

# OIL-FIRED CENTRAL FURNACE

## Installation, Operation, and Service Manual With Users Information Section

### Models:

THV1C072A948SA

THV1C072A9V4SA

### ⚠ WARNING:

- Do NOT store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.
- Improper installation, adjustment, alteration, service, or maintenance can cause a fire or explosion resulting in property damage, personal injury, or loss of life. For assistance or additional information consult a qualified installer or service agency.

These instructions should be:

- read prior to installing the furnace
- retained for reference by qualified service personnel
- reviewed before performing any service or maintenance





## I. SAFETY SECTION

This page contains various warnings and cautions found throughout the Oil Furnace Manual. Please read and comply with the statements below.

### **△WARNING AND CAUTIONS:**

**△WARNING:** This furnace is not to be used as a construction heater. See Page 1.

**△ CAUTION MUST BE TAKEN NOT TO EXCEED 90° ROTATION (OF THE FLUE ELBOW) COUNTERCLOCKWISE OR RIGHT FROM THE VERTICAL POSITION.**  
See Page 2.

**△WARNING:** The predetermined limit location on this oil fired furnace has been tested and approved. Any attempt to relocate this safety control or replace this safety control with a control that is not approved, or is incompatible, may result in personal injury, substantial property damage or death. See Page 4.

**△WARNING:** Turn off the electrical power to the unit before attempting to change supply air blower speed wiring. See Page 7

**△WARNING:** THE HEAT EXCHANGER MUST BE CLEANED BY A QUALIFIED SERVICE PERSON. See Page 11.

**△CAUTION:** DO NOT ATTEMPT TO MAKE REPAIRS YOURSELF! See Page 12.

**△WARNING:** The area around the furnace should be kept free and clear of combustible liquids and material, especially papers and rags. See Page 12.

**△WARNING:** NEVER burn garbage or refuse in your furnace. Never try to ignite oil by tossing burning papers or other material into your furnace. See Page 12.

**△WARNING:** This oil furnace is designed to burn No. 1 or No. 2 distillate fuel oil. Bio fuel blend up to 5% is permissible. **NEVER USE GASOLINE OR A MIXTURE OF OIL AND GASOLINE.** See Page 12.

**△CAUTION:** DO NOT ATTEMPT TO START THE BURNER WHEN:

1. Excess oil has accumulated,
2. The furnace is full of vapors
3. The combustion chamber is very hot.

IF ONE OR MORE OF THESE CONDITIONS EXIST, CONTACT A QUALIFIED SERVICE PERSON. See Page 12.

**△WARNING:** To avoid injury from moving parts, hot surfaces, or electrical shock, shut off the power to the furnace before removing any furnace access doors to service the air filters. See Page 13.

All installations and services must be performed by qualified service personnel.

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**All installations and services must be performed by qualified service personnel.**

## **II. GENERAL INSTRUCTIONS - READ BEFORE START OF INSTALLATION**

1. The heating output capacity of the furnace proposed for installation should be based on a heat loss calculation made according to the manuals provided by the Air Conditioning Contractors of America (ACCA) or the American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc. (ASHRAE).
2. All local codes and/or regulations take precedence over the instructions in this manual and should be followed accordingly. In the absence of local codes, installation must conform with these instructions and regulations of the National Fire Protection Association, and to the provisions of the National Electrical Code (ANSI/NFPA 70-1999 or latest edition).
3. The installed furnace must be level and positioned in a central location with respect to outlet registers. It should be located near the chimney to minimize any horizontal run of flue pipe, which may be required.
4. A furnace installed in a residential garage must be installed so the burner and ignition source are located higher than 18 inches above the floor, unless the required combustion air is taken from the exterior of the garage. Also, the furnace must be located or protected to avoid physical damage by vehicles.
5. It is recommended that a commercially available CO alarm be installed in conjunction with any fossil fuel burning appliance. The CO alarm shall be installed according to the alarm manufacturer's installation instructions and be listed in accordance with latest edition of the UL Standard for Single and Multiple Station Carbon Monoxide Alarms, UL 2034, or the CSA International Standard, Residential Carbon Monoxide Alarming Devices, CSA 6.19.

**⚠WARNING:** This furnace is not to be used as a construction heater.

6. Listed below are definitions of "COMBUSTIBLE MATERIAL" and "NON-COMBUSTIBLE MATERIAL."

### **COMBUSTIBLE MATERIAL:**

Material made of or surfaced with wood, compressed paper, plant fibers, plastics, or other material that will ignite and burn, whether flame resistant or not.

### **NON-COMBUSTIBLE MATERIAL:**

Material that is not capable of being ignited and burned. Such materials consist entirely of, or a combination of, steel, iron, brick, tile, concrete, slate, or glass.

### **MINIMUM CLEARANCES TO COMBUSTIBLE MATERIALS**

<b>TYPE OF UNIT</b>	<b>MODEL NO.<sup>1</sup></b>	<b>FROM SIDES OF FURNACE</b>	<b>FRONT</b>	<b>TOP &amp; SIDES OF PLENUM</b>	<b>FROM THE FLUE/VENT</b>	<b>REAR</b>
<b>HIGHBOY</b>	THV1C*	0"	Note <sup>1</sup>	1"	7"	0"

Notes: <sup>1</sup> THV1C\* front clearance 6" for Closet, 24" for Alcove.

The minimum clearances listed in the preceding table are for fire protection. Clearance for servicing the front of the furnace should be at least 24 inches. A clearance of 24 inches is recommended for passage to all points on the furnace requiring service access.

**NOTE: The THV1C\* furnace may be installed on combustible flooring.**

**NOTE:** The THV1C\* furnace is approved for closet installation. If the furnace is installed in a closet, it requires two openings in the closet door for combustion air, each having a minimum area of 162 sq. inches. This free area intentionally exceeds the recommended minimum free area of 2 square inches per 1000 BTUH of input rate.

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**A. VENTING:**

**NOTE:** On the THV1C\* it is possible to rotate the flue elbow (which is factory installed for vertical discharge) 90° counterclockwise from the vertical position to adapt to various venting systems.

**⚠ CAUTION MUST BE TAKEN NOT TO EXCEED 90° ROTATION (OF THE FLUE ELBOW) COUNTERCLOCKWISE OR RIGHT FROM THE VERTICAL POSITION.**

**ROTATION OF FRONT FLUE ELBOW**

When an installation requires that the flue exit out the left hand side casing on a front flue unit, remove screw securing the 90 deg. elbow and rotate it 90° **counterclockwise**. Then, remove knock-out in side casing and extend vent through the opening.

A trim collar may be ordered from the manufacturer of this furnace to hide the gap around the flue pipe. This trim collar, however, is not required for operation. Trim collar/gasket part numbers(s) R14121 / R330073.

**NOTE: ROTATION OF FLUE PIPE IS ONLY ALLOWED FOR LEFT HAND SIDE VENTING APPLICATIONS.**

The THV1C\* may be vented through a standard correctly sized chimney.

The THV1C\* may also be horizontally vented through a side wall. The manufacturer of this furnace has available the Field model RFDVS-45/RFVOP-415 side wall vent kit for such applications. When installing the RFDVS-45/RFVOP-415 side wall vent kit, outside combustion air must also be applied to the burner. The following table identifies application order information.

SIDE WALL VENTING APPLICATION ORDER INFORMATION			COMBUSTION AIR INTAKE HOOD KIT (FOR COMBUSTION AIR APPLICATIONS ONLY)  PART NUMBER
BURNER	FIELD VENT TERMINATION KIT (15' application MAX)  PART NUMBER	SIDE WALL VENT ACCESSORIES KIT (BURNER SPECIFIC)  PART NUMBER	
Beckett AFG	AOPS8393	AOPS8394	

The Field vent kit is set up with 4 inch diameter vent pipe with concentric through-the-wall vent termination/inlet air vent hood. The combustion air inlet pipe diameter is also 4 inch diameter. For Beckett, the combustion air inlet pipe will be reduced to 3" diameter with the Beckett side wall vent kit.

The side wall vent may be installed either through the upper knock-out on the left side casing of the unit or vertically out the top opening of the vestibule. The 4" flexible vent pipe included w/ Field vent kit is able to be installed at 2" clearance to combustibles.

The combustion air inlet can be installed through the either the lower left side casing knock-out or the lower right side casing knock-out.

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## **B. DRAFT REGULATORS:**

A draft regulator is supplied with the furnace and should be installed according to the regulator manufacturer's recommendations. With the burner operating, use a draft gauge to adjust the regulator to the proper setting. (refer to the instructions enclosed with draft regulator to adjust to the proper setting). When the burner air supply and draft are properly adjusted, the overfire draft should be a negative  $(-).01"$  to  $(-).02"$  WC<sup>1</sup>, as measured at the 5/16" overfire air tap (See Fig. 4). This tap is provided in the upper burner mounting plate. To measure the flue draft, punch a small hole in the vent connector pipe as close to the furnace as possible and always before the draft regulator.

Note: 1. Draft overfire may be positive for high fire applications but not to exceed  $(+).02"$  WC.

## **C. DUCT WORK/AIR CONDITIONING/SUPPLY/RETURN AIRFLOW AND AIR TEMPERATURE:**

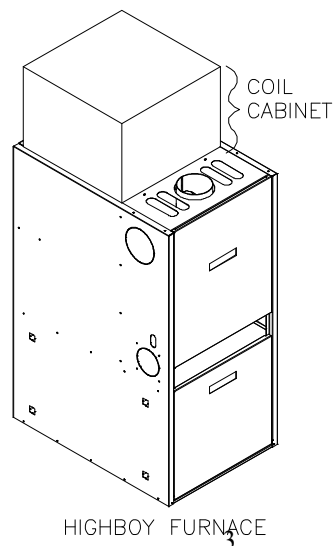
If the furnace is used in connection with summer air conditioning (cooling), the furnace should be installed parallel with or on the upstream side of the evaporator coil to avoid condensation in the furnace heat exchanger. If the cooling unit is installed with a parallel flow arrangement, dampers or other means used to control flow of air should be provided to prevent chilled air from entering the furnace. If such a damper is manually operated, it must be equipped with a means to prevent operation of either unit, unless the damper is in the full heat or cool position.

The supply/return airflow shall be set to obtain an air temperature rise, across the furnace, in the range of 55° to 85°F. Since the flow resistance of each duct system is slightly different, the airflow (fan speed) may have to be changed in the field to achieve a satisfactory temperature rise. The furnace shall not be operated in a condition where the return air is consistently below 55°F.

One way to measure the temperature rise across the furnace is to insert temperature measuring devices (e.g. thermometers) into the return air duct and into the supply air duct about 12 inches from the furnace. After the furnace has been firing continually for over 20 minutes, read the temperature difference between the two (2) thermometers. The temperature difference should not exceed 85°F, nor be less than 55°F. A temperature rise of 70°F is considered to be optimum for comfort.

The blower (fan) speed fan is adjusted by changing the fan motor winding energized by the control system. The furnace is set on fan speed, "ML", at the factory, refer to page 13 of this manual. To adjust the fan speed, change corresponding wire from the appropriate fan speed to the "HEAT" tap on the control.

The duct system should again follow the current design standard of Air Conditioning Contractors of America (ACCA) or ASHRAE Fundamentals volume. The most common location for the A-shaped coil (A style) is shown in Fig. 1.



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**Fig 1: Acceptable locations for the air conditioner evaporator coil.**

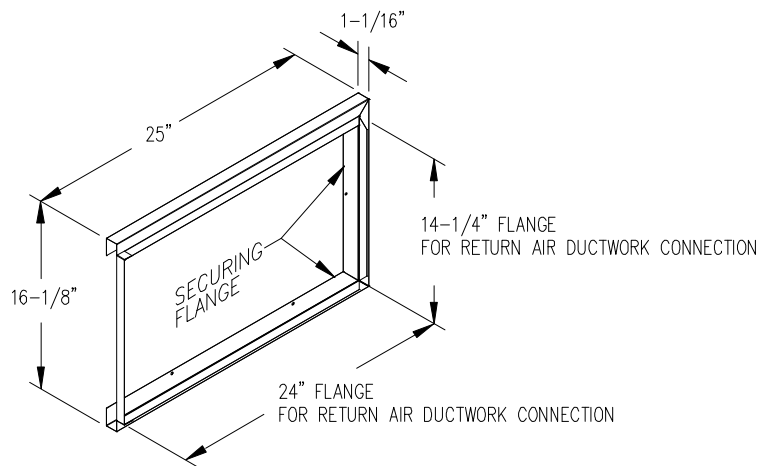
**NOTICE:** The minimum coil pan clearance for a drum type heat exchanger is three inches unless specified otherwise by the individual coil manufacturer.

#### D. FILTERS MOUNTED EXTERNAL TO FURNACE

On **highboy** furnaces, it is necessary to cut the return air opening in the side or rear casing, depending upon the needs of the specific installation.

The filter rack is provided with the furnace, refer to Fig. 2. For your convenience, (4) locator knock-outs have been placed at the proper locations for the cutout on both the left and right side casings. Cut opening between knockouts and screw filter rack in place.

**PLEASE NOTE:** While scribing the return air opening, the filter rack can be held in position by tape or similar temporary means.



**Fig. 2: A typical filter rack and dimensions for the THVIC\* furnace.**

Connect the return air plenum to the filter rack and slide the filter into place. Dimensions for adapting the return air plenum to the filter rack are provided (See Fig. 2).

#### E. LIMIT POSITION AND LOCATION

**⚠WARNING:** The predetermined limit location on this oil fired furnace has been tested and approved. Any attempt to relocate this safety control or replace this safety control with a control that is not approved, or is incompatible, may result in personal injury, substantial property damage or death.



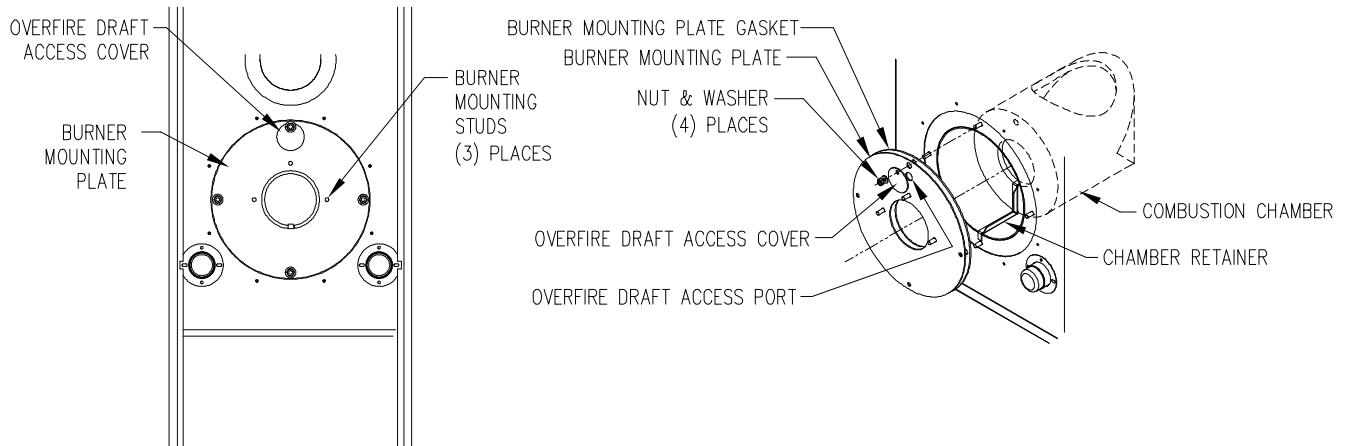
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## **F. BURNER INSTALLATION:**

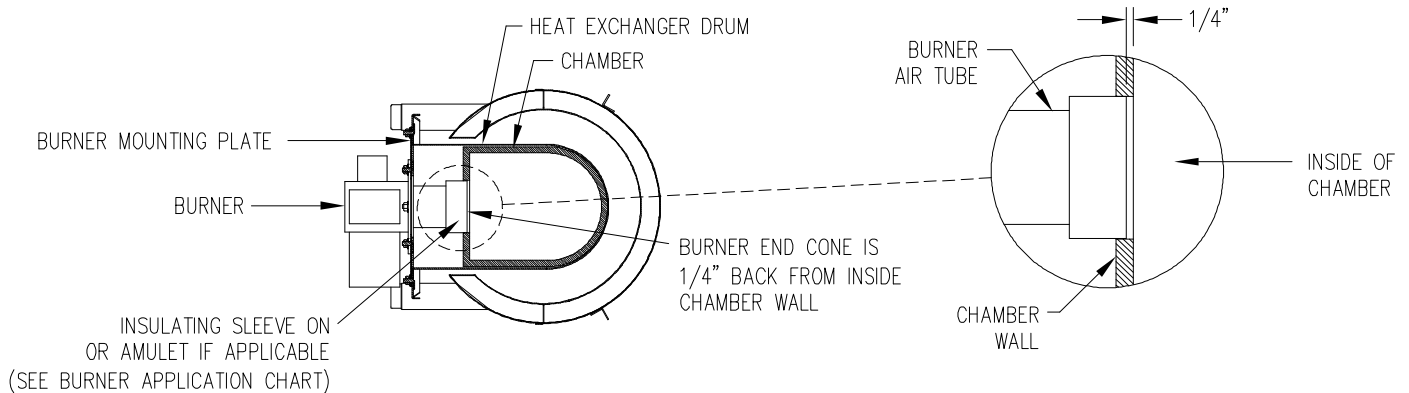
**NOTE: The burner is factory installed on this furnace.**

**NOTICE:** Remove all cardboard packing from around chamber before installing burner.

The oil burner will mount on three stud mounting bolts on the lower mounting plate covering the opening in the front of the heat exchanger. The end of the burner tube should be inserted no further than 1/4 inch back from the inside surface of the combustion chamber. A distance further than 1/4 inch back from the inside chamber wall may cause impingement and sooting. This unit is equipped with a chamber retainer (refer to Fig.4). This retainer secures the chamber during shipping and helps to maintain insertion depth. **DO NOT** remove this retainer when installing burner.



**Fig. 4: Typical location of the overfire air tap and components in burner mounting plate area**



**Fig. 5: Burner insertion illustration (Top view)**

When mounting the burner, the mounting plate (Fig. 4) must be removed to provide access to the area in front of the combustion chamber. A fiber insulating sleeve or amulet is provided on the burner tube of specific burners (see Fig. 5). See burner application chart for type of insulator. Do not allow the burner tube or end cone to physically touch or protrude into the chamber, as excess heat transfer could result in destruction of the tube, end cone or both. The burner tube/end cone is properly positioned, when the end is 1/4 inch back from the inside surface of the combustion chamber wall.

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## **G. BURNER SPECIFICATIONS AND APPLICATIONS**

FURNACE MODEL THV1C* SERIES BURNER	BURNER SPEC NO.	* INS	BURNER MODEL & TUBE LENGTH	HEAD	STATIC PLATE	MAXIMUM NOZZLE SIZE**	SHIPPED NOZZLE SIZE	OIL PUMP PRESSURE (PSIG)
BECKETT (AFG)	EFL201	N	AFG-4.5"	F3	3-5/8U	0.75X80° A	0.60X80° A	120

**\* INSULATOR S = SLEEVE OR N = NONE**

**THE NOZZLE SIZE GIVES THE NOMINAL FLOWRATE, IN GPH, FOLLOWED BY THE SPRAY ANGLE, IN DEGREE'S, AND THE SPRAY PATTERN, EITHER "A" FOR HOLLOW CONE OR "B" FOR SOLID CONE. FOR EXAMPLE, A NOZZLE RATED AT 0.65 GPH @ 100 PSIG THAT PROVIDES AN 80° SPRAY ANGLE AND A HOLLOW SPRAY PATTERN WOULD BE ABBREVIATED IN THE TABLE AS "0.65 X 80°A".**

<b>INPUT CAPACITY SELECTION CHART</b>						
UNITS	EQUIVALENT HEAT INPUT RATE* (BTU/HR)	EFFECTIVE HEATING CAPACITY** (BTU/HR)	NOZZLE SIZE (GPH x TYPE)			
			Beckett AFG			
THV1C*	70,000	60,000	0.50 x 80° A			
THV1C*	85,000	72,000	0.60 x 80° A			
THV1C*	106,250	90,000	0.75 x 80° A			

All rates shown achieved with 120 PSIG pump pressure for Beckett AFG.

\* Based on #2 domestic heating fuel oil having heating value of 140,000 BTU per gallon.

\*\* Based on thermal efficiency of 84%-85%.

## **H. ELECTRICAL CONNECTIONS**

NOTICE: All field wiring must conform to local, state and national codes.

A disconnect switch equipped with overcurrent protection (e.g. a time delay-type fuse or inverse time, circuit breaker) should be installed in the service line for shutting down and protecting the furnace and electrical system.

Since the furnace is entirely pre-wired at the factory, it is only necessary to connect the building electrical service lines to the two (2) pigtail wires extending from the fan center junction box. The fan center is mounted inside the furnace burner compartment. The service lines to the furnace should be no smaller than 14 Ga., insulated copper wire with a temperature rating of 60°C, or greater.

Connect an equipment ground wire to the furnace at the fan center junction box. If wiring is run through metal electrical conduit, it may not be necessary to run a separate equipment ground wire. Consult local codes and authorities for specific minimum requirements.

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## I. BLOWER MOTOR SPEED SELECTION:

**⚠WARNING:** Turn off the electrical power to the unit before attempting to change supply air blower speed wiring.

The furnace comes from the factory with the proper cooling speed selected and the heat rise set to approximately 70°F on mid-fire.

The heat rise is determined by the nozzle size and the switch selection on the control board located in the blower compartment for ECM models or blower speed taps for PSC models.

For ECM unit, switches 7 & 8 are used to select the proper blower speed for heating, refer to figure 5A and page 8. For PSC unit, refer to figure 5B and page 10 for blower speed tap selections.

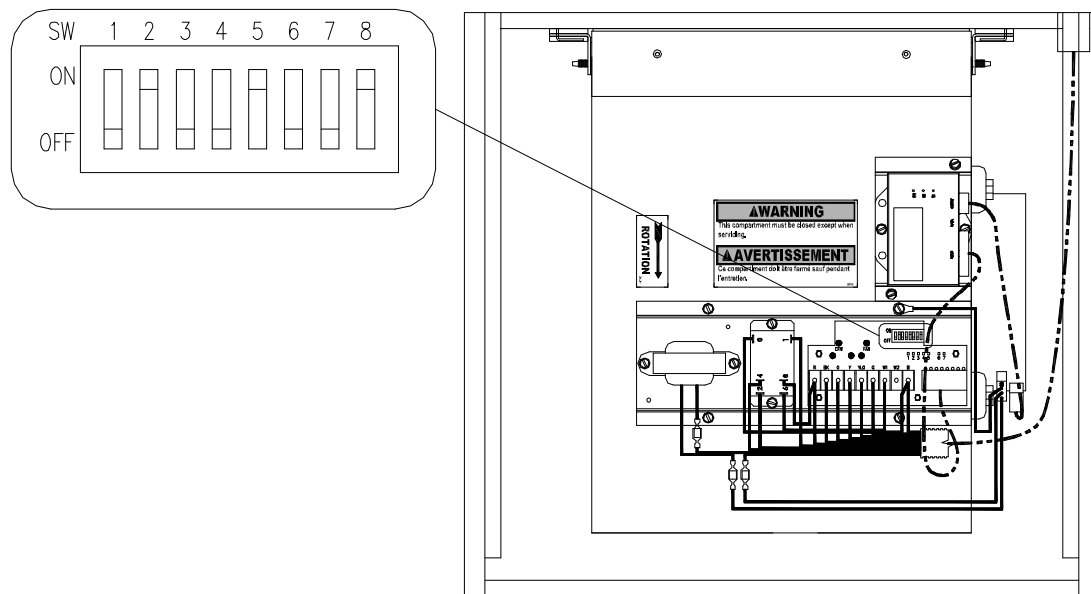


Fig-5A ECM unit

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ECM air flow DIP switch settings:

	outdoor unit size (tons)	airflow setting	dip switch setting					external static pressure					Performance Options		
			sw1	sw2	sw3	sw4		0.1	0.3	0.5	0.7	0.9	Comfort R	2-Stage Cooling	Comfort & Humid Climate
COOLING	4	LOW (350 CFM/TON)	OFF	OFF	OFF	ON	CFM WATTS	1401 315	1415 386	1424 467	1420 534	1392 601	OPTION PERMITTED	OPTION PERMITTED	OPTION PERMITTED
		NORMAL (400 CFM/TON)	OFF	OFF	OFF	OFF	CFM WATTS	1581 435	1597 517	1613 588	1617 680	1601 741			
		HIGH (450 CFM/TON)	OFF	OFF	ON	OFF	CFM WATTS	1803 605	1789 711	1810 800	1728 799	1644 795			
	3.5	LOW (350 CFM/TON)	ON	OFF	OFF	ON	CFM WATTS	1216 232	1258 286	1273 348	1222 425	1179 504			
		NORMAL (400 CFM/TON)	ON	OFF	OFF	OFF	CFM WATTS	1374 319	1411 382	1406 460	1401 530	1365 626			
		HIGH (450 CFM/TON)	ON	OFF	ON	OFF	CFM WATTS	1577 431	1585 512	1605 582	1589 655	1593 724			
	3	LOW (350 CFM/TON)	OFF	ON	OFF	ON	CFM WATTS	1071 173	1071 223	1053 284	1004 355	965 400			
		NORMAL (400 CFM/TON)	OFF	ON	OFF	OFF	CFM WATTS	1176 223	1208 284	1213 339	1197 396	1144 487			
		HIGH (450 CFM/TON)	OFF	ON	ON	OFF	CFM WATTS	1341 300	1355 366	1355 432	1355 496	1317 602			
	2.5	LOW (350 CFM/TON)	ON	ON	OFF	ON	CFM WATTS	847 118	854 163	861 227	824 271	785 298			
		NORMAL (400 CFM/TON)	ON	ON	OFF	OFF	CFM WATTS	951 170	971 200	984 282	955 333	925 365			
		HIGH (450 CFM/TON)	ON	ON	ON	OFF	CFM WATTS	1121 197	1127 254	1149 302	1076 396	1070 440			
	2 *	NORMAL	ON	ON	OFF	ON	CFM WATTS	847 118	854 163	861 227	824 271	785 298			NA

\* CONNECT Y - COOLING SIGNAL TO Y10 ON BOARD

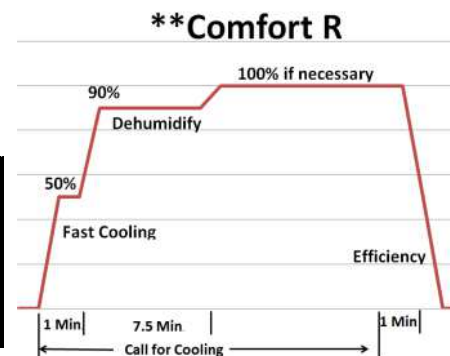
	AIRFLOW SETTING	DIP SWITCH SETTING			EXTERNAL STATIC PRESSURE				
		SW7	SW8		0.1	0.3	0.5	0.7	0.9
HEATING	LOW	ON	ON	CFM	791	822	749	732	723
				WATTS	103	148	209	245	281
	MEDIUM LOW	OFF	ON	CFM	938	958	971	875	882
				WATTS	141	189	237	302	337
	MEDIUM HIGH	ON	OFF	CFM	1124	1152	1163	1152	1101
				WATTS	210	267	330	383	463
	HIGH	OFF	OFF	CFM	1420	1424	1446	1428	1397
				WATTS	325	447	476	536	613

**NOTES:**

1. CONTINUOUS FAN SETTING: HEATING OR COOLING AIRFLOW IS APPROXIMATELY 50% OF SELECTED COOLING VALUE.
2. FOR VARIABLE SPEED: LOW SPEED AIRFLOWS ARE APPROXIMATELY 30% OF LISTED VALUES.
3. LOW 350 CFM/TON IS RECOMMENDED FOR VARIABLE SPEED APPLICATION FOR COMFORT & HUMID CLIMATE SETTING: NORMAL IS 400 CFM/TON: HIGH 450 CFM/TON IS FOR DRY CLIMATE SETTING.

FACTORY SETTING

	DIP SWITCH SETTING		HEATING ON & OFF DELAY OPTIONS		COOLING DELAY OPTIONS
	SW5	SW6	DELAY ON	DELAY OFF	
HEATING	OFF	OFF	1 MIN	3 MIN	1 MIN OFF DELAY
	ON	OFF	1 MIN	4 MIN	1 MIN OFF DELAY
	OFF	ON	1 MIN	6 MIN	1 MIN OFF DELAY
	ON	ON	1 MIN	4 MIN	**





BLOWER DELAY SWZ SWITCH SETTINGS  
N=ON F=OFF

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PSC air flow Speed Tap settings:

ALTERATIONS REQ'D FOR A/C @ DESIGN EXTERNAL STATIC PRESSURE				
COOLING UNIT	HTG Speed by Input			Recommended CLG Speed
	Low Fire	Mid Fire	High Fire	
24,000	Low	ML	MH	Low
30,000	Low	ML	MH	Med Low
36,000	Low	ML	MH	Med High
42,000	Low	ML	MH	Med High
48,000	Low	ML	MH	High

Speed Tap\ Static Pressure	Furnace Airflow (CFM) vs. External Static pressure (in. WC.)						
	0.1	0.2	0.3	0.4	0.5	0.6	0.7
Low	930	915	912	910	822	774	730
ML	1155	1152	1130	1126	1085	1042	920
MH	1442	1432	1418	1382	1334	1293	1230
High	1802	1762	1705	1635	1569	1493	1428
Speed Tap\ Static Pressure	Furnace Motor Current Draw (Amps) vs. External Static pressure (in. WC.)						
	0.1	0.2	0.3	0.4	0.5	0.6	0.7
Low	3.28	3.1	3.02	2.91	2.64	2.49	2.36
ML	4.18	4.02	3.91	3.74	3.59	3.34	2.95
MH	5.44	5.17	4.95	4.72	4.43	4.21	3.95
High	6.61	6.36	6.04	5.73	5.46	5.17	4.9

Speed Tap\ Static Pressure	High Fire Temperature Rise vs. External Static pressure (in. WC.)						
	0.1	0.2	0.3	0.4	0.5	0.6	0.7
Low	90	91	91	92	101	108	114
ML	72	72	74	74	77	80	91
MH	58	58	59	60	62	64	68
High	46	47	49	51	53	56	58

Speed Tap\ Static Pressure	Mid Fire Temperature Rise vs. External Static pressure (in. WC.)						
	0.1	0.2	0.3	0.4	0.5	0.6	0.7
Low	72	73	73	73	81	86	91
ML	58	58	59	59	61	64	72
MH	46	47	47	48	50	52	54
High	37	38	39	41	42	45	47

Speed Tap\ Static Pressure	Low Fire Temperature Rise vs. External Static pressure (in. WC.)						
	0.1	0.2	0.3	0.4	0.5	0.6	0.7
Low	60	61	61	61	68	72	76
ML	48	48	49	49	51	53	60
MH	39	39	39	40	42	43	45
High	31	32	33	34	35	37	39

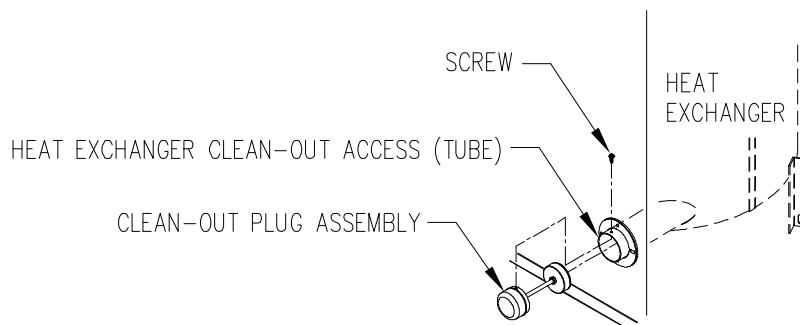
All installations and services must be performed by qualified service personnel.

#### J. HEAT EXCHANGER CLEANING INSTRUCTIONS:

**⚠WARNING: THE HEAT EXCHANGER MUST BE CLEANED BY A QUALIFIED SERVICE PERSON.**

It is important to inspect and clean the heat exchanger once a year, or as necessary, to remove any build-up of soot. A layer of soot on the inside of the heat exchanger will act as an insulator and reduce heat transfer, resulting in less efficiency.

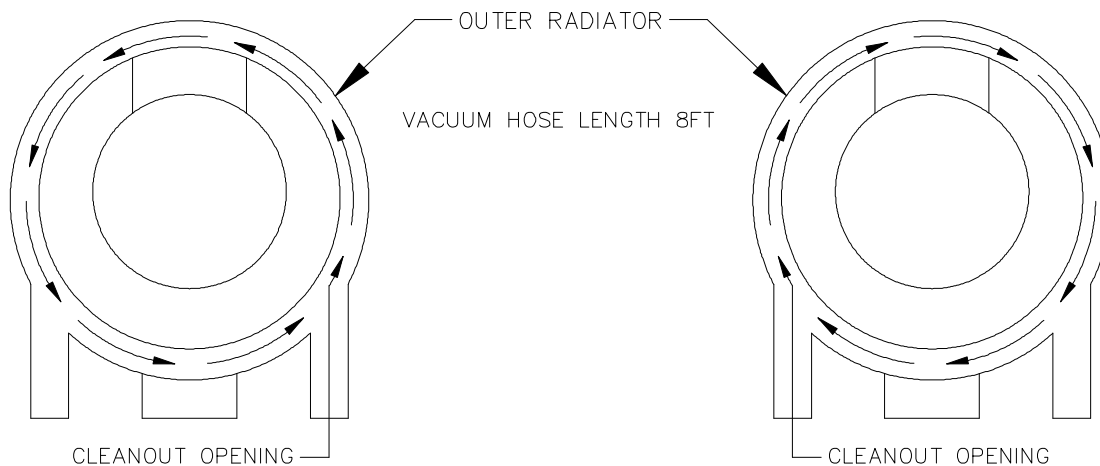
To clean the heat exchanger, first turn off all power to the unit. Remove clean-out plugs, the vent connector pipe to the chimney, the burner, and the burner mounting plates. When removing the clean-out plugs, remove the screw at the 12 o'clock position. Then, pull clean-out plug straight back.



**Fig. 6: Clean-out plug removal**

With access to the inside of the heat exchanger through the burner area, clean-out openings, and vent pipe connection, it is possible to use a long, flexible wire brush and an industrial type vacuum cleaner to remove any soot build-up. **NOTE:** A one inch (outside diameter) vacuum cleaner hose will fit into the radiator.

To vacuum and brush the outer radiator of the heat exchanger, go through the clean-out openings in both directions, as shown in figure 7, below.



**Fig. 7: Recommended method and device for cleaning inside of heat exchanger.**

Reassemble the furnace to its original construction\*. Remount the burner being certain that the air tube is properly inserted into the chamber opening (see section F). If heavy soot deposits were found in the heat exchanger, this may indicate the burner is out of adjustment.

\*When returning clean-out plugs to their original position, insert plug and replace screw at the 12 o'clock position. This is sufficient for sealing the access tube.

**All installations and services must be performed by qualified service personnel.**

### **III. USERS INFORMATION SECTION**

**A. OIL SUPPLY:** Do not allow the fuel tank to run completely empty. During the summer, keep the tank full to prevent condensation of moisture on the inside surface of the tank. If the fuel tank runs completely dry, it may be necessary to purge the lines of trapped air. Contact a qualified technician to bleed the lines and restart the burner.

**OIL SUPPLY VALVE:** Turn the oil supply valve off if the burner is shut down for an extended period of time.

**B. COMBUSTION AIR SUPPLY:** The burner requires a generous amount of clean combustion air to operate safely. Lack of adequate combustion air can result in erratic operation of the burner, noisy combustion, or fuel odors in the air. NEVER BLOCK THE FURNACE FROM THE SUPPLY OF COMBUSTION AIR. If there is an exhaust fan, dryer or return air grill in the furnace room, there should be increased concern and additional efforts may be required to provide adequate combustion air to the furnace at all times.

### **C. INSPECTION AREAS**

**VESTIBULE:** The furnace vestibule area or burner compartment should be inspected by removing the front door of the furnace and looking for signs of excessive heat such as discoloration of components materials damage, from rust or corrosion, soot or carbon build-up.

**EXTERIOR OF FURNACE:** The furnace exterior should be inspected for signs of excessive heat such as discoloration of materials and damage from rust or corrosion.

**FLUE PIPE, VENT PIPE OR CONNECTOR:** The furnace vent pipe should be inspected for signs of rust, corrosion pitting or holes in pipe, and leakage around seams in pipe, indicated by soot or condensate streaks.

**CHIMNEY OR VENTING SYSTEM:** The furnace venting system should be inspected for signs of rust, corrosion pitting or holes, and signs of condensation or moisture leakage from the venting system.

If any of the above symptoms are evident, call a qualified heating contractor for assistance.

**⚠CAUTION: DO NOT ATTEMPT TO MAKE REPAIRS YOURSELF!**

**⚠WARNING: The area around the furnace should be kept free and clear of combustible liquids and material, especially papers and rags.**

**⚠WARNING: NEVER burn garbage or refuse in your furnace. Never try to ignite oil by tossing burning papers or other material into your furnace.**

**⚠WARNING: This oil furnace is designed to use No. 2 distillate fuel or lighter (home heating) oil. A Bio-fuel mixture may be used but the mixture is not to exceed a B5. NEVER USE GASOLINE OR A MIXTURE OF OIL AND GASOLINE.**

**⚠CAUTION: DO NOT ATTEMPT TO START THE BURNER WHEN:**

- 1. Excess oil has accumulated,**
- 2. The furnace is full of vapors**
- 3. The combustion chamber is very hot.**

**IF ONE OR MORE OF THESE CONDITIONS EXIST, CONTACT A QUALIFIED SERVICE PERSON.**

### **D. STARTING THE BURNER:**

1. Turn the main service switch to "OFF" position.
2. Set thermostat substantially above room temperature.
3. Open shut-off valves in oil supply line to burner.
4. Turn service switch to furnace "ON". If burner starts and runs, but stops again on lockout, it may be necessary to bleed the lines or make burner combustion air adjustments. Contact a qualified service person to adjust and start burner.



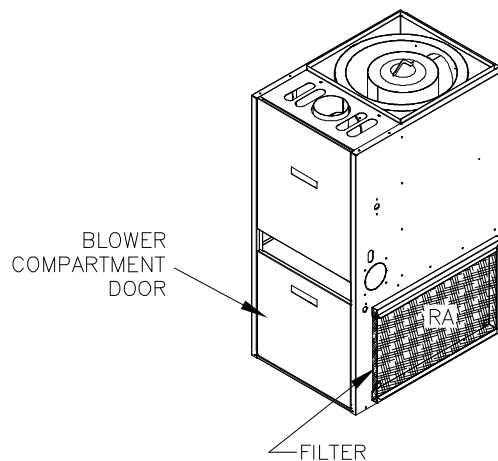
All installations and services must be performed by qualified service personnel.

#### E. FILTER CLEANING AND LOCATION:

The air filters should be inspected each month and cleaned when dirty. Cleaning the air filters frequently may reduce airborne contaminants from entering the furnace and depositing in the furnace, duct system and home.

**⚠WARNING:** To avoid injury from moving parts, hot surfaces, or electrical shock, shut off the power to the furnace before removing any furnace access doors to service the air filters.

The filter rack will be located between the return air plenum and the return air opening on the side of the furnace, refer to figure 8. Slide the dirty filter out, clean it with a mild soap and water solution. Make sure filter is thoroughly dry before replacing.



**Fig. 8: Location of the air filter on the typical highboy furnace.**

All installations and services must be performed by qualified service personnel.

## IV. TROUBLESHOOTING

**⚠ WARNING: When testing electrical equipment, always follow standard electrical safety procedures.**

Before beginning these troubleshooting procedures, always review these basic points.

- 1) Check for 120 VAC power to the furnace. If there is no voltage, check the disconnecting switch for circuit breaker trip or blown fuses.
- 2) Make sure the room thermostat is set on the heating mode and is “calling for heat”.
- 3) Check for sufficient oil supply and that all oil shutoff valves are open.
- 4) To successfully service this oil furnace, the following recently (within the last year) calibrated instruments must be available.
  - Smoke spot test kit with Bacharach-type oil burner smoke scale
  - Carbon dioxide (CO<sub>2</sub>) and carbon monoxide (CO) test kit or analyzer
  - Flue gas temperature measuring instrument
  - Draft gauge, capable of measuring 0.01 to 0.25 in. W.G. draft  
(Draft is the pressure differential between the static pressure measured in the vent pipe, or just above the combustion chamber, and the indoor atmospheric pressure. Under normal operating conditions, it will have a **negative** value, i.e. the pressure in the combustion chamber and the vent system are less than room air pressure.)
  - Multimeter (analog or digital type)
  - Oil pressure gauge, capable of measuring at least 0 to 200 PSIG
  - Burner electrode and nozzle setting gauge
- 5) Be familiar with the correct operation of these instruments as well as how to adjust the oil burner settings (refer to burner manufacturer’s literature).

### A. Symptom: Furnace does not operate.

Items to check:

**⚠ WARNING: Repeated operation of the oil primary safety control reset button can cause a build-up of unburned oil in the combustion chamber. An accumulation of oil in the combustion chamber is a hazardous situation and may cause a fire or explosion.**

- 1) Make sure the disconnecting switch is “ON” and the circuit breaker has not tripped, or fuses have not blown.
- 2) Confirm there is 120 VAC at the junction box and oil furnace control terminal S1.

**All installations and services must be performed by qualified service personnel.**

- 3) Confirm the room thermostat is wired correctly, set on the “HEAT” mode, and “calling for heat”.
- 4) For all primary controls, lockout can be confirmed by measuring voltage from the oil primary safety control to the burner motor. If none, depress the oil primary reset button. If the LED indicates a lockout condition, depress the oil primary reset button.

**If the burner does not operate properly after depressing the reset button three (3) times, turn off the electrical power to the furnace and close the manual oil shutoff valve. Immediately contact a qualified heating contractor for service.**

**B. Symptom: Burner short cycles or “locks out” on oil primary safety control.**

Items to check:

- 1) Fuel oil tank nearly empty or oil flow restriction. Refill oil tank, replace oil filter, open all shutoff valve(s), and purge oil line(s) of air.
- 2) If the oil primary control has not “locked out”, measure the electrical current to the room thermostat. Set the heat anticipator on the room thermostat to the current value measured. Also, check the wiring between the thermostat and primary control to be sure it is correct and no loose connections exist.
- 3) Inspect the burner flame sensor, “cad cell”, to be sure the lens is clean and the cell is correctly aimed at the flame.
- 4) Inspect the burner oil nozzle for blockages and signs of deterioration. Replace the nozzle, if required. Also, measure and reset the electrode gap and alignment. If badly worn or deformed, replace the electrodes. (Refer to the burner manufacturer’s instructions.)
- 5) Confirm there is a strong spark across electrodes. Generally, viewing a spark jump across the electrodes is sufficient indication the ignition transformer is operating correctly. **Testing an electronic ignition transformer with a transformer tester is generally not recommended.**
- 6) Inspect the heat exchanger through the cleanout ports for signs of excessive soot, scale buildup, or blockage. If a heavy deposits are present, clean the heat exchanger.

All installations and services must be performed by qualified service personnel.

**C. Symptom: Burner short cycles on high limit thermostat, but does not “lock out” on oil primary safety control.**

Items to check:

- 1) Open dampers or registers in the air distribution system. Clear any duct system restrictions.
- 2) Inspect and clean all air filters in the air distribution system.
- 3) Inspect blower for interference with rotation or locked rotor condition. Also, confirm the blower wheel is secured to the fan motor shaft.
- 4) The fan motor or run capacitor may be damaged. Test and replace the motor or capacitor, as required.
- 5) Increase fan speed.

**D. Symptom: Unable to achieve clean combustion by making burner air adjustments.**

Items to check:

- 1) Measure the burner air tube insertion depth and alignment. The end of the tube should **not** protrude inside the combustion chamber. The end of the tube should be approximately ¼ inch away from the inner wall surface of the combustion chamber.
- 2) Inspect the oil nozzle for excessive wear, blockage, or deterioration. Measure and, if necessary, reset the nozzle depth or turbulator location with respect to end of the burner head. Replace the nozzle, if necessary (refer to the oil burner manufacturer’s instructions).
- 3) Measure the oil pump pressure. If required, adjust the pressure to burner nameplate value. (This is the typical minimum pressure required to obtain the full input rate from the furnace).
- 4) Verify the burner is configured as specified in Table 1 and adjusted according to the **Initial Burner Operation** section of this manual and the burner manufacturer’s instructions.
- 5) Measure the overfire draft. If required, adjust the barometric damper to increase the stack draft to obtain an overfire draft of 0.02 in. W.G. with the burner operating. (This is the typical minimum draft required to obtain the specified flue gas combustion analysis values given in Table 1.) If the specified overfire draft cannot be obtained with a stack draft of 0.02 in. W.G., the heat exchanger may be partially blocked and could require cleaning.

**All installations and services must be performed by qualified service personnel.**

- 6) Measure the draft at the point where the vent connector attaches to the heat exchanger flue pipe. With the burner operating, the stack draft should not exceed 0.05 in. W.G. If the stack draft has been adjusted above this value to give the proper overfire draft, the heat exchanger will require cleaning.

If there is little or no stack draft, the chimney flue way may require cleaning, the chimney is too restrictive, or a downdraft condition exists.

**E. Symptom: Furnace blower will not start.**

Items to check:

- 1) Confirm there is 120 VAC at the blower terminal labeled “HEAT” on the oil furnace control.
- 2) If there **is not** 120 VAC at the blower motor terminal, measure the voltage at the S1 terminal on the oil furnace control. If the fan can be activated by itself from the room thermostat subbase, confirm it will operate. If so, the oil furnace control may have a burnt or damaged relay. Confirm and replace the control if necessary.
- 3) If there **is** 120 VAC at the blower motor terminal “HEAT”, either the run capacitor or blower motor may be damaged. Test and replace the capacitor or motor, as required.

**F. Symptom: Blower cycles on and off after the burner has shutdown.**

Item to check for PSC blower application:

- 1) Increase the fan off time by changing the DIP switch selections on SW2. Refer to Table 2 for blower delay off settings.

**NOTICE: If the high limit control is faulty, it should be replaced. However, it must only be replaced by the same make and model as the original. Refer to the electrical diagrams for proper electrical connections.**

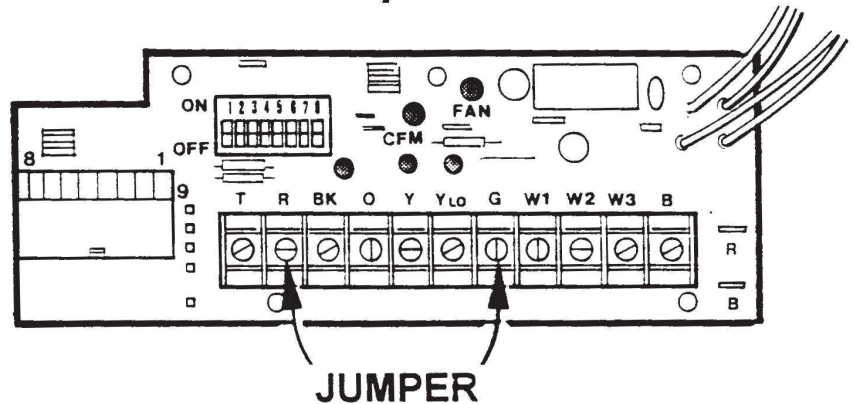
**G. Symptom: ECM blower motor will not run.**

**1. Jumper 24 Volt A.C "R" T terminal to "G" terminal on the Low Voltage Terminal board on the variable speed interface board.**

**Does motor run?**

**NO:** Go to step #2.

**YES:** Motor runs, check thermostat and thermostat wire.



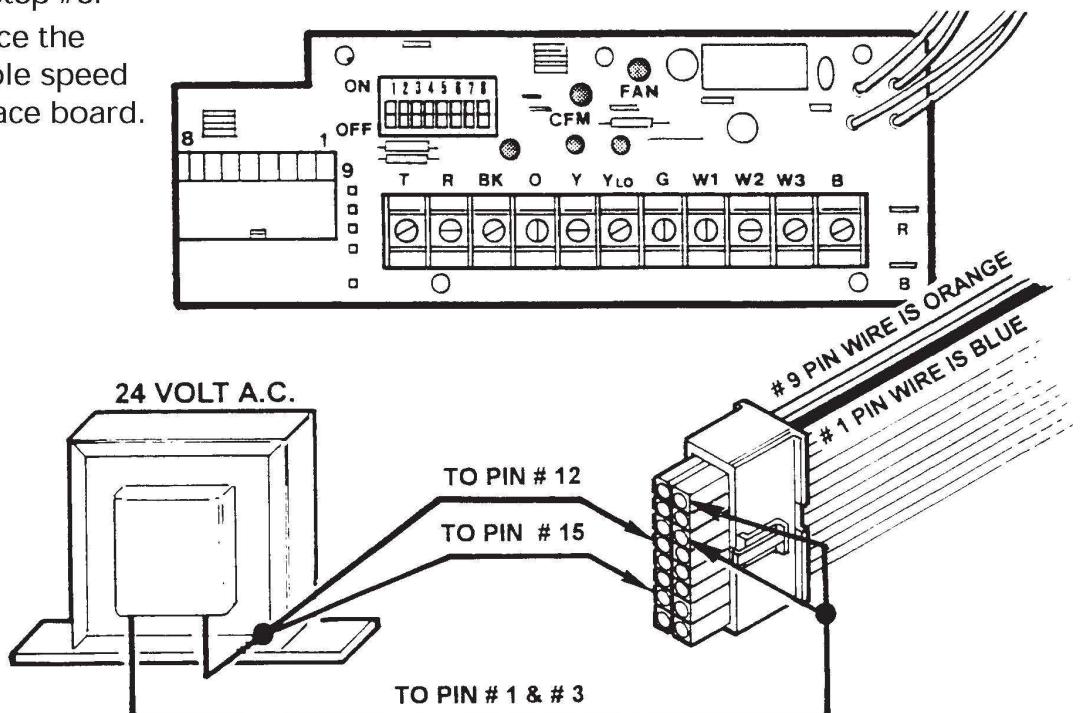
**2. Unplug 16 wire low voltage harness from the interface board.**

**Jumper 24 Volts A. C. to pins #12, #15 and common pins #1 and #3.**

**Does the motor run?**

**NO:** Go to step #3.

**YES:** Replace the variable speed interface board.



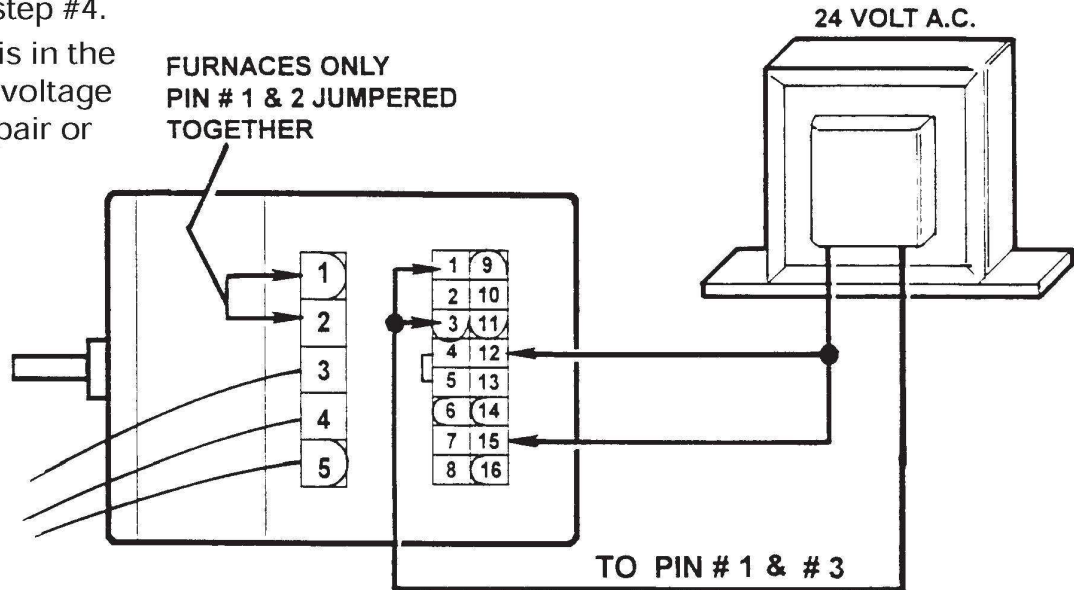
All installations and services must be performed by qualified service personnel.

**3. Unplug 16 wire low voltage harness from the motor. Jumper 24 Volts A.C. to motor low voltage plug pins #12 and #15 and pins #1 and #3 which are common.**

**Does motor run?**

**NO:** Go to step #4.

**YES:** Fault is in the 16 wire low voltage harness. Repair or replace it.

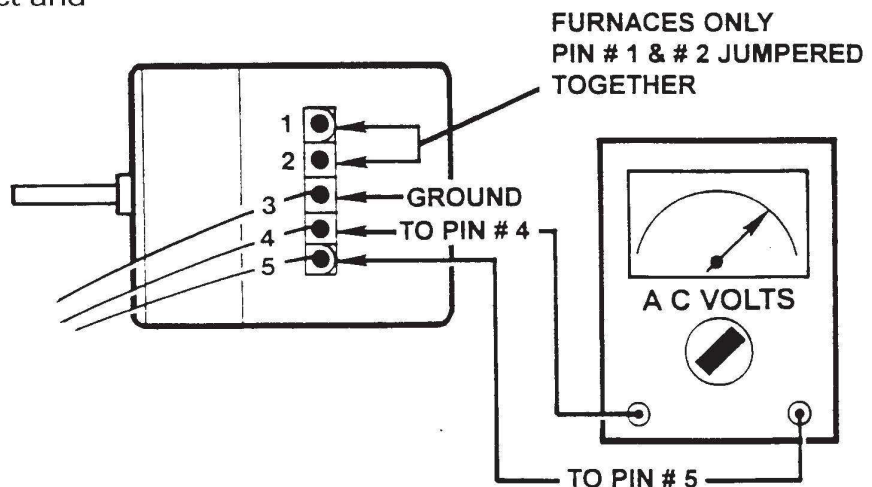


**4. Is the line voltage to the motor high voltage power plug pin #4 and pin #5 correct?**

**Furnace ICM-2 motor correct voltage is 120 Volts A.C. and there must be a jumper wire in this plug between pins #1 and #2.**

**NO:** Correct line voltage fault.

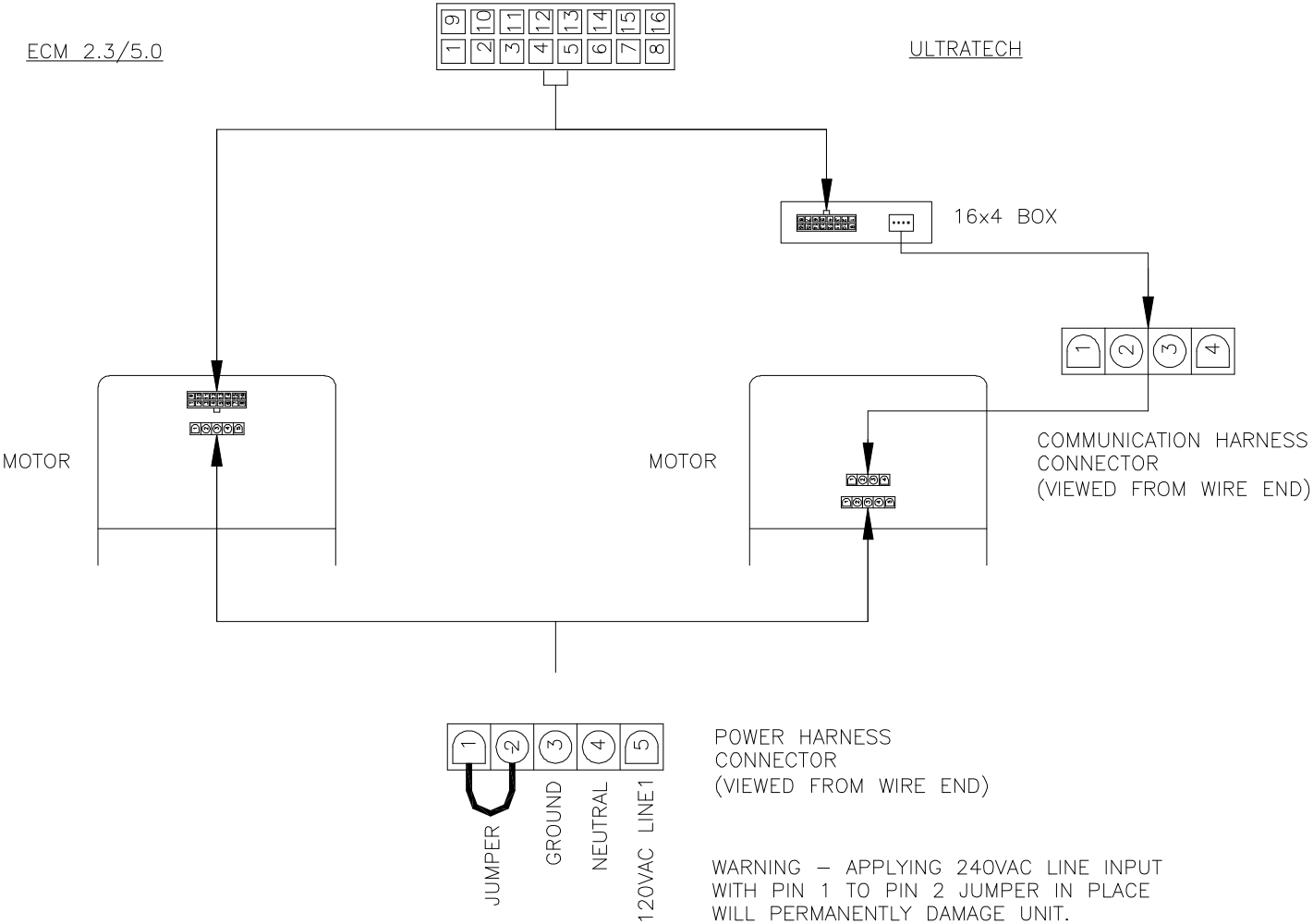
**YES:** Live voltage correct and motor will not run. Replace motor.



All installations and services must be performed by qualified service personnel.

CONTROL HARNESS CONNECTOR	
PIN	DESCRIPTION
1	C1
2	W/W1
3	C2
4	DELAY
5	COOL
6	Y1
7	ADJUST
8	OUT-
9	Q
10	BK/PWM
11	HEAT
12	R
13	EM/W2
14	Y/Y2
15	G
16	OUT+

CONTROL HARNESS CONNECTOR  
(VIEWED FROM WIRE END)





## **H. Symptom: ECM Blower cycles on and off after burner has shut down.**

Item to check:

1) Increase the fan off time by changing the DIP switch SW5 and SW6 to a longer off delay time. See pages 19-20 for correct DIP switch settings.

**NOTICE: If the high limit control is faulty, it should be replaced. However, it must only be replaced by the same make and model as the original. Refer to the electrical diagrams for proper electrical connections.**

## **Flame Sensor (“Cad Cell”) Checkout Procedure**

On the oil primary control, to check the electrical resistance of the flame sensor (referred to as a cadmium sulfide photocell, or “cad cell”), depress the reset button on the oil primary safety control while the burner is firing. The oil primary control will report the measured resistance range of the cad cell by flashing the LED (light emitting diode) one (1) to four (4) times. Refer to the primary control manufacturer’s instructions for further details.

For all primary controls, an alternate procedure to check the flame sensor operation is as follows:

- 1) Remove the flame sensor lead wires from the terminals (labeled “CAD CELL” on the underside of the Honeywell control) of the oil primary safety control module. Start the burner. Shortly after combustion is established, place a temporary jumper wire across the cad cell terminals, or leads, of the control. Connect an ohmmeter across the flame sensor lead wires. The measured resistance should be less than 1600 Ohms for the Honeywell cad cell.
- 2) Stop the burner and remove the jumper wire.
- 3) With the burner off, measure the resistance of the flame sensor with the ohmmeter. The resistance of the sensor without “seeing” a light source (so-called “dark” cell resistance) should be greater than 20,000 Ohms for the Honeywell cad cell.
- 4) If the sensor resistances are outside the acceptable ranges given above, confirm the lens of the cell is clean and the cell is located correctly in the burner housing. If the cell is clean and correctly located, replace the flame sensor.

**NOTICE:** All resistances are approximate values only and will vary depending upon the intensity of the light source (flame or sunlight) and the condition or age of the cad cell.

**All installations and services must be performed by qualified service personnel.**

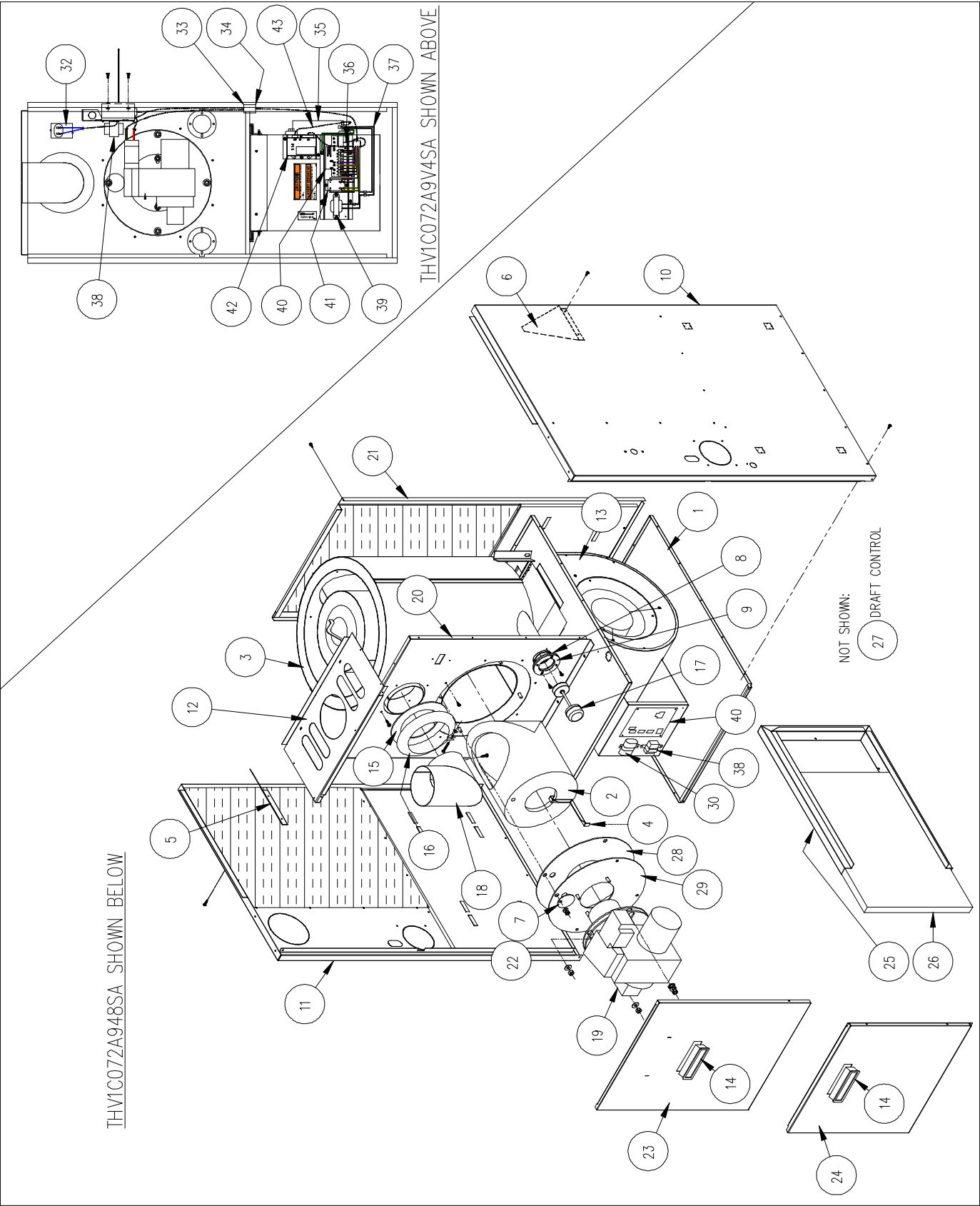
# **COMBUSTION AND EFFICIENCY TESTING FOR OIL FIRED CENTRAL FURNACES.**

Complete this form for each furnace installed. Read instruction manual carefully before making tests. Retain this form with furnace.

<b>CUSTOMER</b>	NAME				
	ADDRESS				
	CITY, STATE				
<b>HEATING SYSTEM</b>	BURNER MODEL NO.	BLAST TUBE LGTH. INS.	AIR SHUTTER OPENING % OF MAX. (EST)		
	COMBUSTION CHAMBER	CONDITION	MATERIAL	FURNACE MODEL	
	TYPE OF VENTING SYSTEM <input type="checkbox"/> MASONRY CHIMNEY <input type="checkbox"/> METAL CHIMNEY <input type="checkbox"/> SIDEWALL POWER VENTER <input type="checkbox"/> MASONRY CHIMNEY W/INDUCER <input type="checkbox"/> METAL CHIMNEY <input type="checkbox"/> MASONRY CHIMNEY W/METAL LINER				
	FUEL LINE FILTER	DRAFT CONTROL		FURNACE SERIAL NUMBER	
		INITIAL INSTALLATION	SERVICE	SERVICE	SERVICE
<b>COMBUSTION TESTS</b>  (Operate burner at least 10 minutes before starting tests.)	CO2 in stack pipe				
	Draft Over-fire				
	Draft in stack pipe				
	Smoke number				
	Gross stack temp.				
	Furnace room temp.				
	Net stack temp. (Gross stack minus furnace room temp.)				
	Efficiency				
	Nozzle size and spray				
	Oil pump pressure				
	Operation of Controls				
	Burner Safety Controls				
	Check for oil leaks				
	Tests taken by				
	Date				
	NOTES:				
	INSTALLER NAME & ADDRESS				

All installations and services must be performed by qualified service personnel.

APPENDIX-A Replacement Parts List



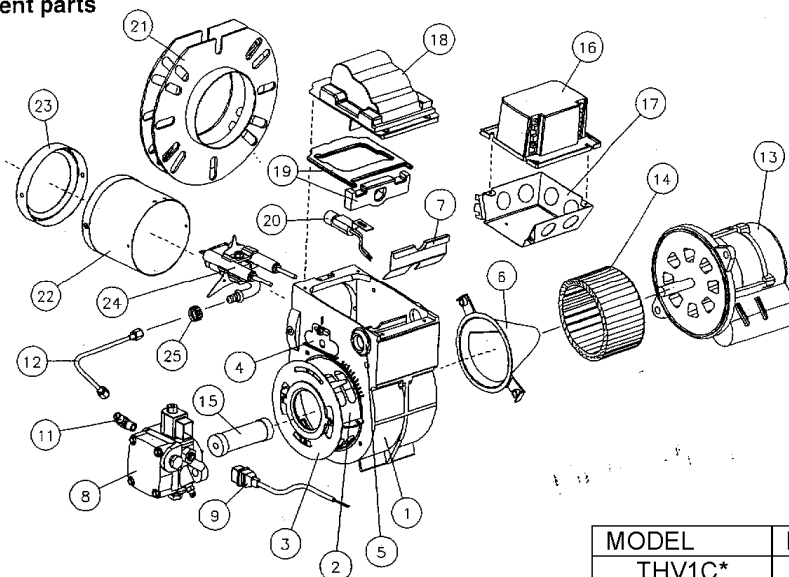
**All installations and services must be performed by qualified service personnel.**

ITEM	UNIT PARTS DESCRIPTION	THV1C072A948SA		THV1C072A9V4SA	
		PART NO.	QTY.	PART NO.	QTY.
1	BASE	18463	1	18463	1
2	COMBUSTION CHAMBER, SOFT	AOPS7492	1	AOPS7492	1
3	HEAT EXCHANGER	31924	1	31924	1
4	CHAMBER RETAINER	18557	1	18557	1
5	BAFFLE, LEFT SIDE CASING	11928	1	11928	1
6	BAFFLE, RIGHT SIDE CASING	11926	1	11926	1
7	COVER, OVER-FIRE DRAFT OPENING	18556	1	18556	1
8	GASKET	330215	2	330215	2
9	TRIM PLATE	618553	2	618553	2
10	CASING, RIGHT SIDE	628468-11	1	628468-11E	1
11	CASING, LEFT SIDE	628467-11	1	628467-11E	1
12	PANEL, TOP FRONT	618466-11	1	618466-11	1
13	BLOWER SUB-ASSEMBLY	S00S4157	1	S00S4516	1
13A	BLOWER HSG W/ WHEEL	S00S4143	1	S00S4143	1
13B	BLOWER WHEEL	340083	1	340083	1
13C	MOTOR BRACKET	AOPS7670	1	AOPS7670	1
14	DOOR PULL	320157	2	320157	2
15	GASKET, FLUE COLLAR	330073	1	330073	1
16	DRAW COLLAR	14121	1	14121	1
17	CLEAN-OUT PLUG ASSEMBLY	S00S4471	2	S00S4471	2
18	ELBOW	36050	1	36050	1
19	OIL BURNER, BECKETT	380704	1	380704	1
20	PANEL, FRONT SEPARATOR	618469	1	618469E	1
21	CASING, REAR	628725-11	1	628725-11E	1
22	GASKET, OFDO COVER	330343	1	330343	1
23	DOOR, FRONT	619176-11	1	619176-11	1
24	DOOR, BLOWER ACCESS	618464-11	1	618464-11E	1
25	FILTER RACK	AOPS7547	1	AOPS7547	1
26	FILTER	370187	1	370187	1
27	DRAFT CONTROL	370110	1	370110	1
28	GASKET, BURNER MOUNTING PLATE	330212	1	330212	1
29	PLATE, BURNER MOUNTING ASS'Y	AOPS7597	1	AOPS7597	1
30	CAPACITOR	350073 10/370	1	—	
31					
32	LIMIT SWITCH	350953	1	350953	1
33	WIRE HARNESS, VESTIBULE	350926	1	350277	1
34	WIRE HARNESS, BLWR CMPRTMNT	350927	1	350278	1
35	MOTOR	AOPS7657 1/2 H.P.	1	350255 3/4 H.P. ECM	1
36	WIRE HARNESS, (MOTOR CONTROL)	—		350849	1
37	WIRE HARNESS, (MOTOR POWER)	—		350850	1
38	TRANSFORMER 24v	350464	1	350464	1
39	INDUCTOR (POWER CHOKE)	—		350855 2.65 MH	1
40	CONTROL, FAN TIMER	AOPS8380	1	350393	1
41	RELAY	—		350528	1
42	16x4 BOX PROGRAMMED	—		AOPS7536	1
43	WIRE HARNESS, (16x4 BOX)	—		350259	1

All installations and services must be performed by qualified service personnel.

## EFL201 AFG BECKETT BURNER, 380704

### Replacement parts



MODEL	NOZZLE SIZE	PART #
THV1C*	.50 x 80° A	380279
	.60 X 80° A <sup>1</sup>	380398
	.75 X 80° A	380366

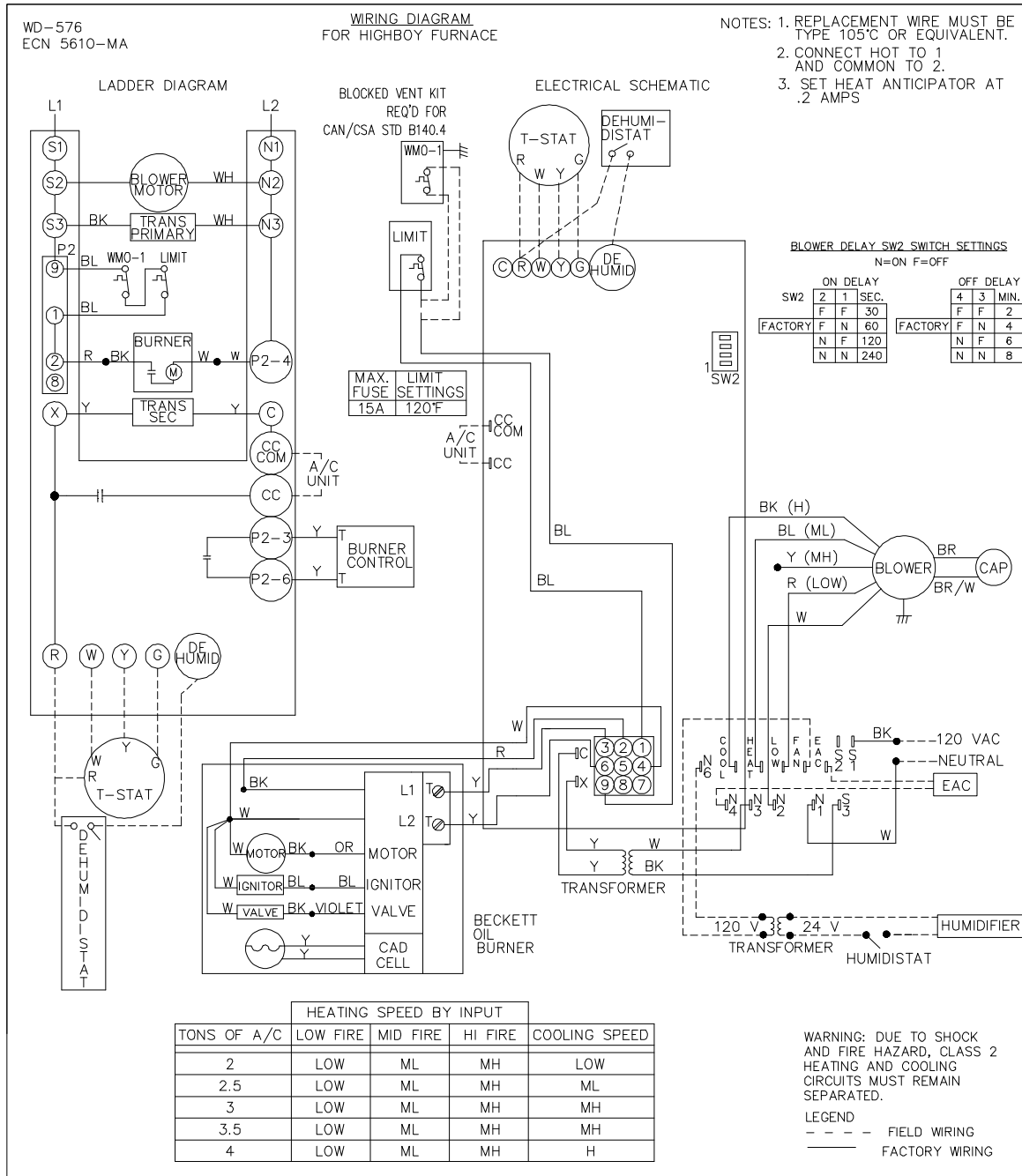
ITEM	DESCRIPTION	BECKETT PART #	TP PART #
1	BURNER HOUSING ASSY.	5874GY	
2	AIR BAND ASSY.	5151502	
3	AIR SHUTTER 4 - SLOT	3709U	380289
4	ESCUTCHEON PLATE	3493	
	SCREW	4292	
5	HOLE PLUG	2139	
6	AIR GUIDE	31231U	
7	LOW FIRING RATE BAFFLE	5880	
8	*PUMP 120PSI	21844	380674
	*SOLENOID	21755	380654
9	VALVE CORD SET	21807U	380653
11	PUMP ELBOW	2256	320815
12	CONNECTION TUBE	5394	380107
13	*MOTOR 1/7 HP 3450 RPM	21805E	380644
14	BLOWER WHEEL 4 1/4 X 2 7/16 TAB	2999	380271
15	*COUPLING	2454	380241
16	*PRIMARY CONTROL	7505B1500	350431
17	ELECTRICAL BOX	5770	
18	*IGNITER W/ GASKETS	51771U	380645
19	IGNITER GASKET KIT	51304	
20	*CAD CELL w/ SOCKET	7006U	350104
21	FLANGE WELDED TO TUBE	N/A	N/A
	GASKET	3616	380270
22	AIR TUBE COMBINATION W/FLG, GUN ASSY & HEAD	58020165	380108
	BLAST TUBE ONLY	AF60YHHSSS	
23	HEAD W/ SHIELD KIT	360063	380320
24	ELECTRODE NOZZLE ASSY	NL60YH	380706
	*ELECTRODES PAIR	5780	380269
	STATIC PLATE, 3 5/8 U	3384	
25	SPLINED NUT	3666	320121
	BULK HEAD FITTING	3488	320120

<sup>1</sup> Nozzle installed in burner.

**All installations and services must be performed by qualified service personnel.**

## APPENDIX-B Wiring Diagrams

### THV1C072A948SA



### **BLOWER SPEED TAPS**

COOL = A/C Tap

HEAT = Heating Tap

LOW = Constant air or  
Dehumidifier

# ELECTRICAL DIAGRAMS & OPERATING INSTRUCTIONS FOR HIGHBOY/LOWBOY FURNACE

THV1C072A9V4SA

All installations and services must be performed by qualified service personnel.

## OPERATING INSTRUCTIONS

For your safety, read this information before operating this furnace.

**WARNING: Failure to follow these instructions may result in a fire or explosion causing property damage, personal injury, or loss of life.**

### WHAT TO DO IN THE EVENT OF AN OIL LEAK:

- Do not try to operate this or any other nearby appliance.
- Immediately call a qualified heating contractor for service.
- If you cannot reach a qualified heating contractor, call the fuel oil supplier or the fire department.

DO NOT use this furnace if any component was underwater. Immediately call a qualified heating contractor to inspect the furnace and replace any part of the furnace control system that was underwater.

This furnace does not have a pilot light. It is equipped with an ignition system that automatically lights the burner. DO NOT attempt to light the burner by hand.

### TO OPERATE THIS FURNACE:

1. Adjust the room thermostat to the lowest setpoint and set the operating mode, if equipped, to "OFF".
2. Turn off all electric power to the furnace at the disconnecting switch.
3. Rotate the manual oil shutoff valve to the open or on position.
4. This furnace is equipped with an electronic ignition system that automatically lights the burner. DO NOT try to light the burner by hand.
5. Turn on the electric power to the furnace at the disconnecting switch.
6. Adjust the room thermostat to the desired setpoint and set the operating mode, if equipped, to "HEAT".
7. If the furnace will not operate, call a qualified heating contractor for service.

### TO INTERRUPT (STOP) OPERATION OF THIS FURNACE:

1. Adjust the room thermostat to the lowest setpoint and set the operating mode, if equipped, to "OFF".
2. If service will be performed, turn off all electrical power to the furnace at the disconnecting switch.
3. Turn the manual oil shutoff valve to the closed or off position.

### Notes:

1. Using wirenuts, connect power supply wire L1 to pigtail marked "1" and wire L2 to pigtail marked "2" in fan center. Connect an earth grounding wire to ground wire terminal in J-box.
  2. If any electrical wiring must be replaced, new wiring must have an insulation type rated for 105°C or greater.
  3. Use only copper conductors for all field and replacement wiring.
  4. For adequate overcurrent protection, maximum acceptable size time delay type fuse or inverse time circuit breaker refer to name plate.
  5. Typical room thermostat anticipator setting is 0.1 A.
  6. Use Class I type electrical wiring to make thermostat connections to fan center and oil primary safety control.
  7. Electrical schematic shown with heating system, cooling system (if equipped), and fan off.
- \* For 2-Ton application - Refer to ECM air flow DIP switch settings.

## LADDER SCHEMATIC

## CONNECTION DIAGRAM

