O23V SERIES UNITS

The O23V is a member of the DAVE LENNOX *SIGNATURE*™ COLLECTION ™. The O23V is an upflow oil furnace equipped with a variable speed motor and manufactured with a Beckett oil burner. The O23V is available in heating capacities of 70,000 to 154,000 Btuh (20.5 to 45.1 kW) with AFUE up to 83% and cooling applications from 1 1/2 to 5 tons (5.3 through 17.6 kW). Refer to Engineering Handbook for proper sizing.

The drum type heat exchanger comes with strategically placed ports allowing easy cleaning, while the oil burner can be removed for inspection and service. The maintenance section gives a detailed description on how this is done.

Information contained in this manual is intended for use by experienced HVAC service technicians only. All specifications are subject to change. Procedures outlined in this manual are presented as a recommendation only and do not supersede or replace local or state codes.

⚠WARNING

Electric shock hazard. Can cause injury or death. Before attempting to perform any service or maintenance, turn the electrical power to unit OFF at disconnect switch(es). Unit may have multiple power supplies.

⚠WARNING

Improper installation, adjustment, alteration, service or maintenance can cause property damage, personal injury or loss of life. Installation and service must be performed by a qualified installer or service agency.

⚠ IMPORTANT

If using programmable thermostat, be sure to use a type of thermostat that retains its memory in event of a power loss.

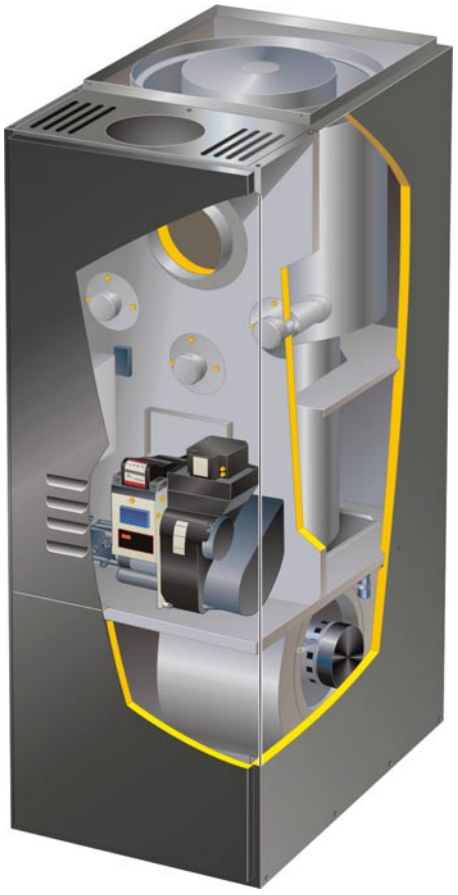


TABLE OF CONTENTS

SPECIFICATIONS

Oil Heating Performance		**Model Number**	**O23V2/3-70/90**	**O23V3/4-105/120**	**O23V5-140/154**
	Low Fire	Input - Btuh (kW)	70,000 (20.5)	105,000 (30.8)	140,000 (41.0)
		Output - Btuh (kW)	58,000 (16.7)	85,000 (24.9)	113,000 (33.1)
	High Fire	Input	90,000 (26.4)	119,000 (34.8)	154,000 (45.1)
		Output	74,000 (21.7)	97,000 (24.9)	125,000 (36.6)
		[1] A.F.U.E.	83%	81%	81%
		Flue Connection Round - in. (mm)	6 (152)	6 (152)	6 (152)
		Temperature Rise Range °F (°C)	50 - 80 (28 - 44)	50 - 80 (28 - 44)	55 - 85 (31 - 47)
Oil Burner		Nozzle rating - gph (L/hr) - Low	.50 (1.9)	.65 (2.5)	.85 (3.2)
		[4] High	[4] .65 (2.5)	[4] .75 (2.8)	[4] 1.00 (3.8)
		Nozzle spray angle - Low	80° hollow	80° solid	80° solid
		[4] High	80° solid	80° solid	80° solid
		Oil Burner Pump	1 Stage	1 Stage	1 Stage
		Oil Burner Pump Pressure - psig (Pa)	100 (690)	140 (965)	140 (965)
		Oil Burner Air Inlet Connection (dia.) - in (mm)	4 (102)	4 (102)	4 (102)
Blower Data		Motor hp (W)	1/2 (373)	1/2 (373)	3/4 (560)
		Wheel nom. diameter x width - in. (mm)	10 x 8 (254 x 203)	10 x 10 (254 x 254)	12 x 11 (305 x 280)
		Nominal add-on cooling - Tons (kW)	1.5 - 3 (5.3 - 10.6)	2 - 3.5 (7.0 - 12.3)	3 - 5 (10.6 - 17.6)
[2] Filter		Number of filters	1	1	[3] 2
		Size of filters - in.	16 x 25 x 1	16 x 25 x 1	16 x 25 x 1
		mm	406 x 635 x 25	406 x 635 x 25	406 x 635 x 25
Shipping weight — lbs. (kg) 1 package			225 (102)	225 (102)	275 (125)
Electrical		Characteristics	120V-60hz-1ph	120V-60hz-1ph	120V-60hz-1ph
		Maximum overcurrent protection (amps)	15	15	15

Optional Accessories - Must Be Ordered Extra

Half-Height Coil Case	**19M11**	**19M11**	**19M12**
Fits uncased C33 coils	“B”-width	“B”-width	“C”-width
Dimensions - in.	5 x 19-1/2 x 21-3/4	5 x 19-1/2 x 21-3/4	5 x 22-1/2 x 22-7/8
mm	127 x 495 x 552	127 x 495 x 552	127 x 572 x 581
Oil Filters 10 micron without mounting bracket	**81P89**	**81P89**	**81P89**
10 micron with mounting bracket	**53P92**	**53P92**	**53P92**
Replacement cartridge - 10 micron, 45 gph	**53P93**	**53P93**	**53P93**
Filter restriction indicator gauge	**53P90**	**53P90**	**53P90**
SignatureStat™ Home Comfort Control	**81M27**	**81M27**	**81M27**
Two Stage Oil Pump	**65A44**	**65A44**	**65A44**

[1] Annual Fuel Utilization Efficiency based on U.S. DOE test procedures and FTC labeling regulations. Isolated combustion system rating for non-weatherized furnaces.
[2] Cleanable frame type filters. Furnished with unit in Side Filter Adaptor Kit for field installation external to the cabinet.
[3] Requires return air from both sides of cabinet.
[4] Nozzle must be field provided for field conversion to higher heating input.

O23 GENERAL PARTS ORIENTATION

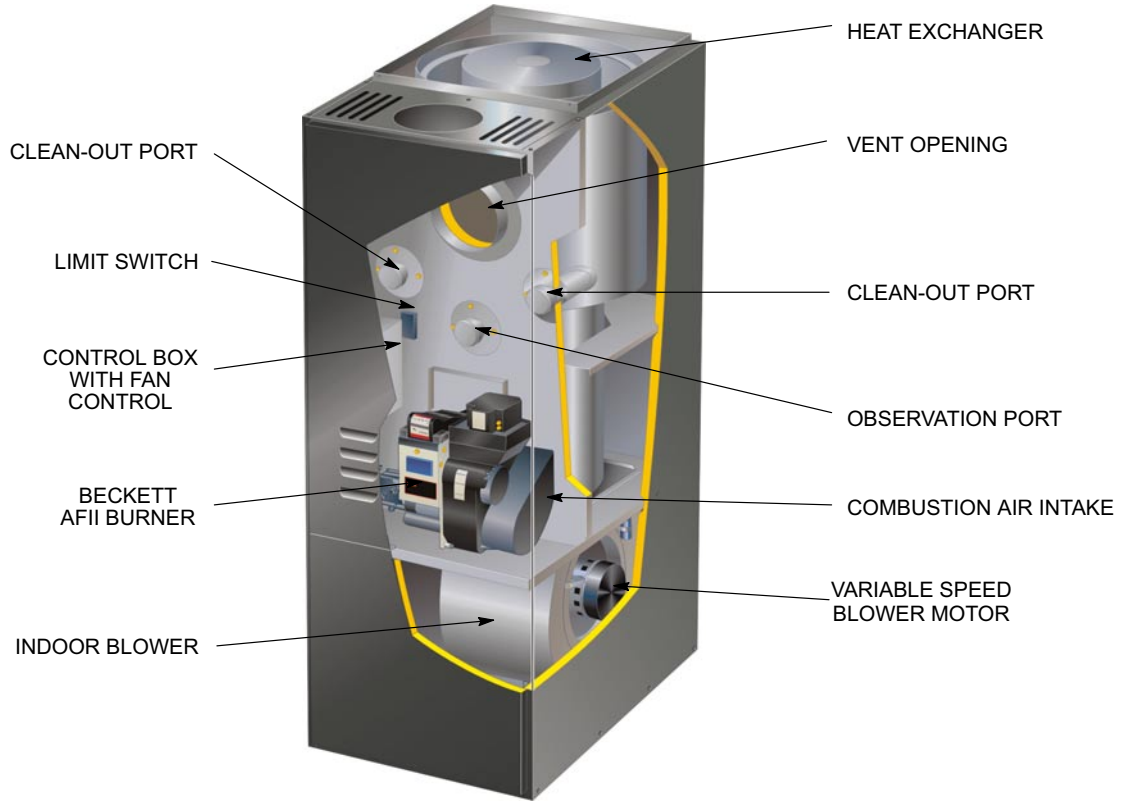


FIGURE 1

I-UNIT COMPONENTS

General parts orientation for the O23V is shown in figure 1. The O23V control box, burner, limit switch and clean-out ports may be accessed by removing the front access panel. The blower can be accessed by removing the blower access panel.

ELECTROSTATIC DISCHARGE (ESD) Precautions and Procedures

⚠ CAUTION

Electrostatic discharge can affect electronic components. Take precautions during unit installation and service to protect the unit's electronic controls. Precautions will help to avoid control exposure to electrostatic discharge by putting the unit, the control and the technician at the same electrostatic potential. Neutralize electrostatic charge by touching hand and all tools on an unpainted unit surface before performing any service procedure.

A-Blower Control Board (A54) Figure 2

⚠ WARNING

Electric shock hazard. Can cause injury or death. Before attempting to perform any service or maintenance, turn the electrical power to unit OFF at disconnect switch(es). Unit may have multiple power supplies.

O23V units are equipped with a variable speed motor which is controlled by the A54 blower control board. Blower control board settings and operation are described in this section.

O23V units equipped with a variable speed motor are capable of maintaining a specified CFM throughout the external static range. A particular CFM can be obtained by positioning jumpers (**COOL**, **HEAT**, and **ADJUST**) on the blower control board. The HEAT and COOL jumpers are labeled A, B, C and D; each letter corresponds with an air volume (CFM) setting. The **ADJUST** jumper is labeled Test, -, +, and Norm. The + and - pin settings are used to add or subtract a percentage of the CFM selected in the COOL mode only. The Test jumper is used to operate the motor in the test mode.

Factory settings for the blower speed jumpers are given in the wiring diagram. Use tables 1, 2 and 3 to determine the correct air volume for operation in heat and cool mode.

The CFM LED located on the blower control board flashes one time per 100 cfm to indicate selected blower speed. For example, if the unit is operating at 1000 CFM, **CFM** LED will flash 10 times.

At times, the light may appear to flicker or glow. This takes place when the control is communicating with the motor between cycles. This is normal operation. Read through the jumper settings section before adjusting the jumper to obtain the appropriate blower speed.

To change jumper positions, gently pull the jumper off the pins and place it on the desired set of pins. The following section outlines the different jumper selections available and conditions associated with each one (see figure 2).

After the CFM for each application has been determined, the jumper settings must be adjusted to reflect those given in tables 1, 2 and 3. From the tables, determine which row most closely matches the desired CFM. Once a specific row has been chosen (+, NORMAL, or -), CFM volumes from other rows cannot be used. Page 5 has descriptions of the jumper selections.

The variable speed motor slowly ramps up to and down from the selected air flow during both cooling and heating demand. This minimizes noise and eliminates the initial blast of air when the blower is initially energized.

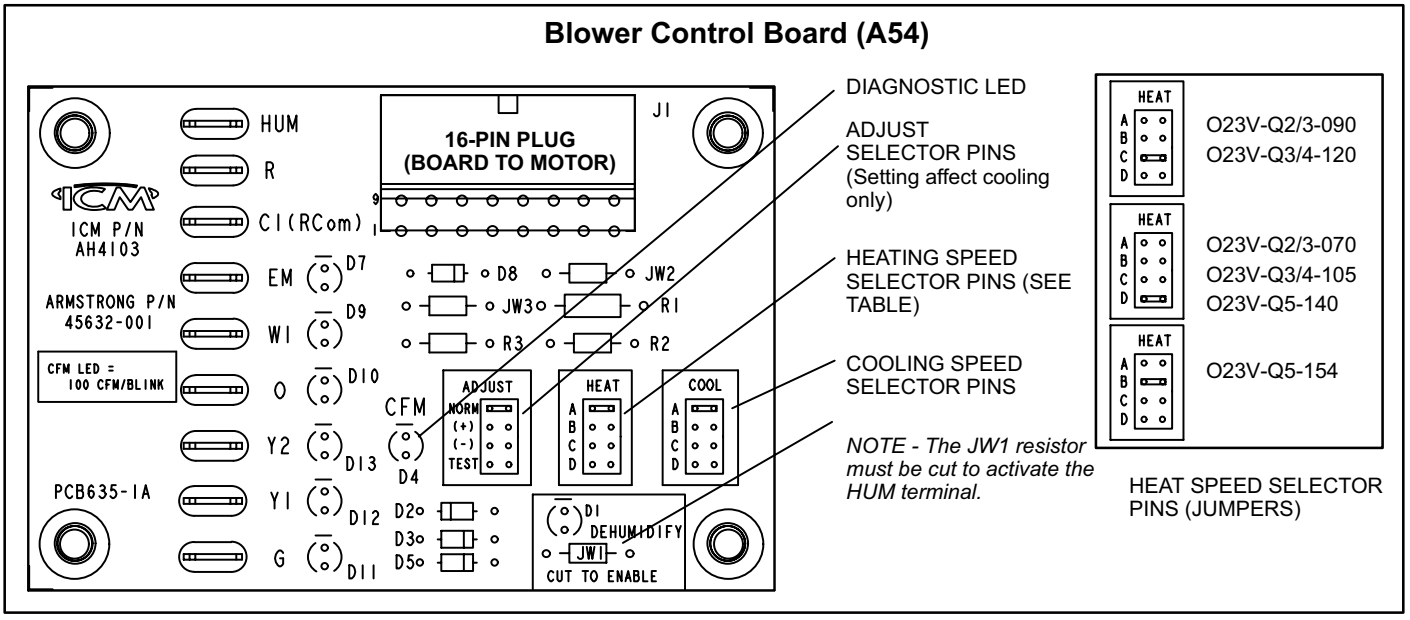


FIGURE 2

ADJUST

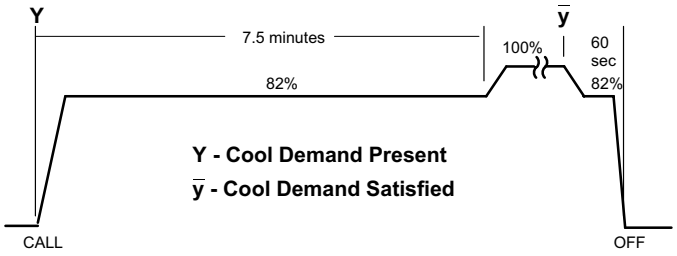
The **ADJUST** pins allow the motor to run at approximately 15% higher, or approximately 15% lower, than normal speed. Tables 1, 2 and 3 give three rows (+, NORM, and -) with their respective CFM volumes. Notice that the normal (NORM) adjustment setting for cool speed position C in table 1 is 800 CFM. The + adjustment setting for that position is 920 CFM (115% of 800 CFM) and for the - adjustment setting is 680 CFM (85% of 800 CFM). After the adjustment setting has been determined, choose the remaining speed settings from those offered in the table in that row.

The TEST pin is available to bypass the blower control and run the motor at approximately 70% to make sure that the motor is operational. This is used mainly in troubleshooting. The G terminal must be energized for the motor to run.

COOL

The **COOL** jumper is used to determine the CFM during cooling operation. This jumper selection is activated for cooling when Y1 is energized. Y1 and Y2 must be jumpered for single stage cooling.

The blower motor runs at 82% of the selected air flow for the first 7-1/2 minutes of each cooling demand. This feature allows for greater humidity removal and saves energy.

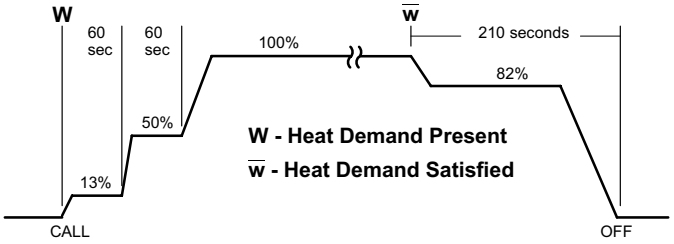


When the demand for cool is met, the blower ramps down to 82% for 60 seconds, then turns off.

HEAT

The **HEAT** jumper is used to determine CFM during heat operation only. These jumper selections are activated only when W1 is energized.

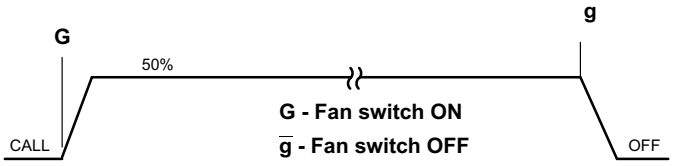
During the heat ON delay, the blower runs at 13% CFM for the first minute, 50% for the second minute, and full CFM after two minutes.



When the demand for heat is met, the blower ramps down to 82% for 3-1/2 minutes, then turns off.

Continuous Fan

When the thermostat is set for “Continuous Fan” operation and there is no demand for heating or cooling, the blower control will provide 50% of the **COOL** CFM selected.



When a continuous fan is on (G demand present), the fan runs at 50% until switched off; there is no ramp up or off delays.

NOTE - With the proper thermostat and subbase, continuous blower operation is possible by closing the R to G circuit.

Dehumidification

The A54 blower control board (see figure 2) includes a HUM terminal which provides for connection of a humidistat. The JW1 resistor on the blower control board must be cut to activate the HUM terminal. The humidistat must be wired to open on humidity rise. When the dehumidification circuit is used, the variable speed motor will reduce the selected air flow rate by 18% when humidity levels are high. An LED (D1) lights when the blower is operating in the dehumidification mode.

Humidification

Terminals are provided on the A15 control board for 120 volt output to operate a humidifier. The “HUM” terminal is energized when there is a call for heat. See unit wiring diagram.

Electronic Air Cleaner

Terminals are provided on A15 control board for 120 volt output to an electronic air cleaner. The “EAC” terminal is energized when there is a call for heat, cool, or continuous blower. See unit wiring diagram.

TABLE 1

O23V-Q2/3-70/90 Blower Performance 0 through 0.80 in. w.g. (0 through 200 Pa) External Static Pressure Range																
	Jumper Speed Positions															
	"COOL" Speed				"HEAT" Speed								"CONTINUOUS FAN" Speed			
					Do not use		-90		-70							
"ADJUST" Jumper Setting	A cfm L/s	B cfm L/s	C cfm L/s	D cfm L/s	A cfm L/s	B cfm L/s	C cfm L/s	D cfm L/s	A cfm L/s	B cfm L/s	C cfm L/s	D cfm L/s				
+	1380 565	1150 540	920 435	690 325	SAME AS NORM											
NORM	1200 565	1000 470	800 380	600 285	1300 614	1100 520	1000 470	750 354	600 285	500 235	400 190	300 143				
-	1020 480	850 400	680 320	510 240	SAME AS NORM											

TABLE 2

O23V-Q3/4-105/120 Blower Performance 0 through 0.80 in. w.g. (0 through 200 Pa) External Static Pressure Range																
	Jumper Speed Positions															
	"COOL" Speed				"HEAT" Speed								"CONTINUOUS FAN" Speed			
					Do not use		-120		-105							
"ADJUST" Jumper Setting	A cfm L/s	B cfm L/s	C cfm L/s	D cfm L/s	A cfm L/s	B cfm L/s	C cfm L/s	D cfm L/s	A cfm L/s	B cfm L/s	C cfm L/s	D cfm L/s				
+	1620 765	1380 650	1150 540	920 435	SAME AS NORM											
NORM	1400 660	1200 565	1000 470	800 360	1500 713	1400 660	1300 613	1200 565	700 333	600 285	500 235	400 190				
-	1190 560	1020 480	850 400	680 320	SAME AS NORM											

TABLE 3

O23V-Q5-140/154 Blower Performance 0 through 0.80 in. w.g. (0 through 200 Pa) External Static Pressure Range																
	Jumper Speed Positions															
	"COOL" Speed				"HEAT" Speed								"CONTINUOUS FAN" Speed			
					Do not use	-154	Do not use	-140								
"ADJUST" Jumper Setting	A cfm L/s	B cfm L/s	C cfm L/s	D cfm L/s	A cfm L/s	B cfm L/s	C cfm L/s	D cfm L/s	A cfm L/s	B cfm L/s	C cfm L/s	D cfm L/s				
+	2300 1085	2070 975	1840 870	1380 650	SAME AS NORM											
NORM	2000 944	1800 850	1600 755	1200 565	1850 873	1730 816	1550 732	1400 660	1000 470	900 425	800 380	600 285				
-	1700 802	1530 720	1360 640	1020 480	SAME AS NORM											

B-Burner Control (A3)

All O23V units are equipped with a burner control R7184B manufactured by Honeywell. The burner control, along with the matching cad cell, proves flame and controls the burner. An LED on the control shows unit status. See table 4 for status codes. After the cad cell closes a circuit to the burner control, the burner control de-energizes the safety switch heater to allow the unit to operate normally. When there is a call for heat the control performs a 2 to 6 second delay safety check. Once this is established a 15 second pre-purge will follow. The valve then opens for a 15 second trial for ignition. If flame is not sensed during the 15 second trial, the control shuts down and must be manually re-set. After three consecutive lockouts the control goes into restricted lockout. Once flame is established after 10 seconds of run time, the ignitor is de-energized.

If flame is lost during the heat cycle the control will shut down the burner and begin a 60 second recycle delay. After 60 seconds the control repeats the ignition process. If flame is lost three consecutive times during a single thermostat demand the control goes into restricted lockout.

Reset button

If the control locks out three consecutive times the control will go into restricted lockout. To reset control hold down the reset button for 30 seconds until the LED flashes twice.

At any time the burner motor is energized, press and hold the reset button to disable the burner. The burner will remain disabled as long as the reset button is held down and return to operation once the button is released.

TABLE 4

LED	STATUS
On	Flame sensed
Off	Flame not sensed
Flashing (1/2 sec on1/2 sec off)	Lockout / Restricted Lockout
Flashing (2 sec on 2 sec off)	Recycle

C-Control ST9103A (A15)

Control ST9103A manufactured by Honeywell, is a printed circuit board which monitors limit operation and oil burner operation. Line voltage and thermostat connections are made on this control. See table 5 for terminal designations.

TABLE 5

J58 Pin #	Function
1	Limit S10
2	L1 120V
3	24V
4	L2 Common
5	**Jumpered to Pin 4**
6	24V
7	Burner Motor
8	Jumpered to Pin 7
9	Limit S21 (if used)

D-Transformer (T1)

Transformer T1 provides power to the low voltage section of the unit. Transformers are rated 40VA with a 120V primary and 24V secondary.

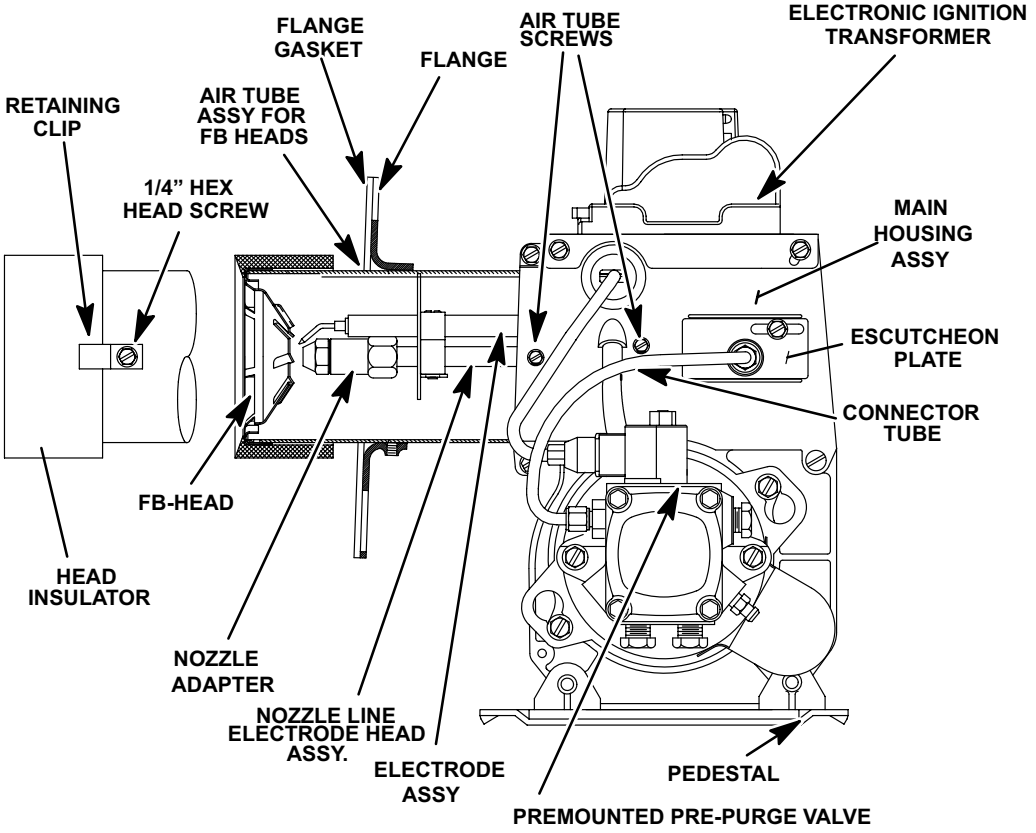
E-Primary Limit Control (S10)

The primary limit on all O23V units, is located on the vestibule panel. When excess heat is sensed in the heat exchanger, the limit will open. If the limit is tripped, 24 volt power to terminal “R” on the indoor thermostat is lost and the unit shuts down but the indoor blower continues to run. The limit automatically resets when unit temperature returns to normal. The switch is factory set and cannot be adjusted. The setpoint is printed on the face plate of the limit.

⚠ IMPORTANT

If using programmable thermostat, be sure to use a type of thermostat that retains its memory in event of a power loss.

O23V BURNER PARTS ARRANGEMENT



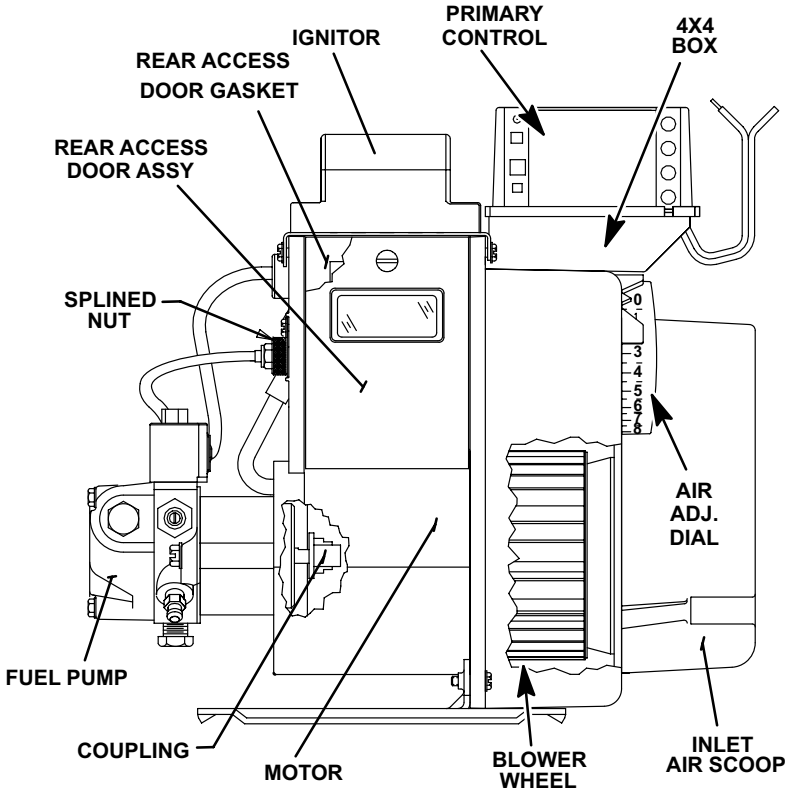


FIGURE 3

TABLE 6

FURNACE / BURNER SPECIFICATIONS							
Unit	Lennox Burner Part Number	Burner Model	*Initial Air Dial Setting	Output	Nozzle Size (Delevan)	Pump Pressure	Head
-70	39M85	AFII 85	3.0	57,000 BTU (16.7 kW)	0.50 X 80°A	100 psig (689.5 kPa)	FB0
-090	39M85	AFII 85	3.5	74,000 BTU (21.7 kW)	0.50 X 80°A	100 psig (689.5 kPa)	FBO
-105	39M86	AFII 85	4.0	84,000 BTU (24.6 kW)	0.65 X 80°B	140 psig 965.3 kPa)	FB3
-120	39M86	AFII 85	4.5	105,000 BTU (30.8 kW)	0.75 X 80°B	140 psig 965.3 kPa)	FB3
-140	39M87	AFII 150	6.0	112,000 BTU (32.8 kW)	0.85 X 80°B	140 psig 965.3 kPa)	FB6
-154	39M87	AFII 150	6.5	125,000 BTU (36.6 kW)	1.00 X 80°B	140 psig 965.3 kPa)	FB6

NOTE: The initial air dial setting is provided to get unit started. The air dial setting **MUST be adjusted after start-up to achieve proper combustion.*

F-Burner (Figure 3)

The O23V oil furnace uses the Beckett AFII burner. The oil burner provides an atomized oil vapor mixed with the correct proportion of air when it is ignited in the combustion chamber. Oil burner minimum and maximum ratings are listed on the unit nameplate. Proper air adjustment for these ratings is achieved through the air adjustment dial. Set air dial to the initial air dial setting (see table 6). After start up adjust air dial to achieve proper combustion. Remember to tighten set screw on air dial.

The AFII burner is available in six sizes with either a single or two stage pump. Table 6 identifies the burners used in Lennox units.

G-Combustion Air Blower / Pump Motor (B6)

The burner is activated by the primary control. A combustion air blower is mounted on the motor shaft. The motor shaft also connects to the direct drive oil pump through a coupler. The burner motor turns both the combustion air blower and the oil pump. The motor operates at 3500 RPM.

Burner motors are overload protected. In the event of excess motor temperature or current, the overload opens to de-energize the motor. The overload automatically resets after temperature has returned to normal. Keep motor clean to prevent starting switch from sticking. All AFII motors are permanently lubricated. No further oiling is required.

H- Pump

The O23V units all utilize the Cleancut Fuel Unit manufactured by Beckett. This pump uses a solenoid valve to control the piston cut-on cut-off operation instead of a cone valve and diaphram used by other conventional pumps. The solenoid works with the R7184B Honeywell burner control to provide cut-on cut-off operation while the burner motor is at full speed.

At start up the pump shaft is brought to full speed before the solenoid is energized. At this time low pressure oil (approximately 20-25 psi) from the gear set circulates around the pressure regulator piston which is closed and through the open solenoid valve. The solenoid valve returns the oil to either the cover cavity (one-pipe) or return line (two-pipe). When the solenoid valve is energized, it closes (and remains closed while energized) blocking the return path to the cover cavity and return line creating pressure build up in the piston cavity. The piston opens and regulates pressure and delivers pressurized oil to the nozzle.

At shutdown the solenoid valve will de-energize and open before the pump shaft rotation stops. When the solenoid valve opens the oil by-passes the cover cavity and return line causing a pressure drop in the piston cavity. The piston closes blocking oil to the nozzle while the burner motor is running at full speed.

I-Cad Cell (R26)

Together the cad cell and the burner control prove flame. The cad cell senses the presence of burner light (less resistance) to close a circuit to the burner control.

IMPORTANT-Burner should not be installed so it is exposed to direct sunlight or electric bulb light. If the cell is exposed to light on start up, the burner will not operate.

Resistance for the cad cell can be checked while the burner is firing and after ignition is off. Press (1/2 second or less) and release the reset button. The LED will flash 1 to 4 times depending on the cad cell resistance. The cad cell resistance should read less than 1600 Ohms. See table 7.

TABLE 7

LED FLASHES	RESISTANCE
1	0 - 400Ohms
2	400 - 800 Ohms
3	800 - 1600 Ohms
4	$\geq$ 1600 Ohms

J-Electronic Ignitor (A73)

The electronic ignitor provides the needed hot spark at the electrodes to ignite the fuel mixture. The ignitor is a solid state transformer with 120V primary and 20,000V secondary windings. The center of the secondary winding is grounded. Each secondary terminal is 7000V to ground and the total voltage between the electrodes is 14,000V.

NOTE-The leads for the solid state transformer are replaceable and are available in a kit form.

NOTE-When testing the solid state transformer, do not use a transformer tester designed for iron magnet transformers. Damage to the tester may result.

Testing the Ignitor

WARNING

SHOCK HAZARD
Do not touch ignitor or any metal touching ignitor when ignitor is energized. Can result in serious personal injury.

If the ignitor fails it will not produce a spark. Looking and listening for the arc is a simple way to check. The most sure way is to perform the screwdriver check. By placing the blade of an insulated screwdriver across the ignitor terminal leads will test for an arc. First, remove power from the burner and disconnect the oil supply from nozzle. The cad cell will not let the control energize the ignitor if the cad cell senses light. Therefore remove one lead of the cad cell from the burner control, or remove the cad cell all together (do not forget to put back when test is complete). Place the screwdriver blade across the terminals and slowly raise one end of the blade off the terminal while the other remains in contact with the other terminal. There should be an arc from terminal to the blade up to 3/4" away. If not replace the ignitor. If an arc is present then place one end of the screwdriver on one terminal and the other end with the grounded baseplate. Raise the blade from the baseplate and draw an arc. Repeat with the other terminal. If the arc from the baseplate to one terminal is weaker than the arc from the baseplate to the other terminal, replace the ignitor.

K-Gun Assembly

The gun assembly receives oil from the oil pump and feeds it to the nozzle. The nozzle converts liquid oil into a fog-like mist that is discharged through the flame retention head into the combustion chamber.

L-Flame Retention Heads

The stainless steel flame retention head (see figure 4) is used to swirl (cone) the fog-like oil and air mixture as it enters the combustion chamber. Three different heads are used in the O23V. The firing rate dictates which head is used. See table 6. The greater the FB number the larger the slots on the head. When combustion takes place, the flame will be cylindrical compact shaped as a result.

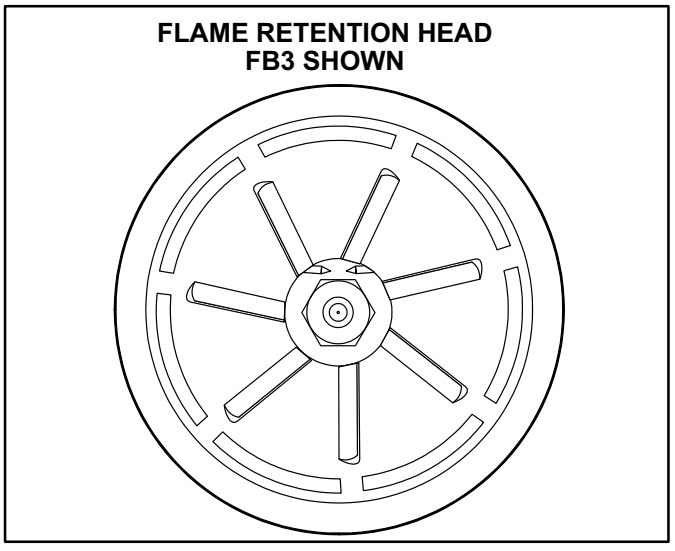


FIGURE 4

II-PLACEMENT AND INSTALLATION

Make sure unit is installed in accordance with installation instructions and applicable codes.

A-Piping

The piping system and it's components (oil filter, safety valves, shut-off valves, etc.) must be designed to provide clean, air free fuel to the burner.

An oil filter is required for all models. Use an oil filter of generous capacity for all installations. Install filter inside the building between the tank shut-off valve and the burner. Locate filter close to burner for easy servicing. The GAR-Ber 11BV-R or equivalent filter (with the below specifications) is recommended.

Maximum Firing Rate: 10GPH (38LPH)

Micron Removal: 10

Filtering Area: 500 in.^{2} (3225.8 cm^2)

Working Pressure: 15 PSI (103.4 kPa)

Inlet/Outlet Dimension: 3/8" (9.5 mm) NPT

Flow Rate: 45GPH (171LPH)

Care must be taken to ensure the restriction of the piping system, plus any lift involved, does not exceed the capability of the oil pump. Each installation will be different. Use the following guidelines when determining to use a single or two stage pump.

When using a single-pipe system with the fuel supply level with or above the burner (see figure 5) and a vacuum of 6" (152 mm) Hg or below, a single stage fuel unit with a supply line and no return line should be adequate. Manual bleeding of the fuel unit is required on initial start up. Failure to bleed air from the pump could result in an air lock/oil starvation condition.

NOTE-As an extra precaution, cycle heating on and off ten times after bleeding air from the pump. This will eliminate air in the gun assembly.

When using a two pipe system with the fuel supply level below the level of the burner (see figure 6) a single stage fuel unit should be used in lift conditions of up to 10 feet (3 m) and/or a vacuum of 10" (254 mm) Hg or below. A two stage fuel unit should be used when lift exceeds 10 feet (3 m) and/or a vacuum of 10" (254 mm) Hg to 15" (381 mm) Hg. Both conditions require the use of a return line that purges the fuel unit of air by returning it to the fuel tank. Use table 8 when determining the run and lift for piping.

Before converting a one-pipe system to a two-pipe system the pump must be converted to a two-pipe system. To convert the pump, install the bypass plug according to the instructions. Notice in the two-pipe system the return line must terminate 3" (76 mm) to 4" (102 mm) above the supply inlet. Failure to do this may introduce air into the system and could result in loss of prime.

NOTE-If using an outside tank in cold climates a number one fuel or an oil treatment is strongly recommended.

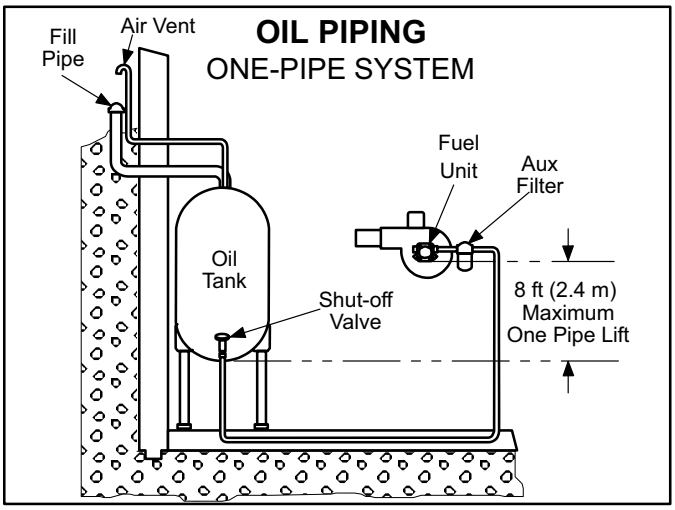


FIGURE 5

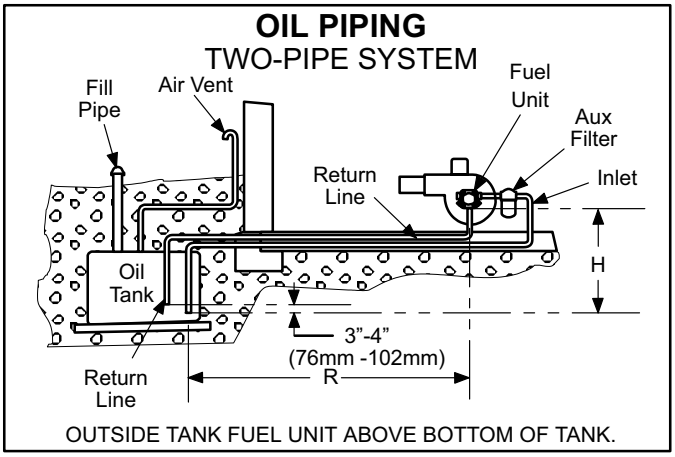


FIGURE 6

TABLE 8

TWO-PIPE MAXIMUM LINE LENGTH (H + R)

Lift "H" Figure 5	3450 RPM - 3 GPH (11.4 LPH)			
	3/8" (10 mm) OD Tubing		1/2" (12 mm) OD Tubing	
	Single Stage	Two Stage	Single Stage	Two Stage
0' (0.0 m)	84' (25.6 m)	93' (28.3 m)	100' (30.5 m)	100' (30.5 m)
2' (0.6 m)	73' (22.3 m)	85' (25.9 m)	100' (30.5 m)	100' (30.5 m)
4' (1.2m)	63' (19.2 m)	77' (23.5 m)	100' (30.5 m)	100' (30.5 m)
6' (1.8m)	52' (15.8 m)	69' (21.0 m)	100' (30.5 m)	100' (30.5 m)
8' (2.4m)	42' (12.8 m)	60' (18.3 m)	100' (30.5 m)	100' (30.5 m)
10' (3.0m)	31' (9.4 m)	52' (15.9 m)	100' (30.5 m)	100' (30.5 m)
12' (3.7m)	21' (6.4 m)	44' (13.4 m)	83' (25.3 m)	100' (30.5 m)
14' (4.3m)	---	36' (11.0 m)	41' (12.5 m)	100' (30.5 m)
16' (4.9m)	---	27' (8.2 m)	---	100' (30.5 m)
18' (5.5m)	---	---	---	76' (23.2 m)

B-Venting Considerations

⚠ WARNING

Combustion air openings in front of the furnace must be kept free of obstructions. Any obstruction will cause improper burner operation and may result in a fire hazard or injury.

⚠ WARNING

The barometric shall be in the same atmospheric pressure zone as the combustion air inlet to the furnace. Deviation from this practice will cause improper burner operation and may result in a fire hazard or injury.

⚠ CAUTION

Do not store combustible materials near the furnace or supply air ducts. The material (such as paint, motor oil, gasoline, paint thinner, etc.) may ignite by spontaneous combustion creating a fire hazard.

⚠ WARNING

This furnace is certified for use with type "L" vent. "B" vent must not be used with oil furnaces.

NOTE-Oil burning equipment may be vented into an approved masonry chimney or type L vent. (Type L vent is similar in construction to type B gas vent except it carries a higher temperature rating and is constructed with an inner liner of stainless steel rather than aluminum).

Prior to installation of unit, make a thorough inspection of the chimney to determine whether repairs are necessary. Make sure the chimney is properly constructed and sized according to the requirements of the National Fire Protection Association. The smallest dimensions of the chimney should be at least equal to the diameter of the furnace vent connector. Make sure the chimney will produce a steady draft sufficient to remove all the products of combustion from the furnace. A draft of at least 0.04" w.c. (9.9 Pa) is required during burner operation.

1- Local building codes may have more stringent installation requirements and should be consulted before installation of unit.

2- The vent connector should be as short as possible to do the job.

3- The vent connector should not be smaller than the outlet diameter of the vent outlet of the furnace.

4- Pipe should be at least 24 gauge galvanized.

5- Single wall vent pipe should not run outside or through any unconditioned space.

6- Chimney should extend 3 feet (0.9 m) above the highest point where the vent passes through the roof, and 2 feet (0.6 m) higher than any portion of a building within a horizontal distance of 10 feet (3 m).

7- The vent must not pass through a floor or ceiling. Clearances to single wall vent pipe should be no less than 6" (152 mm); more if local codes require it.

8- The vent may pass through a wall where provisions have been made for a thimble as specified in the Standards of the National Board of Fire Underwriters. See figure 7.

9- The vent pipe should slope upward toward the chimney on horizontal run at least 1/4 inch (6 mm) to the foot (0.3 m) and should be supported by something other than the furnace, such as isolation hangers. See figure 8.

10- Extend the vent pipe into the chimney so that it is flush with the inside of the vent liner. Seal the joint between the pipe and the liner.

11- The furnace shall be connected to a factory built chimney or vent complying with a recognized standard, or masonry or concrete chimney lined with a lining material acceptable to the authority having jurisdiction.

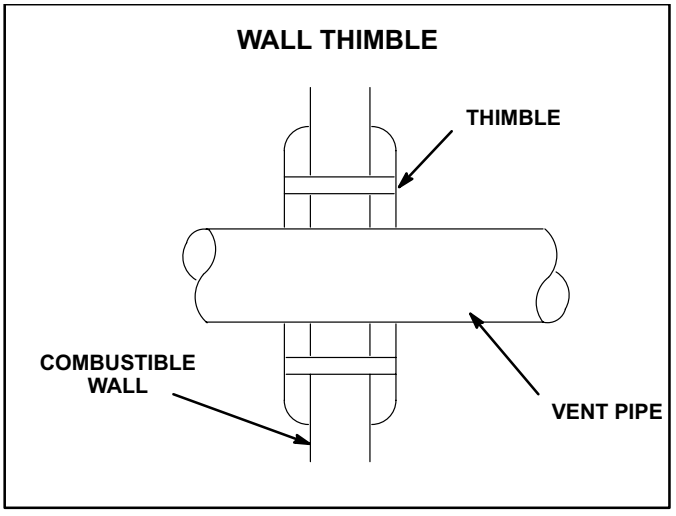


FIGURE 7

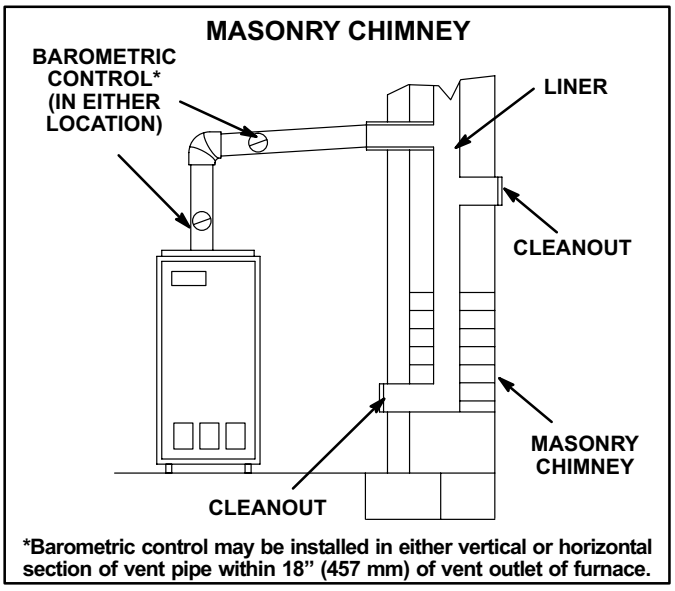


FIGURE 8

12- When two or more appliances vent into a common vent, the area of the common vent should not be less than the area of the largest vent or vent connection plus 50% of the areas of the additional vent or vent connection. Chimney must be able to sufficiently vent all appliances operating at the same time.

13- The vent pipe shall not be connected to a chimney vent serving a solid fuel appliance or any mechanical draft system.

14- All unused chimney openings should be closed.

15- All vent pipe run through unconditioned areas or outside shall be constructed of factory built chimney sections. See figure 9.

16- Where condensation of vent gas is apparent, the vent should be repaired or replaced. Accumulation of condensation in the vent is unacceptable.

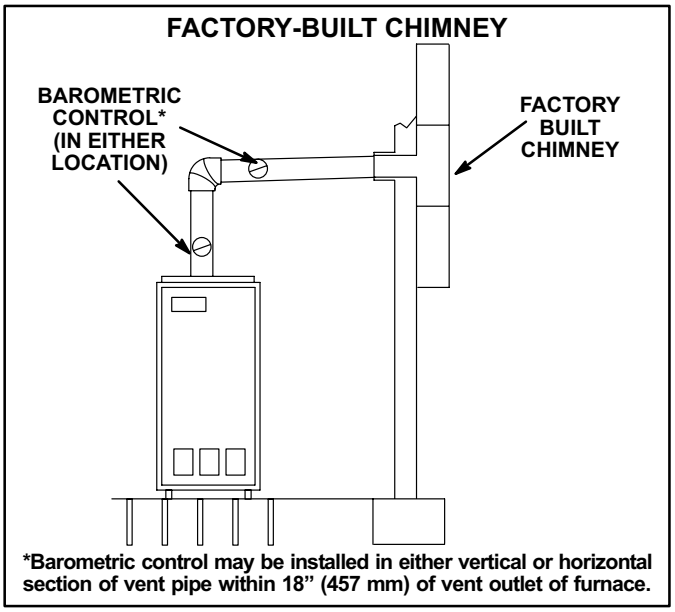


FIGURE 9

17- Vent connectors serving this appliance shall not be connected into any portion of mechanical draft systems operating under positive pressure.

18- Keep the area around the vent terminal free of snow, ice and debris.

NOTE-If vent pipe needs to exit from side of cabinet, use the cross hairs (located on either side of the unit) to cut a 6" (152 mm) round hole. Attach finishing plate (provided) with four sheet metal screws to cover rough edges.

Combustion and Ventilation Air (Confined and Unconfined Spaces)

Until recently, there was no problem in bringing in sufficient amounts of outdoor air for combustion -- infiltration provided all the air that was needed and then some. In today's homes built with energy conservation in mind, tight construction practices make it necessary to bring in air from outside for combustion. Consideration must also be given to the use of exhaust fans, appliance vents, chimneys and fireplaces because they force additional air that could be used for combustion out of the house. Unless outside air is brought into the home for combustion, negative pressure (pressure outside is greater than inside pressure) will build to the point that a down draft can occur in the furnace vent pipe or chimney. Combustion gases enter the living space creating a potentially dangerous situation.

The importance of the previous paragraph cannot be overstated. Users may inadvertently block fresh air intakes after installation.

In the absence of local codes concerning air for combustion and ventilation, the following section outlines guidelines and recommends procedures for operating oil furnaces in a manner that ensures efficient and safe operation. Special consideration must be given to combustion air needs as well as requirements for exhaust vents and oil piping.

Combustion Air Requirements

⚠ CAUTION

Insufficient combustion air can cause headaches, nausea, dizziness or asphyxiation. It will also cause excess water in the heat exchanger resulting in rusting and premature heat exchanger failure. It can also cause property damage.

All oil-fired appliances require air to be used for the combustion process. If sufficient amounts of combustion air are not available, the furnace or other appliance will operate in an inefficient and unsafe manner. Enough air must be provided to meet the needs of all fuel-burning appliances, as well as appliances such as exhaust fans which force air out of the home. When fireplaces, exhaust fans, or clothes dryers are used at the same time as the furnace, much more air is required to ensure proper combustion and to prevent a downdraft situation. Insufficient amounts of air also cause in-

complete combustion which can result in sooting. Requirements for providing air for combustion and ventilation depend largely on whether the furnace is installed in an unconfined or confined space.

Unconfined Space

An unconfined space is an area such as a basement or large equipment room with a volume greater than 50 cubic feet (1.4 cubic meters) per 1,000 Btu (293 W) per hour of the combined input rating of all appliances installed in that space. This space also includes adjacent rooms which are not separated by a door. Though an area may appear to be unconfined, it might be necessary to bring in outdoor air for combustion if the structure does not provide enough air by infiltration. If the furnace is located in a building of tight construction with weather stripping and caulking around the windows and doors, follow the procedures outlined for using air from the outside for combustion and ventilation.

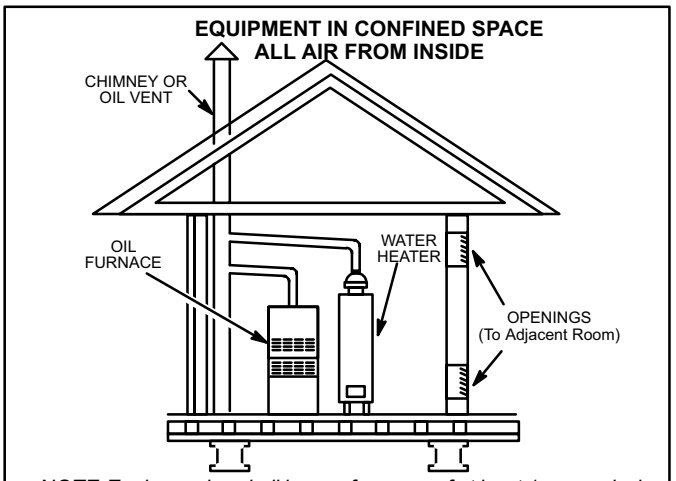
Confined Space

A confined space is an area with volume less than 50 cubic feet (1.4 cubic meters) per 1,000 Btu (293 W) per hour of the combined input rating of all appliances installed in that space. This definition includes furnace closets or small equipment rooms.

When the furnace is installed so that supply ducts carry air circulated by the furnace to areas outside the space containing the furnace, the return air must be handled by ducts which are sealed to the furnace casing and which terminate outside the space containing the furnace. This is especially important when the furnace is mounted on a platform in a confined space such as a closet or small equipment room. Even a small leak around the base of the unit at the platform or at the return air duct connection can cause a potentially dangerous negative pressure condition. Air for combustion and ventilation can be brought into the confined space either from inside the building or from outside.

Air from an Adjacent Space

If the confined space housing the furnace adjoins space categorized as unconfined, air can be brought in by providing two permanent openings between the two spaces. Each opening must have a minimum free area of 1 square inch (6.4 square centimeters) per 1,000 Btu (293 W) per hour of the total input rating of all fuel-fired equipment in the confined space. Each opening must be at least 100 square inches (614.5 square centimeters). One opening shall be within 12” (305 mm) of the top of the enclosure and one opening within 12” (305 mm) of the bottom (See figure 10).

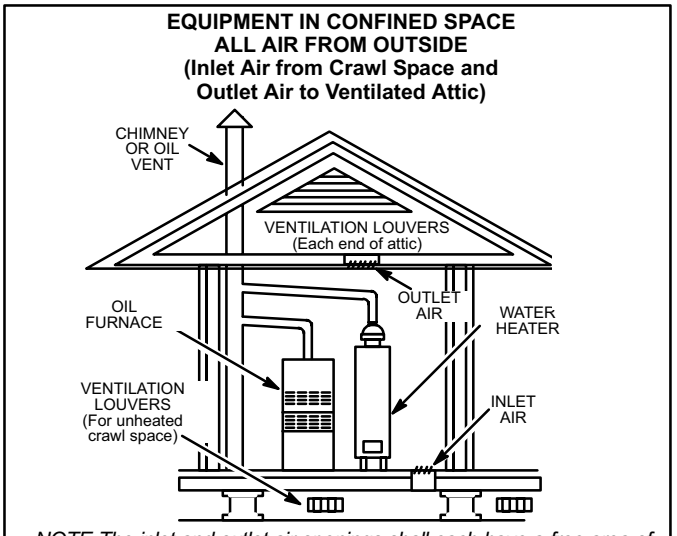


NOTE-Each opening shall have a free area of at least 1 square inch (6.4 square centimeters) per 1,000 Btu (293 W) per hour of the total input rating of all equipment in the enclosure, but not less than 100 square inches (614.5 square centimeters).

FIGURE 10

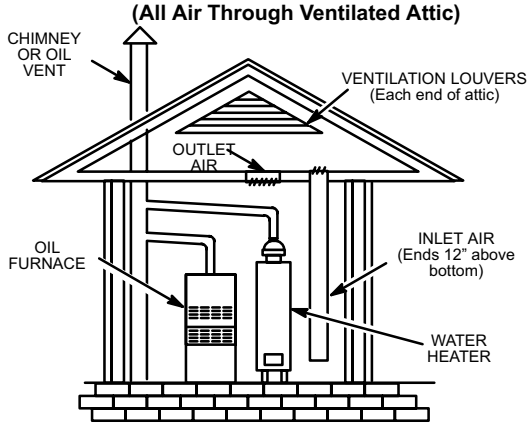
Air from Outside

If air from outside is brought in for combustion and ventilation, the confined space shall be provided with two permanent openings. One opening shall be within 12” (305 mm) of the top of the enclosure and one within 12” (305 mm) of the bottom. These openings must communicate directly or by ducts with the outdoors or spaces (crawl or attic) that freely communicate with the outdoors or indirectly through vertical ducts. Each opening shall have a minimum free area of 1 square inch (6.4 square centimeters) per 4,000 Btu (1172 W) per hour of total input rating of all equipment in the enclosure (See figures 11 and 12). When communicating with the outdoors through horizontal ducts, each opening shall have a minimum free area of 1 square inch (6.4 square centimeters) per 2,000 Btu (586 W) per total input rating of all equipment in the enclosure (See figure 13).



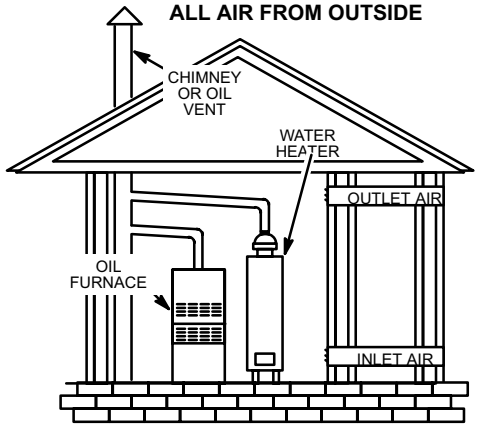
NOTE-The inlet and outlet air openings shall each have a free area of at least one square inch (6.4 square centimeters) per 4,000 Btu (1172 W) per hour of the total input rating of all equipment in the enclosure.

FIGURE 11



NOTE-The inlet and outlet air openings shall each have a free area of at least one square inch (6.4 square centimeters) per 4,000 Btu (1172 W) per hour of the total input rating of all equipment in the enclosure.

FIGURE 12



NOTE-Each air duct opening shall have a free area of at least one square inch (6.4 square centimeters) per 2,000 Btu (586 W) per hour of the total input rating of all equipment in the enclosure. If the equipment room is located against an outside wall and the air openings communicate directly with the outdoors, each opening shall have a free area of at least one square inch (6.4 square centimeters) per 4,000 Btu (1172 W) per hour of the total input rating of all other equipment in the enclosure.

FIGURE 13

When ducts are used, they shall be of the same cross-sectional area as the free area of the openings to which they connect. The minimum dimension of rectangular air ducts shall be no less than 3" (76 mm). In calculating free area, the blocking effect of louvers, grilles, or screens must be considered. If the design and free area of protective covering is not known for calculating the size opening required, it may be assumed that wood louvers will have 20 to 25 percent free area and metal louvers and grilles will have 60 to 75 percent free area. Louvers and grilles must be fixed in the open position or interlocked with the equipment so that they are opened automatically during equipment operation.

⚠ CAUTION

Combustion air openings in the front of the furnace must be kept free of obstructions. Any obstruction will cause improper burner operation and may result in a fire hazard or injury.

⚠ CAUTION

The barometric shall be in the same atmospheric pressure zone as the combustion air inlet to the furnace. Deviation from this practice will cause improper burner operation and may result in a fire hazard or injury.

Direct Connection of Outdoor Air for Combustion

The Beckett AFII burner was designed to allow for direct air intake piping (4" [102 mm]). The maximum equivalent length of pipe is 70 feet (21.3 m). A 90° elbow equals 6 feet (1.8 m).

To convert the AFII burner from confined space to outside combustion air, simply remove the three screws attaching the inlet air scoop to the burner and insert 4" (102 mm) direct air intake piping.

The use of a barometric relief placed in the intake pipe is recommended when outdoor combustion air is directly connected to the burner. This will allow confined space air to be used as combustion air in the event that the opening to the outdoor air becomes blocked. Using a barometric relief in the intake will reduce the chance of sooting.

⚠ CAUTION

DO NOT USE a barometric draft relief in exhaust vent pipe if outdoor combustion air is connected directly to the burner. The only exception are barometric draft reliefs as required by FIELD or TJERNLUND power vents.

Removal of Unit from Common Venting System

In the event that an existing furnace is removed from a venting system commonly run with separate appliances, the venting system is likely to be too large to properly vent the remaining attached appliances. The following test should be conducted while each appliance is in operation and the other appliances not in operation remain connected to the common venting system. If venting system has been installed improperly, the system must be corrected as outlined in the previous section.

1- Seal any unused openings in the common venting system.

2- Visually inspect venting system for proper size and horizontal pitch and determine there is no blockage or restriction, leakage, corrosion or other deficiencies which could cause an unsafe condition.

3- Insofar as is practical, close all building doors and windows and all doors between the space in which the appliances remaining connected to the common venting system are located and other spaces of the building. Turn on clothes dryers and any appliances not connected to the common venting system. Turn on any exhaust fans, such as range hoods and bathroom exhausts, so they will operate at maximum speed. Do not operate a summer exhaust fan. Close fireplace dampers.

4- Following the lighting instruction on the unit, place the appliance being inspected in operation. Adjust thermostat so appliance will operate continuously.

5- Test for spillage using a draft gauge.

6- After it has been determined that each appliance remaining connected to the common venting system properly vents when tested as outlined above, return doors, windows, exhaust fans, fireplace dampers and any other fuel burning appliance to their previous condition of use.

7- If improper venting is observed during any of the above tests, the common venting system must be corrected.

Horizontal Venting

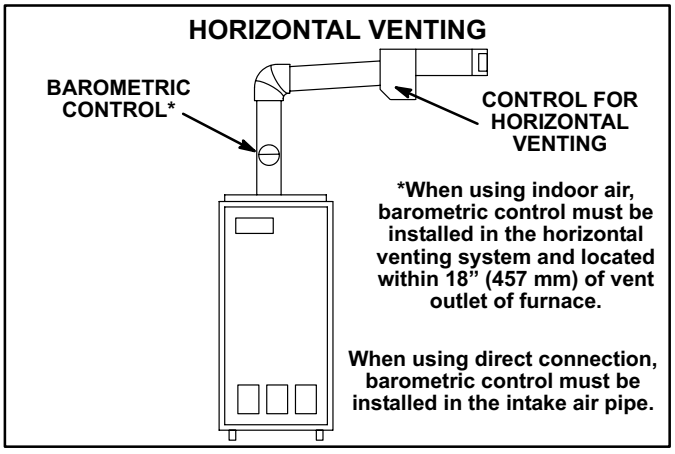


FIGURE 14

The O23V is approved for horizontal venting with the following mechanical vent systems:
Tjernlund (sideshot) #SS1C (Cat. #35E08) or Field Controls #SWG-5 (Cat. #35P08) with the CK-61 (Cat. #18N28) control kit. Refer to manufacturers' installation instructions for proper installation procedures and service parts information.

Do not common vent with any other appliance when using sidewall vent system.

Maximum permissible vent length is 70 equivalent feet (21.3 m). Minimum length is 15 equivalent feet (4.6 m). Calculate the equivalent vent pipe footage from the furnace to the mechanical vent system (Tjernlund or Field Controls) by adding the straight vent pipe length and the equivalent elbow lengths together.

The barometric draft control must be used in horizontal (sidewall) venting system. It must be located within 18" (457 mm) of the furnace vent outlet. See figure 14 for barometric draft control location.

III-START-UP

A-Preliminary and Seasonal Checks

1- Inspect electrical wiring, both field and factory installed for loose connections. Tighten as required.

2- Check line voltage. Voltage must be within range listed on the nameplate. If not, consult the power company and have voltage condition corrected before starting unit.

B-Heating Start-Up

FOR YOUR SAFETY READ BEFORE LIGHTING

⚠ WARNING

Do not attempt to start the burner when excess oil has accumulated in the chamber, when the furnace is full of vapor or when the combustion chamber is very hot.

1- Set thermostat for heating demand.

2- Turn on electrical supply to unit and open all shut-off valves in the oil supply line to the burner..

3- Check air adjustment dial on the right side of the burner (see figure 3). Set according to table 6.

4- On single line applications the oil pump must be primed by bleeding the oil line. Open air bleed port and start burner. A hose may be attached to direct oil into a container. After last bubble is seen, bleed pump for 15 seconds. Hurried bleeding will impair efficient unit operation. Close port to stop bleeding. Single line installations must be absolutely air tight to prevent leaks or loss of prime.

5- If burner stops after flame is established, repeat the bleeding procedure.

NOTE-Air bleeding is automatic on two line applications; however, opening air bleed port will allow a faster bleed. Run return line back to tank and terminate three to four inches above the inlet line. Failure to bleed the system may cause air to be introduced into the system resulting in a loss of prime.

6- If the burner does not start immediately, check the safety switch on the burner primary control.

7- If burner fails to light again, refer to the troubleshooting section in the back of this manual.

8- Proceed to section IV to complete start up.

C-Safety or Emergency Shutdown

Turn off unit power. Close all shut-off valves in the oil supply line.

D-Extended Period Shutdown

Turn off thermostat or set to “UNOCCUPIED” mode. Close **all** shut-off valves in the oil supply line to guarantee no oil leaks into burner. Turn off all power to unit. All access panels, covers and vent caps must be in place and secured.

IV-HEATING SYSTEM SERVICE CHECKS

A-Oil Piping

All oil supply piping (factory and field) must be carefully checked for oil leaks.

B-Electrode Adjustment

When adjusting the electrode, use the AFII multipurpose gauge (Beckett part # T-500) available from Beckett.

To set the electrode tip gap spacing, position the gauge as shown in figure 15. Align the center mark with the nozzle and adjust the electrodes to the two outer marks (1/8” [3mm] to 1/16” [2mm] minimum).

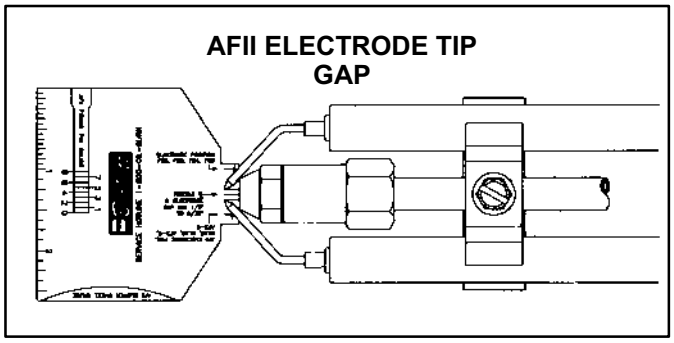


FIGURE 15

To position the electrode tips beyond the face of the nozzle and above the center line, position the gauge as shown in figure 16. Align the center mark with the nozzle and adjust the electrodes to the **AC cross marks.**

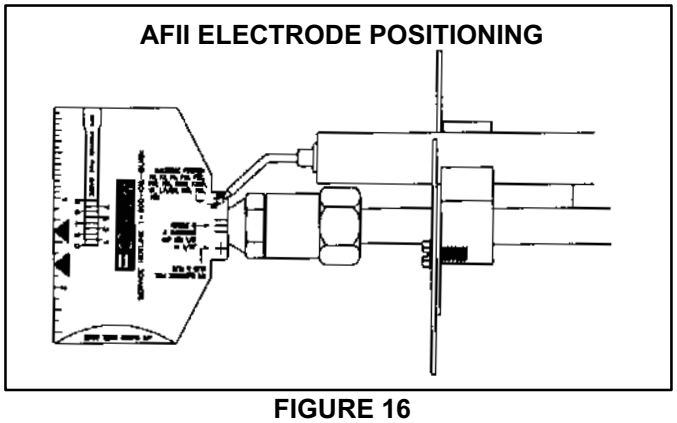


FIGURE 16

To check that the nozzle is approximately centered with the head inside diameter, align the center mark of the gauge with the center of the nozzle orifice, as shown in figure 17, and move the gauge from side to side at several points. **Be careful not to scratch the nozzle surface.**

The “Z” or zero dimension is important because it locates the nozzle for the precise relationship with the combustion head. To set the “Z” dimension, position the gauge as shown in figure 17 and loosen the nozzle line electrode assembly so that it can be moved forward or backward in the air tube until the nozzle becomes flush against the gauge. Tighten the nozzle line escutcheon plate screw (shown in figure 17) to lock this “Z” dimension securely.

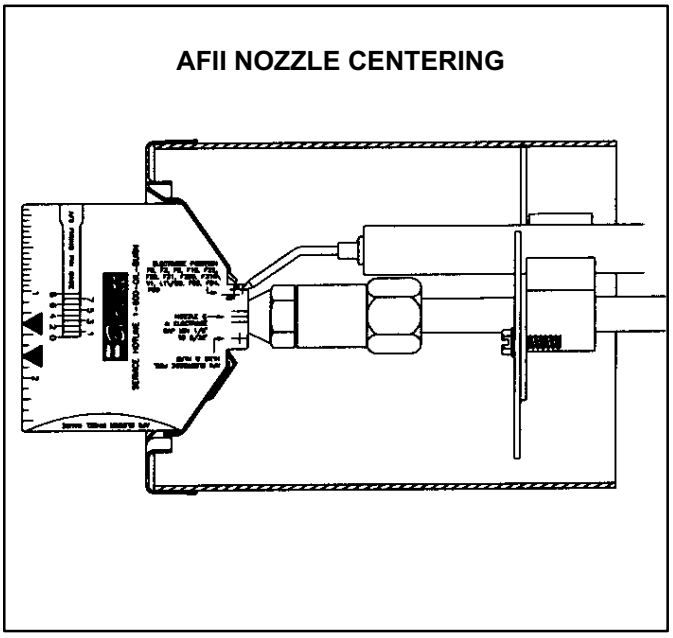


FIGURE 17

C-Pressure Check

The O23V is not equipped with a gauge port. Install a pressure gauge in the nozzle port or bleeder port. See figure18. The pump is factory set at **100 psig (689.5 kPa)** for the O23V-70 and **140 psig (965.3 kPa)** for all other O23V units but is adjustable . Never operate the pump in excess of 10 psig (69 kPa) above set point. Average nozzle cutoff pressure is 80 psig (551.6 kPa). Use the same gauge in the nozzle port to check cut-off pressure. To do so run the burner for a short period and then turn off. The gauge will show cutoff pressure.

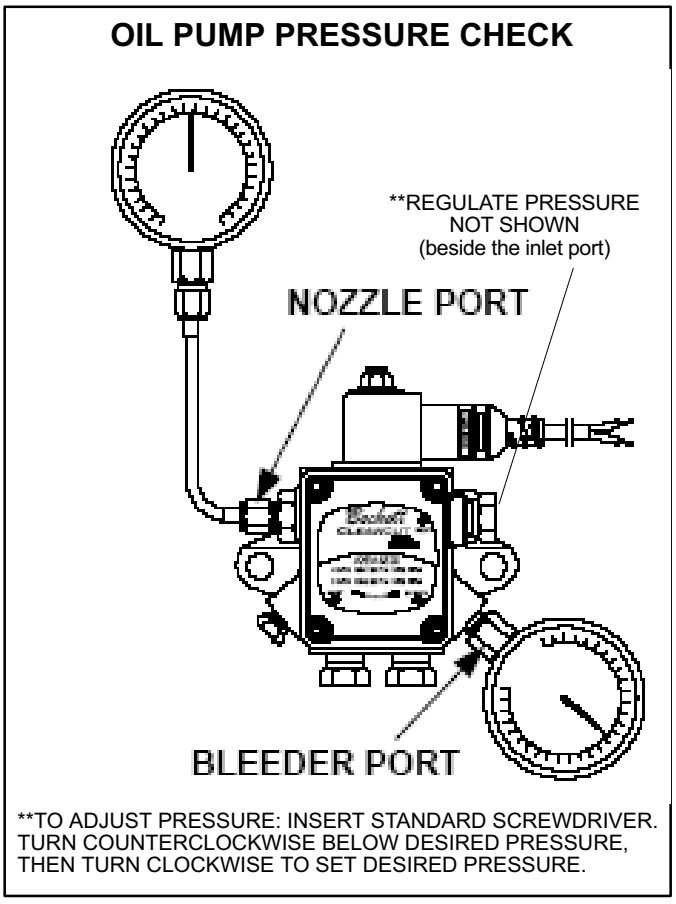


FIGURE 18

D-Burner Adjustment

The following instructions are essential to the proper operation of O23V series oil furnaces. To prevent sooting, these instructions must be followed in sequence:

NOTE-All w.c. measurements are below atmospheric pressure (negative readings).

⚠ CAUTION

Failure to adjust burner properly will result in sooting.

1-Draft

This test should be taken at the outlet of the vent pipe from the furnace and the barometric damper. Generally a 1/4" (6 mm) hole will need to be drilled for the draft gauge to be inserted into the vent connector.

A minimum of 0.03" w.c. (7.5 Pa) draft must be established without the burner in operation. With the burner in operation, the draft should be 0.04" w.c. (9.9 Pa) to 0.05" w.c. (12.4 Pa). This is VERY critical to the flame retention head burners.

Oil furnace installations also require careful inspection to make sure the chimney is in good condition and can accommodate the products of combustion. The temperature in unconditioned space will also affect the draft if long vent connectors are allowed to get too cold.

2-Overfire Draft

This test should be taken with the burner in operation. Remove the screw from the center of the center inspection port. Insert your draft gauge into the hole.

A reading of the overfire draft should be 0.02" w.c. (5.0 Pa) less than the reading found in the vent connector. If a positive reading is seen at this point, the secondary heat exchanger may be sooted or to much air may be entering into the heat exchanger from the combustion fan. Adjustments to the combustion fan can be made using the air adjustment dial.

3-Smoke Test

The smoke test should be taken at hole drilled in step 1.

Using a smoke test gun adjust the air inlet shutter so that you will have just a trace of smoke. Somewhere between a 0 and #1 smoke. This is the *starting* point. Do not stop here. After the smoke test take a CO sample. C.S.A. requires no more than 400ppm. However, a properly installed unit under normal operating conditions should not read more than 50ppm.

4-CO_2 Test

Again to be taken at the vent connector pipe. With the unit firing at a trace of smoke, test for percentage of CO_2 in the vent gas.

From the results of this test, a "window of operation" will be determined. This window of operation establishes some tolerance. The tolerance the installer builds in provides room within the set-up for those things which might affect combustion. Those things which might affect combustion can then do so without causing the unit to start sooting/smoking. Things which might affect combustion include a nozzle going bad, draft that changes during different climatic conditions, dirty oil, dirt obstructing the air inlet, etc.

To build in a "window of operation," set up the burner to be 2% less in CO_2. For example, if you find a reading of 12% CO_2, adjust the air inlet shutter to increase the air and drop the CO_2 to 10%.

5-Retest the Smoke

With a drop in the CO_2 and increase in the air you should see that the smoke has returned to 0.

6-Retest the Overfire Draft

This test serves to confirm that you have not increased the air too much. Again you do not want a positive pressure at the test port. It should still be 0.02" w.c. (5.0 kPa) less than the draft from the vent connector. You may need to increase the stack draft by adjusting the barometric damper.

NOTE - A negative heat exchanger is important in the event of a breach (crack) in the heat exchanger. The negative pressure along with positive pressure from the indoor blower will pull or blow air in to the heat exchanger preventing combustion products or soot into the air stream.

7-Stack Temperature

Take a stack temperature reading in the vent connector pipe. Subtract the room air temperature from the stack temperature. This will give you the net stack temperature. Using efficiency charts provided in most CO_2 analyzers you can tell at what efficiency the furnace is operating.

V-DISASSEMBLY PROCEDURES

Use the following procedures to access and disassemble the burner or blower if service to either is needed.

⚠WARNING

Electric shock hazard. Can cause injury or death. Before attempting to perform any service or maintenance, turn the electrical power to unit OFF at disconnect switch(es). Unit may have multiple power supplies.

A-Disassembling Burner

The burner assembly is attached to the vestibule panel by three nuts. Slots are provided in the mounting flange for removing the burner assembly from the vestibule. By loosening the nuts and by turning the whole burner assembly counterclockwise (figure 19), the entire burner assembly will come out of the furnace. There is adequate wire to remove the burner without disconnecting wires. Once removed, just turn the burner around in the vest panel area.

NOTE-Before disassembling any part of the burner, turn off power and oil supply to the burner.

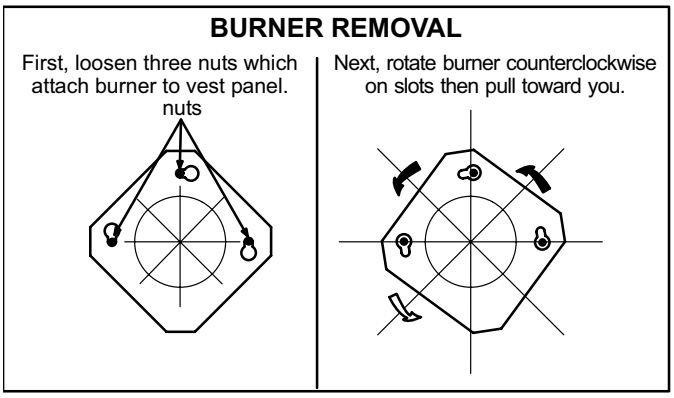


FIGURE 19

1-Removing Ignition Transformer

1- Remove all four screws located on the side of the ignition transformer. See figure 20.

2- **Lift the ignition transformer straight up.** Do not hinge back. Porcelain isolators may break if hinged back.

NOTE-When testing the solid state transformer, do not use a transformer tester designed for iron magnet transformers. Damage to the tester may result

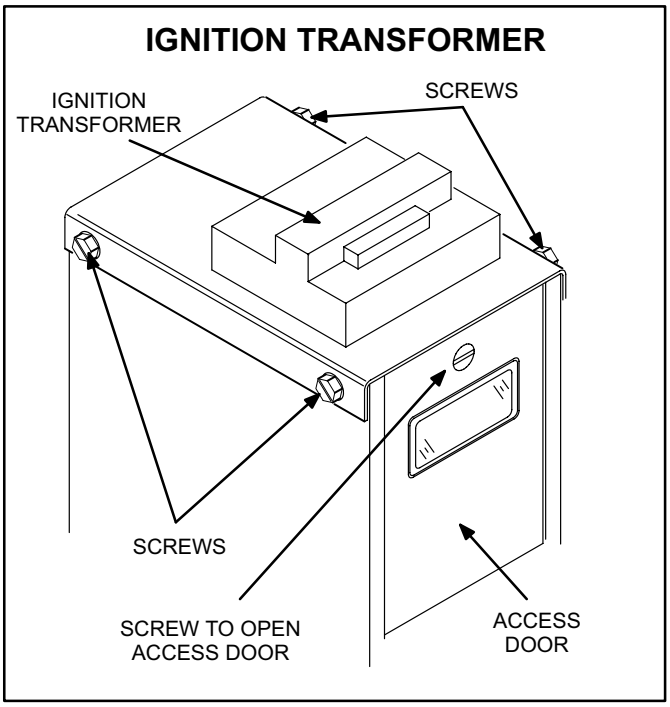


FIGURE 20

2-Removing Cad Cell

1- Loosen the screw to the back access door until door opens. See figures 20 and 21.

2- The cad cell will be located on the right side of the chassis wall hung on a bracket. See figure 21.

3- Remove by loosening the screw on the bracket.

4- Disconnect the leads from the primary control terminal strip.

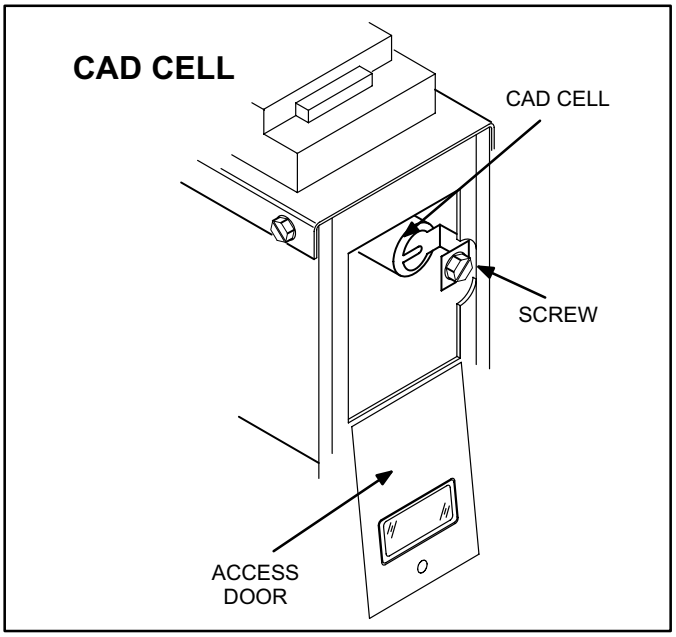


FIGURE 21

3-Removing Nozzle Gun Assembly

1- Loosen the screw to the back access door until door opens. See figures 20 and 21.

2- Remove flare fitting nut on oil line at pipe adjusting plate located on outside of blower housing.

3- Remove nut connecting oil line to gun assembly oil line. See figure 22.

4- Remove gun assembly from air tube.

5- Remove transformer leads.

NOTE-When reinstalling gun assembly, check and set position and "Z" dimension as shown in figure 17.

NOTE-When reconnecting gun assembly oil line, make sure flat side of nut goes first.

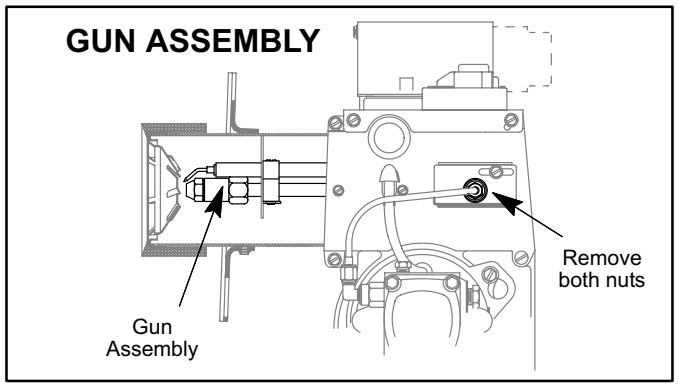


FIGURE 22

4-Removing Oil Pump

1 - Shut off oil.

2 - Disconnect supply line at pump and oil line at gun assembly. On 2 pipe system remove return line.

3 - Loosen two bolts on sides of pump securing pump to blower housing. See figure 23.

4 - Detach pump and motor shaft coupler from pump.

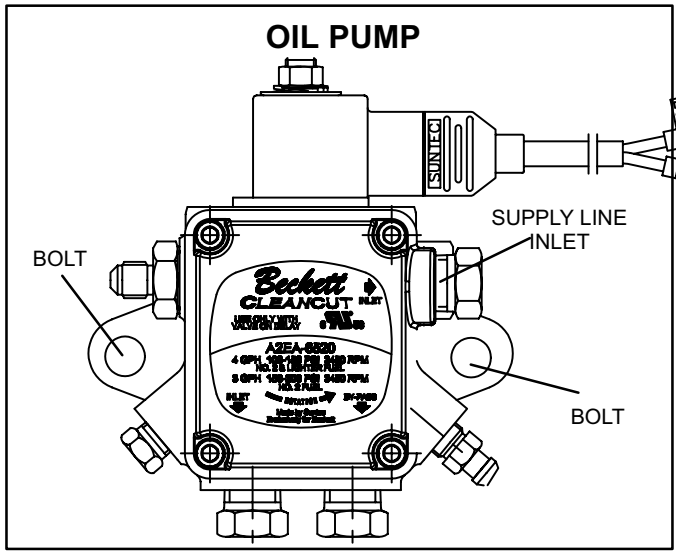


FIGURE 23

5-Removing Combustion Air Blower

1- Turn off power. Disconnect supply line at pump and oil line at gun assembly as shown in figure 23.

2- If motor and blower wheel are to be removed away from the burner, disconnect motor wiring harness from the primary control. If the motor and blower wheel only need to be removed to check and clean, there is adequate wire in the motor wiring harness without disconnecting.

3- Loosen two bolts securing motor to blower housing. Key hole slots are provided for easy removal. See figure 24.

4- Loosen allen set screw holding the blower wheel onto the motor shaft and remove blower wheel.

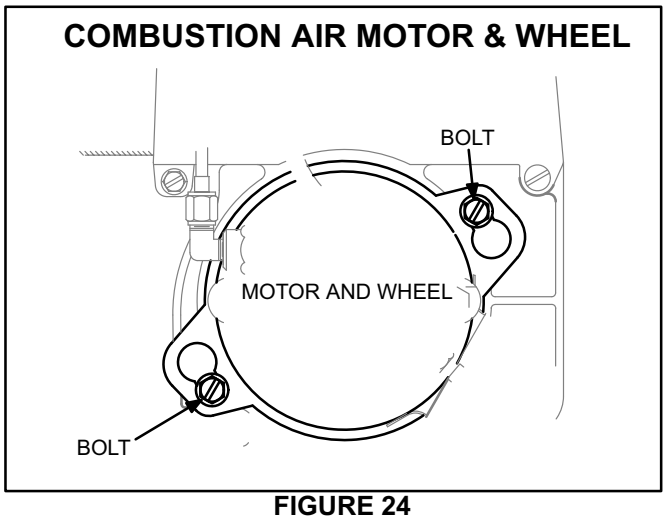


FIGURE 24

NOTE-When reinstalling blower wheel use the AFII multipurpose gauge (Beckett part # T-500) to space the distance from the back of the blower wheel to the face of the motor (1/16" [2 mm]).

B-Removing Indoor Blower

1- Turn off electric power to furnace.

2- Remove blower access door.

3- Remove two screws located in the front blower rails.

4- Pull blower forward enough to disconnect the motor leads.

5- Pull blower assembly out and place to the side.

VI-TYPICAL OPERATING CHARACTERISTICS

A-Blower Operation and Adjustment

NOTE- The following is a generalized procedure and does not apply to all thermostat controls.

1- Blower operation is dependent on thermostat control system.

2- Generally, blower operation is set at thermostat subbase fan switch. With fan switch in ON position, blower operates continuously. With fan switch in AUTO position, blower cycles with demand.

3- In all cases, blower and entire unit will be off when line voltage is disconnected.

B-Temperature Rise

Temperature rise for O23V units depends on unit input blower speed, blower horsepower and static pressure. The blower speed must be set for unit operation within the range of "AIR TEMP. RISE °F" listed on the unit rating plate.

To Measure Temperature Rise:

1. Place plenum thermometers in the supply and return air plenums. Locate supply air thermometer in the first horizontal run of the plenum where it will not pick up radiant heat from the heat exchanger.
2. Set thermostat to highest setting.
3. After plenum thermometers have reached their highest and steadiest readings, subtract the two readings. The difference should be in the range listed on the unit rating plate.

C-Blower Speed

Blower speed selection is accomplished by changing the jumpers on the blower motor control board. Page 5 explains blower speed adjustments.

D-External Static Pressure

1. Measure tap locations as shown in figure 25.
2. Punch a 1/4" (6 mm) diameter hole in supply and return air plenums. Insert manometer hose flush with inside edge of hole or insulation. Seal around the hose with permagum. Connect the zero end of the manometer to the discharge (supply) side of the system. On ducted systems, connect the other end of manometer to the return duct as above. For systems with non-ducted returns, leave the other end of the manometer open to the atmosphere.

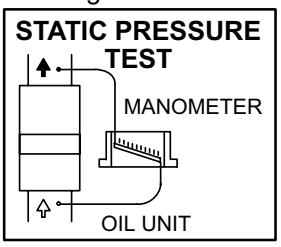


FIGURE 25

3. With only the blower motor running and the evaporator coil dry, observe the manometer reading.
4. Pressure drop must not exceed 0.5" W.C. (124.3 Pa).
5. Seal around the hole when the check is complete.

VII-MAINTENANCE

⚠ CAUTION

Never operate unit with access panels to the blower compartment off or partially open.

A-Filters

If throw-away type filters are used, check monthly and replace when necessary to assure proper furnace operation. Replace filters with like kind and size.

If reusable type filters are used, check monthly and clean with water and mild detergent when necessary. When dry, they should be sprayed with filter handicoater prior to reinstallation. Filter handicoater is RP Products coating no. 418 and is available as Lennox part no. P-8-5069 or cat no. 30165.

B-Cleaning Heat Exchanger

NOTE-Use papers or protective covering in front of furnace while cleaning furnace.

Cleaning the heat exchanger is made easier with a heat exchanger clean-out kit ABRSH380 (catalog # 35K09) available from Lennox.

1- Remove vent pipe from furnace.
2- Remove locking screws and caps from cleanout tubes. Remove vent access elbow.
3- Using a long spiral wire brush, sweep down the outer drum of the heat exchanger. Then using the hose attachment, vacuum out loose debris.
4- Remove locking screw and cap from the observation tube and with the spiral wire brush, reach upward toward the rear of the heat exchanger to clean out the crossover tube.

   NOTE- Do not attempt to clean the combustion chamber. It can be easily damaged.

5- Replace the cleanout caps and vent access elbow. Make sure locking screws are secure.
6- Brush out and vacuum the vent outlet area of the outer drum and replace vent pipe.
7- Clean around the burner, blower deck and vestibule area.

C-Annual Burner Maintenance

⚠ IMPORTANT

The homeowner should be instructed to have burner inspected at the beginning of every heating season.

1- Replace the oil supply line filter.
2- Remove and clean the pump strainer if applicable.
3- Replace the nozzle with an equivalent nozzle.
4- Check the pump pressure when changing nozzle.
5- Clean and inspect the electrodes for damage, replacing any that are cracked or chipped.
6- Clean the combustion head of all lint and soot.
7- Inspect the transformer cables and connectors.
8- Remove and clean the cad cell.
9- Clean the blower wheel and the air control of any lint.
10- Check all wiring for secure connections or insulation breaks.
11- Re-adjust the burner as described in section IV of this manual.

D-Supply Air Blower

1- Disconnect power to unit.
2- Check and clean blower wheel.
3- Motors are prelubricated for extended life; no further lubrication is required.

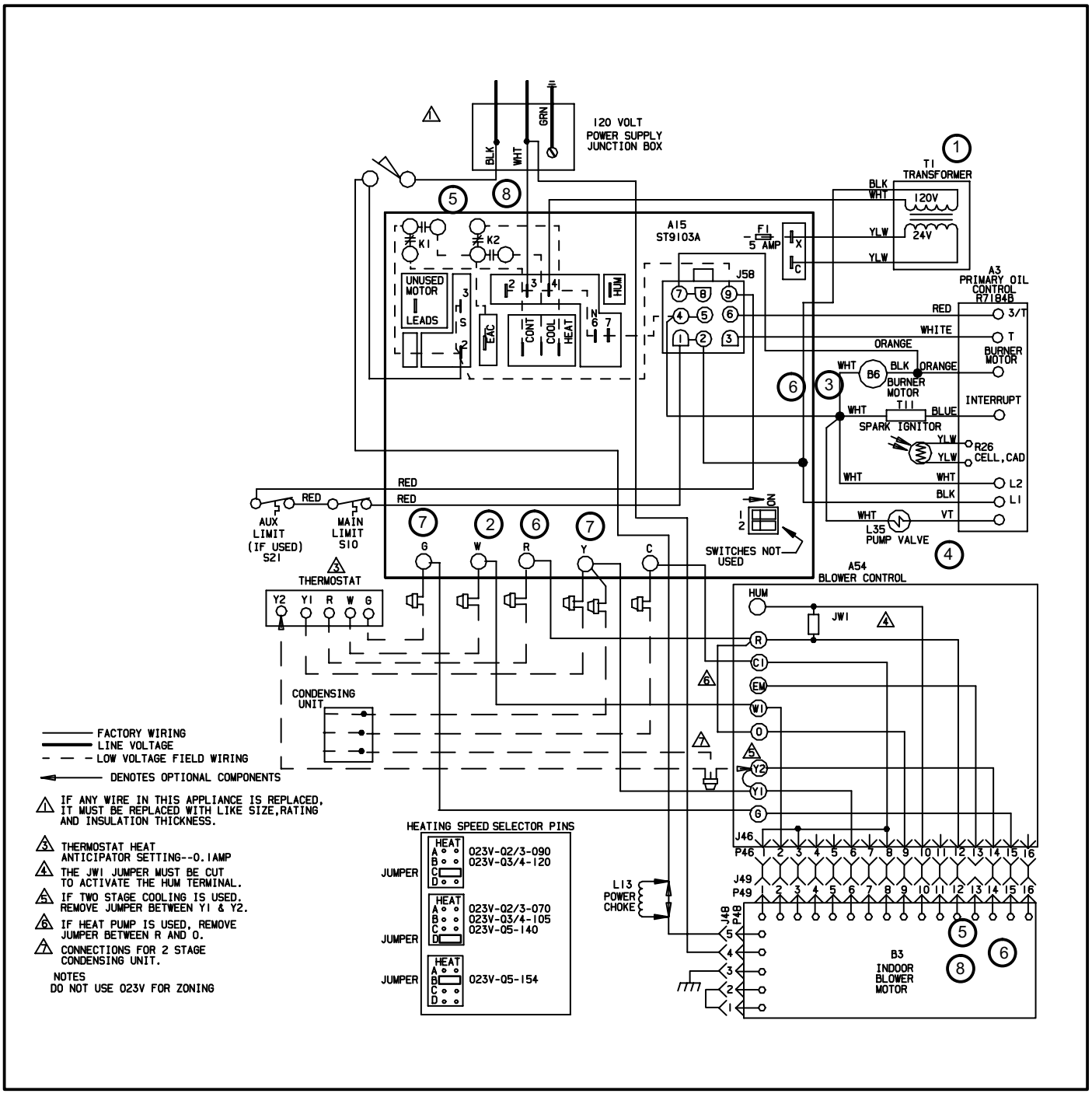
E-Vent Pipe

The vent pipe should be inspected annually. Remove and clean any soot or ash found in the vent pipe. Vent pipe deteriorates from the inside out and must be disconnected in order to check thoroughly. Inspect pipe for holes or rusted areas. Inspect the vent control device and replace if found defective. Check for tightness and to make sure there is no blockage or leaks.

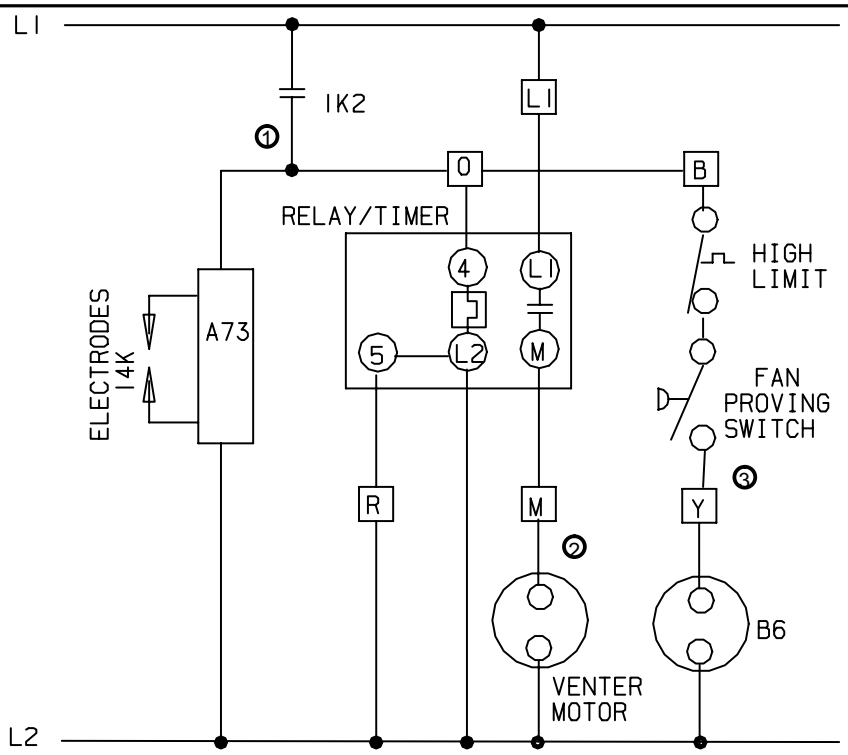
F-Electrical

1- Check all wiring for loose connections.
2- Check for correct voltage at unit (unit operating).
3- Check amp-draw on blower motor.
   Motor Nameplate_____Actual_____
4- Check to see that heat is operating.

VIII-WIRING DIAGRAMS AND SEQUENCE OF OPERATIONS

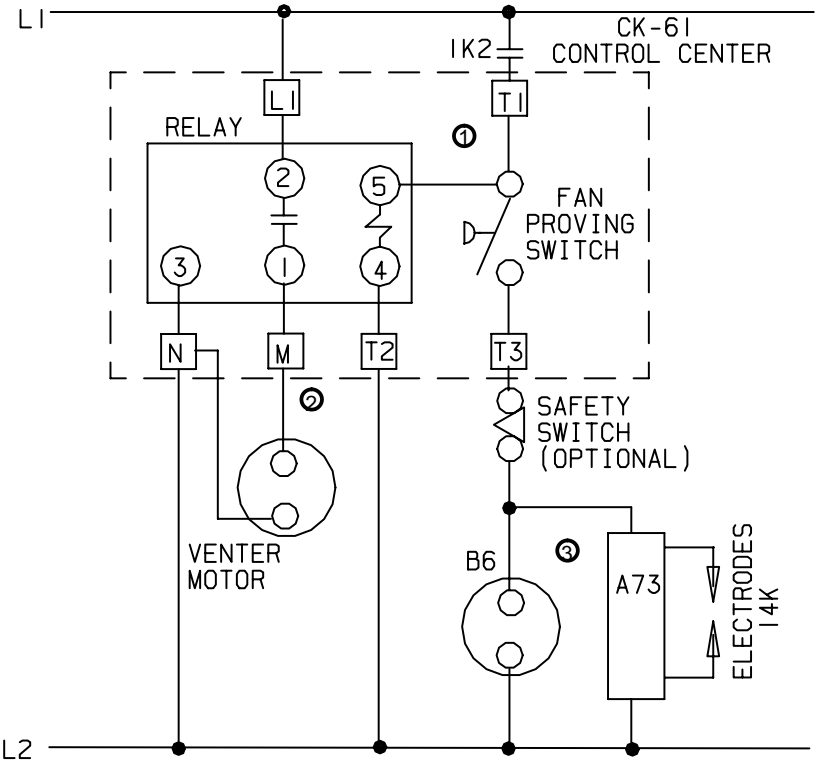


1. When disconnect is closed, 120V is routed to control board (A15). The control board feeds line voltage to transformer (T1).
2. When there is a call for heat, W1 of the thermostat energizes W of the A15 board with 24VAC.
3. A15 energizes combustion air inducer B6 (burner motor) assuming primary limit (S10) is closed.
4. Burner control A3 energizes the electronic ignitor causing a 20,000VAC spark . Pump valve (L35) is delayed for a 15 second pre-purge. The pre-purge is followed by a 15 second trial for ignition.
5. After the pre-purge and trial for ignition (30 seconds) voltage passes through contactor K1 the energizing the indoor blower B3 on heating speed.
6. When heat demand is satisfied, W1 of the thermostat de-energizes W of the ignition control. Combustion air inducer B6 is de-energized. The indoor blower ramps down to 82% for 3 1/2 minutes then shuts off.
7. When there is a call for cooling, Y1 of the thermostat energizes Y and G of the A15 board with 24VAC.
8. A15 energizes relay K2. When K2 contacts close, the indoor blower B3 energizes on cooling speed.
9. When cooling demand is satisfied, Y1 of the thermostat de-energizes Y and G. The condensing unit shuts off immediately and the indoor blower ramps down to 82% for 60 seconds then shuts off.



TJERNLUND HORIZONTAL VENTING SYSTEM (SIDESHOT) OPERATION SEQUENCE:

1. When 1K2 closes, 120VAC is routed through the relay/timer, electronic ignitor (A73), and the limit switch.
2. The relay/timer energizes the venter motor.
3. After the venter motor establishes a draft, the N.O. fan proving switch closes completing the circuit to the burner motor.



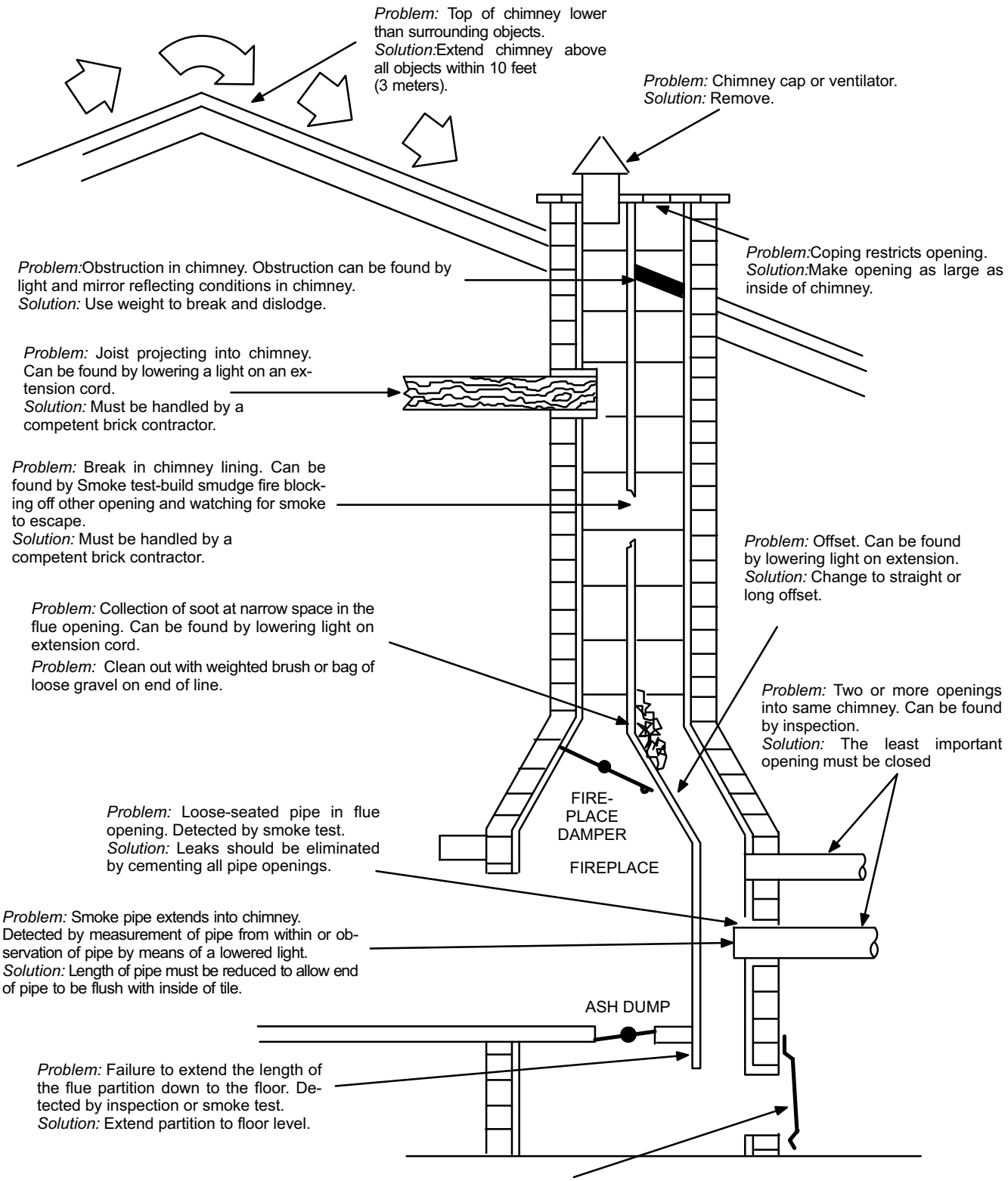
FIELD CONTROL HORIZONTAL VENTING SYSTEM OPERATION SEQUENCE:

1. When 1K2 closes, 120VAC is routed through the relay.
2. The relay energizes the venter motor.
3. After the venter motor establishes a draft, the N.O. fan proving switch closes, completing the circuit to the burner motor and electronic ignitor (A73).

IX-TROUBLESHOOTING

Burner failure or improper unit operation can be caused by various conditions. Often the problem can be solved by a logical process of checks and eliminations. The following pages lists a few common problems along with the solutions. Carefully check the most obvious items first before proceeding to more involved procedures.

COMMON CHIMNEY VENTING PROBLEMS



Troubleshooting: Fan board operating sequence	
Action	**System Response**
Thermostat calls for heat. (W terminal is energized.)	Blower control board closes oil primary control T-3T connections. Ignition system and oil primary control start the furnace. Oil flows as long as oil primary control senses flame. Burner motor energized and heat fan on delay timing begins. When timing is complete, the circulating fan is energized at heat speed and warm air is delivered to the controlled space.
Thermostat ends call for heat. (W terminal is de-energized.)	Oil primary control is de-energized, terminating the burner cycle. Heat fan off delay timing begins. When timing is complete, circulating fan is de-energized. Blower control board returns to standby mode (oil primary control and circulating fan are off).
Burner fails to light.	Oil primary control locks out within lockout timing (timing depends on oil primary control). Burner motor is de-energized.
Established flame fails.	Burner motor is de-energized and oil primary control goes into recycle mode. If the fan off delay is longer than the recycle timing, the heat fan continues to run through the next trial for ignition.
Limit switch opens.	Oil primary control shut off the burner. Circulating fan is energized immediately. A15 control board opens oil primary control T-3T connections. Circulating fan runs as long as limit stays open.
Limit switch closes.	If there is a heat demand, A15 control board energizes oil primary control, initiating burner light off.

Troubleshooting: Burner fails to start			
Source	**Procedure**	**Causes**	**Correction**
Thermostat	Check thermostat settings.	Thermostat in **OFF** or **COOL**	Switch to **HEAT**.
		Thermostat is set too low	Turn thermostat to higher temperature.
Safety Overloads	Check burner motor, primary safety control, & auxiliary limit switch.	Burner motor overload tripped	Push reset button pump motor.
		Primary control tripped on safety	Reset primary control.
		Auxiliary limit switch tripped on safety	Reset auxiliary limit.
Power	Check furnace disconnect switch & main disconnect.	Open switch	Close switch.
		Blown fuse or tripped circuit breaker	Replace fuse or reset circuit breaker.
Thermostat	Touch jumper wire across thermostat terminals on primary control. If burner starts, then fault is in the thermostat circuit.	Broken or loose thermostat wires	Repair or replace wires.
		Loose thermostat screw connection	Tighten connection.
		Dirty thermostat contacts	Clean contacts.
		Thermostat not level	Level thermostat.
		Faulty thermostat	Replace thermostat.
CAD Cell	Disconnect the flame detector wires at the primary control. If the burner starts, fault is in the detector circuit.	Flame detector leads are shorted	Separate leads.
		Flame detector exposed to light	Seal off false source of light.
		short circuit in the flame detector	Replace detector.

table continued on next page

Troubleshooting: Burner fails to start			
Source	**Procedure**	**Causes**	**Correction**
Primary Control	Place trouble light between the black and white leads. No light indicates that no power is going to the control.	Primary or auxiliary control switch is open	Check adjustment. Set the maximum setting.
			Jumper terminals; if burner starts, switch is faulty, replace control.
		Open circuit between disconnect switch and limit control	Trace wiring and repair or replace it.
		Low line voltage or power failure	Call the power company.
	Place trouble light between the orange and white leads. No light indicates faulty control.	Defective internal control circuit	Replace the control.
Burner	Place the trouble light between the black and white leads to the burner motor. No light indicates that no power is getting to the motor.	Blown fuse	Replace the fuse.
	Place trouble light between the black and white leads to the blower motor. Light indicates power to the motor and burner fault.	Binding burner blower wheel	Turn off power and rotate the blower wheel by hand. If seized, free the wheel or replace the fuel pump.
		Seized fuel pump	
		Defective burner motor	Replace the motor.

Troubleshooting: Burner starts, but no flame is established			
Source	**Procedure**	**Causes**	**Correction**
Oil Supply	Check tank gauge or use dip stick.	No oil in tank	Fill tank.
	Coat dip stick with litmus paste and insert into bottom of tank.	Water in oil tank	If water depth exceeds 1 inch, pump or drain water.
	Listen for pump whine.	Tank shut-off valve closed	Open valve.
Oil Filters & Oil Line	Listen for pump whine.	Oil line filter is plugged	Replace filter cartridges.
		Kinks or restriction in oil line	Repair or replace oil line.
		Plugged fuel pump strainer	Clean strainer or replace pump.
	Open bleed valve or gauge port. Start the burner. No oil or milky oil indicates loss or prime.	Air leak in oil supply line	Locate and correct leak. Tighten all connections.
Oil Pump	Install pressure gauge on pump and read pressure. -70/90 should not be less than 100 psi. -105/120, -140/154 should not be less than 140 psi.	Pump is partially or completely frozen. No pressure and the motor locks out on overload.	Replace pump.
		Coupling disengaged or broken - no pressure	Re-engage or replace coupling.
		Fuel pressure too low	Adjust psi.
Nozzle	Disconnect ignition leads. Observe the oil spray (gun assembly must be removed from unit). Inspect the nozzle for plugged orifice or carbon build-up around orifice.	Nozzle orifice plugged Nozzle strainer plugged Poor or off center spray	Replace nozzle with the same size, spray angle, and spray type.

table continued on next page

Troubleshooting: Burner starts, but no flame is established			
Source	**Procedure**	**Causes**	**Correction**
Ignition Electrodes	Remove gun assembly and inspect electrodes and leads.	Fouled or shorted electrodes	Clean electrode leads.
		Dirty electrodes and leads	
		Eroded electrode tips	Clean electrode tips and reset the gap and correct position tips. See figure 15.
		Improper electrode gap spacing	
		Improper position of electrode tips	
		Damaged Transformer Leads	Replace Transformer
		Cracked or chipped insulators	Replace electrode.
		Cracked or burned lead insulators	Replace electrode leads.
Ignition Transformer	Connect ignition leads to the transformer. Start burner and observe spark. Check line voltage to transformer primary.	Low line voltage	Check voltage at power source. Correct cause of voltage drop or call the power company.
		Burned out transformer windings.	Replace the transformer.
		No spark or weak spark	Properly ground the transformer case.
Burner Motor	Motor does not come up to speed and trips out on overload. Turn off power and rotate blower wheel by hand to check for binding or excessive drag.	Low line voltage	Check voltage at power source. Correct cause of voltage drop or the call power company.
		Pump or blower overloading motor	Correct cause of overloading.
		Faulty motor	Replace motor.

Troubleshooting: Burner starts and fires, but lock out on safety			
Source	**Procedure**	**Causes**	**Correction**
Poor Fire	After burner fires, immediately jumper across flame detector terminals at the primary control. • If burner continues to run, this may be due to poor fire. Inspect fire.	Unbalanced fire	Replace nozzle
		Too much air - -lean short fire	Reduce combustion air - check combustion.
		Too little air - - long dirty fire	Increase combustion air - check combustion.
		Excessive draft	Adjust barometric damper for correct draft.
		Too little draft or restriction	Correct draft or remove restriction.
Flame Detector	• If fire is good, fault is in the flame detector. Check detector circuit.	Dirty cad cell face	Clean cad cell face.
		Faulty cad cell - exceeds 15000 hms	Replace cad cell.
		Loose or defective cad cell wires	Secure connections or replace cad cell holder and wire leads.
Primary Control	• If burner locks out on safety, fault is in the primary control.	Primary control circuit defective	Replace primary control.

Troubleshooting: Burner starts and fires, but short cycles (too little heat)			
Source	**Procedure**	**Causes**	**Correction**
Thermostat	Check thermostat.	Heat anticipator set too low	Correct heat anticipator setting.
		Vibration at thermostat	Correct source of vibration.
		Thermostat in the path of a warm air draft	Shield thermostat from draft or relocate.
Limit Control	Connect voltmeter between line voltage connections to primary control (black & white leads). If burner cycles due to power interruption, it is cycling on limit.	Dirty furnace air filters	Clean or replace filter.
		Burner running too slow	Increase blower speed to maintain proper temp. rise.
		Blower motor seized or burned out	Replace motor.
		Blower bearings seized	Replace bearings and shaft.
		Blower wheel dirty	Clean blower wheel.
		Blower wheel in backward	Reverse blower wheel.
		Wrong motor rotation	Replace with properly rotating wheel.
		Restrictions in return or supply air system	Correct cause of restriction.
		Adjustable limit control set too low	Reset limit to maximum stop setting.
Power	If voltage fluctuates, fault is in the power source. Recheck voltage at the power source.	Loose wiring connection	Locate and secure connection.
		Low or fluctuating line voltage	Call power company.

Troubleshooting: Burner starts and fires, but loses flame and lock out on safety			
Source	**Procedure**	**Causes**	**Correction**
Poor Fire	After burner fires, immediately jumper across flame detector terminals at the primary control. • If burner continues to run (does not lock out of safety), fault may be poor fire. Inspect fire.	Unbalanced fire	Replace nozzle
		Too much air - - lean short fire	Reduce combustion air - check combustion.
		Too little air - - long dirty fire	Increase combustion air - check combustion.
		Excessive draft	Adjust barometric damper for correct draft.
		Too little draft or restriction	Correct draft or remove restriction.
Flame Detector	• If fire is good, check for fault in flame detector circuit.	Dirty CAD cell face	Clean CAD cell face.
		Faulty CAD cell - - exceeds 15000 hms	Replace CAD cell.
		Loose or defective cad cell wires	Secure connections or replace cad cell holder and wire leads.
		Pump loses prime - air slug	Prime pump at bleed port
Oil Supply	• If burner loses flame (does not lock out on safety), fault is in the fuel system.	Pump loses prime - air leak in supply line	Check supply line for loose connections and tighten fittings.
		Water slug in line	Check oil tank for water (over 1 inch) pump or drain out water.
		Partially plugged nozzle or nozzle strainer	Replace nozzle.
	Listen for pump whine	Restriction in oil line	Clear restriction.
		Plugged fuel pump strainer	Clean strainer or replace pump.
		Cold oil - outdoor tank	Change to number 1 oil.

Troubleshooting: Burner runs continuously (too much or too little heat)			
Too much heat			
Source	**Procedure**	**Causes**	**Correction**
Thermostat	Disconnect thermostat wires at the primary control. • Burner turns off: thermostat circuit faulty.	Shorted or welded thermostat contacts	Repair or replace the thermostat.
		Stuck thermostat bimetal	Clear obstruction or replace thermostat.
		Thermostat not level	Level thermostat.
		Shorted thermostat wires	Repair short or replace wires.
		Thermostat out of calibration	Replace thermostat.
		Thermostat in cold draft	Correct draft or relocate the thermostat.
Primary control	• Burner not turning off: primary control faulty.	Defective primary control	Replace the defective primary control.
Too little heat			
Combustion	Check burner combustion for CO2, stack temperature, and smoke • Low CO_2 less than 10%.	Too much combustion air	Reduce combustion air.
		Air leaks into heat exchanger around inspection door, etc.	Correct cause of air leak.
		Excessive draft	Adjust barometric draft control for correct draft.
		Incorrect burner head adjustment	Correct burner head setting.
	• High smoke reading more than a trace.	Dirty or plugged heat exchanger	Clean heat exchanger. Readjust burner.
		Insufficient draft	Increase draft.
		Incorrect burner head adjustment	Correct burner setting.
		Too little combustion air	Increase combustion air.
	• High stack temperature is more than 550°F Net.	Too little blower air	Increase blower speed to maintain proper temperature rise.
		Blower belt too loose (if equipped)	Tighten blower belt.
		Dirty or plugged heat exchanger	Clean heat exchanger.
		Dirty blower wheel	Clean blower wheel.
		Dirty furnace air filters	Clean or replace filter.
		Restricted or closed registers/dampers	Readjust registers or dampers.
Oil Pressure	Inspect fire and check oil pressure.	Partially plugged or defective nozzle	Replace nozzle.
		Oil pressure too low: See table 6.	Increase oil pressure. See table 6.