
OIL FURNACE INSTALLATION INSTRUCTIONS

MODELS

FH085D36D

FH110D48D

FH110D60D

FLF085D36D

FLR085D36D

FLF110D48D

FLR110D48D

FLR140D60D

FC085D36D

WARNING

READ ALL INSTRUCTIONS CAREFULLY BEFORE BEGINNING THE INSTALLATION.

THIS INSTALLATION MUST COMPLY WITH THESE INSTRUCTIONS AND THE REQUIREMENTS OF ALL GOVERNING CODES AND ORDINANCES FOR THE INSTALLATION LOCATION.

IT IS THE RESPONSIBILITY OF INSTALLER TO KNOW AND UNDERSTAND ALL OF THESE REQUIREMENTS.

FAILURE TO DO SO COULD CREATE A HAZARD RESULTING IN PROPERTY DAMAGE, BODILY INJURY OR DEATH.

FOR YOUR SAFETY

DO NOT STORE OR USE GASOLINE OR OTHER FLAMMABLE VAPORS OR LIQUIDS IN THE VICINITY OF THIS OR ANY OTHER APPLIANCE.

IMPORTANT NOTICE

THIS FURNACE IS NOT INTENDED FOR USE AS A CONSTRUCTION HEATER. USE OF THIS FURNACE DURING CONSTRUCTION AND FINISHING PHASES OF A STRUCTURE IS CONSIDERED AS "OPERATION IN A CORROSIVE ATMOSPHERE" AND "UNUSUAL, NEGLIGENT OR IMPROPER USE" AND AS SUCH ARE CONSIDERED EXCLUSIONS BY THE BARD MANUFACTURING COMPANY LIMITED WARRANTY.



Bard Manufacturing Company
Bryan, Ohio 43506

Since 1914...Moving ahead just as planned.

Manual: 2100-392
Supersedes:
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GETTING OTHER INFORMATION and PUBLICATIONS

These publications can help you install the furnace. You can usually find these at your local library or purchase them directly from the publisher. Be sure to consult current edition of each standard.

National Fuel Gas Code ANSI Z223.1/NFPA 54

National Electrical Code ANSI/NFPA 70

Standard for the Installation ANSI/NFPA 90A
of Air Conditioning and Ventilating Systems

Standard for Warm Air ANSI/NFPA 90B
Heating and Air Conditioning Systems

Standard for Chimneys, Fireplaces, Vents ... NFPA 211
and Solid Fuel Burning Appliances

Load Calculation for ACCA Manual J
Residential Winter and Summer Air Conditioning

Duct Design for Residential ACCA Manual D
Winter and Summer Air Conditioning
and Equipment Selection

FOR MORE INFORMATION, CONTACT THESE PUBLISHERS:

ACCA **Air Conditioning Contractors of America**
1712 New Hampshire Ave. N.W.
Washington, DC 20009
Telephone: (202) 483-9370
Fax: (202) 234-4721

ANSI **American National Standards Institute**
11 West Street, 13th Floor
New York, NY 10036
Telephone: (212) 642-4900
Fax: (212) 302-1286

ASHRAE **American Society of Heating Refrigerating,
and Air Conditioning Engineers, Inc.**
1791 Tullie Circle, N.E.
Atlanta, GA 30329-2305
Telephone: (404) 636-8400
Fax: (404) 321-5478

NFPA **National Fire Protection Association**
Batterymarch Park
P.O. Box 9101
Quincy, MA 02269-9901
Telephone: (800) 344-3555
Fax: (617) 984-7057

INSTALLATION and OPERATING INSTRUCTIONS

EQUIPMENT SELECTION

An accurate heating load calculation must be conducted using American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) or Air Conditioning Contractors of America (ACCA) manuals. **Do not** add a large safety factor above the calculated value. If the calculated heating load requirement exceeds the heating capacity rating of a given model, use only the next larger size available. Never increase by any more than absolutely necessary based upon available equipment **heating capacities**. Always select based upon heat capacity (output), never use input capacities.

NOTE: *It is the personal responsibility and obligation of the purchaser to contract a qualified installer to assure that installation is adequate and is in conformance with governing codes and ordinances.*

LOCATING THE FURNACE

When installing the furnace be sure to provide adequate space for easy service and maintenance. Locate the furnace as close to the chimney as practical, giving consideration to the accessibility of the oil burner, controls, and blower for service. Allow a minimum of 24 inches at front of furnace for servicing oil burner. Allow adequate room for filter and blower maintenance. **Clearance from combustible material as stated on the furnace and repeated in Table 1 must be maintained.** For damp basement installations, a raised concrete pad is recommended. This will help keep the bottom of the furnace dry and reduce rusting.

An oil burner must have a generous supply of combustion air to operate properly. The flow of combustion and ventilating air must not be obstructed from reaching the furnace. See "Ventilation and Combustion Air" section.

The furnace area must be kept clear and free of combustible materials, gasoline and other flammable vapors and liquids.

This unit is not designed for mobile home or trailer installations. Always install furnace in a level position.

**TABLE 1
MINIMUM CLEARANCES**

Model	Minimum Installation Clearances - - Inches								Minimum Service Clearances		
	Furnace			Plenum		① Duct	Flue Pipe	Floor			
	Front	Back	Sides	Top	Sides				Front	Back	Sides
FH085D36D	4	1	2	2	2	2	9	C	24	---	---
FH110D48D	4	1	2	2	2	2	9	C	24	---	---
FH110D60D	4	1	2	2	2	2	9	C	24	---	---
FLF085D36D	6	0	2	2	2	2	9	NC	24	24	18 *
FLR085D36D	6	18	2	2	2	2	9	NC	24	24	18 *
FLF110D48D	6	0	2	2	2	2	9	NC	24	24	18 *
FLR110D48D	6	18	2	2	2	2	9	NC	24	24	18 *
FLR140D60D	6	18	2	2	2	2	9	NC	24	24	18 *
FC085D36D	6	1	2	2	2	2	9	NC **	24	---	---

① For the first three (3) feet from plenum. After three (3) feet, no clearance required.

C Combustible flooring

NC Noncombustible floor

* Maintained on one side or the other to achieve filter access and/or blower service.

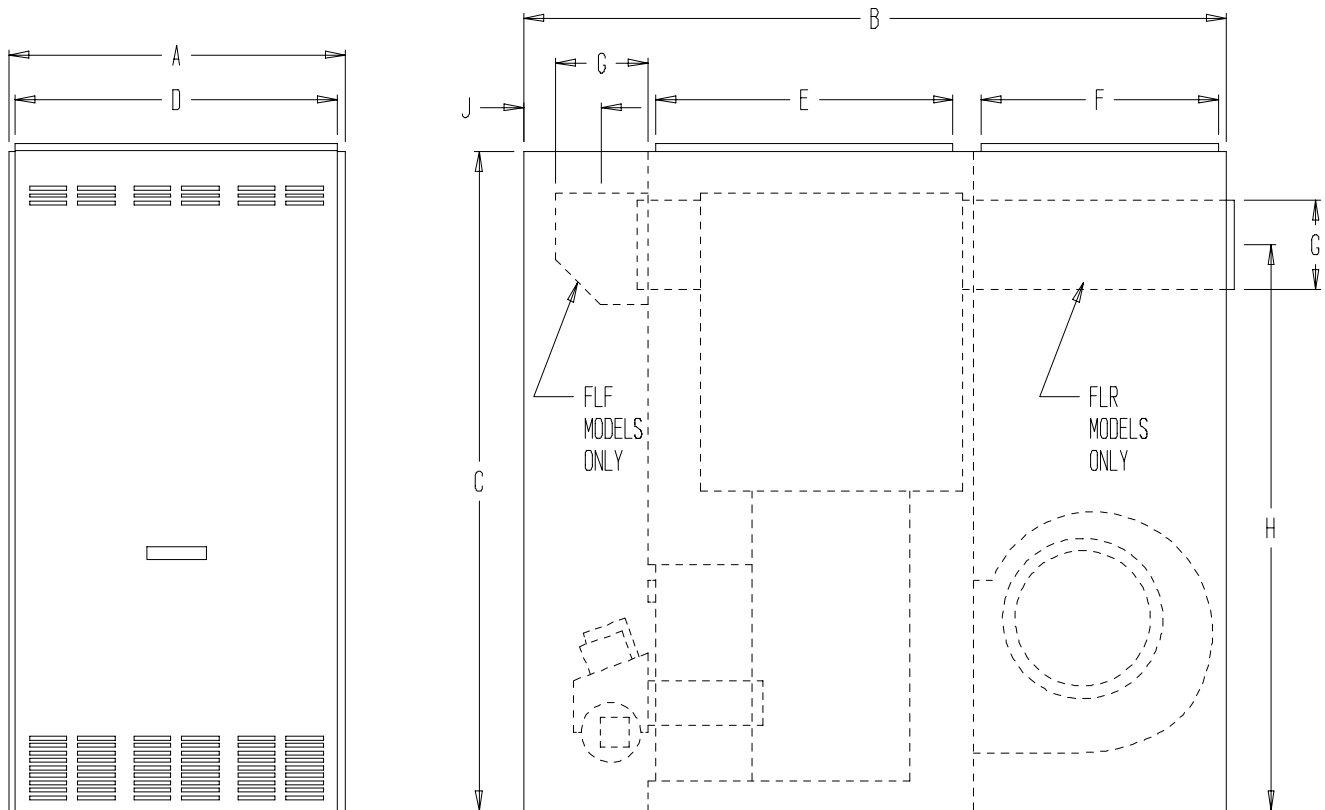
** Floor must be noncombustible. For furnace only installation can be installed on combustible flooring only when installed on special base part no. CFB7 available from factory. When air conditioning coil cabinet DCB23-22 is used then use special base part no. CFB23.

**TABLE 2
LO-BOY MODELS
DIMENSIONS (INCHES)**

Model Number	Cabinet			Plenum Openings		Flue Connection				Air Filters ①	
	A Width	B Depth	C Height	D x E Supply	D x F Return	Location	G Dia.	H	J	Size	No. Used
FLF085D36D	23	47-1/4	40-1/4	22x20	22x16	Front	6	---	5-1/4	16 x 20 x 1	1
FLR085D36D	23	47-1/4	40-1/4	22x20	22x16	Rear	6	34	---	16 x 20 x 1	1
FLR110D48D	23	47-1/4	44-1/4	22x20	22x16	Front	6	---	5-1/4	20 x 20 x 1	1
FLR110D48D	23	47-1/4	44-1/4	22x20	22x16	Rear	6	38	---	20 x 20 x 1	1
FLR140D60D	26	50	50	25x20	25x16	Rear	6	43-5/8	---	20 x 25 x 1	1

① Washable type filter 1" nom. thickness

**FIGURE 1
LO-BOY MODELS DIMENSIONS**



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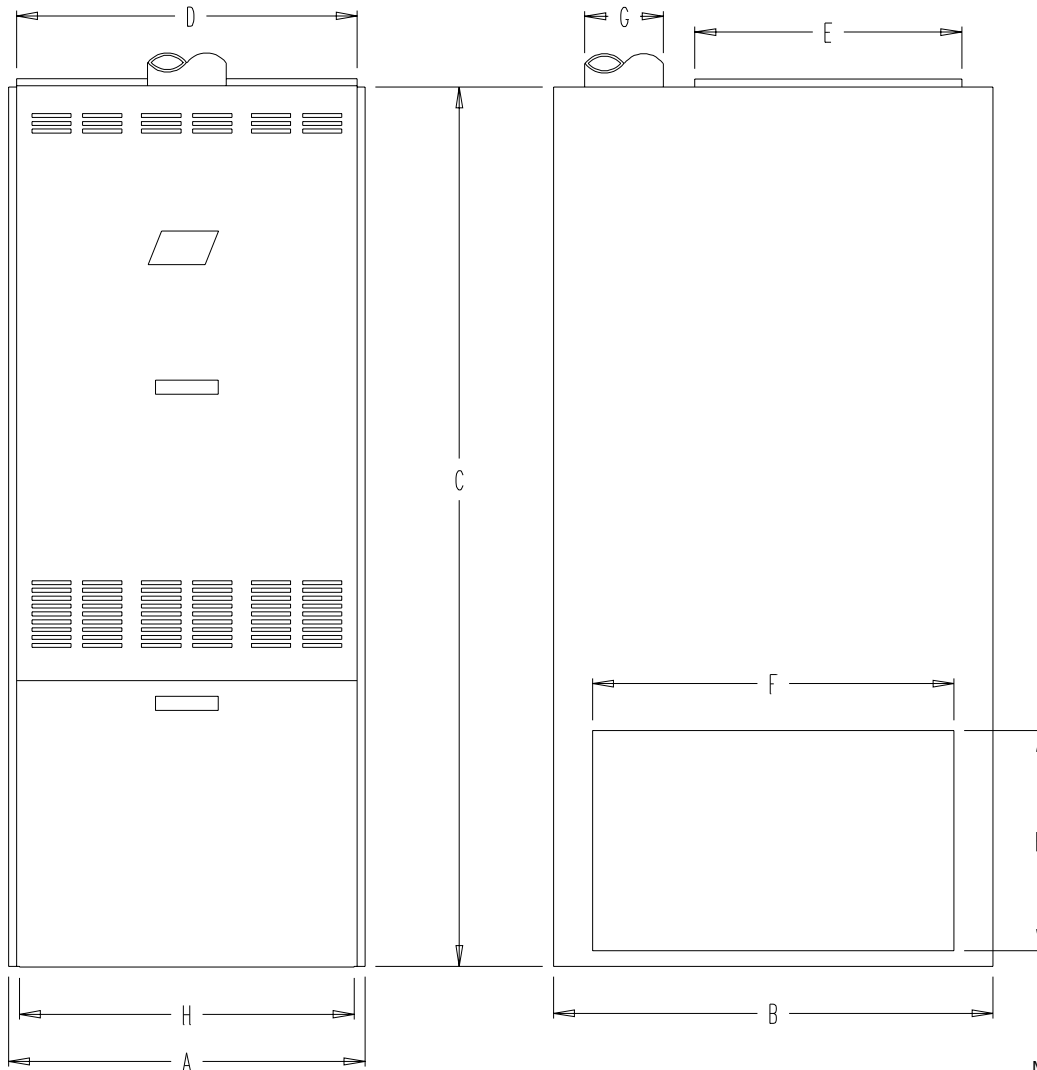
**TABLE 3
HI-BOY MODELS
DIMENSION (INCHES)**

Model Number	Cabinet			Plenum Openings		G Flue Dia.	① Filter Size
	A Width	B Depth	C Height	D x E Supply	F x H ② Return		
FH085D36D	23	31-1/2	56	22x20	23x14	6	16 x 25
FH110D48D	23	31-1/2	60	22x20	23x14	6	16 x 25
FH110D60D	23	31-1/2	60	22x20	23x14	6	20 x 25

① Washable type filter

② Left or right side return air option. Must be cut in by installer.

**FIGURE 2
HI-BOY MODELS DIMENSIONS**



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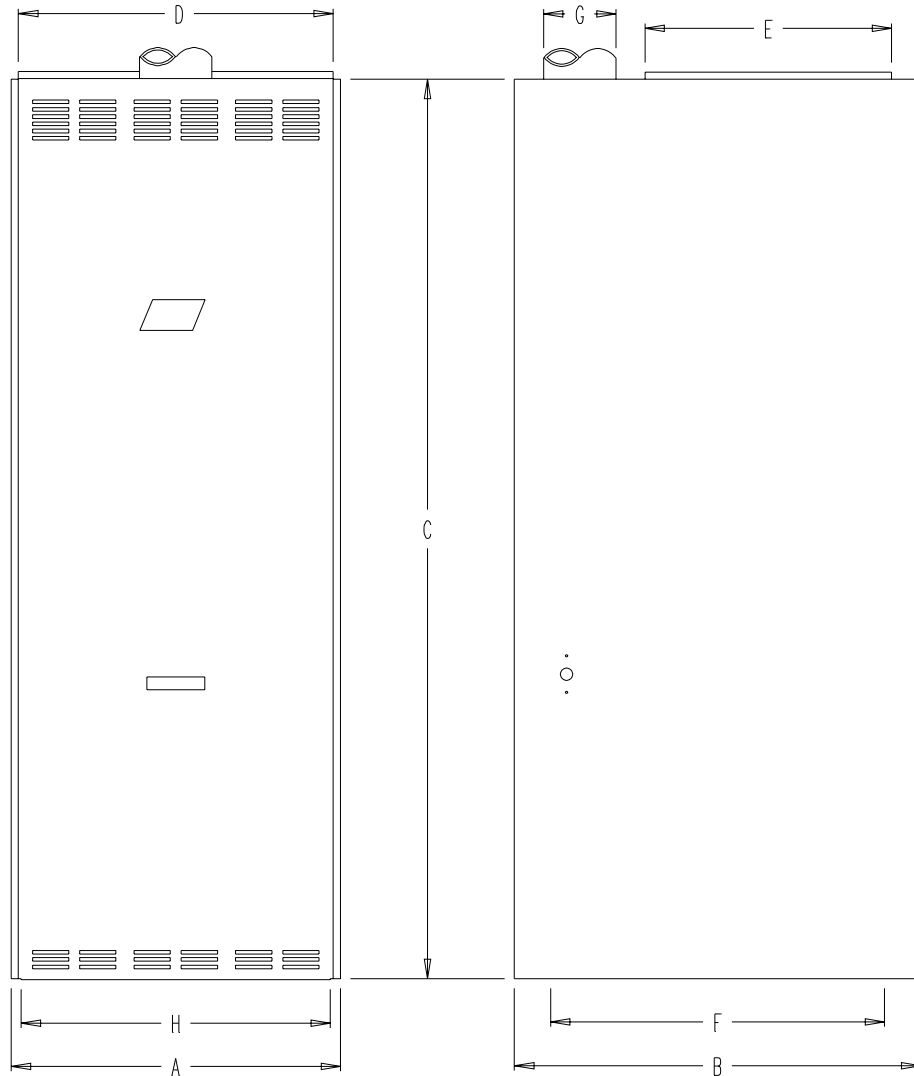
**TABLE 4
COUNTERFLOW MODELS
DIMENSION (INCHES)**

Model Number	Cabinet			Plenum Openings		G Flue Dia.	① Filter Size
	A Width	B Depth	C Height	D x E ② Return	F x H Supply		
FC085D36D	23	29-1/2	56	22 x 20	18 x 19	6	10 x 20 15 x 20

① Washable type filter

② Left or right side return air option. Must be cut in by installer.

**FIGURE 3
COUNTERFLOW MODELS DIMENSIONS**



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DUCT WORK

The air distribution system should be designed and installed in conformance with manuals published by Air Conditioning Contractors of America (ACCA) as set forth in Manual D, or ASHRAE publications.

IMPORTANT

When a 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 also be handled by a duct(s) sealed to the furnace casing and terminating outside the space containing the furnace. This is to prevent drawing possible hazardous combustion products into the circulated air.

When the furnace is used in connection with a cooling unit*, the furnace shall be installed parallel with or on the upstream side of the cooling unit to avoid condensation in the heating element. With a parallel flow arrangement, the dampers or other means used to control flow of air shall be adequate to prevent chilled air from entering the furnace, and if manually operated, must be equipped with means to prevent operation of either unit, unless the damper is in the full heat or cool position.

* *A cooling unit is an air conditioning coil, heat pump coil or chilled water coil.*

See CFM versus static pressure tables on pages 23-26 for additional information.

INADEQUATE SUPPLY AIR and/or RETURN AIR DUCT SYSTEMS

Short cycling because of limit control operation can be created by incorrectly designed or installed supply and/or return air duct systems.

The duct systems must be designed using ASHRAE or ACCA design manuals and the equipment CFM and external static pressure ratings to insure proper air delivery capabilities.

On replacement installations, particularly if equipment is oversized, the duct systems can easily be undersized. Modifications may be required to assure that the equipment is ***operating within the approved temperature rise range when under full rated input conditions***, and that no short cycling on limit controls is occurring.

INSTALLING THE FURNACE

A typical installation is shown in Figure 4. All parts of the furnace installation (furnace, oil tank and piping systems, combustion and ventilation air, venting, etc.) must comply with NFPA31, Installation of Oil Burning Equipment -- latest edition. This drawing shows the typical connecting parts needed to correctly install this furnace. Make sure that all parts of the heating system comply with the local codes.

Check the furnace and your load calculation to verify that the unit is properly sized. (Refer to Equipment Selection" section on Page 2.)

The correct size of unit needed may be substantially smaller than the unit being replaced due to home improvements and technology advancements since the initial installation.

WIRING

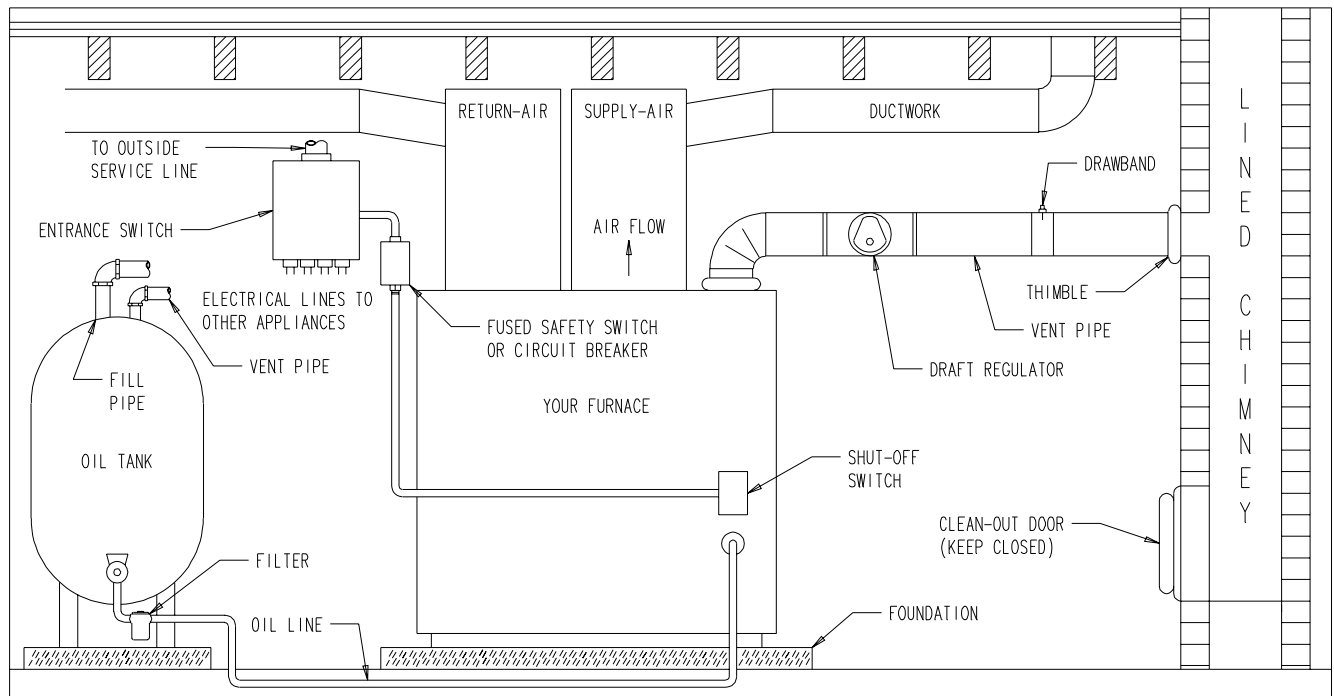
FACTORY

All units are fully factory wired. Multispeed blowers are factory wired on high speed for cooling/manual fan operation. Heating speeds are wired for the largest input and may need lower speed for field installed low input nozzle. If replacement wire is necessary, use 105 degrees C minimum. See electrical data, Table 5.

FIELD

All wiring must conform to the National Electrical Code and all local codes. A separate fuse or breaker should be used for the furnace.

FIGURE 4
TYPICAL INSTALLATION REQUIREMENTS
FRONT FLUE LO-BOY MODEL SHOWN



MIS-1335

NOTE: The chimney must be lined with a high temperature noncorrosive material that complies with the local codes, or in their absence with Standard for Chimneys and Vents, NFPA211. Also see section on Venting in these instructions.

TABLE 5
ELECTRICAL DATA

Model	Volts-HZ-PH	Total Amps	Blower Motor		Burner Motor		Minimum Circuit Ampacity	Max. Time Delay Fuse or HACR Circuit Breaker
			HP	FLA	HP	FLA		
FH085D36D	115-60-1	9.2	1/3	7.5	1/7	1.7	15	15
FH110D48D	115-60-1	12.2	1/2	10.5	1/7	1.7	16	20
FH110D60D	115-60-1	14.2	3/4	12.5	1/7	1.7	19	20
FLF085D36D	115-60-1	17.3	1/3	5.6	1/7	1.7	15	15
FLR085D36D	115-60-1	17.3	1/3	5.6	1/7	1.7	15	15
FLF110D48D	115-60-1	12.2	1/2	10.5	1/7	1.7	16	20
FLR110D48D	115-60-1	12.2	1/2	10.5	1/7	1.7	16	20
FLR140D60D	115-60-1	14.2	3/4	12.5	1/7	1.7	19	20
FC085D36D	115-60-1	7.3	1/3	5.6	1/7	1.7	15	15

OIL LINE PIPING

First determine whether the pipe system is to be a single line system or a two line system. All connections must be absolutely air tight or you will have a malfunction of the burner. When installing the piping, a good oil filter should be installed close to the burner. A single line system is recommended for gravity feed.

A typical single inside tank installations shown in Figure 5. For installation details for this and other tank configurations, refer to NFPA31 -- latest edition. All tank and pipe setups must comply with NFPA31.

BECKETT AFG OIL BURNER

This furnace is equipped with a high static Beckett AFG oil burner which is designed to produce adequate draft in nearly any vertically vented application. The burner employs the latest time tested controls of the highest quality. The controls consist of a high voltage Beckett solid state igniter, a Beckett "CleanCut" oil pump with an integral solenoid valve, and a Beckett R7184B primary control.

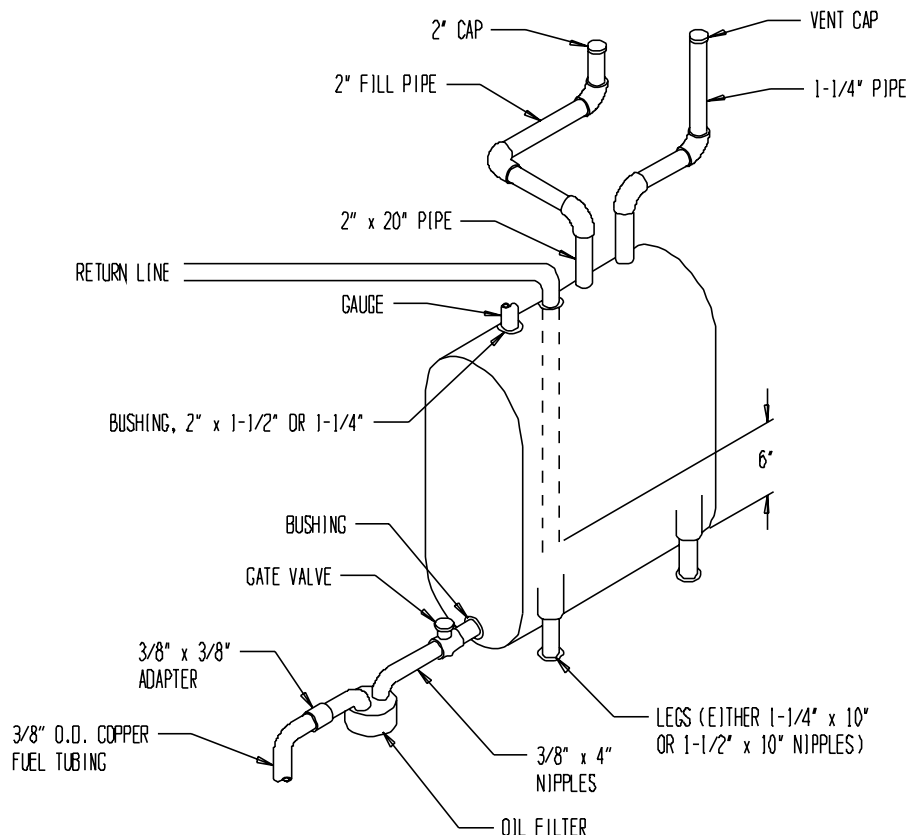
These controls were selected for their proven high quality, dependability, and serviceability. With proper maintenance this burner assembly will provide many years of reliable service.

All units are shipped with the oil burner installed, and with high rate oil nozzle installed designed for use with No. 1 or No. 2 fuel oil. **Inspect firepot refractory before firing to be sure it has not been jarred out of position in shipment. Burner air tube *must not* extend beyond inside surface of firepot. Burner head should be centered on the combustion chamber opening.** See Figures 16A and 16B.

WARNING

Never attempt to use gasoline in your furnace. Gasoline is more combustible than fuel oil and could result in a serious explosion causing damage, injury or death.

**FIGURE 5
TYPICAL SINGLE INSIDE TANK INSTALLATION**



MIS-1340

The following is a detailed explanation of each control included in the Beckett AFG Oil Burner, how each operates, how to set up the burner, and how to troubleshoot problems should they occur.

BECKETT “CLEANCUT” OIL PUMP

This oil pump is equipped with an oil solenoid valve installed in the pump housing. This feature provides quick cutoffs resulting in reduction in smoke after the burner shuts down. This is a time proven pump design and is capable of both one and two pipe systems. This pump *requires* a pre-purge style primary control such as the R7184B primary. All installation and set up instructions are outlined in the “Oil Pump Specification” section of the installation instructions manual.

As an improved service feature Bard Manufacturing has installed a brass tee fitting next to the oil line output of the pump for installing a pressure gauge to ensure the correct pump pressure. Refer to the “Burner Set Up and Adjustment” section in the manual.

BECKETT SOLID STATE IGNITER

This igniter differs from the traditional iron core transformer in that it produces a 14,000 volt spark instead of a 10,000 volt spark of the iron core

transformer. This hotter spark provides for cleaner, faster ignitions. Being solid state technology this igniter is less susceptible to problems caused by voltage variations. It also has a greater ability to ignite cold and/or inconsistent oil. The solid state igniter is wired to the primary control the same as a standard iron core transformer.

BECKETT R7184B PRIMARY CONTROL

The R7184B Interrupted Electronic Oil Primary is a line voltage, safety rated, interrupted ignition oil primary control for residential oil burners. The R7184B used with a cad cell flame sensor, operates the oil burner and oil valve. The primary controls fuel oil, senses flame, controls ignition spark and is designed to notify a remote alarm circuit before going into lockout when equipped with a flame monitoring system.

This primary control, though it possesses the latest technology, is a very simple control to operate and provides additions troubleshooting features to ease service and reduce down time. Once the features and operation of this control are understood the service person will find it a welcomed addition. In an effort to help in the transition to the R7184B primary control the operational guide is provided following on Page 10.

BECKETT R7184B PRIMARY

OPERATIONAL GUIDE

Pre-Purge Delay – 15 seconds on delay

LED Codes – Flashing 1/2 second on / 1/2 second off – system is locked out or in restricted mode (hard lockout).

- Flashing 2 seconds on / 2 seconds off – control is in recycle mode (soft lockout).
- ON – CAD cell is sensing flame
- OFF – CAD cell is not sensing flame.

Ignition Trials – On any given call for heat the control will allow three ignition trials. After the three trials the control will go into a *soft lockout* mode. The LED will flash 2 seconds on and 2 seconds off when in this recycle mode. The control may then be reset by pressing the RED reset button on the control. If within the same original call for heat the control will again allow three ignition trials followed by another *soft lockout* and a 2 second on / 2 second off LED code. The control may be reset one additional time by pressing the red reset button. This will allow

three final ignition trials. If all three of the final ignition trials fail then the control goes into a *hard lockout* or *Restricted Mode*. This series of ignition failures must all occur with the original call for heat in order to reach the *Restricted Mode*. The LED will now flash 1/2 second on / 1/2 second off indicating the *restricted mode*. The control can be resurrected from the restricted mode only by pressing and holding the red reset button for approximately 30 seconds until the LED flashes twice. Removing unit power or resetting the thermostat will not reset the control

Checking CAD Cell – With a call for heat and the burner ignited, press and release the red reset button. The LED will go out and then flash 1, 2, 3, or 4 times before returning to the run mode. The CAD cell resistance must be below 1600 ohms for proper operation.

- 1 flash – Less than 400 ohms
- 2 flashes – More than 400 and less than 800 ohms
- 3 flashes – More than 800 and less than 1600 ohms
- 4 flashes – More than 1600 and less than 5000 ohms

Future Option – Flame Quality Monitor

This control is trained to recognize and remember a good flame based on initial burner set up. Control then monitors the flame via the CAD cell signal for deviation in the combustion characteristics of the burner. If the control senses a deviation on the high side or on the low side from the original set up condition for three consecutive cycles, it will trigger an alarm circuit which can be tied to an audible local device to signal the home owner or into the home security

system. Upon being notified of the of the alarm, the security agency will notify the dealer of choice based upon information supplied by the home owner. The system will also be capable of being connected to a phone line that will contact the dealer directly with the alarm. This alarm will typical sound 3 to 5 days prior to the primary control going into lockout giving the service agency a prior notice before a sooting condition or other failure can occur resulting in untold savings.

**TABLE 6
FURNACE DATA**

Model Number	Furnace Installed Standard			Field Installed Option		
	① Nozzle Size	Input BTUH	② Heating Capacity BTUH	① Nozzle Size	Input BTUH	② Heating Capacity BTUH
FLF085D36D	.75	105,000	85,000	.65	91,000	75,000
FLR085D36D	.75	105,000	85,000	.65	91,000	75,000
FLF110D48D	1.00	140,000	115,000	.85	119,000	98,000
FLR110D48D	1.00	140,000	115,000	.85	119,000	98,000
FLR140D60D	1.25	175,000	141,000	1.10	154,000	125,000
FC085D36D	.75	105,000	84,000	.65	91,000	74,000
FH085D36D	.75	105,000	84,000	.65	91,000	74,000
FH110D48D	1.00	140,000	113,000	.85	119,000	96,000
FH110D60D	1.00	140,000	113,000	.85	119,000	96,000

- ① 70 degree hollow cone spray pattern, 100 PSIG pump pressure
- ② Annual fuel utilization efficiency and heating capacity based upon U.S. Government standard test using D.O.E. isolated combustion rating procedure.

BURNER SETUP AND ADJUSTMENTS

All oil burner installations should be performed by a qualified installer in accordance with regulations of the National Fire Protection Standard for Oil-Burning Equipment, NFPA31 -- latest edition, and in complete compliance with all local codes and authorities having jurisdiction. A qualified installer is an individual or agency who is responsible for the installation and adjustments of the heating equipment and who is properly licensed and experienced to install oil-burning equipment in accordance with all codes and ordinances.

The proper installation and adjustment of any oil burner requires technical knowledge and the use of combustion test instruments. The following procedure must be followed to correctly adjust the burner to match the specific characteristics of the installation.

IMPORTANT

Always use combustion test instruments when making burner adjustments and draft gauge when setting the barometric damper. It is virtually impossible to make accurate and reliable adjustments using the "eyeball" method.

CHECK AND ADJUSTMENT PROCEDURE:

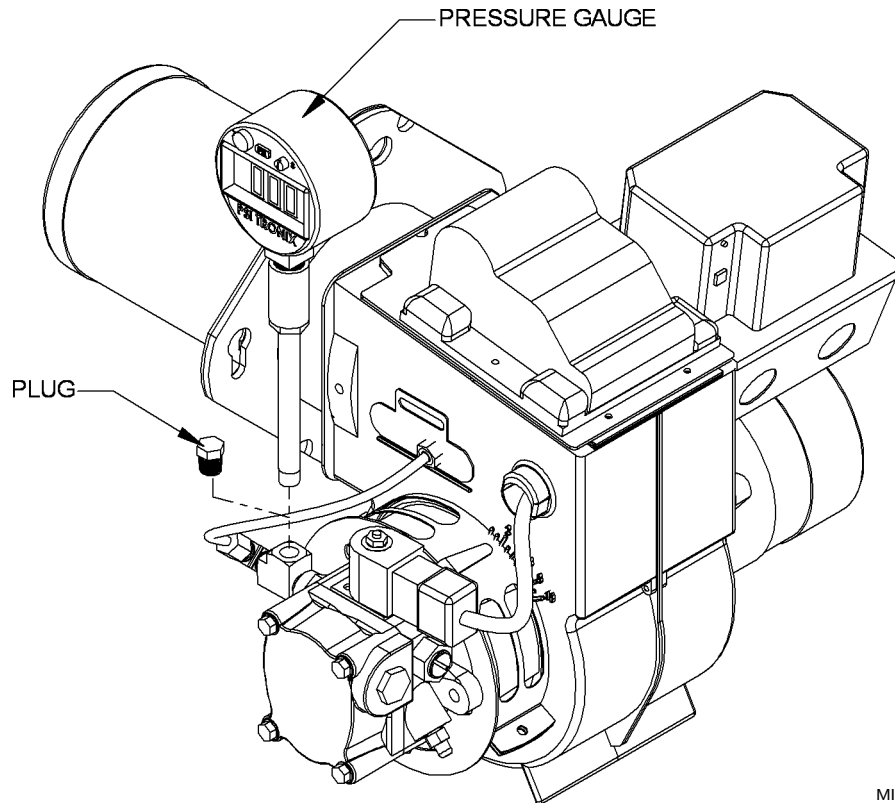
1. Check all oil lines and connections for leaks.
2. Connect pressure gauge to pressure gauge port in brass tee fitting. See Figure 6.
3. Operate the burner for 5 - 10 minutes so that the system is near steady state temperature conditions.
4. Check fuel pump pressure, and adjust to 100 PSIG if necessary.
5. Set the overfire draft to -.02" W.C. by adjusting the barometric damper. The sample tube can be inserted into the heat exchanger over the combustion chamber by loosening the two (2) screws securing the sliding door on the hinged burner observation door.
6. A small diameter hole will be required in the flue pipe **between** the flue connection on the furnace and the barometric damper for purposes of taking the smoke tests and measuring the CO₂ (or O₂) and flue gas temperature.
7. The burner air adjustment shutters are factory set to the recommended start up settings as shown in Table 9. These settings are for initial start up only. Reduce or increase the air supply until a **trace of smoke** is obtained on the smoke tester. ***This is a reference point only not the final adjustment.***

8. Measure the CO₂ (or O₂) in the flue gas at the **trace of smoke** level. Open the air control and add reserve air until the CO₂ is lowered by 1.5%.

Example: Original CO₂ at **trace of smoke** level was 13.0% (3.30% O₂). Lower to 11.5% CO₂ (5.3% O₂). See Table 7.

9. Perform the smoke test again. It should now be at zero. Lock the air settings securely.
10. Measure the stack temperature. Subtract the room temperature to obtain the net reading and use the Efficiency Chart, Table 8, to determine the steady-state efficiency.

FIGURE 6
PRESSURE GAUGE CONNECTION TO PRESSURE GAUGE PORT



MIS-1660

TABLE 7
CORRELATION OF PERCENT OF CO₂, O₂
AND RESERVE AIR

Carbon Dioxide	Oxygen	Reserve Air (Approx.)
15.4	0.0	0.0
15.0	0.6	3.0
14.5	1.2	6.0
14.0	2.0	10.0
13.5	2.6	15.0
13.0	3.3	20.0
12.5	4.0	25.0
12.0	4.6	30.0
11.5	5.3	35.0
11.0	6.0	40.0
10.5	6.7	45.0
10.0	7.4	50.0

TABLE 8
NO. 2 FUEL OIL EFFICIENCY CHART
(NET STACK TEMP. DEGREES F)

% O ²	200	250	300	350	400	450	500	550	600	650	700	750	800	% O ²
1	89.6	88.4	87.3	86.2	85.1	84.0	82.9	81.7	80.6	79.5	78.4	77.3	76.2	14.7
2	89.4	88.2	87.0	85.9	84.7	83.6	82.4	81.2	80.1	78.9	77.7	76.6	75.4	14.0
3	89.2	87.9	86.7	85.5	84.3	83.1	81.9	80.7	79.4	78.2	77.0	75.8	74.6	13.2
4	88.9	87.7	86.4	85.1	83.8	82.6	81.3	80.0	78.7	77.5	76.2	74.9	73.6	12.5
5	88.7	87.3	86.0	84.6	83.3	82.0	80.6	79.3	77.9	76.6	75.3	73.9	72.6	11.7
6	88.4	87.0	85.5	84.1	82.7	81.3	79.9	78.5	77.0	75.6	74.2	72.8	71.4	11.0
7	88.0	86.5	85.0	83.5	82.0	80.5	79.0	77.5	76.0	74.5	73.0	71.5	70.0	10.3

TABLE 9
RECOMMENDED START-UP SETTINGS

Furnace Model No.	Burner Style Part No.	Factory Installed			Field Installed Option		
		① Nozzle	Air Band Setting	Air Shutter Setting	① Nozzle	Air Band Setting	Air Shutter Setting
FH085D36D	AFG/9020-026	.75	0	6	.65	0	5
FH110D48D	AFG/9020-027	1.00	2	10	.85	0	8
FH110D60D	AFG/9020-027	1.00	2	10	.85	0	8
FLF085D36D	AFG/9020-026	.75	0	6	.65	0	5
FLF110D48D	AFG/9020-027	1.00	2	10	.85	0	8
FLR085D36D	AFG/9020-028	.75	0	6	.65	0	5
FLR110D48D	AFG/9020-029	1.00	2	10	.85	0	8
FLR140D60D	AFG/9020-030	1.25	0	8	1.10	0	6
FC085D36D	AFG/9020-026	.75	0	6	.65	0	5

① 70 degree hollow cone spray pattern, 100 PSIG pump pressure

BURNER NOZZLE AND ELECTRODE ADJUSTMENTS

Check nozzle size as to conformance to installation requirements. Install nozzle by screwing into hexagon adapter. Refer to recommended start-up setting in Table 9.

SPACING OF ELECTRODES

The electrodes should be spaced $5/32$ " apart. They should extend $1/16$ " beyond the end and $5/16$ " above the center of the nozzle tip as shown in Figure 7

GUN ASSEMBLY ADJUSTMENT

The gun assembly can be adjusted in the slot inside of fan housing by loosening screw holding slot cover in position. Nozzle tip should ordinarily be located $1-1/8$ " behind the front face of the cone.

REMOVING GUN ASSEMBLY

Disconnect the oil line at the fan housing and remove lock nuts on copper tube fitting. Loosen igniter hold down clamps, then swing igniter up and backward. Gun assembly can now be removed through this opening.

VENTILATION AND COMBUSTION AIR

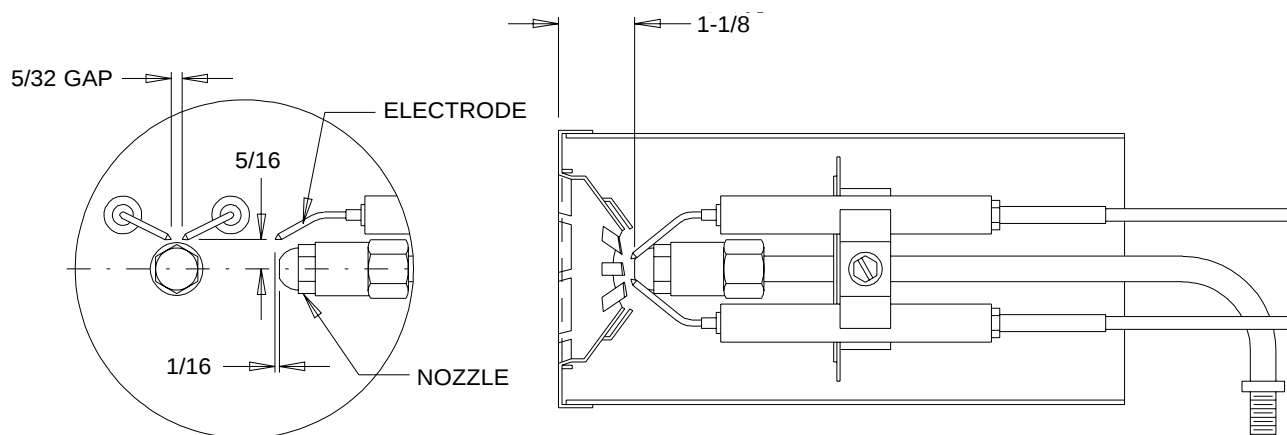
Appliances shall be installed in a location where the facilities for ventilation permit satisfactory combustion of oil, proper venting and the maintenance of ambient temperature at safe limits under normal conditions of use. Applications shall be located in such a manner as to not interfere with proper circulation of air within the confined space. When building are so tight that normal infiltration does not meet air requirements, outside air shall be introduced. Ducts used to convey air from the outdoors shall be of the same cross-sectional area as the free area of the opening to which they connect. The minimum dimensions of rectangular air ducts shall be not less than 3 inches (76 mm). See Table 10 for information on round duct sizing.

For residence-type installations and similar usages, the requirements normally may be obtained by application of one of the methods shown in Figures 8 thru 11 following.

TABLE 10
ROUND DUCT SIZING

4,000 BTUH Per Square Inch Round Duct Size	Total BTUH Input
4-3/8 5-1/8	60,000 80,000
5-1/4 5-7/8	85,000 105,000
6-1/8 6-1/4	115,000 120,000
6-3/4 6-7/8	140,000 145,000
7-1/4 8	160,000 200,000

FIGURE 7
ELECTRODE ADJUSTMENTS



APPLIANCES LOCATED IN CONFINED SPACES

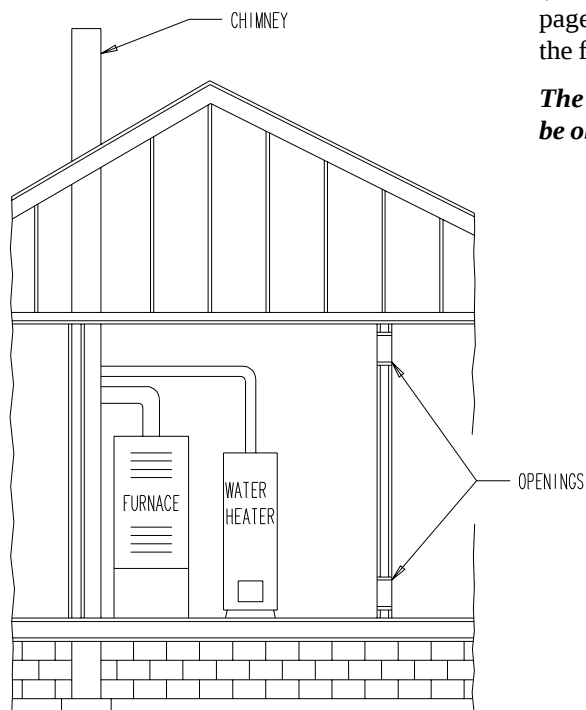
In unconfined spaces in buildings, infiltration may be adequate to provide air for combustion, ventilation, and dilution of flue gasses. However, in buildings of unusually tight construction, additional air shall be provided using the method described under “All Air From Outdoors” in Figure 8.

An unconfined space (such as an open basement) must have a minimum volume of 50 cubic feet per 1,000 BTUH of total of **all** appliances in area. Adjoining rooms may be counted as one area only if there are not doors between the rooms.

Shown in Table 11 are the required minimum areas in square feet to qualify as an unconfined space for various total BTUH input ratings. The table is based on a room(s) with 8 foot ceiling heights.

If the unconfined space is within a building having insufficient air because of tight construction, the air for combustion and ventilation shall be obtained from outdoors or from spaces freely communicating with the outdoors. Under these conditions a permanent opening or openings have a total free area of not less than one square inch per 5,000 BTU per hour (28 square inches per hour) of total input rating of all appliances shall be provided.

**FIGURE 8
APPLIANCES LOCATED
IN CONFINED SPACES
ALL AIR FROM INSIDE THE BUILDING**



MIS-1336

**TABLE 11
SQUARE FEET REQUIRED TO
QUALIFY AS UNCONFINED SPACE**

Total BTUH Input	Unconfined Space Minimum Area In Square Feet 8' Ceiling Height
60,000 80,000	375 500
85,000 105,000	531 656
115,000 120,000	719 750
140,000 145,000	875 906
160,000 200,000	1000 1250

ALL AIR FROM INSIDE BUILDING

The confined space shall be provided with two permanent openings, one near the top of the enclosure and one near the bottom. Each opening shall have a free area of not less than one square inch per 1,000 BTU per hour (140 square inches per gallon per hour) of the total input rating of all appliances in the enclosure freely communicating with interior areas having in turn adequate infiltration from the outside. (See Figure 8.) Also see Table 12 on the following page for specific ventilation opening requirements for the furnace only.

The flow of combustion and ventilating air must not be obstructed from reaching the furnace.

NOTE: Each opening shall have a free area of not less than one square inch per 1,000 BTU per hour (140 square inches per gallon per hour) of the total input rating of all appliances in the enclosure.

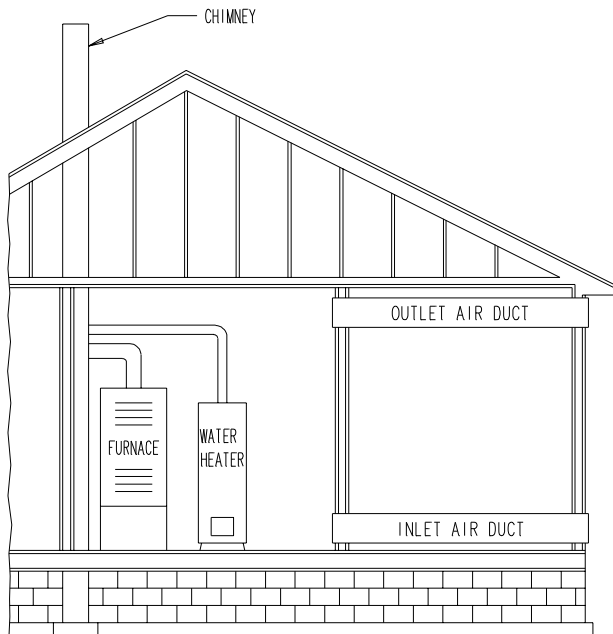
TABLE 12
MINIMUM VENTILATION OPENINGS

Model	Min. Ventilation Opening Square Inch	Recommended Opening (2 Required)	
		Size	Sq. In.
FH085D36D	240	8 x 16	128
FH110D48D	280	9 x 18	162
FH110D60D	280	9 x 18	162
FLF085D36D	290	8 x 19	152
FLR085D36D	290	8 x 19	152
FLF110D48D	340	9 x 19	171
FLR110D48D	340	9 x 19	171
FLR140D60D	360	9.5 x 19	180
FC085D36D	240	8 x 16	128

ALL AIR FROM OUTDOORS

- A. The confined space shall be provided with two permanent openings, one in or near the top of the enclosure and one in or near the bottom. The openings shall communicate directly, or by means of ducts with outdoors or to such spaces (crawl or attic) that freely communicate with outdoors. (See Figures 9, 10, & 11 .)
- B. When directly communicating with outdoors or by means of vertical ducts, each opening shall have a free area of not less than one square inch per 4,000 BTU per hour (35 square inches per gallon per hour) of total input rating of all appliances in the enclosures. If horizontal ducts are used, each opening shall have a free area of not less than one square inch per 2,000 BTU per hour (70 square inches per gallon per hour) of total input of all appliances in the enclosure.

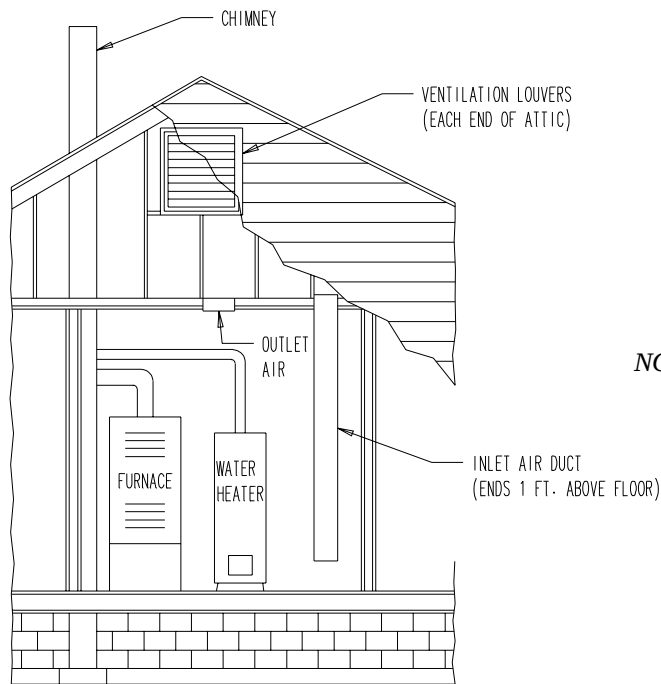
FIGURE 9
APPLIANCES LOCATED IN CONFINED SPACES
ALL AIR FROM OUTDOORS



MIS-1337

NOTE: Each air duct opening shall have a free area of not less than one square inch per 2,000 BTU per hour (70 square inches per gallon per hour) of the total input rating of all appliances in the enclosure.

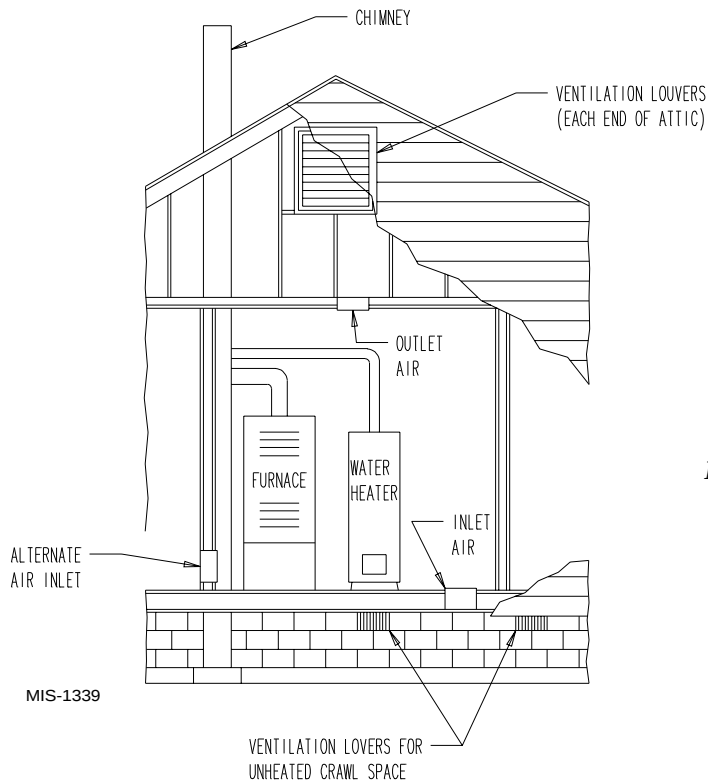
FIGURE 10
APPLIANCES LOCATED IN CONFINED SPACES
ALL AIR FROM OUTDOORS THROUGH VENTILATED ATTIC



MIS-1338

NOTE: The inlet and outlet air openings shall each have a free area of not less than one square inch per 4,000 BTU per hour (35 square inches per gallon per hour) of the total input rating of all appliances in the enclosure.

FIGURE 11
APPLIANCES LOCATED IN CONFINED SPACES
ALL AIR FROM OUTDOORS
INLET AIR FROM VENTILATED CRAWL SPACE AND OUTLET AIR TO VENTILATED ATTIC



MIS-1339

NOTE: The inlet and outlet air openings shall each have a free area of not less than one square inch per 4,000 BTU per hour (35 square inches per gallon per hour) of the total input rating of appliances in the enclosure.

LOUVERS AND GRILLES

In calculating free area for above ventilation and combustion air requirements, consideration shall be given to the blocking effect of louvers, grilles, or screens protecting openings. Screens used shall not be smaller than 1/4 inch (6.3 mm) mesh and shall be readily accessible for cleaning. If the free area through a design of louver or grille is known, it shall be used in calculating the size opening required to provide the free area specified. If the design and free area is not known, it may be assumed that wood louvers will have 30-35 percent free area and metal louvers and grilles will have 60-75 percent free area.

VENTING

The flue pipe to the chimney must be the same size as the flue outlet of the furnace, have no reductions, be of a corrosion-resistant material, and have an upward pitch of 1/4" for every foot of horizontal run. A barometric damper is supplied with the furnace and should be installed in the flue pipe observing the instructions packaged with the damper control. The barometric damper opening must be located in the same atmospheric pressure zone as the combustion air inlet to the furnace. This furnace **must not** be vented into the same chimney with any solid fuel burning appliance. Masonry chimneys must be lined with a listed system or other approved material that will resist corrosion, softening, or cracking from flue gas at temperatures up to 1800° F. See Standard for Installation of Oil Burning Equipment NFPA31 and Standard for Chimneys NFPA211 for additional information.

THERMOSTAT

NOTE: *FC models do not wire directly to the primary control. See wiring diagram on Page 33.*

These furnaces are designed to be controlled with any 24V heating or heating/cooling thermostat. The heat/cool thermostats must be designed for independent heat/cool transformer circuits to assure that the 24V transformer built into the oil primary control does not conflict with the main furnace 24V transformer. The heat anticipator should be set at 0.20A. This is a nominal setting. The thermostat circuit should be checked to verify setting.

FAN AND LIMIT CONTROL

The fan and limit control is factory installed in all units. See Table 13 for factory settings. The fan on/off settings may have to be varied due to the static pressure imposed upon the system. The limit control is factory set at **maximum fixed stop allowable** and must not be reset.

When the installation is completed, measure the air temperature in the discharge plenum and return air plenum. The temperature rise across the unit should fall within the "Rise Range" as shown in Table 13. It is normally desirable to operate in the middle of the range unless air conditioning or other installation requirements make that unfeasible. The speed of the blower may have to be either increased or decreased to obtain this temperature. The blower is equipped with a 3 or 4 speed motor to make these adjustments.

The fan and limit control in the burner compartment governs the blower operation by means of two temperature selections. One lever is set at 140 degrees for example to start the blower, and the other lever is at a lower temperature, 110 degrees to stop the blower. These settings may be varied to suit the homeowner's comfort. A greater temperature difference between settings may result in less repetition of the blower operation at the end of the heating cycle. A low "off" temperature is recommended for longer blower operation as this keeps the air of the home in more constant circulation.

NOTE: *On model FC085D36D the blower "on" setting is timed to assure blower operation. This blower "on" setting cannot be adjusted.*

IMPORTANT

Do not set the blower "on" set point lever of the combination fan/limit control above 150.

TABLE 13
TEMPERATURE RISE RANGES, LIMIT CONTROL SETTINGS,
AND HEATING BLOWER SPEEDS

Model	① Nozzle	Rise Ranges	Heating Blower Speed	Limit Setting	On	Off
FH085D36D	.65	70 - 100	Low	170	110	90
	.75	60 - 90	Med	170	110	90
FH110D48D	.85	70 - 100	Low	170	110	90
	1.00	60 - 90	Med Low	170	110	90
FH110D60D	.85	60 - 90	Low	170	110	90
	1.00	60 - 90	Med Low	170	110	90
FLF085D36D	.65	60 - 90	Low	230	140	110
	.75	60 - 90	Med	230	140	110
FLF110D48D	.85	60 - 90	Med Low	230	140	110
	1.00	60 - 90	Med High	230	140	110
FLR085D36D	.65	60 - 90	Low	250	140	110
	.75	60 - 90	Med	250	140	110
FLR110D48D	.85	60 - 90	Med Low	240	140	110
	1.00	60 - 90	Med High	240	140	110
FLR140D60D	1.10	60 - 90	Med Low	220	140	110
	1.25	60 - 90	Med High	220	140	110
FC085D36D	.65	70 - 100	Low	180	110	90
	.75	60 - 90	Med	180	110	90

① 70 degree hollow cone spray pattern, 100 PSIG pump pressure

FILTERS

All models are shipped with filters. See Table 14 for sizes. See following information. Hi-Boy models are supplied with an external filter rack which can be installed on either left or right side. The counterflow models require a bracket installation and final filter location projects into return air plenum attachment for furnace. See Figure 14. Refer to Figure 14 for Lo-Boy models which have filters internally mounted in blower compartment at rear of furnace.

HI-BOY MODELS – FILTER LOCATIONS, & REMOVAL AND REPLACEMENT PROCEDURES

16 x 25 x 1 external filter racks are supplied as standard equipment for all FH models (20 x 25 x 1 is standard for FH110D60D model). A 14 x 23 opening is to be cut into either the left or right side of the furnace depending upon installation requirements. See Figure 12 for typical installation of a 16 x 25 x 1 filter rack centered over the 14 x 23 cutout.

TABLE 14
FILTER SIZES FOR OIL FURNACES

Model	Size
FH085D36D Hi-Boy	(1) 16x25x1 W
FH110D48D Hi-Boy	(1) 16x25x1 W
FH110D60D Hi-Boy	(1) 20x25x1 W
FLF085D36D FLR085D36D Lo-Boys	(1) 16x20x1 W
FLF110D48D FLR110D48D Lo-Boys	(1) 20x20x1 W
FLR140D60D Lo-Boy	(1) 20x25x1 W
FC085D36D Counterflow	(1) 10x20x1 W (1) 15x20x1 W

FIGURE 12
TYPICAL INSTALLATION OF A 16x25x1
FILTER RACK

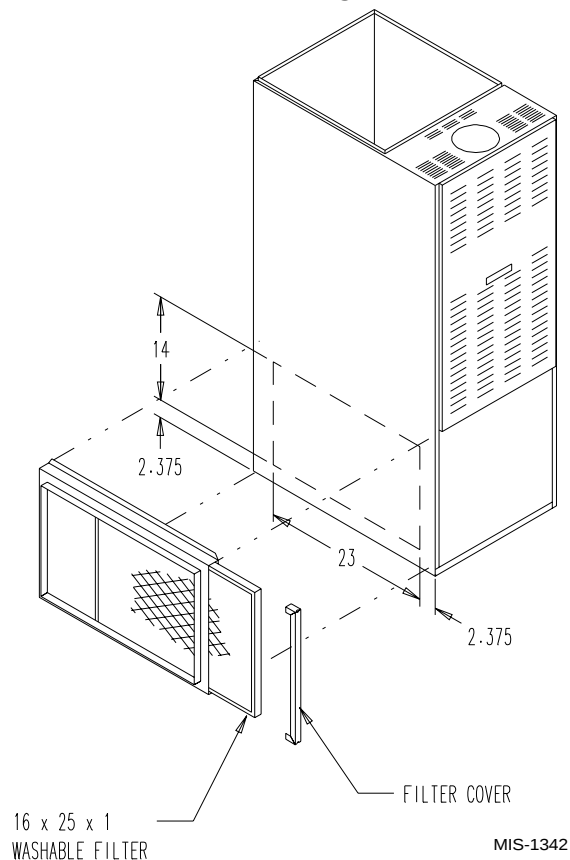


FIGURE 13
TYPICAL INSTALLATION OF A 20x25x1
FILTER RACK

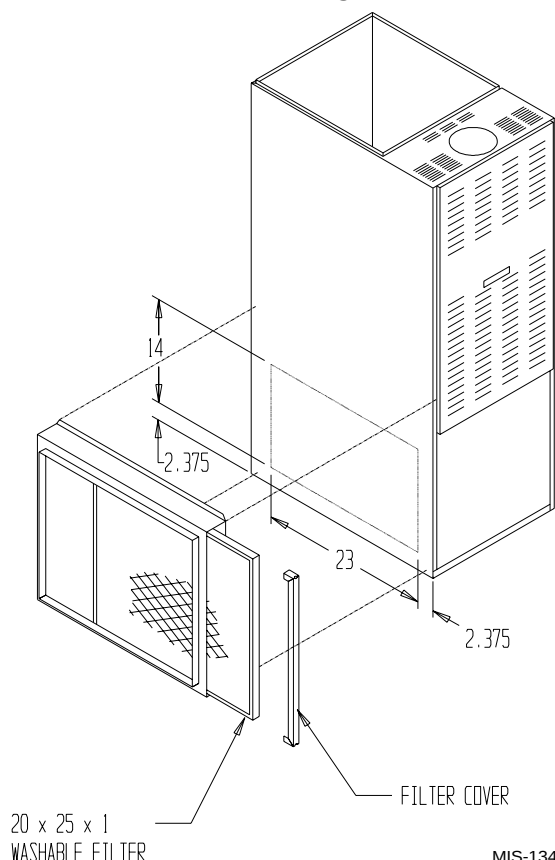


Figure 13 shows a typical installation of a 20 x 25 x 1 filter rack. The same 14 x 23 cutout is required in the furnace side, and the bottom of the filter rack is aligned over the bottom of the 14 x 23 cutout. The top of the filter rack rises approximately 6 inches above the top of the cutout. The 3 inch depth of the filter rack provides ample spacing between furnace side and leaving edge of filter for the entire filter surface to be effective.

To remove filter from the filter rack (see Figures 12 & 13), remove the filter access cover and grasp the end of the filter.

This filter is the high velocity type foam filter which may be washed and used over and over. **Do not** replace it with a fiberglass disposable filter of the same size.

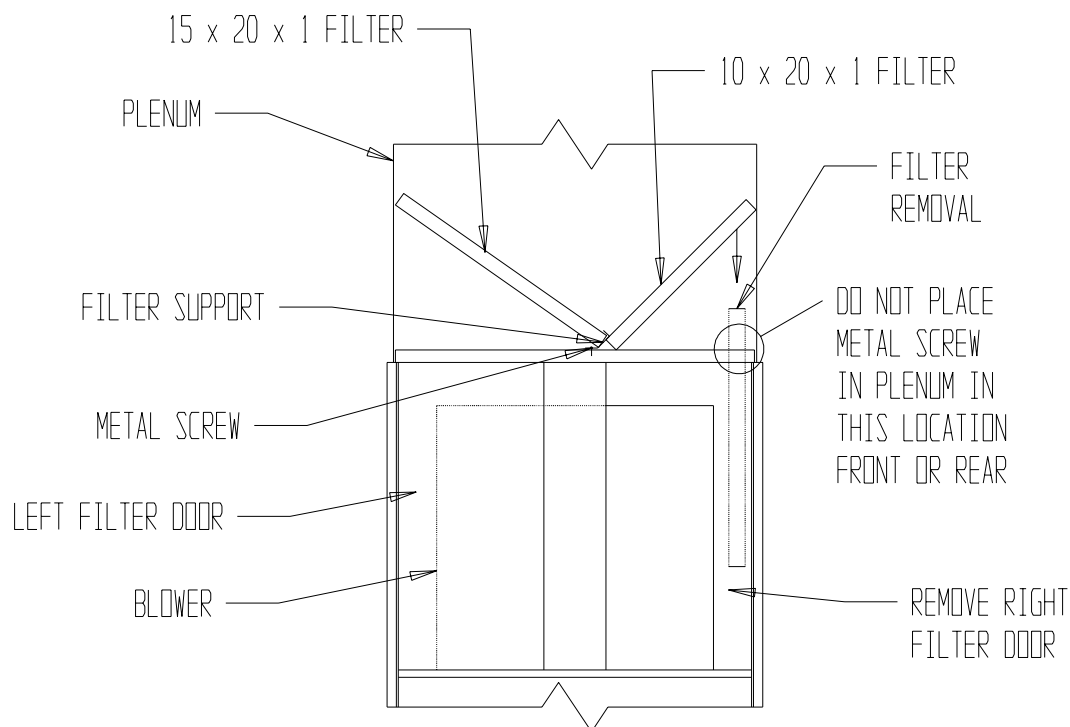
To replace filter, reverse the above procedure.

COUNTERFLOW MODELS – FILTER LOCATIONS

Counterflow models normally have filters installed in the return air plenum above the furnace unless a common return air/filter grille is used.

The electrical switch should be turned “off” before the front door to furnace is removed. After removing the front door, remove the left side filter door in the upper section of the furnace. Refer to Figure 14 for proper filter locations.

**FIGURE 14
FILTER LOCATIONS FOR COUNTERFLOW MODELS**



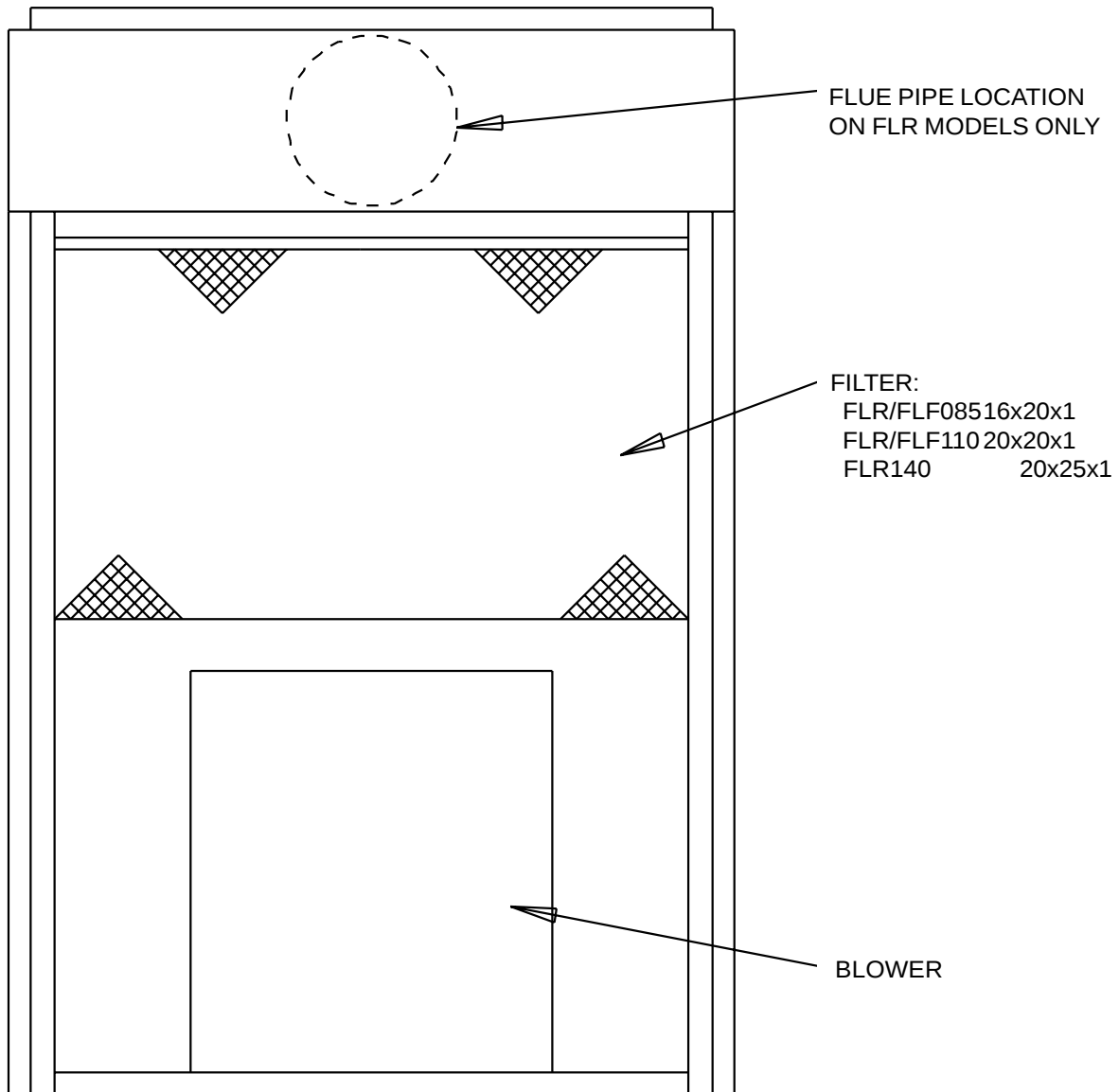
ATTACH FILTER SUPPORT TO FURNACE AS SHOWN WITH TWO SHEET METAL SCREWS. THE FILTERS CAN BE INSTALLED AND REMOVED THROUGH THE RIGHT FILTER DOOR.

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LO-BOY MODELS – FILTER LOCATIONS

Lo-boy models have the filter installed in the return air cabinet section of the furnace. It is accessible from the rear of the furnace by removing the blower/filter access door. The electrical switch should be turned “off” prior to removing the access door. Refer to Figure 15 below.

FIGURE 15
FILTER INSTALLATION – LO-BOY MODELS



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INSPECT AIR FILTER

Washable air filters are supplied with each furnace. Washable filters should not be replaced with disposable type. Clean filters before each heating season begins. It is recommended that filters also be cleaned at least twice during the heating season.

Be sure the new filters are set securely in the filter rack so there can be no leakage around them. (See instructions on inside of blower compartment door.)

FINAL INSPECTION AND TEST

Final inspection and test of an installation shall be made to determine that the work has been done in full accordance with regulations and according to the highest standards for safety, performance and appearance. Such an inspection and test should indicate the following as a minimum:

1. Determine that all parts of the oil storage and circulating system, including tank, piping and burner, are free from oil leaks. Be sure that no oil discharges from the nozzle when burner is not operating.
2. Be sure that the suction line and pump have been entirely vented of air so that the burner has instantaneous oil shutoff at the nozzle and so that the pump operates without an air noise.
3. Check the flame adjustment to determine that the flame is clear, quiet, free of odor and oil nozzle is of proper size for the furnace.
4. Test operation of burner by operating the thermostat. First, set the thermostat above room temperature. Burner should start. Second, set thermostat below room temperature. Burner will stop.
5. Check operation of burner primary control in accordance with manufacturer's instructions included with the control. Following is the method we recommend in checking the safety switch in this primary control.
 - A. Flame Failure – Simulate by shutting off oil supply manual valve while burner is on. Within 9 seconds the control will shut the burner down and flash a diagnostic code of 1/2 second on / 1/2 second off. Ignition and motor stop and oil valve closes

- B. Ignition Failure – Test by closing oil supply while burner is off. Run through starting procedure. The primary control will attempt three trials for ignition. After three attempts, the control will lockout.
- C. Power Failure – Turn off power supply while burner is on. When burner goes out, restore power and burner will restart.
- D. If operation is not as described, check wiring and installation first. If trouble appears to be in the control circuit, replace the flame detector. If trouble still persists, refer to "Common Causes of Trouble" section on page 26.

SERVICE HINTS

Preventive maintenance is the best way to avoid unnecessary expense, inconvenience, and retain operating efficiency of your furnace. It is advisable to have your heating system and burner inspected at periodic intervals by a qualified serviceman. If trouble develops, follow these simple checks before calling the serviceman.

1. Make sure there is oil in tank and valve is open.
2. Make sure thermostat is set above room temperature.
3. Make sure electrical supply to furnace is on and fuses are not blown or circuit breakers tripped.
4. Reset safety switch of burner primary control.



CAUTION

Reset three (3) times only. More than three resets can cause excessive oil to be pumped into combustion chamber which could result in explosion upon ignition.

5. Press thermal protector button of burner motor.
6. Make sure air filters are in place and are clean.
7. Make sure all air openings in furnace, all ventilation and combustion air openings, all return air grilles, and all warm air registers are unobstructed and open.

COMBINATION COMBUSTION CHAMBER/BURNER MOUNTING SYSTEM

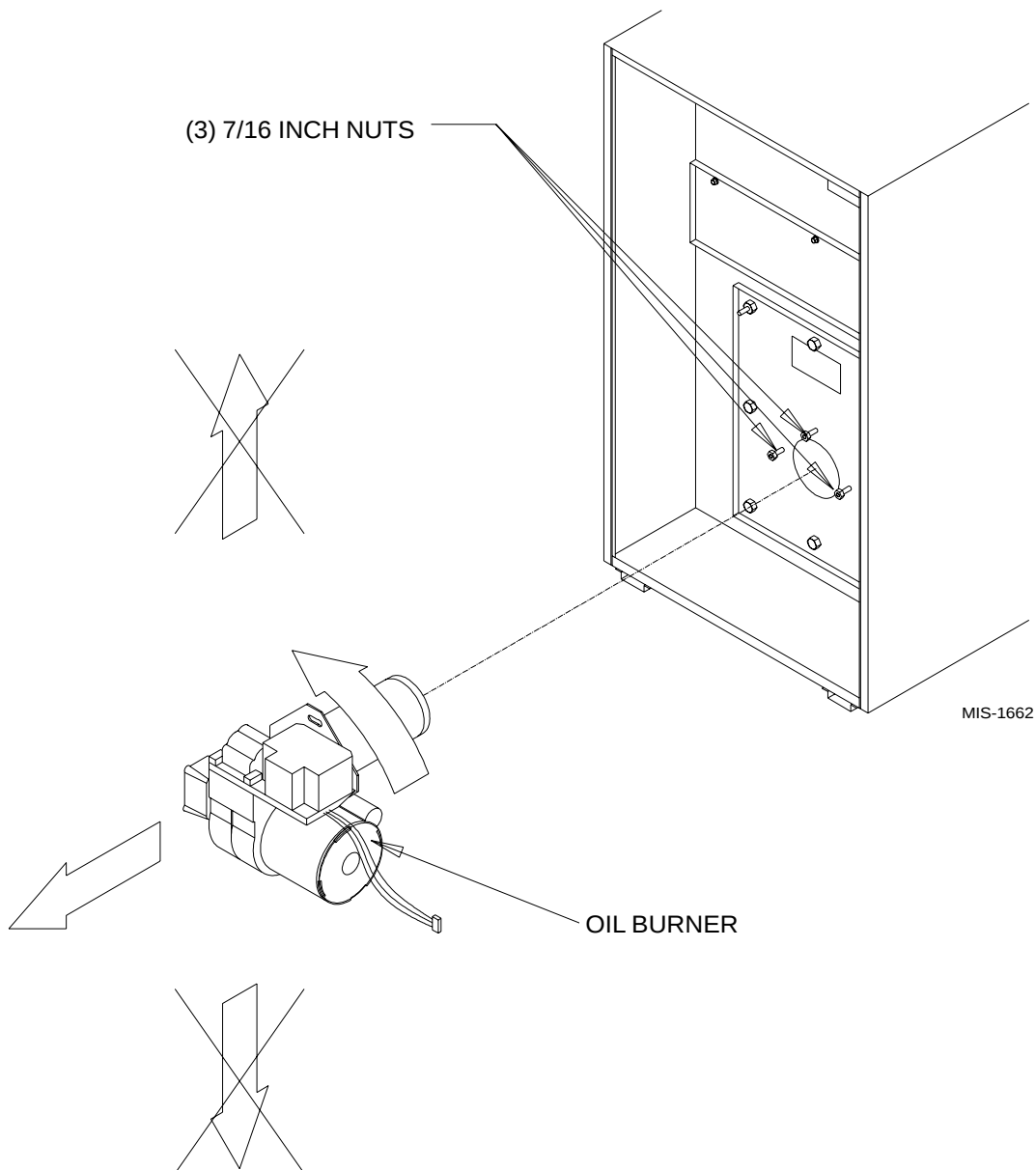
The furnace has been designed with a combustion chamber mounting system that enables service personnel to remove the combustion chamber, its mounting system, and burner assembly as one unit for inspection and/or service on the bench. It has also been designed to remove the burner assembly independently from the mounting system to perform basic annual service and inspection. The mounting system is completely adjustable so exact alignment between the burner tube and combustion chamber may be assured prior to installation into the furnace. See Figure 16A and 16B.

WARNING

The procedures described in Figures 16A and 16B should be conducted only by a qualified service technician.

Improper servicing could cause electric shock hazard, fires or explosion resulting in damage, injury or death.

**FIGURE 16A
REMOVAL OF BURNER ONLY**



TO REMOVE BURNER ONLY

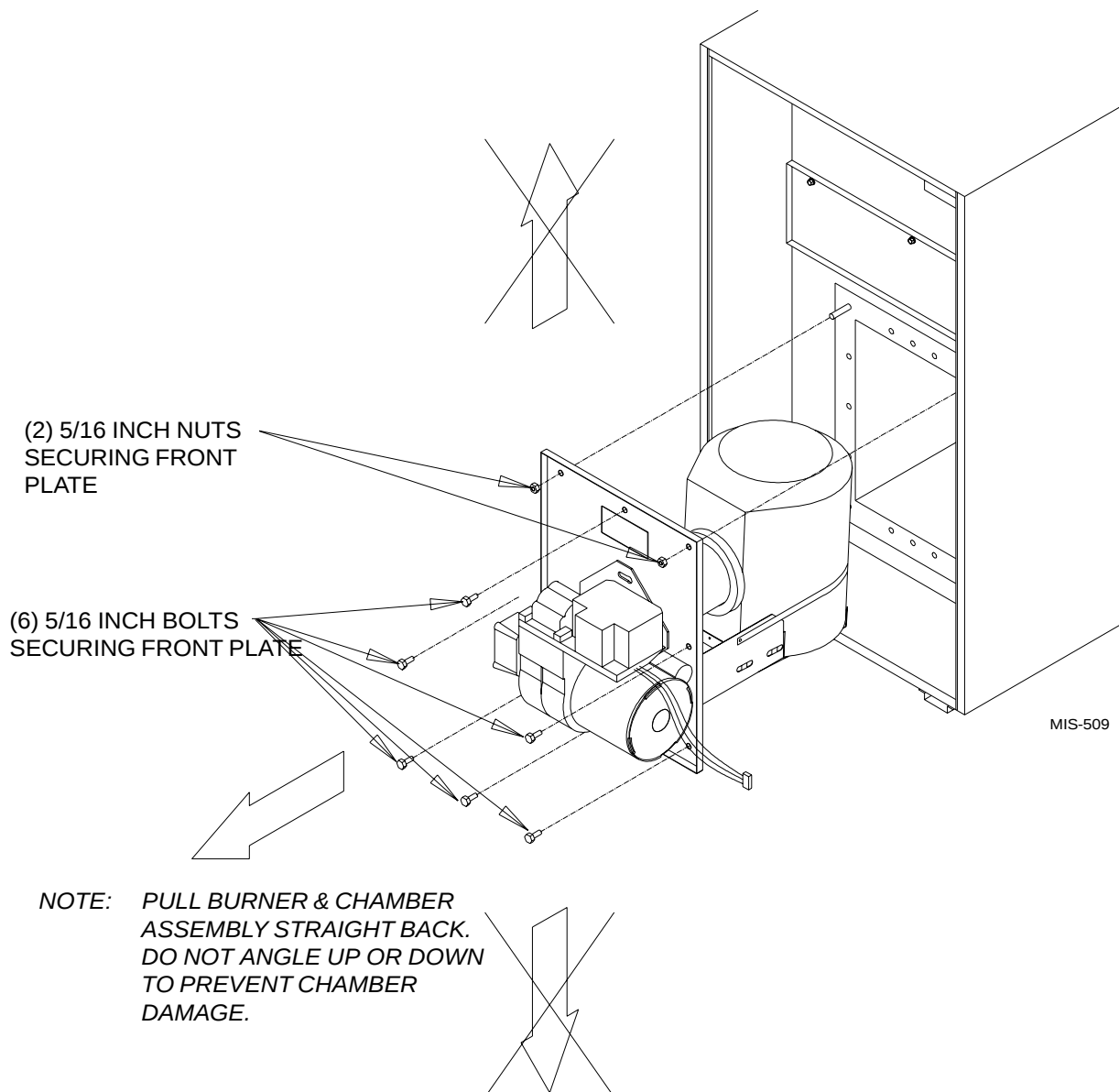
Disconnect fuel line, power cord and wires from T, T on primary control. Loosen (3) 1/4 inch nuts securing burner mounting flange. Twist burner counterclockwise and pull straight back away from the furnace. (See Figure 16A.)

TO REMOVE THE ENTIRE COMBUSTION CHAMBER MOUNTING SYSTEM

Disconnect fuel line, power cord and wires from T, T on primary control. Remove (6) 5/16 inch bolts from around front plate. Next remove (2) 5/16 inch nuts from upper right and left hand corners of the front plate. Pull entire assembly straight back away from furnace.

Be careful not to tip assembly up or down as it may damage the combustion chamber. (See Figure 16B.)

FIGURE 16B
REMOVAL OF ENTIRE COMBUSTION CHAMBER MOUNTING SYSTEM



COMMON CAUSES OF TROUBLE



To avoid accidents, always open main switch (OFF position) when servicing the burner.

BURNER WILL NOT PRODUCE FLAME

Check oil level gauge to see that there is sufficient oil in tank or tanks. Check the burner mounted relay control. ***Do not adjust this control.***

Check position of electrodes – incorrect position will cause slow or delayed ignition. Clean electrodes and nozzle. Check and clean strainer in pump. If oil line filter is used, check filter condition.

If burner runs but there is no flame the fuel pump may be air bound. Follow instructions for bleeding fuel pump.

Check and make sure the solenoid valve on the oil pump is being energized and opening.

BURNER STARTS OR STOPS TOO OFTEN

Limit control may be set too low. Make sure set point indicator is against limit stop on dial. Refer to rating plate for limit setting. Check heat anticipator setting on thermostat.

NOZZLE PRODUCES A STRINGY FLAME

Worn tangential grooves in nozzle. Replace nozzle.

BASEMENT TANK HUM

Occasionally with a two-pipe installation there may be a low return line hum. Eliminate hum by installing a special anti-hum valve in the return line near pump.

HEAVY FIRE OR PULSATING FLAME.

These may occur after burner starts. It may be caused by a slight oil leak in the fuel pump and cannot be corrected except by replacing the pump. This happens only when the burner is started.

CHATTERING SOUND OR HIGH PITCH NOISE

This noise from motor can usually be traced to where a conduit or BX cable is fixed rigidly or attached to some part of the building. Relieving this strain may eliminate noise.

PUMP SQUEALS OR CHATTERS

This may be caused by air in pipes. Check all joints in the oil supply pipe for leaks. Check strainer in pump; if dirty, clean.

INSUFFICIENT HEAT

Check limit control setting. It may be that flame is not allowed to stay on long enough to generate sufficient heat in furnace to heat the house properly. If the proper size furnace has been selected according to house requirements and satisfactory heat is not obtained, recheck the heating plant for size and capacity in relation to house. Check for clogged filters.

Check and make sure the heat anticipator on the thermostat is set correctly.

CARE OF FINISH

Your unit is painted with baked enamel. Like a good piece of furniture, it has an excellent appearance and an occasional waxing and dusting will keep it attractive for years.



Under **no** circumstance should a soot deterioration device be used in the combustion chamber. These products known as "soot busters" or "soot sticks" are comprised of chemicals that burn at very high temperatures which may exceed the temperature rating of the combustion chamber material.

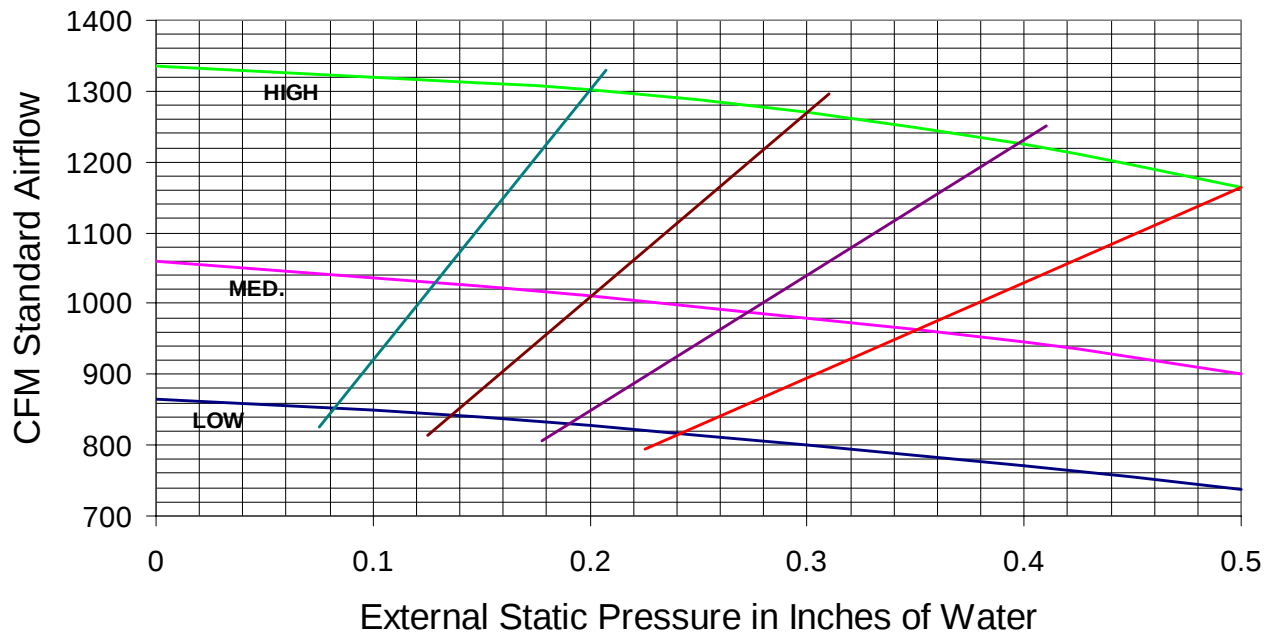
Use of these products are detrimental to the life expectancy of the combustion chamber and will destroy the chamber. Refer to the "Cleaning of Furnace" section for proper cleaning methods.

CLEANING OF FURNACE

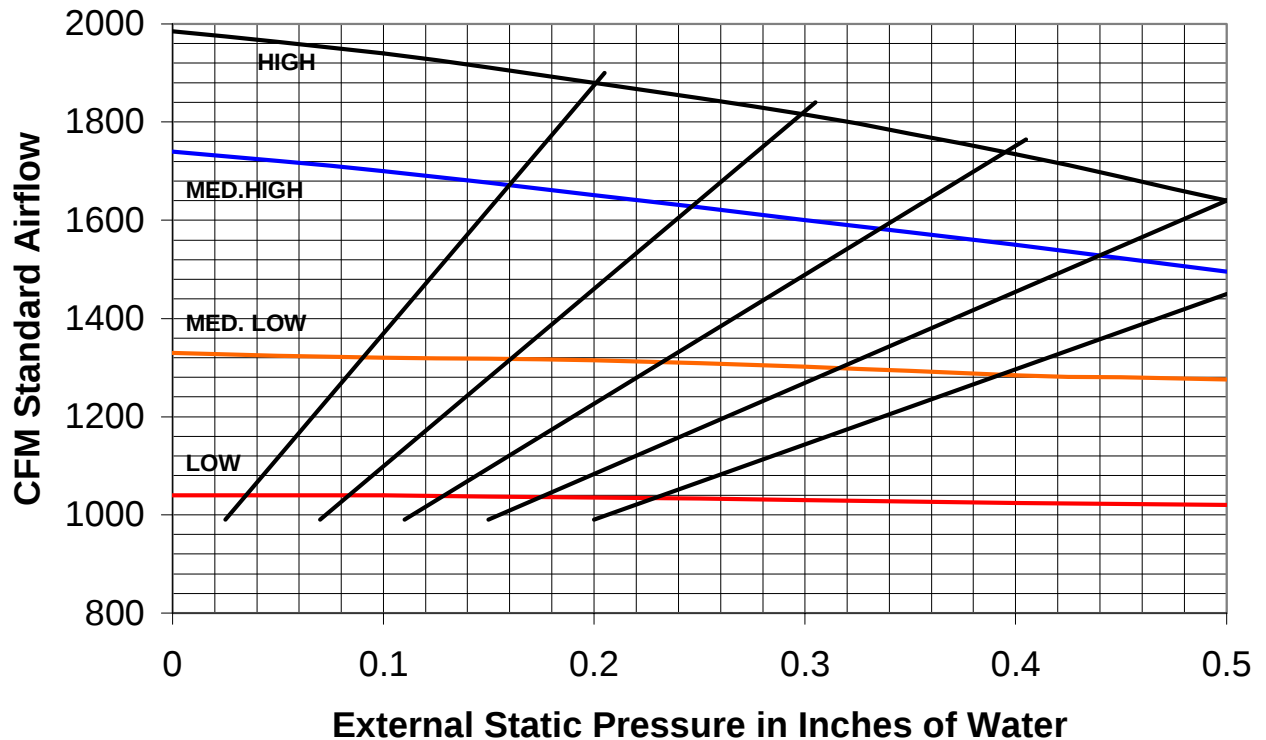
All of these units have two clean out plugs for easy cleaning of the heat exchanger. They are accessible from the front of these units by removing the clean out access cover in the burner compartment. The furnace should be checked annually by a qualified service technician.

FH RESISTANCE CURVES

FH085D36D System Resistance Curves

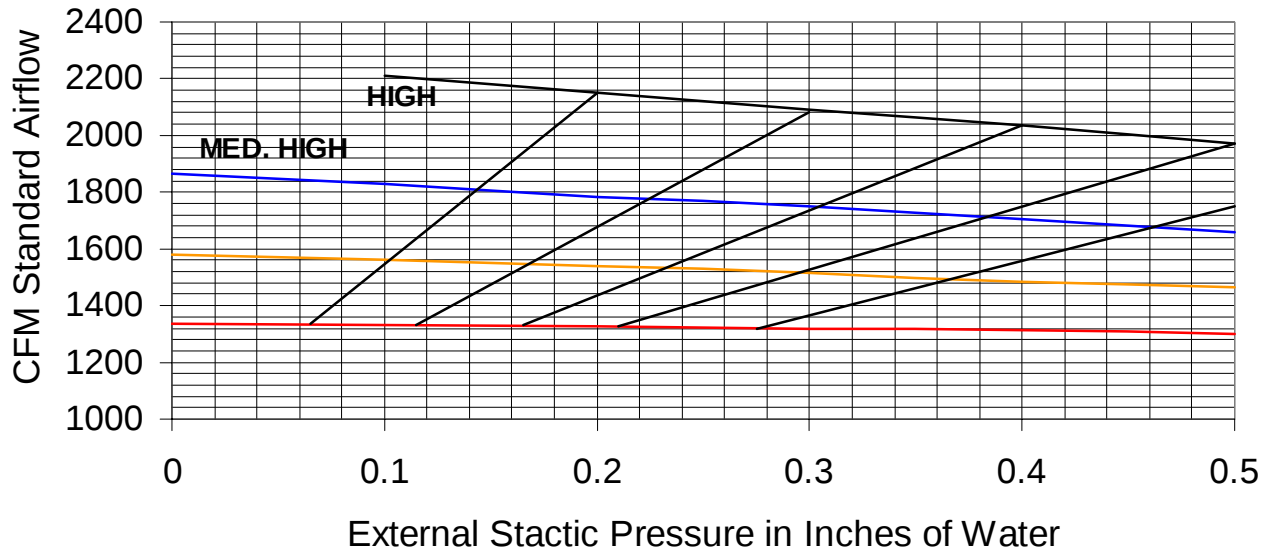


FH110D48D System Resistance Curves



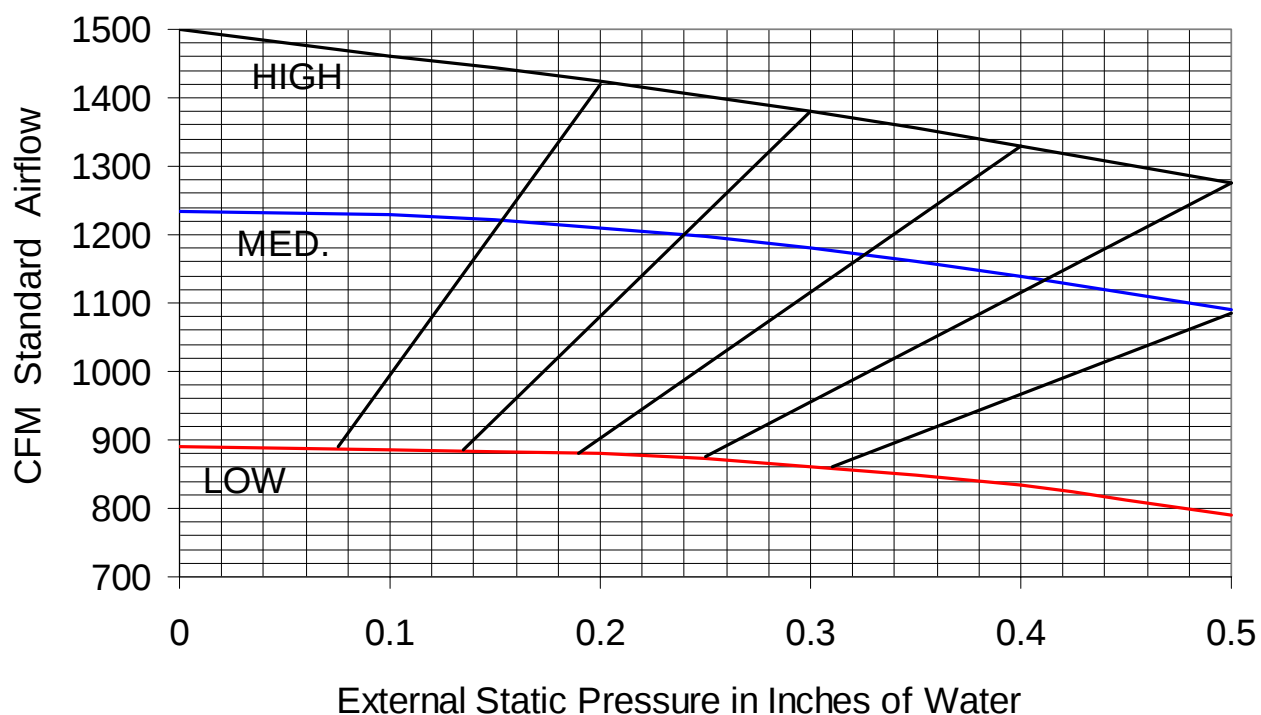
FH RESISTANCE CURVES

FH110D60D System Resistance Curves

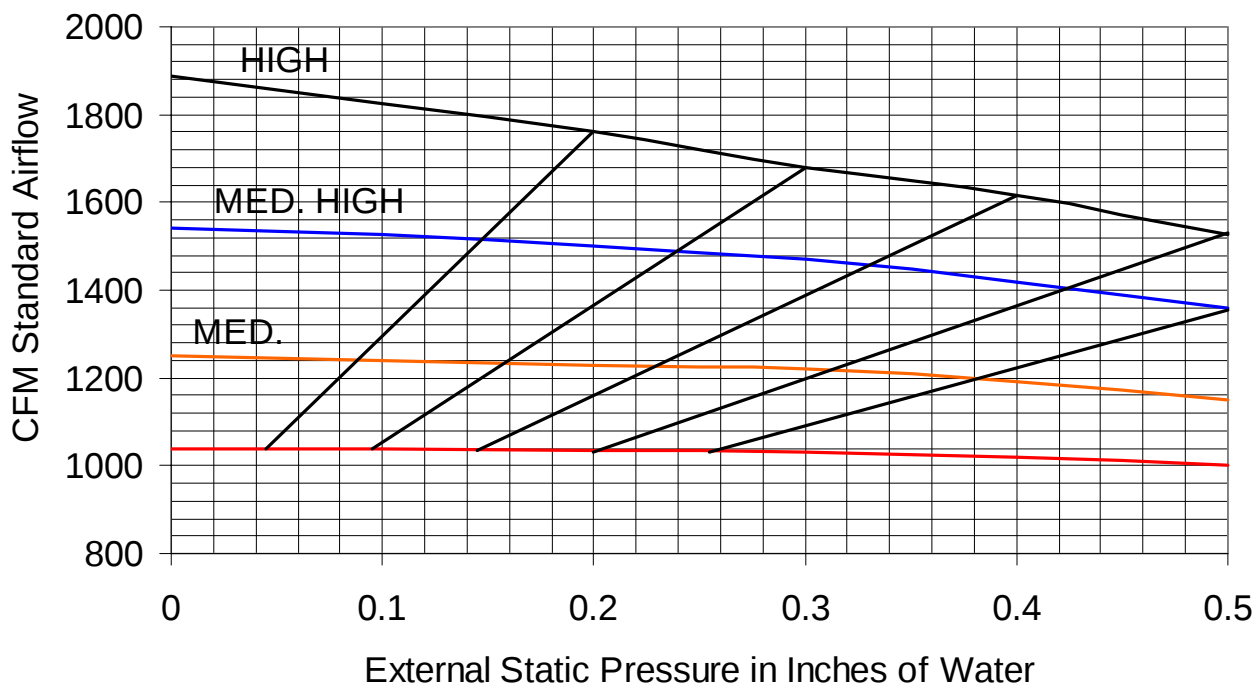


FLF / FLR RESISTANCE CURVES

FLF/R085D36D System Resistance Curves

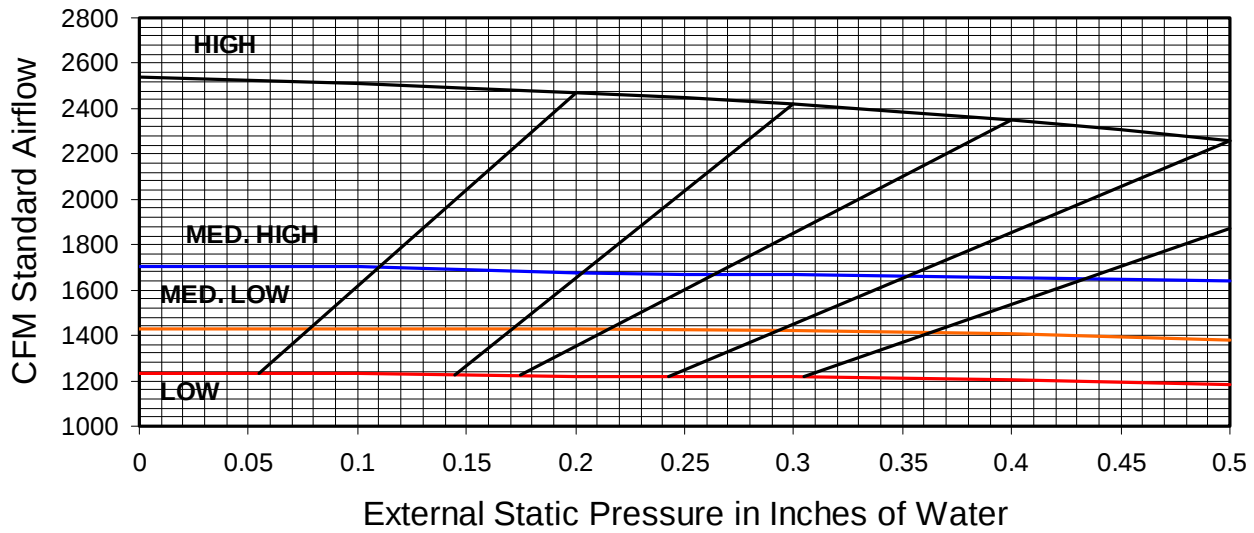


FLF/R110D48D System Resistance Curves

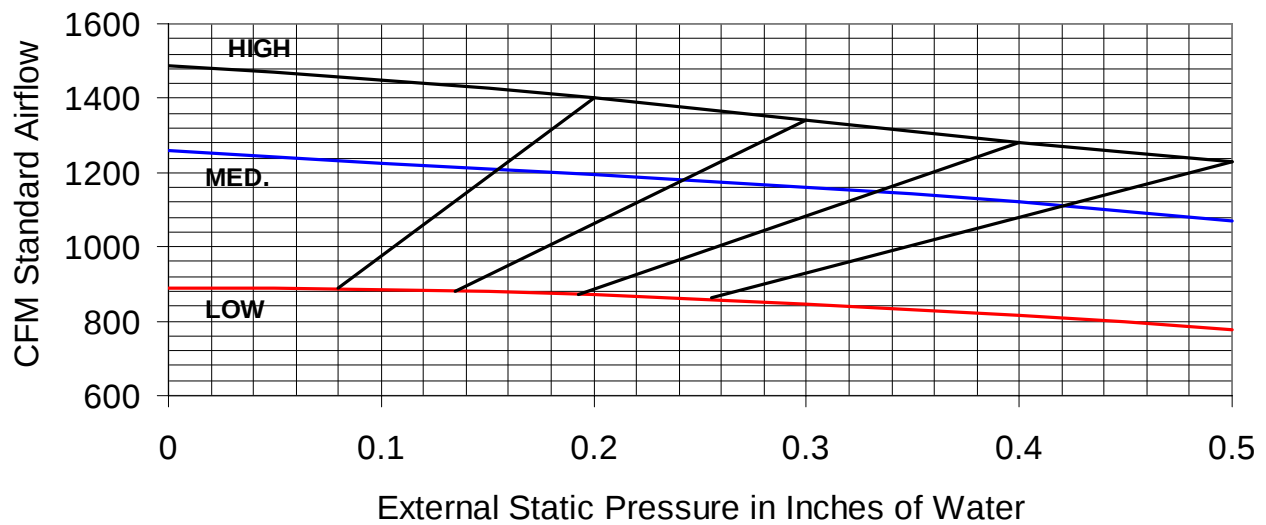


RESISTANCE CURVES

FLR140D60D System Resistance Curves



FC085D36D System Resistance Curves

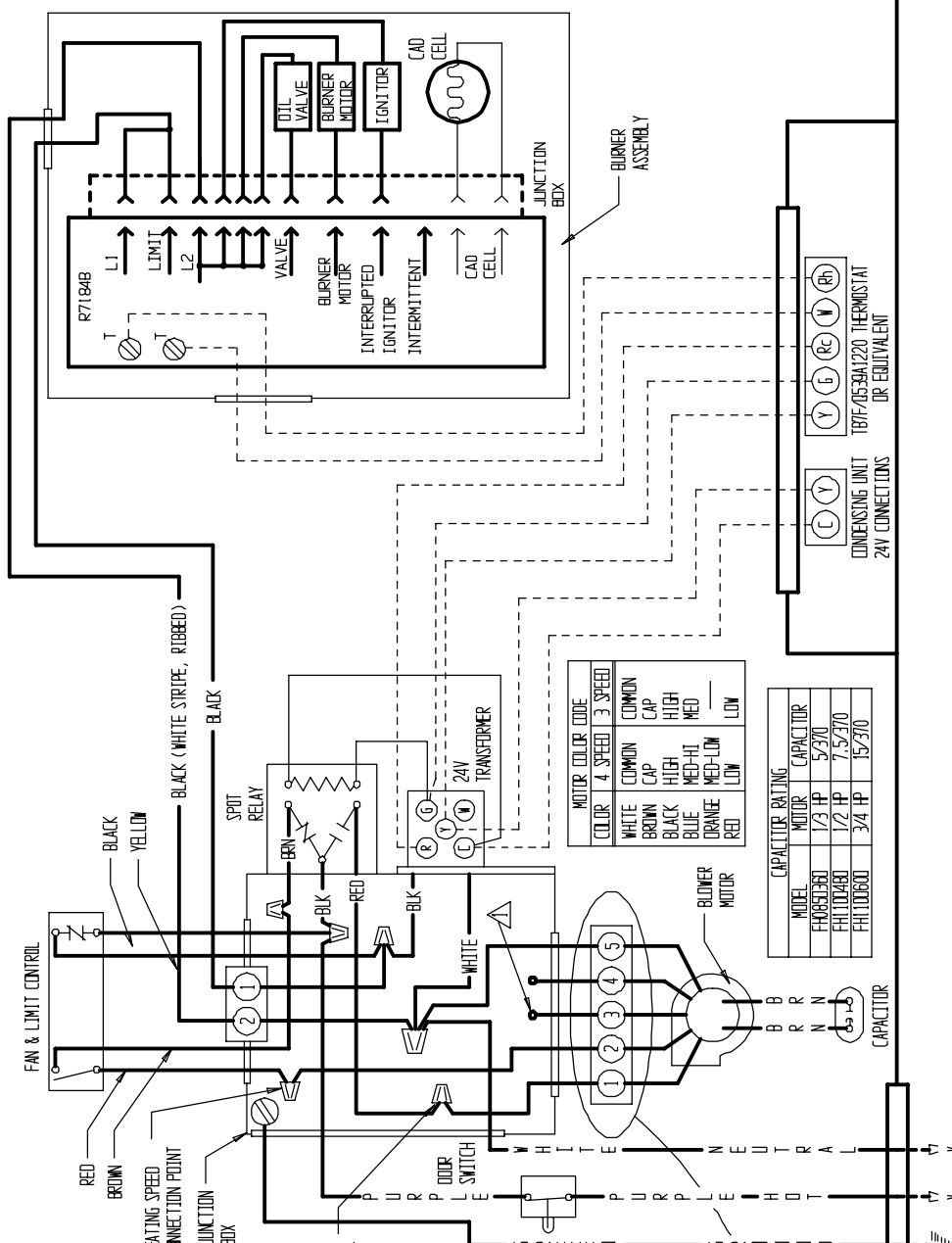
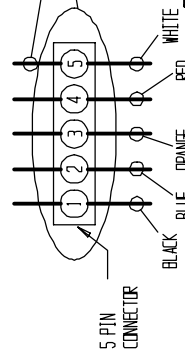


CONNECTION DIAGRAM DANGER: ELECTRICAL SHOCK HAZARD DISCONNECT POWER BEFORE SERVICING.

FACTORY SETTINGS (CHART A)				
MODEL	INPUT RATE GPH	HEATING BLOWER SPEED (COLOR)	COOLING BLOWER SPEED (COLOR)	TEMPERATURE RISE RANGE
FH083360	.65	LOW (RED)	HIGH (BLACK)	70° - 100°
	.75	MED (BLUE)	HIGH (BLACK)	60° - 90°
FH110480	.85	LOW (RED)	HIGH (BLACK)	70° - 100°
	1.00	MED-LOW (ORANGE)	HIGH (BLACK)	60° - 90°
FH110600	.85	LOW (RED)	HIGH (BLACK)	60° - 90°
	1.00	MED-LOW (ORANGE)	HIGH (BLACK)	60° - 90°

COOLING BLOWER SPEEDS (CHART B)			
MODEL	NOMINAL A/C TONS	SPEED (COLOR)	CFM @ 50" W.C.
FH083360	2	LOW (RED)	730
	2 - 1/2	MED (BLUE)	900
	3	HIGH (BLACK)	1160
FH110480	2 - 1/2	LOW (RED)	1020
	3	MED-LOW (ORANGE)	1280
	3 - 1/2	MED-HIGH (BLUE)	1495
	4	HIGH (BLACK)	1640
FH110600	3 - 1/2	LOW (RED)	1300
	4	MED-LOW (ORANGE)	1460
	5	MED-HIGH (BLUE)	1660
		HIGH (BLACK)	1970

SPEED TAPS AVAILABLE FOR HEATING AND COOLING INPUT RATINGS. SEE CHARTS A AND B.
NOTE: ONLY ONE HEATING AND ONE COOLING SPEED CAN BE CONNECTED. THE OTHER SPEED TAP'S MUST BE TAPED OFF INDEPENDENTLY FROM ALL OTHER WIRES.



MOTOR COLOR CODE				
COLOR	4 SPEED	3 SPEED	COMMON	CAP
WHITE	COMMON	COMMON	COMMON	COMMON
BROWN	CAP	CAP	CAP	CAP
BLACK	HIGH	HIGH	HIGH	HIGH
BLUE	MED-HI	MED-HI	MED-HI	MED-HI
ORANGE	MED-LOW	MED-LOW	MED-LOW	MED-LOW
RED	LOW	LOW	LOW	LOW

CAPACITOR RATING		
MODEL	MOTOR	CAPACITOR
FH083360	1/3 HP	5/370
FH110480	1/2 HP	7.5/370
FH110600	3/4 HP	15/370

ON FH110 MODELS THE ORANGE (MED-LOW) SPEED IS THE FACTORY CONNECTED HEATING SPEED



IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE APPLIANCE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT LEAST 105 DEG C.

