SP-4713B (Used in: F, G, H)

XP-4713 (Used in: TS3, A, B, C)

How it works: The High Limit Switch (S3) operates on the principle of differential expansion of metals. The steel outer casing will expand from temperature increases at a higher rate than the internal bridge of the electrical contacts. The case expansion will result in a linear change of the bridge assembly until the electrical contacts open. The switch will have an adjustable dial for a range of operating temperatures but this should be factory set at 600°F and Loctite applied so that it cannot be changed.

How to check:

- Visual
  - Position adjustment dial toward the top of the switch
  - The adjustment dial should be turned clockwise to its maximum position
- Electric
  - Continuity – The switch should have continuity across the screw terminals anytime the switch is under 600°F
  - Voltage
    - Gas Ovens, Single Phase
      - The switch should measure oven-rated voltage on either screw terminal as measured against chassis ground or neutral anytime the switch is under 600°F
    - Electric Ovens, Three Phase
      - The switch should measure oven-rated voltage on either screw terminal as measured against any other line of incoming power anytime the switch is under 600°F

(High Limit Switches: Cont…)

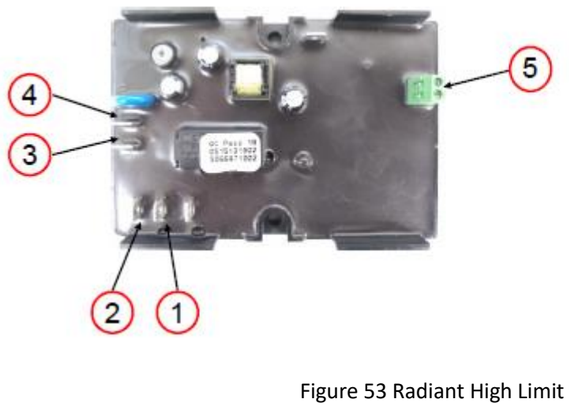
4.34.4.2 Radiant Ovens, Electric

Used in Oven Versions:

- A (Radiant)

PART NUMBER: XP-4723A

Here's what it looks like:



1) COM– Line Voltage
2) N.O.- Switched Line Voltage
3) L2- High Limit Power
4) L1- High Limit Power
5) RTD

Figure 53 Radiant High Limit Switch

How it works: The High Limit Switch will accept oven line voltage for power, either 208 or 240 VAC, on terminals L1 and L2. The voltage applied at terminal L1 is piggybacked from terminal COM (Common) via a circuit breaker. Under normal operating conditions the voltage applied to terminal COM will be output from terminal NO (normally open) to then provide power to the Power Supply (PS). The High Limit will accept a Resistive Thermocouple Detector (RTD) input to monitor the temperature inside the bake chamber. If the RTD detects the temperature to exceed 650°F, then the High Limit Switch will switch closed to interrupt power output from terminal NO. There is a red LED that will illuminate when the High Limit is under normal operation.

How to check:

- Visual
  - Check for red LED to be illuminated, this signifies the switch has power and is under normal operation

(Radiant High Limit: Cont…)

(Radiant High Limit: Continued)

- Electric
  - Input
    - Power
      - Should be oven-rated voltage (208/240 VAC) across terminals L1 and L2
      - Should be oven-rated voltage across terminals L2 and COM
    - RTD
      - Remove red wires from switch
      - Measure resistance across red wire leads. Should be a specific value depending on the temperature of the RTD
  - Output
    - Should be oven-rated voltage across terminals L2 and NO

4.35 SRC – Switch Relocation Cord

Used in Hood Versions:

- A, B, C, D, E

PART NUMBER: HH-9101B

How it works: The Switch Relocation Cord (SRC) is used to move on/off operation from the oven to the hood. The SRC will either tie into oven incoming power or into the remote switch circuit of the OMC. The other end of the SRC will either tie into the hood's oven switches or to the SRC Relays of the Hood Machine Control (HMC). Older relocation cords would have a three wire application where the cord currently used has a two-wire application but is to be supplied with a pigtail where three wire applications are needed. There is a six-foot and twelve-foot variation.

Tools required:

- Multi-meter

How to check – VISUAL:

- Verify Wiring, Check cable to be in good condition
- Check terminals to be flush to the end of the Plug, SRC

How to check – ELECTRIC:

- Continuity
  - HH-9101B Cord (2-Wire)
    - Position 1 of Molex connector should have continuity to position 1 of Plug, SRC
    - Position 3 of Molex connector should have continuity to position 4 of Plug, SRC
  - HH-9101A Cord (3-Wire)
    - Position 1 of Molex Connector should have continuity to position 1 of Plug, SRC
    - Position 2 of Molex Connector should have continuity to position 4 of Plug, SRC
    - Position 3 of Molex Connector should have continuity to position 2 of Plug, SRC
  - HH-2313E (Adapter)
    - Position 1 of female Molex connector should have continuity to position 1 of male Molex connector
    - Position 3 of female Molex connector should have continuity to positions 2 and 3 of male Molex connector

4.36 SR – Spark (Igniter) Rod

Used in Oven Versions:

- D, E, F, G, H

PART NUMBER: XA-4203B-DI-SQ-O (Used in: F, G, and H)

XA-4203A-DI-SQ-O (Used in: D, E, and with upgrade kit SP-4200E)

SP 4203-DI-SQ Kit (Used in: TS3, A, B, C)

SP 4203-DI-RO Kit (Used in: TS, TS2, TS3)

How it works: The Spark Igniter consists of a copper-clad metal mounting plate, and an electrode encapsulated in ceramic insulation. The insulated electrode has a 1/4" male spade welded to it. This spade connects to the Spark Terminal on the Ignition Control (IC) via a spark wire. The end of this rod is positioned near the burner tube in such away so as to create a 3/16" gap. When the high-voltage signal from the IC reaches the gap, it is forced to jump the gap resulting in a spark.

Tools required:

- Multi-meter

How to check:

- Visual
  - Gap – Should be 3/16" +/- 1/32". Too small or too big will cause problems.
  - Ceramic – Should have no cracks or dirt. Cracks and dirt can cause the spark to take a different route to ground.
- Electrical
  - Plug Wire – Should have no cracks or splits. Should have tight connections. Should have continuity from Ignition Control terminal to the tip of the Spark Rod.

4.37 TC – Thermocouple – Type K

Used in Oven Versions:

- DS, TS, TS2, TS3, A, B, C, D, E, F, G, H
- A (Radiant)
- A (Countertop)

PART NUMBER: XP-4509A-90 (Used in Oven Versions: E, F, G, H and Countertop Version: A)

XP-4510A-90 (Used in Oven Versions: E, F, G, H)

XP-4509 (Used in Oven Versions: DS, TS, TS2, TS3, A, B, C, D)

XP-4510 (Used in Oven Version: TS3, A, B, C, D)

RP-5105A (Used in Radiant Version: A)

How it works: The thermocouple is a type K. It consists of two different types of metals, joined together at one end. When the junction of the two metals is heated or cooled, a voltage is created that can be correlated back to the temperature. The millivolt signal is interpreted by the Temperature Control to display the actual temperature.

Tools required:

- Multi-meter

How to check:

- Disconnected
  - Oven OFF
  - Measure millivolts at room temperature – Should be 0.843 millivolts at 70°F – Refer to Figure 54
- Connected
  - Oven ON
  - Measure millivolts on climb

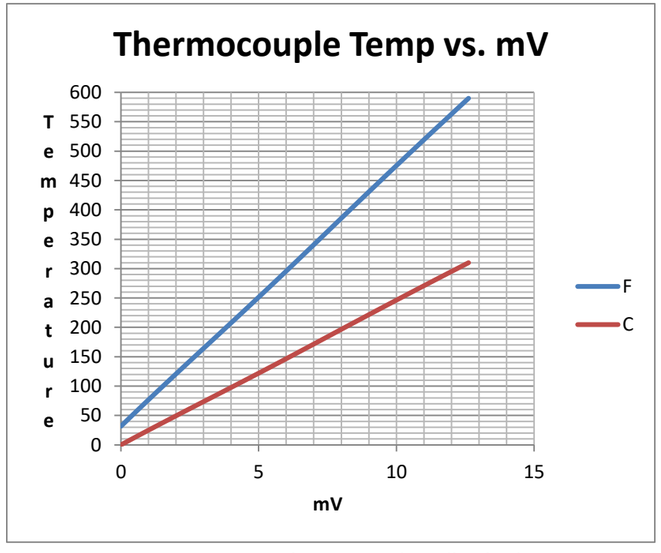


Figure 54 Type K Thermocouple Millivolt Chart

(Thermocouple: Cont…)

(Thermocouple: Continued)

How to replace

- Red is negative
- Yellow is positive

Note: On 2B units, after the oven has achieved set point: If one side seems to be going up in temperature, and the other side seems to be dropping temperature, it may be possible that the thermocouples are switched

4.38 TCM – Thermocouple Module

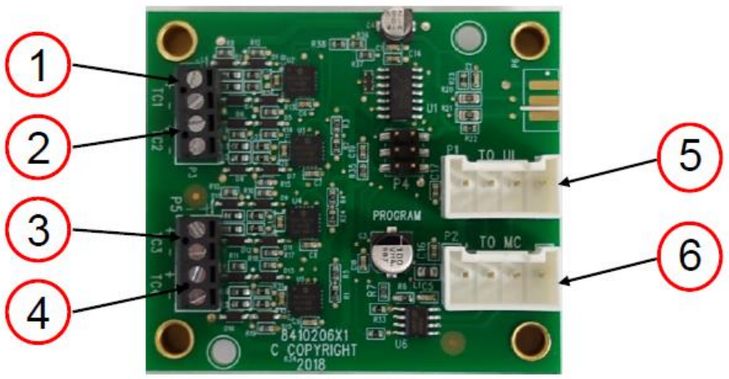
Used in Oven Versions:

- A (Radiant)

PART NUMBER: RP-4724A

How it works: Radiant ovens have a thermocouple for each Heating Element. The Thermocouple Module accepts the millivolt signal from the thermocouples and communicates this to the LUI and OMCs to display temperatures via RS-485 cables. The module's thermocouple positions are terminal position specific and are to be labeled on the circuit board of the module. Thermocouple 1 will be wired to Heating Element 1, while Thermocouple 2 will be wired to Heating Element 2 and so on. These must be wired accordingly as the LUI will display errors specific to these thermocouple and heating element labels.

Here's what it should look like:



1) TC1 (+ & -)
2) TC2 (+ & -)
3) TC3 (+ & -)
4) TC4 (+ & -)
5) RS485 Cable to LUI
6) RS485 Cable to OMC1

Tools required:

- Multi-meter
- Small Flathead Screwdriver

(TCM: Cont…)

(TCM – Thermocouple Module: Continued)

How to check – ELECTRICAL:

- Power Input
  - At TO UI connection, should be 5 VDC across pins 1 and 4
  - At TO MC connection, should be 5 VDC across pins 1 and 4
- Signal Input
  - At TC1, across pins 1 and 2, should be a varying DC millivolt signal from the thermocouple – See Thermocouple Chart
  - At TC2, across pins 1 and 2, should be a varying DC millivolt signal from the thermocouple
  - At TC3, across pins 1 and 2, should be a varying DC millivolt signal from the thermocouple
  - At TC4, across pins 1 and 2, should be a varying DC millivolt signal from the thermocouple
- Signal Output
  - At TO UI connection, pins 2 and 3 are CANBUS communications to the LUI
  - At TO MC connection, pins 2 and 3 are CANBUS communications to the OMC

4.39 Temperature Controls

4.39.1 Impingement Ovens, Gas

4.39.1.1 TC – Temperature Control – Barber/Colman

Used in Oven Versions:

- DS, TS, TS2, TS3, A, B, C, D, E

PART NUMBER: SP-4508A-GA (see replacement: Eurotherm)

How it works: The Temperature Control (TC) has phase voltage applied to terminal T5, and neutral voltage applied to terminal T4. There are two displays; one for actual temperature and one for set-point temperature. Actual temperature is determined by the Thermocouple (T/C), connected to terminals 9 & 10, with T9 being the negative terminal and T10 being the positive terminal. The user determines the set-point temperature by pressing and holding the <UP> or <DOWN> arrow button switches. The TC sends a 4-20 mA (milliamp) signal to the Signal Conditioner (SC) on terminals 6 & 7 depending upon the relationship between actual temperature and set-point temperature. An alarm relay exists between terminals 1 & 2. If the actual temperature rises above 590° F, the alarm circuit will open and not allow voltage through. The Maximum Operating Temperature is set at the factory and cannot be field adjusted. The <UP> key and the <FUNC> key can be pressed for about five (5) seconds to turn the control output off (the Set Point will display “OFF”).

OUT1 is lit steady when indicated temperature is 10° F or more below the set point value.

OUT1 flashes when indicated temperature is within 10° F of set point value.

OUT2 is lit when the indicated temperature rises above 590° F

Here’s what it should look like:

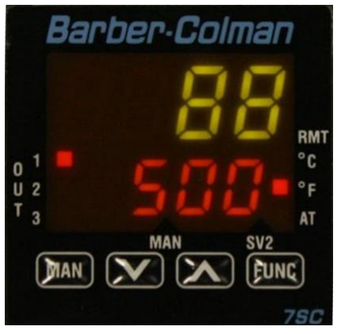


Figure 55 Barber-Colman Display

(Gas, Barber Colman Temp. Control: Cont…)

(Gas, Barber Colman Temp. Control: Continued)

Tools required:

- Multi-meter
- Phillips head screwdriver

How to check:

- Visual
  - These temperature controls slide in and out of a case. It is possible for the contacts in the case to get bent or otherwise not make a good connection. Look closely inside the case for anomalies.
- Electrical
  - All checks are with the control connected and power ON
  - Inputs
    - Power – Should be phase voltage across terminals 4 & 5
    - Thermocouple – Should be millivolt signal across terminals 9 & 10 depending upon temperature See Thermocouple
  - Outputs
    - Control Signal
      - Adjust Set-Point value to at least 100° MORE than indicated temperature
      - Measure voltage across Pins 6 & 7 on Temperature Control – Should be 3.9 VDC
      - Adjust Set-Point value to at least 100° LESS than indicated temperature
      - Measure voltage across Pins 6 & 7 on Temperature Control – Should be 0.78 VDC
    - High temperature alarm
      - Terminal 1 to ground should be +24 VDC anytime the oven is energized
      - Terminal 2 to ground should be +24 VDC anytime the oven is energized and the indicated temperature is below 590° F
      - Wiring at the high temperature alarm relay could be in the opposite orientation where terminal 2 is energized anytime the oven is on, and terminal 1 is energized anytime the oven is on and the indicated temperature is below 590°F (please refer to schematic specific to the version and model you are working on)

Note: These temperature controls slide in and out of a case. It is possible to swap temperature controls between sides of the same oven, or between upper and lower ovens for troubleshooting purposes

(Gas, Temp. Controls: Cont…)

4.39.1.2 TC – Temperature Control – Elan

Used in Oven Versions:

- F, G, H

How it works: The LUI is the user interface for the oven operator to enter desired temperature(s). The LUI and OMC communicate, as the LUI accepts user-defined settings and the OMC holds the logic to execute these commands. The OMC will receive a millivolt signal on P8 via the thermocouple resulting in an Actual Temperature to be displayed on the LUI. Whenever the Actual Temperature is below the Set Temperature, the OMC will ground P11-2 which is connected to either the V2 (the high/low valve) or the Solid State Relays (SSRs). The OMC grounding V2 will result in the gas valve being in its high flame output state. The OMC grounding the SSRs will result in three phase power being released to the Heating Elements. Whenever Actual Temperature and Set Temperature match, then the OMC will unground P11-2 which either drops V2 into its low flame output state or stops three phase power to the Heating Elements.

The OMC's Alarm light will illuminate red when there is an error while the LUI displays an actual error message.

The OMC's Heat light will flash while the Alarm light is illuminated if the error is related to the burner system.

Tools required:

- Multi-meter
- #2 Phillips Screwdriver

How to check:

- See LUI
- See OMC

(Gas, Temp. Controls: Cont…)

4.39.1.3 TC – Temperature Control – Eurotherm

Used in Oven Versions:

- Service part replacement for **TC – Temperature Control – Barber/Colman** (applicable versions: DS, TS, TS2, TS3, A, B, C, D, E)

PART NUMBER: SP-4508A-GA-F

How it works: The Temperature Control (TC) has phase voltage applied to terminal L, and neutral voltage applied to terminal N. There are two displays; one for actual temperature and one for set-point temperature. Actual temperature is determined by the Thermocouple (T/C), connected to terminals V+ and V-. The user determines the set-point temperature by pressing and holding the <UP> or <DOWN> arrow button switches. The TC sends a 4-20 mA (milliamp) signal to the Signal Conditioner (SC) from terminals 2A and 2B depending upon the relationship between actual temperature and set-point temperature. An alarm relay exists between terminals AA and AB. If the actual temperature rises above 590° F, the alarm circuit will open and not allow voltage through. The Maximum Operating Temperature is set at the factory and cannot be field adjusted.

The “2” light is illuminated steadily when indicated temperature is 10° F or more below the set point value.

The “2” light flashes when indicated temperature is within 10° F of set point value.

The “ALM” light is illuminated when the indicated temperature rises above 600°F

Tools required:

- Multi-meter

How to check:

- Visual
  - These temperature controls slide in and out of a case. It is possible for the contacts in the case to get bent or otherwise not make a good connection. Look closely inside the case for anomalies.
- Electrical
  - All checks are with the control connected and power ON
  - Inputs
    - Power – Should be phase voltage across terminals L & N
    - Thermocouple – Should be millivolt signal across terminals V+ & V- depending upon temperature: See Thermocouple

(Gas, Eurotherm Temp. Control: Cont…)

(Gas, Eurotherm Temp. Control: Continued)

- Outputs
  - Control Signal
    - Adjust Set-Point value to at least 100° MORE than indicated temperature
    - Measure voltage across Pins 2A & 2B on Temperature Control – Should be 3.9 VDC
    - Adjust Set-Point value to at least 100° LESS than indicated temperature
    - Measure voltage across Pins 2A & 2B on Temperature Control – Should be 0.78 VDC
  - High temperature alarm
    - Terminal AA to ground should be +24 VDC, 24 VAC, or 120 VAC (please refer to schematic specific to the version and model you are working on) anytime the oven is energized
    - Terminal AB to ground should be +24 VDC, 24 VAC, or 120 VAC (please refer to schematic specific to the version and model you are working on) anytime the oven is energized and the indicated temperature is below 590° F
    - Wiring at the high temperature alarm relay could be in the opposite orientation where terminal AB is energized anytime the oven is on, and terminal AA is energized anytime the oven is on and the indicated temperature is below 590°F (please refer to schematic specific to the version and model you are working on or verify in-field)

Note: These temperature controls slide in and out of a case. It is possible to swap temperature controls between sides of the same oven, or between upper and lower ovens for troubleshooting purposes

(Gas, Temp. Controls: Cont…)

4.39.1.1 TC – Temperature Control – Golander

Used in Oven Versions:

- H

PART NUMBER: XP-4508A-GL

How it works: The Golander Temperature Control will be powered by 24 VDC on positions 1 and 2 being positive and negative respectively. The Golander will utilize a type K thermocouple wired to positions 9 and 10 being positive and negative respectively. Whenever the indicated temperature is below the set-point value, the Golander temperature control will send 6.5 VDC to Solid State Relay 1, Valve Control (SSR1) to energize V2 (high/low valve) and put the gas valve in its high flame output state. The temperature control has a light on the display labeled "OUT" which will be illuminated when the control is calling for heat and energizing the SSR. The temperature control will display "EEEE" when there is an issue with thermocouple input.

Here's what it should look like:

Tools required:

- Multi-meter
- #2 Phillips Screwdriver

How to check:

- Electrical
  - Inputs
    - Power – Should be 24 VDC measured across terminals 1 and 2, anytime the oven switch is ON, with terminal 1 being positive and terminal 2 being negative
    - Thermocouple – Should be millivolt signal across terminals V+ & V- depending upon temperature: See Thermocouple
    - High Alarm Relay – Should be +24 VDC applied to terminal 4 anytime the Main Switch (S1) is turned ON

(Gas, Golander Temp. Control: Cont…)

(Gas, Golander Temp. Control: Continued)

- Outputs
  - V2
    - Should be 6.5 VDC from terminals 6 and 7 anytime the indicated temperature is below the set temperature (NOTE: Wires must be installed to SRR for proper reading; disconnected readings will show around 8 VDC)
    - Should be 0 VDC from terminals 6 and 7 anytime the indicated temperature is at or above the set temperature
  - High Alarm Relay
    - Should be +24 VDC from terminal 5 under normal operation

- Visual
  - OUT Light
    - Should be illuminated anytime the actual temperature is below the set-point temperature
    - Should NOT be illuminated anytime the actual temperature is at or above the set-point temperature
  - AL1 Light
    - Should be illuminated anytime the actual temperature is at or above 600°F
    - Should NOT be illuminated under normal operation

4.39.1.2 TC – Temperature Control – Omron

*Note: Omron changed terminal positions and their functions. This section will state the terminal positions that were original and will state the new terminal positions in brackets where applicable (ex. Terminals 4 and 5 **[7 and 8]**).*

Used in Oven Versions:

- DS

PART NUMBER: SP-4508A-DS

How it works:

- The Temperature Control (TC) has phase voltage applied to terminal 10, and neutral voltage applied to terminal 9.
- There are three displays; one for actual temperature, one for set-point temperature, and one for the high temperature alarm. The Temperature Control has two lights on the left side of the display to indicate which display is being viewed, and these lights are labeled AL (Alarm) and SP (Set-Point). When neither light is illuminated then the user is viewing Actual Temperature. When the SP light is illuminated then the user is viewing the Set Point Temperature. When the AL light is illuminated then the user is viewing the allowance for the temperature to raise over the Set Temperature before going into its High Temperature Alarm state.
- Actual temperature is determined by the Thermocouple (T/C), connected to terminals 1 and 2 **[4 and 5]**.
- The user determines the Set-Point Temperature by pressing the Mode Key until the display has the SP light illuminated along with a temperature shown. Once the Set Point Temperature is displayed, it is adjusted by holding the <UP> or <DOWN> arrow button switches.
- The Temperature Control will energize a Solenoid Valve (V3) any time the Actual Temperature is below the Set Temperature via terminal 7 **[1]** with 120 VAC phase voltage – this voltage is supplied to the Temperature Control on terminal 8 **[2]**. When the Actual Temperature matches the Set Temperature, then the controller will stop energizing the Solenoid Valve – dropping it into its low flame output state.
- The High Temperature Alarm relay exists between terminals 4 and 5 **[7 and 8]** so that anytime the Actual Temperature raises over the Set Temperature by the allowance that is set by the user, as previously detailed, the relay closes and sends 120 VAC phase voltage to the High Limit Relay (R3). The High Limit Relay will then stop supplying 120 VAC phase voltage to the burner system circuit.

Tools required:

- Multi-meter
- #2 Phillips Screwdriver

How to check:

- Visual
  - Dial Switch Settings – There will be two dial switches located on the inside of the temperature control opposite the display
    - Temperature Range Switch (Labeled “IN”) – Should be set to five (5)
    - Alarm Mode Switch (Labeled “ALM) – Should be set to two (2)
  - These temperature controls slide in and out of a case. It is possible for the contacts in the case to get bent or otherwise not make a good connection. Look closely inside the case for anomalies.

(Gas, Omron Temp. Control: Cont…)

(Gas, Omron Temp. Control: Continued)

- Electrical
  - Input
    - Power – Should be phase voltage across terminals 9 and 10
    - Thermocouple – Should be a millivolt signal across terminals 1 and 2 **[4 and 5]** depending upon temperature – See Thermocouple
    - On/Off Gas Valve – Should be phase voltage across terminal 8 **[2]** and terminal 9
    - High Temperature Alarm Relay – Should be phase voltage across terminal 5 **[7]** and terminal 9
  - Output
    - On/Off Gas Valve – Should be phase voltage across terminal 7 **[1]** and terminal 9 anytime the indicated temperature is below the set point temperature
    - High Temperature Alarm Relay – Should be phase voltage across terminal 4 **[8]** and terminal 9 anytime the oven raises above the high temperature limit allowance as set by the operator

Note: These temperature controls slide in and out of a case. It is possible to swap temperature controls between sides of the same oven, or between upper and lower ovens for troubleshooting purposes

(Temp. Controls: Cont…)

4.39.2 Impingement Ovens, Electric

4.39.2.1 TC – Temperature Control – Barber/Colman

Used in Oven Versions:

- TS, TS2, A, B, C, D, E

PART NUMBER: SP-4508-EL

How it works: The Temperature Control (TC) has line voltage applied to terminals 9 and 10. There are two displays; one for actual temperature and one for set-point temperature. Actual temperature is determined by the Thermocouple (T/C), connected to terminals 2 and 3, with T2 being the negative terminal and T3 being the positive terminal. The user determines the set-point temperature by pressing and holding the <UP> or <DOWN> arrow button switches. The TC sends a 14-24 VDC signal to the Solid State Relays (SSRs) on terminals 7 and 8 depending upon the relationship between actual temperature and set-point temperature. If the actual temperature rises above 590°F, the TC will go into an alarm state and stop output to the SSRs. The Maximum Operating Temperature is set at the factory and cannot be field adjusted. The <UP> key and the <FUNC> key can be pressed for about five (5) seconds to turn the control output off (the Set Point will display “OFF”).

OUT is lit steady when indicated temperature is 10° F or more below the set point value.

OUT flashes when indicated temperature is within 10° F of set point value.

ALM is lit when the indicated temperature rises above 590° F

Tools required:

- Multi-meter
- #2 Phillips Screwdriver

How to check:

- Visual
  - These temperature controls slide in and out of a case. It is possible for the contacts in the case to get bent or otherwise not make a good connection. Look closely inside the case for anomalies.
- Electrical
  - All checks are with the control connected and power ON
  - Inputs
    - Power – Should be line voltage across terminals 9 and 10
    - Thermocouple – Should be millivolt signal across terminals 2 and 3 depending upon temperature – See Thermocouple

(Electric, Barber Colman Temp. Control: Cont…)

(Electric, Barber Colman Temp. Control: Continued)

- Outputs
  - Control Signal
    - Adjust Set-Point value to at least 100° MORE than indicated temperature
    - Measure voltage across Pins 7 and 8 on Temperature Control – Should be 24 VDC
    - Adjust Set-Point value to at least 100° LESS than indicated temperature
    - Measure voltage across Pins 7 and 8 on Temperature Control – Should be 0.5 VDC

Note: These temperature controls slide in and out of a case. It is possible to swap temperature controls between sides of the same oven, or between upper and lower ovens for troubleshooting purposes

(Electric, Temp. Controls: Cont…)

4.39.2.2 TC – Temperature Control – Elan

Used in Oven Versions:

- F, G, H

How it works: The LUI is the user interface for the oven operator to enter desired temperature(s). The LUI and OMC communicate, as the LUI accepts user-defined settings and the OMC holds the logic to execute these commands. The OMC will receive a millivolt signal on P8 via the thermocouple resulting in an Actual Temperature to be displayed on the LUI. Whenever the Actual Temperature is below the Set Temperature, the OMC will ground P11-2 which is connected to the Solid State Relays (SSRs). The OMC grounding the SSRs will result in three phase power being released to the Heating Elements. Whenever Actual Temperature and Set Temperature match, then the OMC will unground P11-2 which interrupts three phase power to the Heating Elements.

The OMC's Alarm light will illuminate red when there is an error while the LUI displays an actual error message.

The OMC's Heat light will flash while the Alarm light is illuminated if the error is related to the heating system.

Tools required:

- Multi-meter
- #2 Phillips Screwdriver

How to check:

- See LUI
- See OMC

(Electric, Temp. Controls: Cont…)

4.39.2.3 TC – Temperature Control – Eurotherm

Used in Oven Versions:

- Service part replacement for **TC – Temperature Control – Barber/Colman** (applicable versions: TS, TS2, TS3, A, B, C, D, E)

How it works: The Temperature Control (TC) has line voltage applied to terminals L and N. There are two displays; one for actual temperature and one for set-point temperature. Actual temperature is determined by the Thermocouple (T/C), connected to terminals V+ and V-. The user determines the set-point temperature by pressing and holding the <UP> or <DOWN> arrow button switches. The TC sends a 0-12 VDC signal to the Solid State Relays (SSRs) from terminals 1A and 1B depending upon the relationship between actual temperature and set-point temperature. If the actual temperature rises above 590° F, the TC will go into an alarm state and stop output to the SSRs. The Maximum Operating Temperature is set at the factory and cannot be field adjusted.

The "1" light is illuminated steadily when indicated temperature is 10° F or more below the set point value.

The "1" light flashes when indicated temperature is within 10° F of set point value.

The "ALM" light is illuminated when the indicated temperature rises above 600°F.

Tools required:

- Multi-meter

How to check:

- Visual
  - These temperature controls slide in and out of a case. It is possible for the contacts in the case to get bent or otherwise not make a good connection. Look closely inside the case for anomalies.
- Electrical
  - All checks are with the control connected and power ON
  - Inputs
    - Power – Should be line voltage across terminals L & N
    - Thermocouple – Should be millivolt signal across terminals V+ & V- depending upon temperature (See Thermocouple)
  - Outputs
    - Control Signal
      - Adjust Set-Point value to at least 100° MORE than indicated temperature
      - Measure voltage across Pins 1A & 1B on Temperature Control – Should be 12 VDC
      - Adjust Set-Point value to at least 100° LESS than indicated temperature
      - Measure voltage across Pins 1A & 1B on Temperature Control – Should be 0.0 VDC

Note: These temperature controls slide in and out of a case. It is possible to swap temperature controls between sides of the same oven, or between upper and lower ovens for troubleshooting purposes.

(Electric, Temp. Controls: Cont…)

4.39.3 Radiant Ovens, Electric

4.39.3.1 TC – Temperature Control – Elan

Used in Oven Versions:

- A (Radiant)

How it works: The LUI is the user interface for the oven operator to enter desired temperature(s). The LUI and OMC communicate, as the LUI accepts user-defined settings and the OMC holds the logic to execute these commands. Radiant ovens utilize a Thermocouple Module (TCM). Each Heating Element will have its own Thermocouple (T/C) and so all four thermocouples will be wired to the Thermocouple Module. The TCM, LUI, and OMC are all interconnected with RS-485 cables to communicate the thermocouples' millivolt signals resulting in an Actual Temperature to be displayed on the LUI. Whenever the Actual Temperature is below the Set-Point Temperature the OMCs will output a 24 VDC control voltage to the Solid State Relays (SSRs) to release power to the heating elements.

The OMC's Alarm light will illuminate red when there is an error while the LUI displays an actual error message.

The OMC's Heat light will flash while the Alarm light is illuminated if the error is related to the heating system.

Tools required:

- Multi-meter
- #2 Phillips Screwdriver

How to check:

- See LUI
- See OMC

4.40 TS – Terminal Strip

Used in Oven Versions:

- DS, TS, TS2, TS3, A, B, C, D, E, F, G, H

Used in Hood Versions:

- A, B, C, D, E, F

How it works: The Terminal Strip is used as a junction point for wiring.

Tools required:

- Multi-meter
- #2 Phillips Screwdriver

How to check:

- Electrical
  - Should have continuity across terminal positions for each row

4.41 VFD – Variable Frequency Drive

Used in Oven Versions:

- F, G, H (International Ovens)

Used in Hood Versions:

- A, B, C, D, E, F

How it works: A Variable Frequency Drive (VFD) will take variations of incoming power and utilize diodes, capacitors, and finally micro-switches to then control the power it outputs. The VFD used in XLT World Ovens converts single phase power of 50 or 60 Hertz (Hz) so that the Oven Fan Motor can run at the customer's specified frequency or RPM. This application is not to exceed 65 Hz. The VFD receives a RUN signal voltage from OMC P11-1, and this voltage is +24 VDC.

The VFD used in XLT Hoods converts single or three phase power of 50 or 60 Hz into preset frequencies of three phase power in order to run the exhaust fan at specific speeds correlating to which and how many ovens are in use. The VFD in E-version Hoods receives a RUN signal voltage from the Power Supply (PS) via the Fire Suppression Relay (R1). The VFD receives MODBUS communication from the Hood Machine Control (HMC) to signal the frequency for the VFD to run the exhaust fan. The VFD in any version previous will receive signal voltages from each Oven Switch when turned on, and the presence of these signal voltages communicate to the VFD which frequency to run the exhaust fan.

Tools required:

- Multi-meter
- #2 Phillips Screwdriver
- Small Flathead Screwdriver

(VFDs: Cont…)

4.41.1 VFD, Variable Frequency Drive, ABB

Used in Hood Versions:

- Service part replacement for **VFD, Variable Frequency Drive, Hitachi** (applicable versions: C, D)

PART NUMBER: Discontinued

Note: Differences of wiring or application between versions of hood will be noted for each instance

How to check – VISUAL:

- Error/Fault Codes – When the VFD has detected a fault it should display an error message and this should lead you in the proper direction to troubleshoot
- Should be a jumper wire between terminals 10 and 11 (common/ground)
- Should be a ground jumper wire from terminal PE to chassis ground
- Clean blocked or dirty heat sink fins

How to check – ELECTRIC:

- **Power Input –** Power should be present at VFD at any time under normal operation, if not then check circuit protection **(Applicable Fault Codes: 0002 DC OVERVOLT, 0006 DC UNDERVOLT, 0022 SUPPLY PHASE, 0035 OUTP WIRING)**
  - Measure voltage across terminals U1 and V1, should be 208-240 VAC
- **Signal Voltage**
  - **Output**
    - Signal (Auxiliary) Voltage Output – Should be 24 VDC across terminals 9 and 10 with terminal 9 being +24 VDC and terminal 10 being common/ground
  - **Input**
    - Start/Run Signal – Should be 24 VDC across terminals 16 and 10
    - Bottom Oven Switch (S4) ON – Should be 24 VDC across terminals 12 and 10
    - Middle Oven Switch (S3) ON – Should be 24 VDC across terminals 13 and 10
    - Top Oven Switch (S2) ON – Should be 24 VDC across terminals 14 and 10
    - **Fire Suppression Mode** – Should be 24 VDC across terminals 15 and 10
- **Relay Output** – This Relay is internal to the VFD and switches to normally open (NO) any time the VFD raises pass 5 Hertz (Hz)
  - **C Version Hood**
    - Common (Input) – Should be 120 VAC at terminal 17 as measured against chassis ground
    - Normally Open (Output) – Should be 120 VAC at terminal 19 as measured against chassis ground any time the VFD is running over 5 Hz

(VFD – ABB: Cont…)

(VFD – ABB: Continued)

- **D Version Hood**
  - Common (Input) – Should be common/ground at terminal 17 as wired from terminal 10, check for continuity between terminals 10 and 17
  - Normally Open (Output) – Should be common/ground at terminal 19 as relayed from terminal 17, check for continuity between terminals 10 and 19 anytime the VFD is running over 5 Hz

- **D Version Hood Only** – Digital Output – This will output +24 VDC to the Alarm light any time the VFD has detected a fault
  - Input – Should be 24 VDC across terminals 20 and 22 at any time under normal operation with terminal 20 being +24 VDC and terminal 22 being common/ground
  - Output – Should be 24 VDC across terminals 21 and 22 at any time the VFD has detected a fault with terminal 21 being +24 VDC

- **Output Power**
  - The output voltage will differ and is unrecorded, line voltage should be between 0-230 VAC
  - Turn Oven(s) ON
  - Measure all three legs against one another, this should give a consistent reading
    - U2 to V2
    - U2 to W2
    - V2 to W2
  - Measure all three legs against chassis ground, this should give a consistent reading

- **VFD Input Terminals**
  - Interrupt Power to Equipment – Turn Main Circuit Breaker (CB) OFF or turn store breaker OFF
  - Disconnect all wires from VFD
  - Measure resistance from U1 to V1. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from U1 to W1. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from V1 to W1. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from U1 to PE. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from V1 to PE. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from W1 to PE. Should be infinite, if any continuity, then replace VFD.

- **VFD Output Terminals (Applicable Errors: 0001 OVERCURRENT, 0004 SHORT CIRC, 0016 EARTH FAULT, 0034 MOTOR PHASE)**
  - Interrupt Power to Equipment – Turn Main Circuit Breaker (CB) OFF, or turn store breaker OFF
  - Disconnect all wires from VFD
  - Measure resistance from U2 to V2. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from U2 to W2. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from V2 to W2. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from U2 to G. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from V2 to G. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from W2 to G. Should be infinite, if any continuity, then replace VFD.

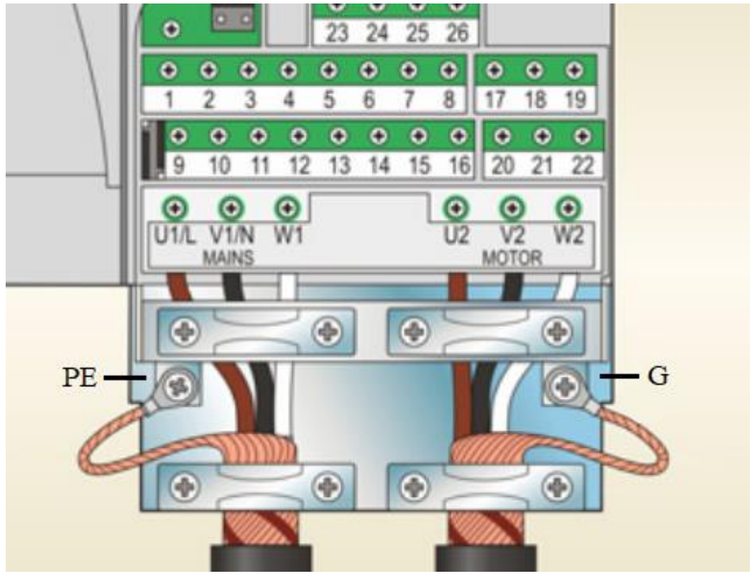


Figure 56 ABB VFD Connections

(VFDs: Cont…)

4.41.2 VFD, Variable Frequency Drive, Allen-Bradley

Used in Oven Versions:

- F, G (International Ovens)

Used in Hood Versions:

- E

PART NUMBER: XP-4718A-4.2

VFD Manufacturer Manual: Available via xltovens.com/technical-support/oven-service-manuals/

How to check – VISUAL:

- When the VFD has detected a fault it should display an error message and this should lead you in the proper direction to troubleshoot
- Programming
    - **OVEN** – See appropriate Parts & Service manual for Oven VFD Programming (Available via xltovens.com/technical-support/oven-service-manuals/)
    - **HOOD** – Determined via HMC
    - Error Codes and Programming can be viewed in the manual mentioned above
- Should be a ground jumper wire from terminal G to chassis ground
- **HOOD** – Should be a ground jumper wire between terminals 4 and 16, as well as from 16 to chassis ground
- Clean blocked or dirty heat sink fins

How to check – ELECTRIC:

- **Power Input** – Power should be present at VFD at any time under normal operation, if not then check circuit protection **(Applicable Errors: F003, F004)**
    - **WORLD OVEN**
        - Check Data-Plate for Voltage Rating of Oven
        - Measure voltage across terminals L1 and L2, should be 230/380 VAC
    - **HOOD**
        - Measure voltage across terminals L1 and L2, should be 208-240 VAC

(VFD – Allen Bradley: Cont…)

(VFD – Allen-Bradley: Continued)

- **Signal Voltage/Input**
  - **WORLD OVEN**
    - Turn Oven ON
    - Start/Run Signal – Should be 24 VDC across terminals 2 and 4
    - Coast-to-Stop Signal – Should be +24 VDC as measured against chassis ground on terminals 1 and 11
      - A factory-wired jumper should be present to supply +24 VDC to terminal 1 from terminal 11
  - **HOOD**
    - Start/Run Signal – Should be 24 VDC across terminals 4 and 6 with terminal 6 being +24 VDC
      - **Fire Suppression Mode** – Should be 24 VDC across terminals 4 and 5 with terminal 5 being +24VDC
    - Coast-to-Stop Signal – Should be +24 VDC as measured against chassis ground on terminals 1 and 11
      - A factory-wired jumper should be present to supply +24 VDC to terminal 1 from terminal 11
    - Run-at-Frequency Signal – Should be MODBUS communication with the Hood Machine Control (HMC) at terminals TB1 and TB2
- **Output Power**
  - The output voltage will differ and is unrecorded, line voltage should be between 0-230 VAC
  - Turn Oven(s) ON
  - Measure all three legs against one another, this should give a consistent reading
    - T1 to T2
    - T1 to T3
    - T2 to T3
  - Measure all three legs against chassis ground, this should give a consistent reading
- **VFD Input Terminals**
  - Interrupt Power to Equipment
    - **WORLD OVEN** – Unplug from Outlet or Turn Main Circuit Breaker (CB1 or CB4) OFF
    - **HOOD** – Turn Main Circuit Breaker (CB1) OFF
  - Disconnect all wires from VFD
  - Measure resistance from L1 to L2. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from L1 to L3. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from L2 to L3. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from L1 to G. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from L2 to G. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from L3 to G. Should be infinite, if any continuity, then replace VFD.

(VFD – Allen Bradley: Cont…)

(VFD – Allen-Bradley: Continued)

- **VFD Output Terminals (Applicable Errors: F013, F038, F039, F040, F041, F042, F043)**
  - Interrupt Power to Equipment
    - **WORLD OVEN** – Unplug from Outlet, or Turn Main Circuit Breaker (CB1 or CB4) OFF, or turn store breaker OFF
    - **HOOD** – Turn Main Circuit Breaker (CB1) OFF, or turn store breaker OFF
  - Disconnect all wires from VFD
  - Measure resistance from T1 to T2. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from T1 to T3. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from T2 to T3. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from T1 to G. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from T2 to G. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from T3 to G. Should be infinite, if any continuity, then replace VFD.

(VFDs: Cont…)

4.41.3 VFD, Variable Frequency Drive, Hitachi

Used in Hood Versions:

- A, B, C, D

PART NUMBER: HP-2051

VFD Manufacturer Manual: Available via xltovens.com/technical-support/oven-service-manuals/

Note: Differences of wiring or application between versions of hood will be noted for each instance

How to check – VISUAL:

- When the VFD has detected a fault it should display an error message and this should lead you in the proper direction to troubleshoot
  - See Brief List of Error Codes in appropriate Parts & Service Manual (Available via xltovens.com/technical-support/oven-service-manuals/)
  - See Full List of Error Codes in Manufacturer Manual mentioned above **(Pg. 224)**
- Programming
  - **B, C, & D Version** – See appropriate Parts & Service Manual (Available via xltovens.com/technical-support/oven-service-manuals/)
  - Programming can also be found in the Manufacturer Manual linked above
- Should be a jumper wire between terminals PCS and L
  - **D Version Hoods** will have an additional jumper between terminals L and CM2
- Clean blocked or dirty heat sink fins

How to check – ELECTRICAL:

- **Power Input –** Power should be present at VFD at any time, if not then check circuit protection
  - **A Version Hood**
    - Should be single phase power applied across terminals L1 and L2, with a neutral line on terminal N
    - Measure voltage across terminals L1 and L2, should be 208-240 VAC
  - **B Version Hood**
    - Should be three phase power applied across terminals L1, L2, and L3
    - Test each leg against one another, should measure 208-240 VAC
  - **C & D Version Hood**
    - Should be single phase power applied across terminals L1 and L3
    - Measure voltage across terminals L1 and L2, should be 208-240 VAC

(VFD – Hitachi: Cont…)

(VFD – Hitachi: Continued)

- **Signal Voltage**
  - **Output**
    - Signal (Auxiliary) Voltage Output – Should be 24 VDC across terminals P24 and L with terminal P24 being +24 VDC and terminal L being common/ground
  - **Input**
    - **A Version Hood**
      - Schematic: HD-9130A-S
        - Bottom Oven Switch (S4) ON – Should be 24 VDC across terminals 1 and L
        - Middle Oven Switch (S3) ON – Should be 24 VDC across terminals 2 and L
        - Top Oven Switch (S2) ON – Should be 24 VDC across terminals 3 and L
      - Schematic: HD-9130C-S
        - Run/Start Signal – Should be 24 VDC across terminals 1 and L
        - Bottom Oven Switch (S4) ON – Should be 24 VDC across terminals 2 and L
        - Middle Oven Switch (S3) ON – Should be 24 VDC across terminals 3 and L
        - Top Oven Switch (S2) ON – Should be 24 VDC across terminals 4 and L
    - **B Version Hood**
      - Bottom Oven Switch (S4) ON – Should be 24 VDC across terminals 1 and L
      - Middle Oven Switch (S3) ON – Should be 24 VDC across terminals 2 and L
      - Top Oven Switch (S2) ON – Should be 24 VDC across terminals 3 and L
      - **Fire Suppression Mode** – Should be 24 VDC across terminals 4 and L
    - **C & D Version Hood**
      - Run/Start Signal – Should be 24 VDC across terminals 1 and L
      - Bottom Oven Switch (S4) ON – Should be 24 VDC across terminals 2 and L
      - Middle Oven Switch (S3) ON – Should be 24 VDC across terminals 3 and L
      - Top Oven Switch (S2) ON – Should be 24 VDC across terminals 4 and L
      - **Fire Suppression Mode** – Should be 24 VDC across terminals 5 and L

(VFD – Hitachi: Cont…)

(VFD – Hitachi: Continued)

- **Alarm Relay**
  - **C Version Hood –** Any time the VFD is set into operation, the Alarm Relay will switch to normally open (NO) to output voltage to Relay, Cooling Fans (R1).
    - **Input**
      - Should be 120 VAC at terminal AL0 as measured against chassis ground or neutral at all times
    - **Output**
      - Should be 120 VAC at terminal AL1 as measured against chassis ground or neutral any time the VFD is in operation
  - **D Version Hood** – Any time the VFD has detected a fault, the Alarm Relay will switch to normally open (NO) to output voltage to Alarm, Exhaust Fan (AL).
    - **Input**
      - Should be 24 VDC across terminals AL0 and PCS, with terminal AL0 being +24 VDC and terminal PCS being common/ground, any time the VFD has input power
    - **Output**
      - Should be 24 VDC across terminals AL1 and PCS with terminal AL1 being +24 VDC and terminal PCS being common/ground, any time the VFD has detected a fault
      - Terminal 11 should be a common/ground output any time the VFD is in operation originating at terminal CM2
        - Should measure continuity between terminals 11 and CM2 any time the VFD is in operation
- **Output Power**
  - The output voltage will differ and is unrecorded, line voltage should be between 0-230 VAC
  - Turn Oven(s) ON
  - Measure all three legs against one another, this should give a consistent reading
    - T1 to T2
    - T1 to T3
    - T2 to T3
  - Measure all three legs against chassis ground, this should give a consistent reading
- **VFD Input Terminals**
  - Interrupt Power to Equipment – Turn Main Circuit Breaker (CB) OFF or turn store breaker OFF
  - Disconnect all wires from VFD
  - Measure resistance from L1 to L2. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from L1 to L3. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from L2 to L3. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from L1 to GND. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from L2 to GND. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from L3 to GND. Should be infinite, if any continuity, then replace VFD.

(VFD – Hitachi: Cont…)

(VFD – Hitachi: Continued)

- **VFD Output Terminals**
  - Interrupt Power to Equipment – Turn Main Circuit Breaker (CB) OFF, or turn store breaker OFF
  - Disconnect all wires from VFD
  - Measure resistance from T1 to T2. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from T1 to T3. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from T2 to T3. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from T1 to GND. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from T2 to GND. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from T3 to GND. Should be infinite, if any continuity, then replace VFD.

(VFDs: Cont…)

4.41.4 VFD, Variable Frequency Drive, Invertek

Used in Oven Versions:

- G, H (International Ovens)

Used in Hood Versions:

- E, F

PART NUMBER: XP-4718A-4.3

VFD Manufacturer Manual: Available via xltovens.com/technical-support/oven-service-manuals/

How to check – VISUAL:

- When the VFD has detected a fault it should display an error message and this should lead you in the proper direction to troubleshoot
- Programming
    - **Oven** – See appropriate Parts & Service manual for Oven VFD Programming (Available via xltovens.com/technical-support/oven-service-manuals/)
    - **Hood** – Determined via HMC
    - Programming can also be found in the Manufacturer Manual mentioned above
- Clean blocked or dirty heat sink fins

How to check – ELECTRIC:

- **Power Input** – Power should be present at VFD at any time, if not then check circuit protection **(Applicable Errors: O-volt, U-volt, FLt-dc, P-LOSS)**
    - **WORLD OVEN**
        - Check Data-Plate for Voltage Rating of Oven
        - Measure voltage across terminals L1 and L2, should be 230/380 VAC
    - **HOOD**
        - Measure voltage across terminals L1 and L2, should be 208-240 VAC
- **Signal Voltage/Output**
    - User (Auxiliary) Output – Should be +24 VDC output from terminal 1 as tested against chassis ground

(VFD – Invertek: Cont…)

(VFD – Invertek: Continued)

- **Signal Voltage/Input**
  - **WORLD OVEN**
    - Turn Oven ON
    - Run/Stop Signal – Should be 24 VDC across terminals 2 and 7
    - Run-at-Frequency Signal – Should be 24 VDC across terminals 3 and 7
  - **HOOD**
    - **Normal Operation**
      - Run Signal – Should be +24 VDC input at terminal 2 as tested against chassis ground
      - Run Signal – Should be +24 VDC input at terminal 6 as tested against chassis ground
      - Run-at-Frequency Signal – Should be MODBUS communication with the Hood Machine Control (HMC)
    - **Fire Suppression**
      - Should be +24 VDC at terminal 4 as tested against chassis ground anytime the Fire Suppression system has been activated
- **Output Power**
  - The output voltage will differ and is unrecorded, line voltage should be between 0-230 VAC
  - Turn Oven(s) ON
  - Measure all three legs against one another, this should give a consistent reading
    - U to V
    - U to W
    - V to W
  - Measure all three legs against chassis ground, this should give a consistent reading
- **VFD Input Terminals**
  - Interrupt Power to Equipment
    - **WORLD OVEN** – Unplug from Outlet, or Turn Main Circuit Breaker (CB1 or CB4) OFF, or turn store breaker OFF
    - **HOOD** – Turn Main Circuit Breaker (CB1) OFF, or turn store breaker OFF
  - Disconnect all wires from VFD
  - Measure resistance from L1 to L2. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from L1 to L3. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from L2 to L3. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from L1 to G. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from L2 to G. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from L3 to G. Should be infinite, if any continuity, then replace VFD.

(VFD – Invertek: Cont…)

(VFD – Invertek: Continued)

- **VFD Output Terminals (Applicable Errors: h 0-1, Out-F, O-I)**
  - Interrupt Power to Equipment
    - **WORLD OVEN** – Unplug from Outlet, or Turn Main Circuit Breaker (CB1 or CB4) OFF, or turn store breaker OFF
    - **HOOD** – Turn Main Circuit Breaker (CB1) OFF, or turn store breaker OFF
  - Disconnect all wires from VFD
  - Measure resistance from U to V. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from U to W. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from V to W. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from U to G. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from V to G. Should be infinite, if any continuity, then replace VFD.
  - Measure resistance from W to G. Should be infinite, if any continuity, then replace VFD.

4.42 Valves

4.42.1 V1 & V2 – Gas Valve Combination Main/Pilot

Used in Oven Versions:

- DS, TS, TS2

PART NUMBER: SP-4207-NAT

SP-4207-LPG

The combination gas valve serves four functions:

- Manual gas shutoff,
- Outlet pilot pressure regulation,
- Outlet main pressure regulation, and
- Automatic electric redundant double-seated gas shutoff.

How it works:

- The Main/Pilot Combination Gas Valve (Combo Valve) will be controlled by and will receive 24 VAC from the Honeywell Burner Control (BC) or Fenwal Ignition Control.
- The Combo Valve will have three wire connections made from the burner/ignition control:
  - 24 VAC applied to the Pilot Valve (PV) terminal,
  - 24 VAC applied to the Main Valve (MV) terminal, and
  - A common wire to the Main Valve/Pilot Valve (MV/PV) terminal.
- Once 24 VAC is applied to the PV terminal, the Combo Valve will output pilot gas pressure to the Flame Sensor/Spark Igniter (FS/SI), and once pilot flame is proven the Combo Valve will receive 24 VAC on the MV terminal and will output main valve (manifold) gas pressure to the Modulating Valve (V3).
- These pressures are adjustable:
  - The pilot pressure adjustment is under a cap screw directly next to the pilot gas line outlet.
  - The manifold pressure adjustment is under a cap screw on the inlet side of the valve directly next to the inlet pressure tap.
  - The manifold pressure tap is on the outlet side of the gas valve directly in between the wiring terminals and the pilot pressure adjustment.
  - **See image for reference at the end of this section** (see Figure 57).
- The Combo Valve will have an On/Off switch on the top of the valve acting as a manual gas shutoff.
- The body of the Combo Valve should have a ground wire connected to chassis ground.

(V1/V2 – Combo Valve: Cont…)

(V1/V2 – Combo Valve: Continued)

Tools required:

- Multi-meter
- Manometer
- Needle Nose Pliers
- Pipe Wrenches
- Allen Wrenches

How to check – ELECTRIC:

- PV
  - Turn oven OFF, unplug oven from outlet
  - Remove wires from Combo Valve
  - Measure resistance between PV terminal and Ground. Should be infinite. If any continuity, replace valve.
- MV
  - Turn oven OFF, unplug oven from outlet
  - Remove wires from Combo Valve
  - Measure resistance between MV terminal and Ground. Should be infinite. If any continuity, replace valve.

- PV – Input Voltage
  - Turn oven ON
  - Should be 24 VAC applied across terminal PV and MV/PV anytime the oven is on and the burner is in operation
- MV – Input Voltage
  - Turn oven ON
  - Should be 24 VAC applied across terminal MV and MV/PV anytime the oven is on and the burner is in operation (NOTE: Pilot flame **must** be proven before 24 VAC is applied to terminal MV from burner/ignition control)

(V1/V2 – Combo Valve: Cont…)

(V1/V2 – Combo Valve: Continued)

How to check – GAS:

- Incoming Gas Pressure
  - Shut off gas supply to oven
  - Remove plug from inlet pressure tap (see Figure 57)
  - Install manometer hose
  - Turn on gas supply to oven
  - Should be 6” – 8” W.C. with Natural Gas and 11” – 14” W.C. with Propane
- Pilot Valve Output
  - Turn oven OFF
  - Remove cap from tee-fitting pressure tap on pilot gas line **OR** if the pilot gas line does not have a pressure tap, then fully remove pilot gas line from valve body (see Figure 57)
  - Install manometer hose to pressure tap on pilot gas line **OR** directly to pilot outlet on valve body (see Figure 57)
  - Turn oven ON
  - Should be 5” – 7” W.C. with Natural Gas and 8” – 10” W.C. with Propane
  - See below section for adjustment
- Main Valve Output
  - Turn oven OFF
  - Remove plug from manifold pressure tap (see Figure 57)
  - Install manometer hose
  - Turn oven ON
  - Should be 3.5” W.C. with Natural Gas and 10” W.C. with Propane
  - See below section for adjustment

(V1/V2 – Combo Valve: Cont…)

(V1/V2 – Combo Valve: Continued)

How to adjust – GAS:

- PV
  - Remove cap screw from pilot pressure adjustment (see Figure 57)
  - To increase pressure: Rotate screw CCW
  - To decrease pressure: Rotate screw CW
- MV
  - Remove cap screw from manifold pressure regulator (see Figure 57)
  - To increase pressure: Rotate screw CCW
  - To decrease pressure: Rotate screw CW

How to check – VISUAL:

- On/Off Switch on top of valve is turned on
- Perform Leak Test
  - Paint Combo Valve with soapy solution
  - Operate oven burner
  - Observe if soapy solution begins to bubble anywhere on the gas valve
    - If leak is detected at inlet/outlet connections
      - Look for damaged threads
      - Look for cracks, broken or damaged material
      - Reapply pipe sealant and retest
    - If a leak is detected anywhere on the body of the Combo Valve, then replace the valve

(V1/V2 – Combo Valve: Cont…)

(V1/V2 – Combo Valve: Continued)

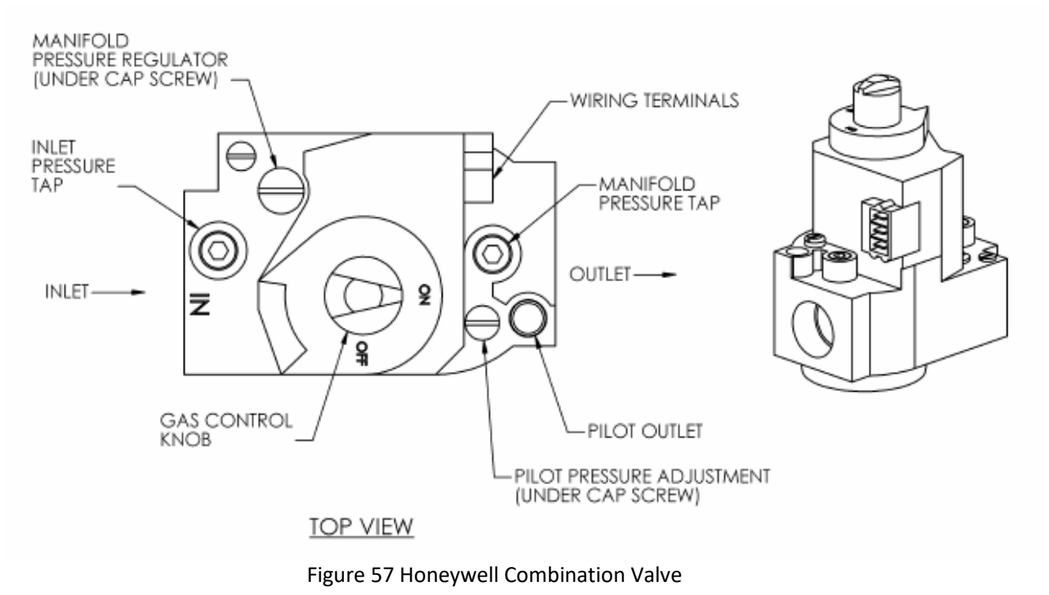


Figure 57 Honeywell Combination Valve

(Valves: Cont…)

4.42.2 V1 & V2 – Gas Valve On/Off

Used in Oven Versions:

- F, G, H

PART NUMBER: Natural Gas: XP-4207C-DI-N, Propane: XP-4207C-DI-P

Alternate Option: V1, 120 VAC Solenoid – Natural Gas: SP-4207A-DI-N-120V, Propane: SP-4207A-DI-P-120V

Plunger Assembly: XP-4207A-DI-Poppet

24V Solenoid Coil Only: SP-4207-DI-24V-Sol

120V Solenoid Coil Only: XP-4207-DI-120V-Sol

How it works: The Gas Valve consists of two (2) solenoid valves

- V1 is a safety feature designed to shut off total gas flow. It is open continuously during normal burner operation. It will close if the high limit is reached or if no flame is detected. V1 can alternatively be used with a blue 120 VAC solenoid coil rather than the standard, green 24 VDC solenoid coil. The 120 VAC coil would be used in conjunction with the Capable Controls Ignition Control and Oven Ignition Control Relay (R2). Please refer to product data and schematic specific to your oven.
- V2 regulates the gas flow and therefore the temperature of the oven. It is controlled by the OMC via the grounding of P11-2. This will always be a 24 VDC solenoid coil.

The valve also has an internal pressure regulator used to adjust incoming fuel pressure to manifold pressure.

There are two (2) brass fuel pressure testing ports.

- The upper port is used for measuring incoming pressure
- The lower port is used for measuring manifold pressure.

Different springs are required for different fuels.

There is either **A.)** a threaded Bypass Orifice under a cap on the opposite side of the bottom pressure testing port, or **B.)** a threaded stem with a flathead end to adjust bypass pressure (see Section 4.22.1)

There is a Main Orifice and the size of which will depend on fuel being used and model of oven (refer to Installation and Operation Manual specific to the oven you are working on)

Tools required:

- VOM
- Manometer
- Flathead screwdriver, Allen wrenches, Torx driver

(V1/V2 – On/Off Valve: Cont…)

(V1/V2 – On/Off Valve: Continued)

How to check – ELECTRIC:

- V1 & V2 Solenoid Coils
  - Disconnect both wires from V1
  - Measure resistance between terminals. 24V coil should be about 1.2 Mega-Ohms. 120V coil should be about 1.0 Mega-Ohms. If infinite Ohms, replace valve.
  - Measure resistance between one terminal and Ground. Should be infinite. If any continuity, replace valve.
  - Measure resistance between other terminal and Ground. Should be infinite. If any continuity, replace valve.
  - Reconnect wires
  - Repeat above steps for V2
- V1 – Input Voltage
  - Turn Oven ON
  - **Elan Controls:** After 30 seconds, should have 24 VDC applied across solenoid terminals the entire time the oven is on and the burner is lit
  - **Discrete Control Package:** After 30 seconds, should have 120 VAC applied across solenoid terminals the entire time the oven is on and the burner is lit
- V2 – Input Voltage
  - Turn Oven ON
  - After 30 seconds, should have 24 VDC applied across solenoid terminals anytime the oven's indicated temperature is below the set point temperature
  - **Elan Controls:** Once set point is reached, the OMC will stop grounding V2 via the black wire, although +24 VDC will still be applied to V2 via the red wire
  - **Discrete Control Package:** Once set point is reached, the Golander Temp. Control will stop applying 6.5 VDC to the SSR in turn opening the circuit to stop supplying 24 VDC to V2

How to check – GAS:

- V1
  - Incoming Gas Pressure
    - Shut off gas supply to oven
    - Rotate screw CCW in upper test port 1-1/2 turns
    - Connect manometer to upper port
    - Turn on gas supply to oven
    - Measure pressure, should be within 6" - 14" WC with Natural Gas and 10.5" - 14" WC with Propane. If no pressure, ensure gas supply is on, but location may need to contact their gas supplier

(V1/V2 – On/Off Valve: Cont…)

(V1/V2 – On/Off Valve: Continued)

- V2
  - High Flame Output
    - Rotate screw CCW in lower test port 1-1/2 turns
    - Connect manometer to lower port
    - Turn oven ON
    - Measure pressure. After 30 seconds, there should be manifold pressure. If no pressure, check voltage and/or mechanical function
  - Low Flame (Bypass) Output
    - Following High Flame check, remove Black wire from V2 coil
    - Measure pressure, should be low-flame pressure. If no pressure, check for a clogged orifice in valves that utilize a fixed-orifice bypass **OR** attempt to adjust pressure in valves that utilize a threaded stem adjustable bypass

How to check – MECHANICAL:

- V1 & V2
  - Disconnect gas and electric utilities
  - Remove solenoid coil
  - Remove 4 screws that hold the stem to the valve body
  - Inspect plunger and stem for wear or carbon build-up

How to adjust – GAS:

- V2 – High Flame
  - Rotate screw CCW in lower testing port 1-1/2 turns
  - Connect manometer to lower port
  - Turn oven ON
  - Measure pressure. After 30 seconds, there should be manifold pressure.
  - Remove cap on opposite side of fuel pressure testing ports
    - To increase pressure: Rotate screw CW
    - To decrease pressure: Rotate screw CCW

(V1/V2 – On/Off Valve: Cont…)

(V1/V2 – On/Off Valve: Continued)

- V2 – Low Flame
  - Following High Flame check/adjustment, remove Black wire from V2 coil
  - Measure pressure, should be low-flame pressure
  - Fixed-Orifice Bypass
    - No adjustments can be made, bypass orifice would be replaced with different diameter orifice size
    - Natural gas orifice is larger than Propane orifice
  - Adjustable Bypass – Should be 0.4” W.C. with Natural Gas, and 0.8” W.C. with Propane
    - To increase pressure: Rotate threaded stem CCW
    - To decrease pressure: Rotate threaded stem CW

How to check – VISUAL:

- Perform Leak Test
  - Paint Combo Valve with soapy solution
  - Operate oven burner
  - Observe if soapy solution begins to bubble anywhere on the gas valve
    - If leak is detected at inlet/outlet connections
      - Look for damaged threads
      - Look for cracks, broken or damaged material
      - Reapply pipe sealant and retest
    - If a leak is detected anywhere on the body of the valve, then replace the valve

(Valves: Cont…)

4.42.3 V3 – Valve, Solenoid (Pilot On/Off)

Used in Oven Versions:

- DS

PART NUMBER: SP-4504-(A/J)

Manufacturer: ASCO or Johnson

How it works: The Solenoid Valve will receive 120 VAC power. The neutral voltage will be wired straight from incoming power, while the phase voltage will be controlled via the Temperature Control (TC). The Temperature Control will send this phase voltage to the solenoid anytime the indicated temperature is below the set temperature; putting the valve in its high flame output state. Once the set temperature is reached, the Temperature Control will shut off phase voltage output to the solenoid and this will put the valve into its low flame output state.

Tools Required:

- Multi-meter
- Manometer

How to check – ELECTRICAL:

- V3
  - Remove wire leads from incoming power
  - Measure resistance from each wire to the body of the valve. Should be infinite, if any continuity, then replace valve
- Input Power
  - Johnson Solenoid Valve – Should be 120 VAC applied across black and white wire leads any time the oven's indicated temperature is below the set point temperature
  - ASCO Solenoid Valve – Should be 120 VAC applied across red wire leads any time the oven's indicated temperature is below the set point temperature

How to check – VISUAL:

- Perform Leak Test
  - Paint Combo Valve with soapy solution
  - Operate oven burner
  - Observe if soapy solution begins to bubble anywhere on the gas valve
    - If leak is detected at inlet/outlet connections
      - Look for damaged threads
      - Look for cracks, broken or damaged material
      - Reapply pipe sealant and retest
    - If a leak is detected anywhere on the body of the Combo Valve, then replace the valve

4.42.4 V1, V2, V3 – Multi Valve

Used in Oven Versions:

- TS, TS2, TS3, A, B, C, D E

PART NUMBER: XP-4207-DI

Manufacturer: Honeywell

How it works: The Multi-Valve assembly has three (3) Gas Valves. The Main Valves (V1-V2) operate in series, and are wired in series via the Rectifier Plug (RP). The Rectifier Plug rectifies 24 VAC from the Ignition Control (IC) to 22 VDC. V1-V2 are solenoid valves and are open continuously during burner operation, regardless of either actual or set-point temperature values.

V3 is a modulating valve, and is controlled by 0-15 VDC from the Signal Conditioner (SC). There are two (2) fuel pressure testing ports; one for incoming pressure, and one for both high-bias and low-bias pressure. The upper port is used for incoming pressure, while the lower port is used for high- and low-bias pressure. There are two (2) hex adjusting nuts; a brass 8mm nut for adjusting high-bias pressure, and a black 5mm nut for adjusting low-bias pressure.

Tools required:

- VOM
- 5 mm Nut Driver (or Combination Wrench)
- 8 mm Nut Driver (or Combination Wrench)
- #2 Phillips Screwdriver
- 5/32” Hex Wrench
- Manometer

How to check – ELECTRIC:

- V1 & V2
  - Unplug Rectifier Plug
  - Measure resistance between Pin 1 and Pin 5. Should be about 50 Ohms, +/- 10%. If infinite Ohms, replace valve.
  - Measure resistance between Pin 1 and Ground. Should be infinite. If any continuity, replace valve.
  - Measure resistance between Pin 5 and Ground. Should be infinite. If any continuity, replace valve.
  - Turn oven ON, and after 30 seconds, should be 22 VDC applied across Pins 1 and 5 anytime the oven is on and the burner is lit (see Rectifier Plug)

(V1/V2/V3 – Multi-Valve: Cont…)

(V1/V2/V3 – Multi-Valve: Continued)

- V3
  - Unplug both blue wires
  - Measure resistance between Pin 1 and Pin 2. Should be about 50 Ohms, +/- 10%. If infinite Ohms, replace valve.
  - Measure resistance between Pin 1 and Ground. Should be infinite. If any continuity, replace valve.
  - Measure resistance between Pin 2 and Ground. Should be infinite. If any continuity, replace valve.
  - Re-install both blue wires
  - Turn oven ON, should be 0-15 VDC applied across Pins 1 and 2 (see Signal Conditioner)

How to check – GAS:

- V1 & V2
  - Rotate screw CCW in lower testing port 1-1/2 turns
  - Connect manometer to lower port
  - Turn oven ON
  - Measure pressure. After 30 seconds, there should be some pressure. If no pressure, try to adjust, verify electrical, then replace valve.
- V3
  - Rotate screw CCW in lower testing port 1-1/2 turns
  - Connect manometer to lower port
  - Turn oven ON
  - Adjust Set-Point value to at least 100° more than indicated temperature
  - Measure pressure. After 30 seconds, pressure should equal manifold pressure. If pressures are not equal, adjust valve.
  - Disconnect one (1) blue wire.
  - Measure pressure. Pressure should drop to about 1” W.C. or less. If pressure is incorrect, adjust valve.

How to adjust – GAS:

- High Bias Adjust
  - Target pressure is 3.5” W.C. for NAT gas and 10.0” W.C. for PROPANE.
  - Rotate 8 mm nut CW to increase pressure
  - Rotate 8 mm nut CCW to decrease pressure
  - If unable to achieve desired pressure, and incoming is more than desired, replace valve.

(V1/V2/V3 – Multi-Valve: Cont…)

(V1/V2/V3 – Multi-Valve: Continued)

- Low Bias Adjust
  - Target pressure is 0.1” W.C. for NAT gas and 0.5” W.C. for PROPANE.
    - If low bias is too high, then the actual temperature will go above set-point value.
    - If low bias is too low, then the flame will extinguish.
  - Rotate 5 mm nut CW to increase pressure
  - Rotate 5 mm nut CCW to decrease pressure
  - If unable to achieve desired pressure, replace valve.

How to check – VISUAL:

- Perform Leak Test
  - Paint Combo Valve with soapy solution
  - Operate oven burner
  - Observe if soapy solution begins to bubble anywhere on the gas valve
    - If leak is detected at inlet/outlet connections
      - Look for damaged threads
      - Look for cracks, broken or damaged material
      - Reapply pipe sealant and retest
    - If a leak is detected anywhere on the body of the Combo Valve, then replace the valve

(Valves: Cont…)

4.42.5 V3 – Valve, Modulating – Maxitrol (Pilot Multi)

Used in Oven Versions:

- DS, TS, TS2

PART NUMBER: SP-4208-(NAT/LPG)

Manufacturer: Maxitrol

How it works: V3 is a modulating valve, and is controlled by 0-20 VDC from the Signal Conditioner (SC). This valve will not have a connection port for reading outlet pressure, instead it has bypass adjustment fittings on the front and back of the valve. A pressure adjustment spring has been factory set to obtain an outlet pressure slightly above atmospheric pressure (0.1" W.C.) with the bypass closed and zero voltage being applied. The minimum flow rate would then be adjusted through the bypass.

Tools required:

- VOM
- #2 Phillips Screwdriver
- Flathead Screwdriver

How to check – ELECTRIC:

- V3
  - Remove two wires from screw terminals.
  - Measure resistance across the two screw terminals. Natural gas (M420B) should be about 64 Ohms, +/- 10 Ohms. Propane (M420BH) should be about 40 Ohms, +/- 10 Ohms. If infinite Ohms, replace valve.
  - Measure resistance between each screw terminal and ground. Should be infinite. If any continuity, replace valve.
  - Re-install two wires to screw terminals
  - Turn oven ON, should be 0-20 VDC applied across the screw terminals (see Signal Conditioner)

How to check – VISUAL:

- Perform Leak Test
  - Paint Combo Valve with soapy solution
  - Operate oven burner
  - Observe if soapy solution begins to bubble anywhere on the gas valve
    - If leak is detected at inlet/outlet connections
      - Look for damaged threads
      - Look for cracks, broken or damaged material
      - Reapply pipe sealant and retest
    - If a leak is detected anywhere on the body of the Combo Valve, then replace the valve

4.43 WC – Wago Connector

PART NUMBER: XW-2814 (Two Position)

XW-2815 (Three Position)

How it works: A wago connector is similar to a crimp nut as it is a splicing connector.

How to check: Each position should have continuity to the other positions.

4.44 XFMR – Transformer

Note: This Transformer may also be identified as "XR1 - Transformer".

Used in Oven Versions:

- DS, TS, TS2, TS3, A, B, C, D, E

PART NUMBER: XP-4706

How it works: The Transformer steps down line voltage to 24 VAC. One terminal on the secondary side is connected to chassis ground by a green wire. Electric ovens rated for 480V will utilize a transformer to step down line voltage to 240 VAC for a suitable voltage to be used with all other components beside the heating elements.

Note: Some transformers are equipped with an integrated circuit breaker for standalone protection.

Tools required:

- Multi-meter

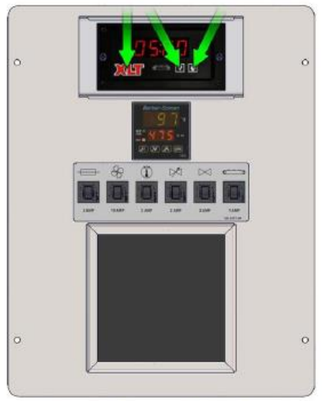
How to check:

- Visual
  - Check circuit breaker
- Electrical
  - Inputs – Should be oven line voltage
  - Outputs
    - Should be 24 VAC
    - For 480V Ovens – Should be 240 VAC

5 Appendix

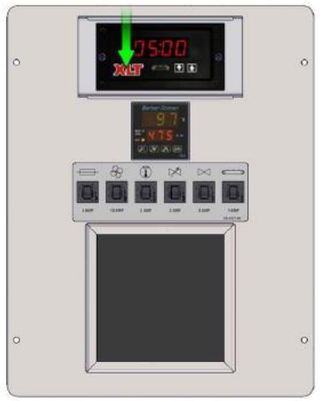
5.1 Anaheim Conveyor Controller Programming Procedure

1



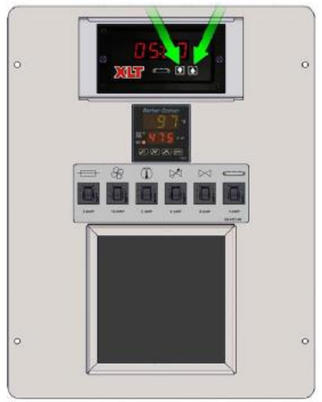
Press and Hold (3) Buttons To Enter Program Mode

2



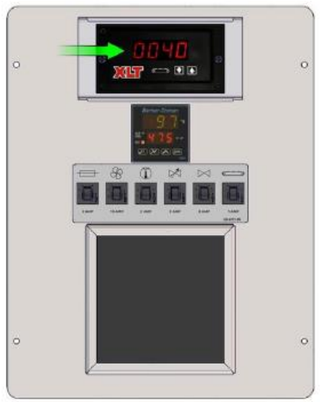
Use XLT Button To Scroll Through Parameters

3



Press Up or Down Arrows To Change Values

4

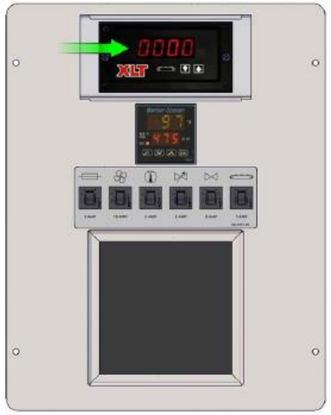


Program Item #1: Bake Chamber Length
0032 For 1832
0040 For 2440 or 3240
0055 For 3255 or 3855
0070 For 3270 or 3870

5

Program Item #2: Reduction Value
Default Is 0300

6



Program Item #3: Trimming
Used For Small Timing Adjustment

7

Program Item #4: Min. Set Time
Default Is 01:30

8

Program Item #5: Max. Set Time
Default Is 17:00

(Anaheim Programming: Cont…) Figure 58 Anaheim Programming Pg. 1

Figure 59 Anaheim Programming Pg. 2

(Anaheim Programming: Continued)

9

Program Item #6: Motor Direction
0001 For A Right To Left
0002 For A Left To Right

10

Program Item #7: In/Rev
Default Is 0556

11

Press XLT Button To Cycle Back To Main Display
To Save Parameters

Figure 60 Anaheim Programming Pg. 3

5.2 Barber Colman Loading Default Parameters

5.2.1 Gas-Heating Controller, 7SC

Step 1: Remove the controller from its housing by pulling on the display bezel to reveal the internal circuit boards.

Step 2: Open the V101 switch as shown in Figure 61.

Step 3: Reinsert controller into housing.

Step 4: Press the <FUNC> key until the display shows parameter P17.

Step 5: Press the <UP> key until the display shows “1”, and then press <DOWN> key to show “0”.

Step 6: Press the <FUNC> key.

Step 7: Remove the controller from its housing by pulling on the display bezel to reveal the internal circuit boards.

Step 8: Close the V101 switch as shown in Figure 61.

Step 9: Reinsert controller into housing.

Step 10: Hold the <DOWN> key and then press the <UP> key. The display will show “OFF” and “dFLt”. Press the <UP> key to show “On” and “dFLt”.

Step 11: Press the <FUNC> to show “LOAd”. This indicates the loading procedure has been initiated, and after a few seconds the display shall revert to the normal operating display. You may now reprogram the controller to XLT specification.

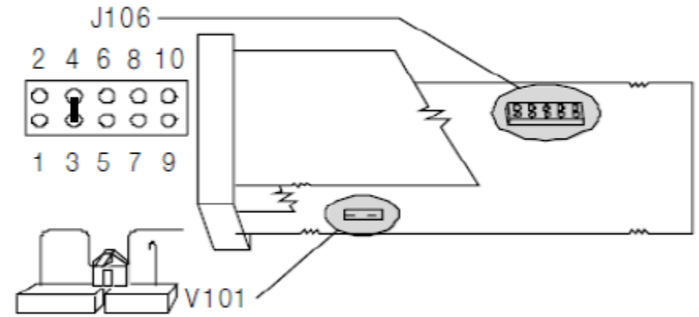


Figure 61 Barber Colman V101 Switch, Gas

5.2.2 Electric-Heating Controller, 7SH

Step 1: Remove the controller from its housing by pulling on the display bezel to reveal the internal circuit boards.

Step 2: Open the V2 switch as shown in Figure 62.

Step 3: Reinsert controller into housing.

Step 4: Press the <FUNC> key until the display shows parameter P11.

Step 5: Press the <UP> or <DOWN> keys until the display shows “0”.

Step 6: Press the <FUNC> key.

Step 7: Remove the controller from its housing by pulling on the display bezel to reveal the internal circuit boards.

Step 8: Close the V2 switch as shown in Figure 62.

Step 9: Reinsert controller into housing.

Step 10: Hold the <DOWN> key and then press the <UP> key. The display will show “OFF” and “dFL”. Press the <UP> key to show “On” and “dFL”.

Step 11: Press the <FUNC> to show “L.dt”. This indicates the loading procedure has been initiated, and after a few seconds the display shall revert to the normal operating display. You may now reprogram the controller to XLT specification.

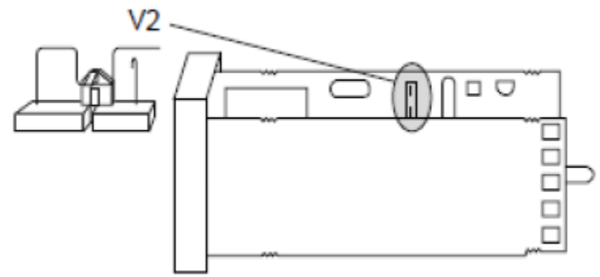


Figure 62 Barber Colman V2 Switch, Electric

5.3 Barber Colman Temperature Controller Programming Procedure

5.3.1 Gas-Heating Controller, 7SC

TIP

Read the entire instruction before programming.

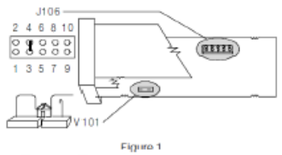


Figure 1

Configuration Button Functions

<FUNC> =The new setting of the selected parameter is stored and the display advances to the next parameter. This is required between each parameter.

△ UP= Increases the setting of the selected parameter.

▽ DOWN=Decrease the setting of the selected parameter.

1. Open V101 switch for Basic/Advanced Configuration (Figure 1)
   - Remove instrument from its case
   - Open switch V101
   - Verify that jumper J106, is configured as shown
   - Re-insert the instrument back in its case
2. Basic Configurations
   - Using the configuration buttons, scroll through parameter codes, changing them to match (Table 1)
   - After P17 _._._. Will appear
   - Using the configuration buttons scroll to 262 and press <FUNC> to enter Advanced Configurations
3. Advanced Configuration Procedure
   - Using the configuration buttons scroll through parameter codes changing them to match (Table 2)
4. Close V101 switch after Basic/Advanced Configuration (Figure 1)
   - Remove instrument from its case
   - Close Switch V101
   - Re-insert the instrument back in its case
5. Operating Parameters Procedure (Table 3)
   - On the first pass through change nnn to 3111 to unlock the advanced configuration
   - Scroll through the parameter codes again and change the nnn to 5 this locks the advanced configuration
   - Scroll through the parameter codes again and verify nnn in ON

Ser1	OFF
P1	5°C/22°F
P3	0
P4	315°C/600°F
P5	reU
P6	4-20
P9	AL1.P
P10	H.A.
P11	nonE
P16	0
P17	SFtA

Table 1

P18	norL
P19	norL
P24	reU
P25	OFF
P28	0
P29	0n
P30	0
P34	OFF
P36	tn.30
P37	0
P39	n0FL
P41	P.I.d.
P42	10.0
P43	Fn.SP
P44	0

Table 2

SP	260°C/500°F
SP2	0
nnn	3111/OFF
AL1	315°C/600°F
HSA1	0.1
Pb	5.0
ti	5.00
td	0.00
1P	30.0
rL	204°C/400°F
rH	310°C/590°F
Grd1	InF
Grd2	InF
OLH	100.00
toL	InF
rnP	InF

Table 3

Figure 63 Barber Colman Programming Procedure, Gas

5.3.2 Electric-Heating Controller, 7SH

TIP

Read the entire instruction before programming.

Configuration Button Functions

<FUNC> =The new setting of the selected parameter is stored and the display advances to the next parameter. This is required between each parameter.

△ UP= Increases the setting of the selected parameter.

▽ DOWN=Decrease the setting of the selected parameter.

1. Open V2 switch for Basic Configuration (Figure 1)
   - Remove instrument from its case
   - Open switch V2
   - Re-insert the instrument back in its case
2. Basic Configurations
   - Using the configuration buttons, scroll through parameter codes, changing them to match (Table 1)
   - After P12 _._._._ Will appear
3. Close V2 switch after Basic Configuration (Figure 1)
   - Remove instrument from its case
   - Close Switch V2
   - Re-insert the instrument back in its case
   - Error 400 will appear. Press and hold the △ and ▽ to clear
   - 000 will appear
4. Advanced Configurations Procedure
   - Scroll through the parameter codes to nnn. Change nnn to 311 to unlock the advanced configuration
   - Using the configuration buttons, scroll through parameter codes, changing them to match (Table 2)
   - Scroll through the parameter codes again and change the nnn to 5. This locks the advanced configuration
   - Scroll through the parameter codes again and verify nnn is ON

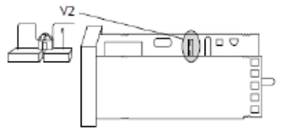


Figure 1

P1	2°C/10°F
P2	0
P3	315°C/600°F
P4	r
P5	1
P6	H.A.
P7	d
P8	OFF
P9	0
P10	100
P11	311
P12	7

Table 1

SP	260°C/500°F
nnn	311/5
AL	315°C/600°F
HSA	.1
Pb	4.0
ti	5.0
td	.00
1P	30
C	2
rL	204°C/400°F
rH	310°C/590°F
OLH	100
tOL	InF

Table 2

Figure 64 Barber Colman Programming Procedure, Electric

5.4 Dart Conveyor Controller, Programming Procedure

Notes/ Warnings	Instructions	Illustrations
Note: Make sure power is off to control before Step 1.	**Step 1.** Remove black plastic cover on control **Step 1.1.** Move J1 program jumper to the ON position.	
Note: When power is turned on to the oven, the display on Dart control will read 1:30. Note: The ENTER button will have to be pressed down for 3 to 4 seconds.	**Step 2.** Turn oven switch to ON position **2.1.** Place Dart controller in programming mode by pressing the ENTER button until the display reads P 0.	
	Step 3. Place Dart controller in time mode function. **3.1.** Press the UP arrow until the display reads P 10, then press the ENTER button once. **3.2.** Press the UP arrow once, the display will read 2. **3.3.** Press the ENTER button once to proceed.	
Note: The RPM rating for the conveyor motor can be located on the name plate on the side of the motor.	**Step 4.** Set Display Minimum. **4.1.** Press the UP arrow until the display reads P 20, then press the ENTER button once. **4.2.** Press the UP arrow key to select the correct time for the specific model. <u>19 RPM</u> xx32 - xx40 = 60 seconds. xx55 - xx70 = 90 seconds. <u>5 RPM</u> ALL MODELS = 240 seconds. **4.3.** Press the ENTER button once to proceed.	 

(Dart Programming: Cont…)

Figure 65 Dart Programming Pg. 1

	Step 5. Set Display Maximum. **5.1.** Press the UP arrow once, the display will read P 21, press the ENTER button once. **5.2.** Press the DOWN arrow key until the setting is reached for the correct RPM motor. 5 RPM = 840 19 RPM = 600 **5.3.** Press the ENTER button once to proceed.	 
	Step 6. Set Display Reference. **6.1.** Press the UP arrow until the display reads P 30. Press the enter button once to proceed. **6.2.** Press the down arrow to select the correct time for the specific oven model: xx32 = 64 seconds. xx40 = 79 seconds. xx55 = 109 seconds. xx70 = 138 seconds. **6.3.** Press the ENTER button once to proceed.	 
	Step 7. Set Reference RPM. **7.1.** Press the UP arrow once, the display will read P 31. **7.2.** Press the ENTER button once to proceed. **7.3.** Press the UP arrow to select the time for the correct RPM motor: 5 RPM = 2980 19 RPM = 770 **7.4.** Press the ENTER button once to proceed.	 
	Step 8. Enable ENTER button as a double click ON/OFF switch. **8.1.** Press the UP arrow until you reach P 38. **8.2.** Press the ENTER button once. **8.3.** Press the UP arrow once, the display will read 1. **8.4.** Press the ENTER button once, the display will read P 38.	 

Figure 66 Dart Programming Pg. 2

(Dart Programming: Continued)

Note: Refer to chart below to check parameter settings for oven model and RPM of motor.	**Step 9.** Exit Programming Mode. **9.1.** Press the DOWN arrow button until the display reads P 0. **9.2.** Press the ENTER button once. **9.3.** Turn power to oven OFF. **9.4.** Move the J1 program jumper back to the OFF position. **9.5.** Replace black plastic cover. **9.6.** Verify conveyor speed by conducting a pan check test.	

Model of Oven					
Parameter	RPM	xx32	xx40	xx55	xx70
P 20	19	60	60	90	90
P 21	19	600			
P 30	19	64	79	109	138
P 31	19	770			
P 20	5	240			
P 21	5	840			
P 30	5	64	79	109	138
P 31	5	2980			

Figure 67 Dart Programming Pg. 3

5.5 Elan Controls, Programming Procedure

5.5.1 Impingement Oven, Large User Interface (LUI) and Oven Machine Control (OMC)

TIP **Read the entire instruction before programming.**

ENTER Used to select and save parameters.

UP Increases the setting of the selected parameter.

DOWN Decrease the setting of the selected parameter.

To enter factory tech mode press both UP and DOWN button simultaneously for ten (10) seconds and the following parameters will be displayed: *Displays will auto-exit programming screens after five (5) seconds of no activity.

1. Software Version
2. Serial Number Entry
3. Elapsed Time:
   - Total Hours.
   - Hours Since Filter has been Cleaned.
4. Belt Length: 32 = 1832 36 = 2336 40 = 2440 or 3240 50 = 3250 55 = 3255 or 3855 or 4455
   65 = 3265 70 = 3270 or 3870 80 = 3280 or 3880
5. Main Fan Type: Defaults to ON/OFF
6. Split Belt: Defaults to No.
7. Dual Burner: Defaults to No
8. Fuel Type:
   - Gas or Electric Options.
9. Remote Hood Switch Installed: Defaults to No.
10. Temperature Offset Adjustments:
    - Offset shown in degrees Fahrenheit.
11. High Temperature range from 590°F (310°C) to Low Temperature.
12. Low Temperature range from 300°F (150°C) to High Temperature.
13. Main Fan (Amps):
    - Press ENTER to see isolated Amp load.
14. Belt Direction: Defaults to right to left.
    - Defaults to Right to Left
    - Can be switched to left to right without physically changing the wire belt direction.
15. Main Fan Off Delay: Defaults to auto 225°F (107°C)
16. Beeper Button Test
17. Done:
    - Press ENTER to return to operating screen.

Figure 68 Elan Programming, Impingement

5.5.2 Radiant Oven, Large User Interface (LUI) and Oven Machine Control (OMC)

Read the entire instruction before programming.

TIP

Configuration Key Functions

ENTER = Used to select and save parameters.
UP = Increases the setting of the selected parameter.
DOWN = Decrease the setting of the selected parameter.

To enter factory tech mode press both UP and DOWN buttons simultaneously for ten (10) seconds and the following parameters will be displayed:

1. Software Version
2. Serial Number Entry
3. Elapsed Time:
   - Total Hours.
   - Hours Since Filter has been Cleaned.
4. Belt Length: 36 = 2336
5. Belt Width: 23 = 2336
6. Split Belt:
   - Defaults to No.
7. Remote Hood Switch Installed:
   - Defaults to No.
8. Temperature Offset Adjustments:
   - Offset shown in degrees Fahrenheit
9. High Temperature range from 1000°F (538°C) to Low Temperature.
10. Low Temperature range from 250°F (121°C) to High Temperature.
11. Belt Direction:
    - Defaults to right to left.
    - Can be switched from left to right without physically changing the wire belt direction.
12. Beeper Button Test
13. Done
    - Will return user to operation screen

Figure 69 Elan Programming, Radiant

5.6 Eurotherm Temperature Controller, Parameters

5.6.1 Gas-Heating Controller

Fahrenheit Programming

Lev 2

Parameter	Description	Set Condition
oP	Output Power	100
A-N	Loop Mode	Auto
Unit	Display Units	F
SP.Lo	Setpoint Low Limit	400
SP.Hi	Setpoint High Limit	600
SP 1	Setpoint 1	User Choice
SP 2	Setpoint 2	400
SP.SL	Setpoint Select	SP 1
SP.rr	Setpoint Rare Limit	Off
AL 1	Alarm 1 Setpoint	600
AL1.H	Alarm 1 Hysteresis	2
A.tun	Auto-Tune Enable	Off
PB	Proportional Band	9
ti	Intergral Time	20
td	Derivative Time	OFF
cb.Lo	Cutback Low	Auto
cb.Hi	Cutback High	Auto
Nr	Manual Reset	0.0
oFS	PV Offset	0
FiLt	PV Input Filter Time	1.6
oP.Lo	Output Low Limit	0
oP.Hi	Output High Limit	100
UcAL	User Calibration	Idle

Conf

Parameter	Description	Set Condition
P1	Input Type	cA.tc
P2	Decimal Point Position	nnnn
P3	Low Scale Range	0
P4	High Scale Range	600
P7	Control Type	HP
P11	Output 1	none
P12	Output 2	HEAt
P14	Output 4	AL 1.1
P15	DC Output Range	4.20
P21	Alarm 1 Type	Hi
P22	Alarm 1 Latching	nonE
P23	Alarm 1 Blocking	no
P24	Alarm 2 Type	nonE
P27	Alarm 3 Type	nonE
P34	Loop Break Alarm Type	oFF
P35	Sensor Break Alarm Type	on
P36	Sage Output Power	100
P37	Break Alarms Output	nonE
P41	Timer Type	nonE
P73	Page Pushbutton	Ac AL
P74	Second Line Of The Display	Std
P76	Level 2 Pass Code	2
P77	Configuration Level Pass Code	4
P81	Energy Meter Source	nonE
rEc.5	Recovery Point Save	nonE
rEc.L	Recovery Point Load	nonE
PHAS	Select Calibration Phase	nonE

Figure 70 Eurotherm Fahrenheit Parameters, Gas

Celsius Programming

Lev 2

Parameter	Description	Set Condition
oP	Output Power	100
A-N	Loop Mode	Auto
Unit	Display Units	C
SP.Lo	Setpoint Low Limit	205
SP.Hi	Setpoint High Limit	310
SP 1	Setpoint 1	User Choice
SP 2	Setpoint 2	205
SP.SL	Setpoint Select	SP 1
SP.rr	Setpoint Rare Limit	Off
AL 1	Alarm 1 Setpoint	315
AL1.H	Alarm 1 Hysteresis	2
A.tun	Auto-Tune Enable	Off
PB	Proportional Band	9
ti	Intergral Time	20
td	Derivative Time	OFF
cb.Lo	Cutback Low	Auto
cb.Hi	Cutback High	Auto
Nr	Manual Reset	0.0
oFS	PV Offset	0
FiLt	PV Input Filter Time	1.6
oP.Lo	Output Low Limit	0
oP.Hi	Output High Limit	100
UcAL	User Calibration	Idle

Conf

Parameter	Description	Set Condition
P1	Input Type	cA.tc
P2	Decimal Point Position	nnnn
P3	Low Scale Range	0
P4	High Scale Range	315
P7	Control Type	HP
P11	Output 1	none
P12	Output 2	HEAt
P14	Output 4	AL 1.1
P15	DC Output Range	4.20
P21	Alarm 1 Type	Hi
P22	Alarm 1 Latching	nonE
P23	Alarm 1 Blocking	no
P24	Alarm 2 Type	nonE
P27	Alarm 3 Type	nonE
P34	Loop Break Alarm Type	oFF
P35	Sensor Break Alarm Type	on
P36	Sage Output Power	0.0
P37	Break Alarms Output	nonE
P41	Timer Type	nonE
P73	Page Pushbutton	Ac AL
P74	Second Line Of The Display	Std
P76	Level 2 Pass Code	2
P77	Configuration Level Pass Code	4
P81	Energy Meter Source	nonE
rEc.5	Recovery Point Save	nonE
rEc.L	Recovery Point Load	nonE
PHAS	Select Calibration Phase	nonE

Figure 71 Eurotherm Celsius Parameters, Gas

5.6.2 Electric-Heating Controller

Fahrenheit Programming

Lev 2

Parameter	Description	Set Condition
oP	Output Power	100
A-N	Loop Mode	Auto
Unit	Display Units	F
SP.Lo	Setpoint Low Limit	400
SP.Hi	Setpoint High Limit	600
SP 1	Setpoint 1	User Choice
SP 2	Setpoint 2	400
SP.SL	Setpoint Select	SP 1
SP.rr	Setpoint Rare Limit	Off
AL 1	Alarm 1 Setpoint	600
AL1.H	Alarm 1 Hysteresis	2
A.tun	Auto-Tune Enable	Off
PB	Proportional Band	28
ti	Intergral Time	104
td	Derivative Time	OFF
cb.Lo	Cutback Low	Auto
cb.Hi	Cutback High	Auto
Nr	Manual Reset	0.0
1pls	Output 1 Minimum Pulse Time	2.0
oFS	PV Offset	0
FiLt	PV Input Filter Time	1.6
oP.Lo	Output Low Limit	0.0
oP.Hi	Output High Limit	100
UcAL	User Calibration	Idle

Conf

Parameter	Description	Set Condition
P1	Input Type	cA.tc
P2	Decimal Point Position	nnnn
P3	Low Scale Range	0
P4	High Scale Range	600
P7	Control Type	HP
P11	Output 1	HEAt
P12	Output 2	NONE
P14	Output 4	NONE
P21	Alarm 1 Type	Hi
P22	Alarm 1 Latching	nonE
P23	Alarm 1 Blocking	no
P24	Alarm 2 Type	nonE
P27	Alarm 3 Type	nonE
P34	Loop Break Alarm Type	oFF
P35	Sensor Break Alarm Type	on
P36	Sage Output Power	0.0
P37	Break Alarms Output	nonE
P41	Timer Type	nonE
P73	Page Pushbutton	Ac AL
P74	Second Line Of The Display	Std
P76	Level 2 Pass Code	2
P77	Configuration Level Pass Code	4
P81	Energy Meter Source	nonE
rEc.S	Recovery Point Save	nonE
rEc.L	Recovery Point Load	nonE
PHAS	Select Calibration Phase	nonE

Figure 72 Eurotherm Fahrenheit Parameters, Electric

Celsius Programming

Lev 2

Parameter	Description	Set Condition
oP	Output Power	100
A-N	Loop Mode	Auto
Unit	Display Units	C
SP.Lo	Setpoint Low Limit	205
SP.Hi	Setpoint High Limit	310
SP 1	Setpoint 1	User Choice
SP 2	Setpoint 2	205
SP.SL	Setpoint Select	SP 1
SP.rr	Setpoint Rare Limit	Off
AL 1	Alarm 1 Setpoint	315
AL1.H	Alarm 1 Hysteresis	2
A.tun	Auto-Tune Enable	Off
PB	Proportional Band	28
ti	Intergral Time	104
td	Derivative Time	OFF
cb.Lo	Cutback Low	Auto
cb.Hi	Cutback High	Auto
Nr	Manual Reset	0.0
1pls	Output 1 Minimum Pulse Time	2.0
oFS	PV Offset	0
FiLt	PV Input Filter Time	1.6
oP.Lo	Output Low Limit	0.0
oP.Hi	Output High Limit	100
UcAL	User Calibration	Idle

Conf

Parameter	Description	Set Condition
P1	Input Type	cA.tc
P2	Decimal Point Position	nnnn
P3	Low Scale Range	0
P4	High Scale Range	315
P7	Control Type	HP
P11	Output 1	HEAt
P12	Output 2	NONE
P14	Output 4	NONE
P21	Alarm 1 Type	Hi
P22	Alarm 1 Latching	nonE
P23	Alarm 1 Blocking	no
P24	Alarm 2 Type	nonE
P27	Alarm 3 Type	nonE
P34	Loop Break Alarm Type	oFF
P35	Sensor Break Alarm Type	on
P36	Sage Output Power	0.0
P37	Break Alarms Output	nonE
P41	Timer Type	nonE
P73	Page Pushbutton	Ac AL
P74	Second Line Of The Display	Std
P76	Level 2 Pass Code	2
P77	Configuration Level Pass Code	4
P81	Energy Meter Source	nonE
rEc.S	Recovery Point Save	nonE
rEc.L	Recovery Point Load	nonE
PHAS	Select Calibration Phase	nonE

Figure 73 Eurotherm Celsius Parameters, Electric

5.7 Eurotherm Temperature Controller, Programming Procedure

Step 1: Energize the controller.

Step 2: Press and hold the <PAGE> key (symbol shows two pages overlapped; left-most button) to display “LEV1”.

Step 3: Press <UP> key to show “LEV2”.

Step 4: Press <ENTER> key to show “Code”.

Step 5: Press <UP> key to show “2”.

Step 6: Press <ENTER> key.

Step 7: Program “LEV2” and refer to Section 5.6.1 for gas-heating controllers and Section 5.6.2 for electric-heating controllers. Press <ENTER> key to scroll through parameters.

Step 8: When you arrive back to the normal operating display, then press and hold the <PAGE> key to show “LEV2”.

Step 9: Press <UP> key to show “Conf”.

Step 10: Press <ENTER> key to show “Code”.

Step 11: Press <UP> key to show “4”.

Step 12: Press <ENTER> key.

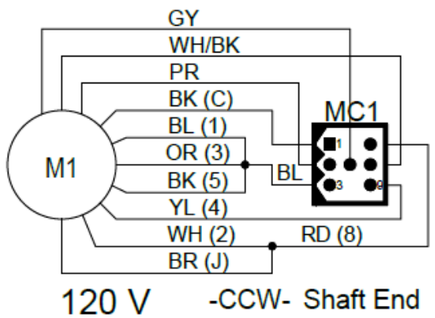
Step 13: Program “Conf” and refer to Section 5.6.1 for gas-heating controllers and Section 5.6.2 for electric-heating controllers. Press <ENTER> key to scroll through parameters.

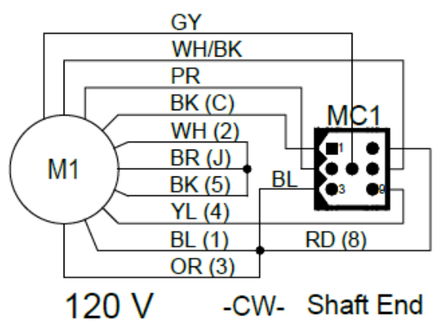
Step 14: When back at Conf press and hold page button.

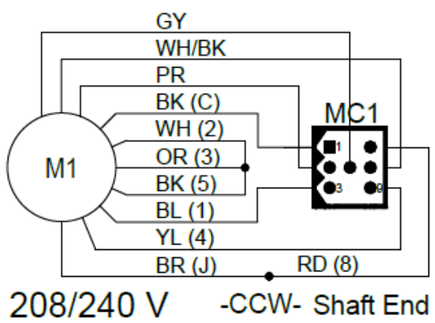
Step 15: Press <UP> key to change “Conf” to “LEV1”.

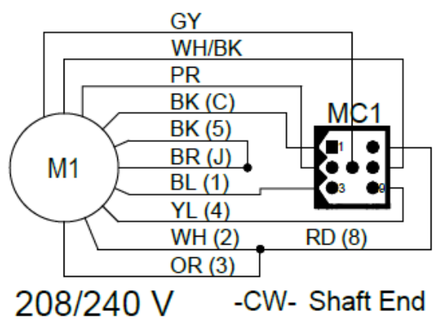
Step 16: Press <ENTER> key to revert to normal operating display.

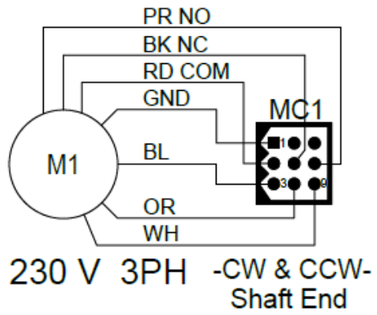
5.8 Fan Motor Wiring







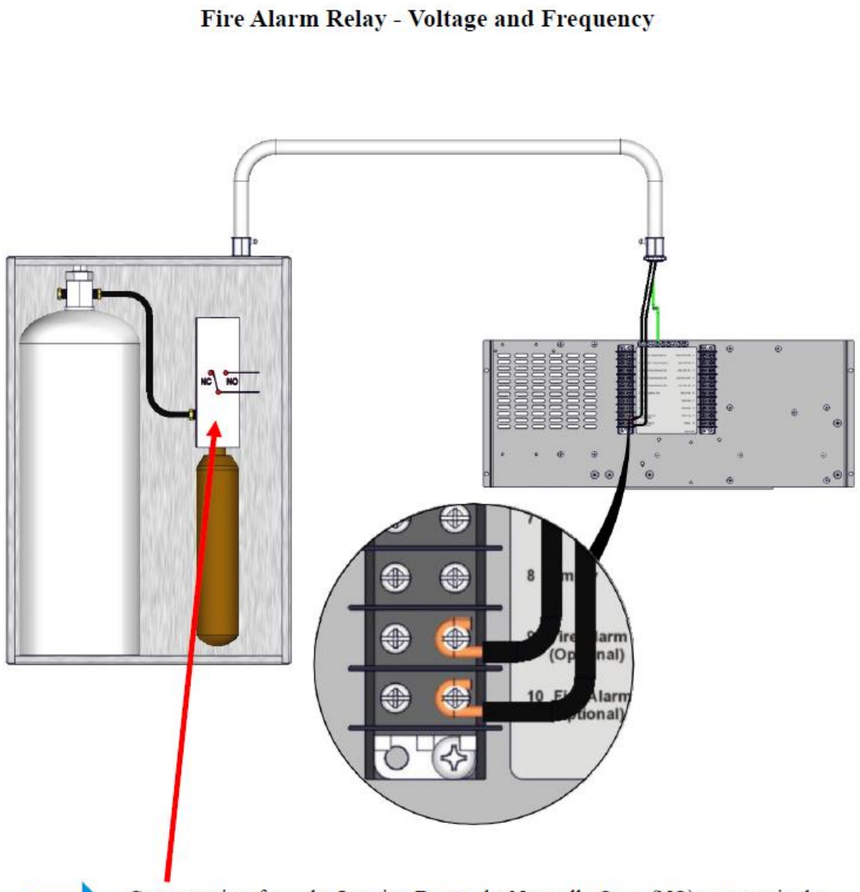




BK-Black BL-Blue BR-Brown GY-Gray OR-Orange PR-Purple RD-Red WH-White YL-Yellow GND-Ground NO-Normally Open NC-Normally Closed COM-Common

Figure 74 Main Fan Motor Wiring

5.9 Fire Suppression Circuit, Elan Controls



NOTE Connect wires from the Junction Box to the Normally Open (NO) contacts in the Fire Suppression cabinet.

NOTE TS1-10R will have voltage when the Fire Suppression system has been activated.

Figure 75 Fire Suppression Circuit

5.10 Heating Element Current, 240V Delta

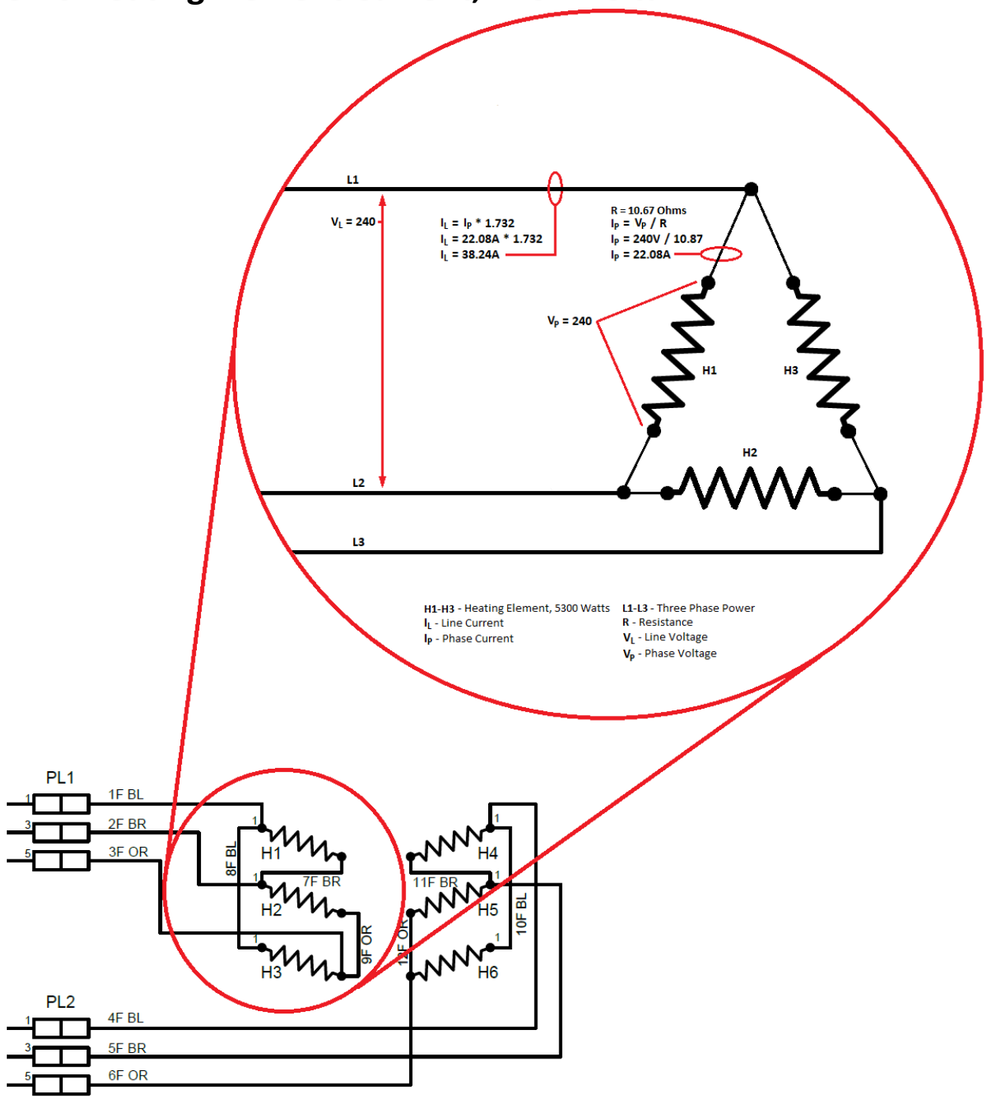


Figure 76 Heating Element Schematic Close-up

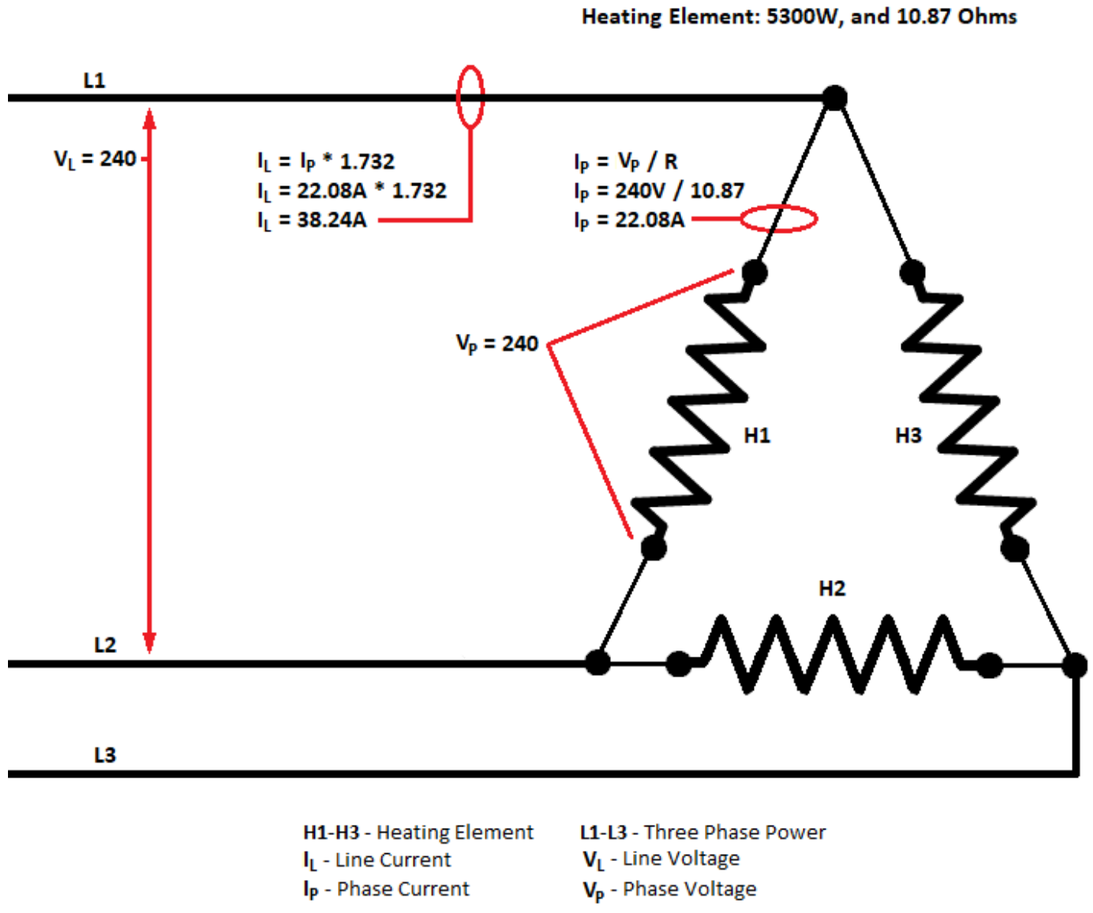


Figure 77 Heating Element Current Calculations