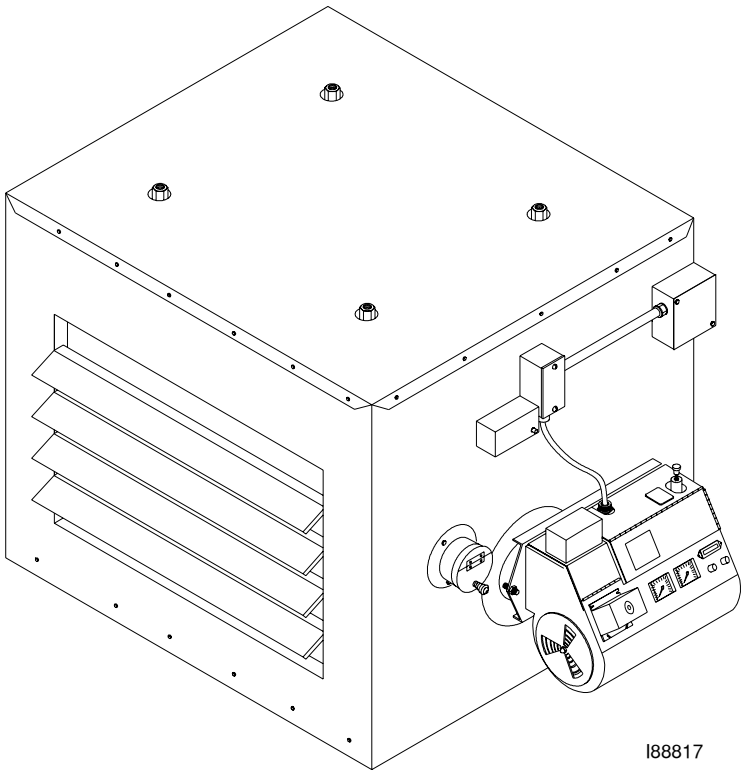
CLEAN BURN
ENERGY SYSTEMS

OPERATOR'S MANUAL

CLEAN BURN MODEL: CB-1400
MULTI-OIL FURNACE
with CB-525-S2 BURNER

U.L. Listed Used Oil Burning Appliance #MH15393 (N)

U.L.-C Listed #CMP217



PUBLICATION DATE: 8/15/07, Rev. 3 **CLEAN BURN PART # 43204**

WARNING: DO NOT assemble, install, operate, or maintain this equipment without first reading and understanding the information provided in this manual. Installation and service must be accomplished by qualified personnel. Failure to follow all safety precautions and procedures as stated in this manual may result in property damage, serious personal injury or death.

IMPORTANT FOR U.S. INSTALLATIONS: All installations must be made in accordance with state and local codes which may differ from the information provided in this manual. Save these instructions for reference.

IMPORTANT FOR CANADIAN INSTALLATIONS: These instructions have been reviewed and accepted by Underwriters' Laboratories of Canada as being appropriate for the installation of the ULC labelled products identified herein. The use of these instructions for the installation of products NOT bearing the ULC label and NOT identified herein may result in an unacceptable or hazardous installation.

IMPORTANT FOR CANADIAN INSTALLATIONS: The installation of this equipment is to be accomplished by qualified personnel and in accordance with the regulation of authorities having jurisdiction and CSA Standard B 139, Installation Code for Oil Burning Equipment.

WARRANTY INFORMATION

Clean Burn, Inc., MANUFACTURER, hereby warrants that MANUFACTURER's products shall be free from defect in material and workmanship under normal use according to the provisions and limitations herein set forth.

MANUFACTURER warrants the **heat exchanger/combustion chamber** for a period of **ten (10) years (or 15,000 hours, whichever comes first)**, from the date of purchase by the purchaser, as follows:

If the defect occurs in the first five (5) years (or 7500 hours, whichever comes first) , Clean Burn pays 100% of parts, replacement or repair (the customer pays 0%), and *pro rata* thereafter according to the following schedule:

(a) If the defect occurs during the sixth year (or 7500-9000 hours, whichever comes first), customer pays 70% of parts, replacement or repair.

(b) If the defect occurs during the seventh year (or 9000-10,500 hours, whichever comes first), customer pays 75% of parts, replacement or repair.

(c) If the defect occurs during the eighth year (or 10,500-12,000 hours, whichever comes first), customer pays 80% of parts, replacement or repair.

(d) If the defect occurs during the ninth year (or 12,000-13,500 hours, whichever comes first), customer pays 85% of parts, replacement or repair.

(e) If the defect occurs during the tenth year (or 13,500-15,000 hours, whichever comes first), customer pays 90% of parts, replacement or repair.

MANUFACTURER warrants **all other Clean Burn component parts, including the energy retention disk**, for a period of **one (1) year** from the date of purchase by the purchaser.

LIMITATIONS:

The obligation of MANUFACTURER for breach of warranty shall be limited to products manufactured by MANUFACTURER (1) that are installed, operated and maintained according to MANUFACTURER's instructions furnished and/or available to the purchaser upon request; (2) that are installed according to all other applicable Federal, State and local codes or regulations; and (3) that the purchaser substantiates were defective in material and workmanship notwithstanding that they were properly installed and correctly maintained as set forth above and were not abused or misused.

The obligation of MANUFACTURER shall be limited to replacing or repairing the defective product, at the option of the MANUFACTURER. MANUFACTURER shall not be responsible for any labor or costs of removal or reinstallation of its products and shall not be liable for transportation costs to and from its plant at Leola, Pennsylvania.

Use of parts for modification or repair of the product or any component part thereof not authorized or manufactured by MANUFACTURER specifically for such product shall void this warranty.

This warranty shall not apply to any damage to or defect in any of MANUFACTURER's products that is directly or indirectly caused by (1) *force majeure*, Act of God or other accident not related to an inherent product defect; or (2) abuse, misuse or neglect of such product, including any damage caused by improper assembly, installation, adjustment, service, maintenance or faulty instruction of the purchaser.

Other than as expressly set forth hereinabove, MANUFACTURER makes no other warranty, express or implied, with respect to any of MANUFACTURER's products, including but not limited to any warranty of merchantability or fitness for a particular purpose.

And in no event shall MANUFACTURER be responsible for any incidental or consequential damages of any nature suffered by purchaser or any other person or entity caused in whole or in part by any defect in any of MANUFACTURER's products. Any person or entity to whom this warranty extends and who claims breach of warranty against MANUFACTURER must bring suit thereon within one year from the date of occurrence of such breach of warranty or be forever barred from any and all legal or other remedies for such breach of warranty.

MANUFACTURER is not responsible for and hereby disclaims any undertaking, representation or warranty made by any dealer, distributor or other person that is inconsistent with or in any way more expansive than the provisions of this limited warranty.

This warranty grants specific legal rights and shall be read in conformity with applicable state law. In some jurisdictions, the applicable law mandates warranty provisions that provide greater legal rights than those provided for herein. In such case, this limited warranty shall be read to include such mandated provisions; and any provision herein that is prohibited or unenforceable in any such jurisdiction shall, as to such jurisdiction, be ineffective to the extent of such prohibition or unenforceability without invalidating the remaining provisions and without affecting the validity or enforceability of such provision in any other jurisdiction(s).

TRADEMARKS

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TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

SECTION 1: INTRODUCTION

Guide to this Manual

This manual contains all the information necessary to safely install and operate the Clean Burn Furnace Model CB-1400. Consult the Table of Contents for a detailed list of topics covered. You'll find this manual's step-by-step procedures easy to follow and understand. Should questions arise, please contact your Clean Burn dealer before starting any of the procedures in this manual.

As you follow the directions in this manual, you'll discover that assembling and operating your new furnace involves five basic activities as outlined here:

- **UNPACKING ..... (Section 2)**
- **ASSEMBLY ..... (Section 3)**
- **INSTALLATION ..... (Section 4)**
- **OPERATION**
  - **Metering Pump Priming ..... (Section 5)**
  - **Starting and Adjusting the Burner ..... (Section 6)**
  - **Resetting the Furnace and Burner ..... (Section 7)**
  - **Adjusting the Draft ..... (Section 8)**
- **MAINTENANCE ..... (Section 9)**

The manual also contains important and detailed technical reference materials which are located at the back of the manual in the Appendixes.

Please read all sections carefully--including the important safety information found in this section--before beginning any installation/operation procedures; doing so ensures your safety and the optimal performance of your Clean Burn furnace.

For Your Safety...

For your safety, Clean Burn documentation contains the following types of safety statements (listed here in order of increasing intensity):

- **NOTE:** A clarification of previous information or additional pertinent information.
- **ATTENTION:** A safety statement indicating that potential equipment damage may occur if instructions are not followed.

CAUTION: A safety statement that reminds of safety practices or directs attention to unsafe practices which could result in personal injury if proper precautions are not taken.

WARNING: A *strong* safetystatement indicating that a hazard exists which can result in injury or death if proper precautions are not taken.

DANGER! *The utmost levels of safety must be observed;* an extreme hazard exists which would result in high probability of death or irreparable serious personal injury if proper precautions are not taken.

In addition to observing the specific precautions listed throughout the manual, **the following general precautions apply and *must be heeded* to ensure proper, safe furnace operation.**

DANGER! DO NOT create a fire or explosion hazard by storing or using gasoline or other flammable or explosive liquids or vapors near your furnace.

DANGER! DO NOT operate your furnace if excess oil, oil vapor or fumes have accumulated in or near your furnace. As with any oil burning furnace, improper installation, operation or maintenance may result in a fire or explosion hazard.

WARNING: DO NOT add inappropriate or hazardous materials to your used oil, such as:

- Anti-freeze
- Carburetor cleaner
- Paint thinner
- Parts washer solvents
- Gasoline
- Oil additives
- Any other inappropriate/hazardous material

WARNING: Burning chlorinated materials (chlorinated solvents and oils) is *illegal,* will *severely damage* your heat exchanger, immediately *void* your warranty, and adversely affect the proper, safe operation of your furnace. Instruct your personnel to *never* add hazardous materials to your used oil.

For Your Safety... (continued)

WARNING: Never alter or modify your furnace without prior written consent of Clean Burn, Inc. Unauthorized modifications or alteration can adversely affect the proper, safe operation of your furnace.

WARNING: The burner which is shipped with your Clean Burn furnace is to be used *only* with your furnace according to the instructions provided in this manual. DO NOT use the burner for any other purpose!

WARNING: ***The Best Operator is a Careful Operator!*** By using common sense, observing general safety rules, and adhering to the precautions specific to the equipment, you, the operator, can promote safe equipment operation. ***Failure to use common sense, observe general safety rules, and adhere to the precautions specific to the equipment may result in equipment damage, fire, explosion, personal injury and/or death.***

WARNING: The installation, operation, and maintenance of this equipment in the U.S. must be accomplished by qualified personnel and in compliance with the specifications in the Clean Burn Operator's Manual and with all national, state, and local codes or authorities having jurisdiction over environmental control, building inspection and fuel, fire and electrical safety and the following standards:

NFPA 30	Flammable and Combustible Liquids Code
NFPA 30A	Automotive and Marine Service Station Code
NFPA 31	Standard for the Installation of Oil Burning Equipment
NFPA 211	Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances
NFPA 88A	Parking Structures
NFPA 88B	Repair Garages
NFPA 70	National Electrical Code

The International Mechanical Code
The International Building Code
The International Fire Code
The International Fuel Gas Code

Likewise, the installation, operation, and maintenance of this equipment **in Canada** is to be accomplished by qualified personnel and in compliance with the specifications in the Clean Burn Operator's Manual and in accordance with the regulation of authorities having jurisdiction and the following CSA Standards:

B139	Installation Code for Oil Burning Equipment
B140.0	General Requirements for Oil Burning Equipment
C22.1	Canadian Electrical Code, Part 1

Failure to comply with these standards and requirements may result in equipment damage, fire, explosion, personal injury and/or death.

For Your Safety... (continued)

Guidelines for Furnace Usage

- This furnace is listed for commercial and/or industrial use only; it is *not* listed for residential use.

- This furnace is listed with Underwriters Laboratory (UL) and Underwriters' Laboratories of Canada (ULC) to burn the following fuels:
    - Used crankcase oil up to 50 SAE
    - Used transmission fluid
    - Used hydraulic oils
    - #2 fuel oil
    - #4 fuel oil
    - #5 fuel oil

  NOTE: Used oils may contain other substances, including gasoline, that may hinder performance.

- Make sure you comply with all EPA regulations concerning the use of your furnace. EPA regulations require that:
    - Your used oil is generated on-site. You may also accept used oil from "do-it-yourself" oil changers.
    - Hazardous wastes, such as chlorinated solvents, are NOT to be mixed with your used oil.
    - The flue gases are vented to the outdoors with an appropriate stack.
    - Your used oil is recycled as fuel for "heat recovery". DO NOT operate your furnace in warm weather just to burn oil.

  Contact your Clean Burn dealer for current EPA regulations.

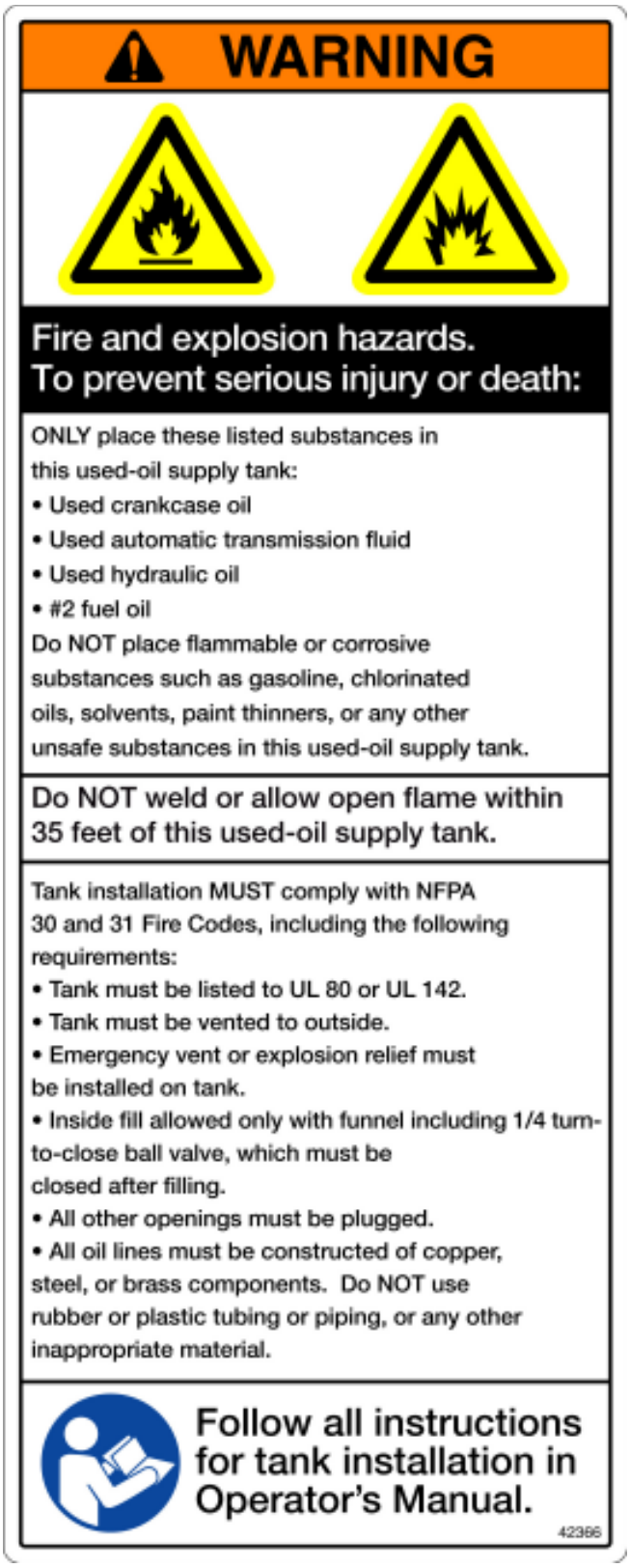
- If your furnace ever requires service, call your Clean Burn dealer. DO NOT allow untrained, unauthorized personnel to service your furnace. Make sure that your furnace receives annual preventative maintenance to ensure optimal performance.

For Your Safety... (continued)

Guidelines for Used Oil Tanks

For the safe storage of used oil and the safety of persons in the vicinity of the used oil supply tank, ensure that your tank installation adheres to the following safety guidelines:

- **The tank installation must meet all national and local codes.** Consult your local municipal authorities for more information as necessary.
- **Review and adhere to the safety guidelines for used oil supply tanks as stated in the WARNING shown.**
- Ensure that the tank for your furnace installation complies with all code and safety requirements as stated here. If the tank does not comply, DO NOT use it.
- If you do not have a copy of the tank safety label pictured at right, please contact your Clean Burn dealer for the label, which is to be affixed directly on your used oil supply tank.



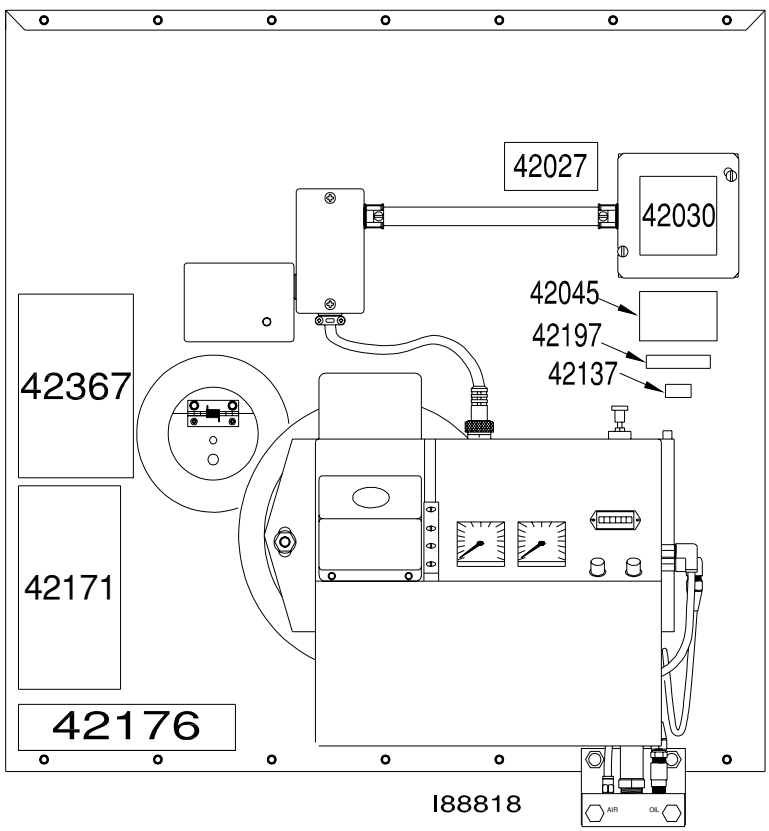
For Your Safety... (continued)

Safety Labels

Following are the locations and descriptions of all labels on your CB-1750 or CB-2501 furnace. The following illustrations show the location of ALL labels on your furnace. Please note that some labels denote model number, model description, etc. while others contain important safety messages.

Each **Safety Label** contains an important safety message starting with a key word as discussed earlier in this section (e.g. ATTENTION, CAUTION, WARNING, DANGER). For your safety and the safe operation of your furnace, review all labels and heed all safety messages as printed on the labels.

If any labels on your Clean Burn furnace ever become worn, lost or painted over, please call your Clean Burn dealer for free replacements.

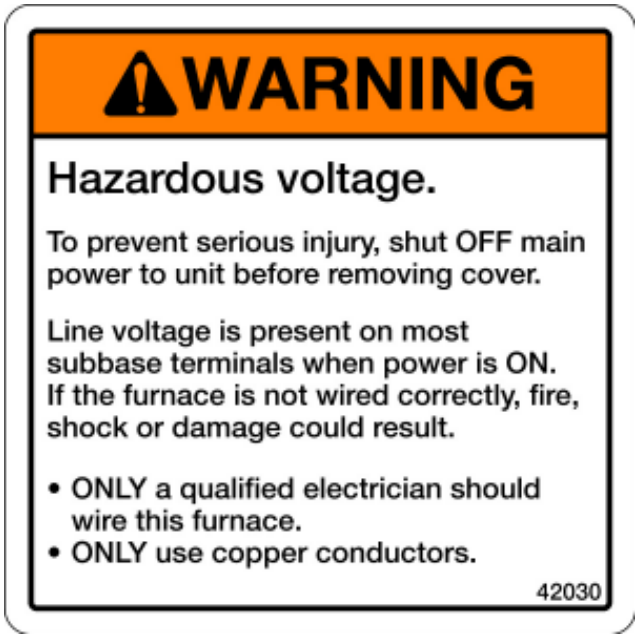


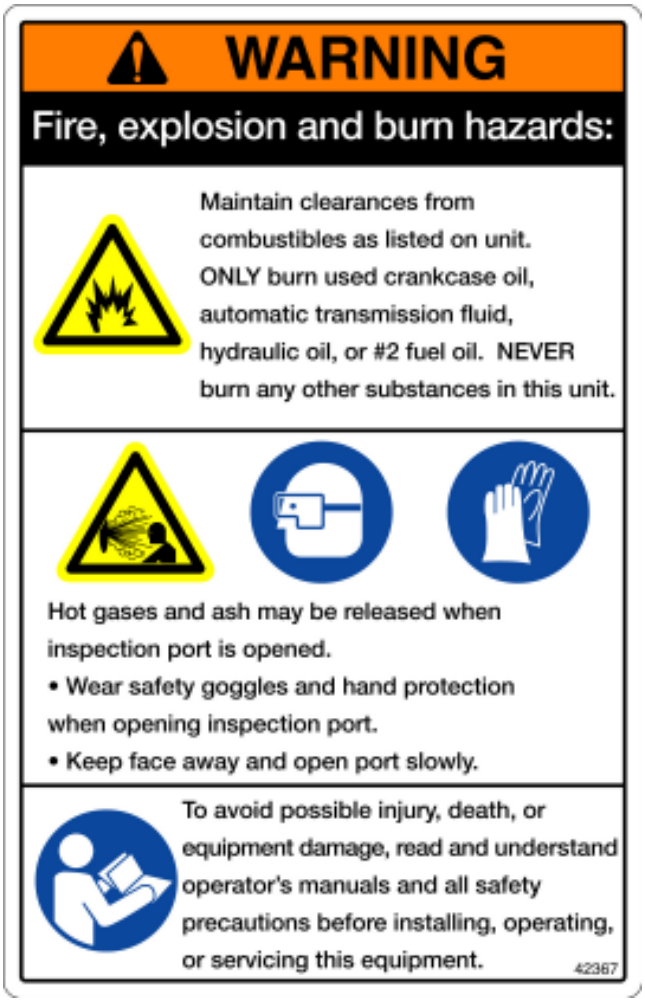
CB-1400 Furnace Cabinet Labels

Label Part #	Description
42030	Furnace Electrical Shock Hazard Warning Label
42027	Furnace Burn Hazard/Hazardous Voltage Warning Label
42171	UL Data Label - CB-1400
42197	Patent Pending Label
42137	Date Code Label
42045	Made in USA Label
42176	Model CB-1400 Label
42367	Furnace Safety Warning Label (Multiple Messages - Fire/Shock/Burn Hazards)
42068	Furnace Blower/Fan Entanglement Hazard Warning Label *(near fan)*

For Your Safety... (continued)

CB-1400 Furnace Cabinet *Safety* Labels





For Your Safety... (continued)

CB-1400 Furnace Cabinet *Safety* Labels

CLEAN BURN, INC.
LEOLA, PA

MH 15393 UL LISTED — ULC UNDERWRITERS' LABORATORIES OF CANADA LISTED

USED-OIL BURNING APPLIANCE — USED-OIL-FIRED FURNACE

NO. _____ 10523

MULTI-OIL BURNING UNIT HEATER

WHEN USED WITH THE FOLLOWING LISTED FUELS

MODEL NO. CB 1400

INPUT RATING W/NO 2 FUEL OIL (BTU/HR) 140000

LISTED FUELS	INPUT -GPH-	ATOM AIR PRESS -PSIG-	OIL PRESS -PSIG-
NO 2 OIL	1.0	15.0	1.5
USED			
CRANKCASE OIL	1.0	15.0	2.0
HYDRAULIC OIL	1.0	15.0	1.5
ATF	1.0	15.0	1.5

MAX. DISCHARGE AIR TEMP-F 200 — FLUE DRAFT IN W.C. .04

CLEARANCE TO COMBUSTIBLE SURFACES: (INCHES)

TOP	18	CHIMNEY	18	LOUVER END	60
FRONT	24	REAR	36	FAN END	24
		BOTTOM	24		

	POWER	VOLTS	AMPS	HZ
FAN MOTOR HP.	1/3	120	5.3	60
OIL PUMP MOTOR HP.	1/20	120	0.75	60
BURNER MOTOR HP.	1/10	120	1.4	60
BURNER HEATER WATTS	400	120	3.3	60
DRAFT IND. (OPT) HP	1/3	120	3.9	60
AIR COMPRESS. (OPT) HP.	1/3	120	3.5	60
TOTAL CIRCUIT AMPACITY W/FAN (UNIT HEATER)			18.2	
MAXIMUM FUSE SIZE / WITH OPTIONS			20/30	

BURNER REQUIRES A MINIMUM AIR SOURCE OF 2 S.C.F.M. AT 25 P.S.I.
THIS APPLIANCE IS NOT TO BE USED WITH AIR FILTERS AND SHALL INCORPORATE NO PROVISIONS FOR MOUNTING AIR FILTERS.
INSTALL AND USE ONLY IN ACCORDANCE WITH THE MFR'S INSTALLATION AND OPERATING INSTRUCTIONS.
FOR COMMERCIAL OR INDUSTRIAL USE ONLY.

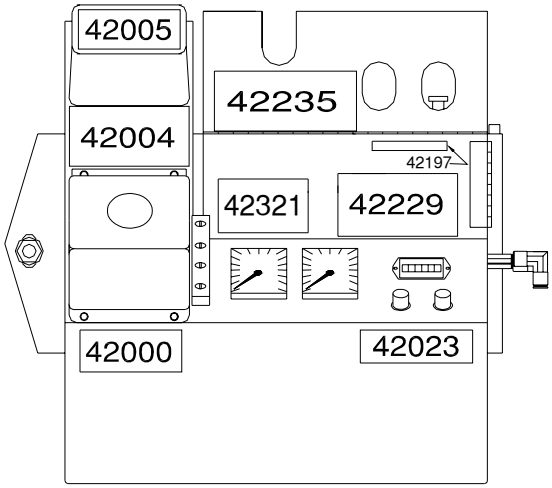
AUTHORITIES HAVING JURISDICTION SHOULD BE CONSULTED PRIOR TO INSTALLATION.

42171

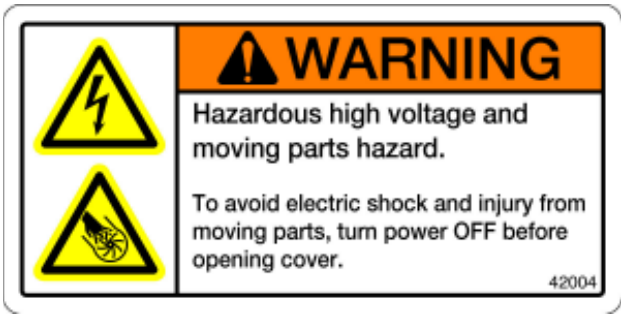
For Your Safety... (continued)

CB-1400 Burner Labels

Label Part #	Description
42005	Sold and Serviced By Label
42004	Burner Safety Warning Label (High Voltage/Moving Parts Hazards)
42000	Burner Safety Warning Label (Fire/Explosion Hazard - Reset Button)
42235	Burner Safety Warning Label (Fire/Explosion Hazard - Burner Installation and Service)
42321	Burner Model/Serial Number Label
42197	Patent Pending Label
42229	Logo/Burner Description Label
42023	Burner Power Label



CB-1400 Burner*Safety* Labels



SECTION 2: UNPACKING

Before assembling your furnace, you must accomplish the following activities described in this section:

- Removing the Shipping Crate
- Unpacking and Inspecting All Components
- Warranty Registration

Removing the Shipping Crate

ATTENTION: Remove the shipping crate prior to assembly and installation of the furnace. **DO NOT** use the pallet as a platform for furnace installation!

1. Carefully remove the top boards of the shipping crate. Then remove the front, back, and side panels of the shipping crate.
2. Carefully lift the furnace off the shipping pallet with a fork lift, and discard the pallet.

NOTE: DO NOT attempt to slide the furnace out of the shipping crate - you may damage the furnace cabinet.

Unpacking and Inspecting All Components

Following is an itemized list of all components you should have received in your Clean Burn furnace shipment. Open all shipping containers and inspect all components according to the list. Immediately notify the freight company and your Clean Burn dealer in case of shipping damage or shortage(s). Keep all components together so you will have them as needed for furnace assembly and installation.

Furnace Component List

ONE SKID containing:

- Furnace Cabinet
- Burner
- Oil Pump
- Accessory Box (includes the following):
  - Canister Filter
  - Vacuum Gauge
  - Check Valve and Check Valve Screen
  - Wall Thermostat
  - Barometric Damper
  - Connector Block
  - Burner Oil Line and Air Line Components
  - Assorted bolts/fittings for assembly/installation of furnace components
  - Operator's Manual Literature Packet (includes Tank Safety Label)

NOTE: You may have received additional boxes or skids if you ordered optional accessories.

Warranty Registration

For proper warranty registration, Clean Burn requires that you fill out the provided warranty registration card and return it *within 30 days* to:

CLEAN BURN WARRANTY REGISTRATION
Clean Burn, Inc.
34 Zimmerman Road
Leola, Pennsylvania 17540

SECTION 3: FURNACE ASSEMBLY

Understanding Assembly

Assembling your Clean Burn Furnace includes the following steps:

(1) Installing the Observation Port
(2) Installing the Fan Assembly
(3) Installing the Burner

Clean Burn recommends that you review all assembly procedures before proceeding, paying careful attention to safety information statements. **Figures 3A and 3B** provide a general overview of the furnace components and their proper assembly and how the unit should look following proper assembly.

Required Tools and Materials

The following tools are required for furnace assembly and should be gathered before starting any procedures:

- 1/4" nut driver
- Medium flat-blade screwdriver
- 9/16" open-end wrench

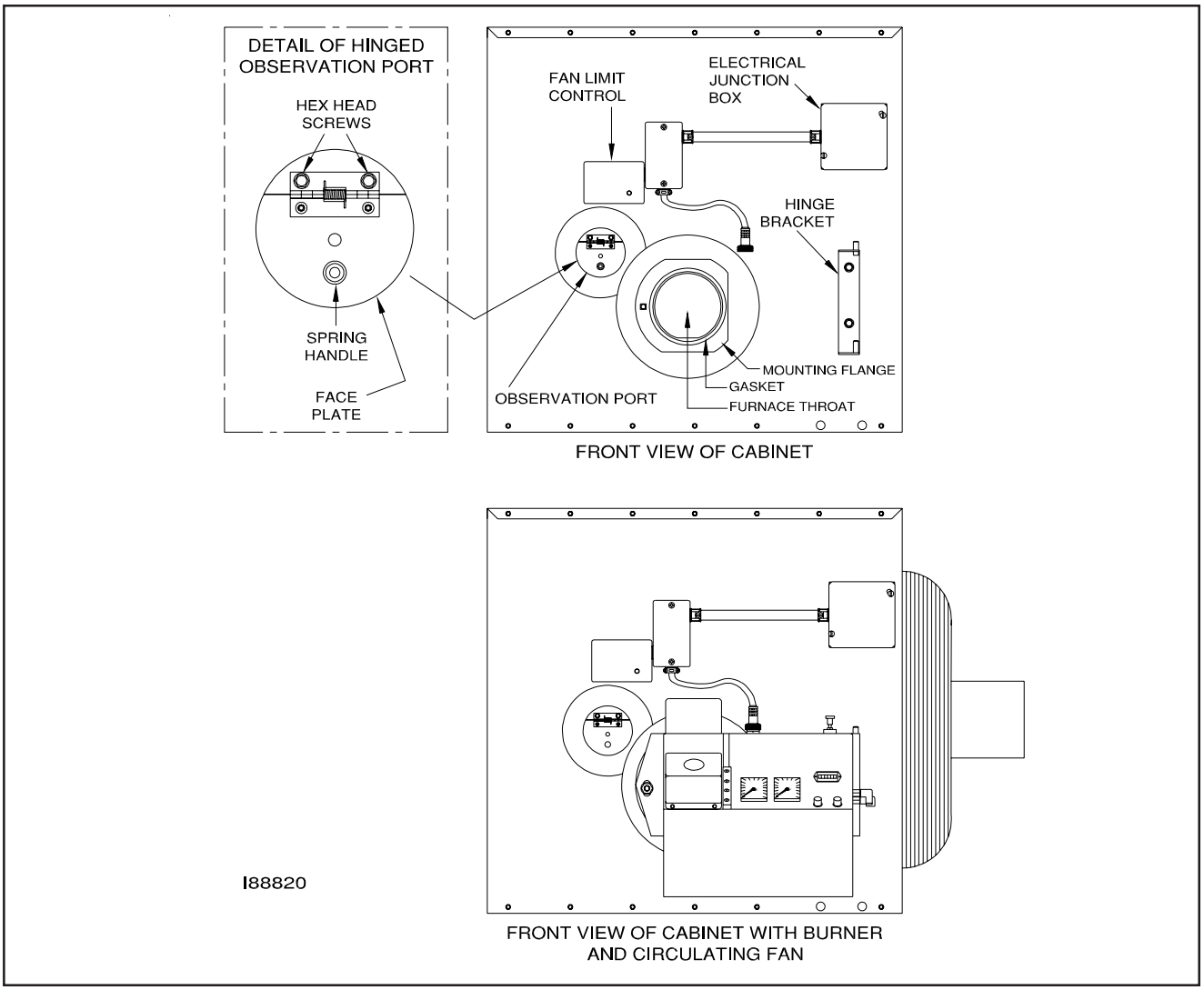


FIGURE 3A - Overview of Furnace Assembly

Installing the Observation Port

CAUTION: To prevent serious personal injury, the observation port must be correctly installed according to the following procedure. A properly installed observation port permits safe observation of the flame during furnace operation. Be sure to follow all safety procedures as outlined in this manual when observing the flame through the port.

1. Refer to Figure 3B.
2. Use a 1/4" nut driver to remove the two (2) self-tapping screws from the half-moon piece.
3. Position the half-moon piece and the faceplate on the observation port, and install the two self-tapping screws.
4. Open the port and make sure the faceplate moves and closes freely. If the faceplate hangs up, loosen the hex-head screws slightly until the faceplate closes correctly.

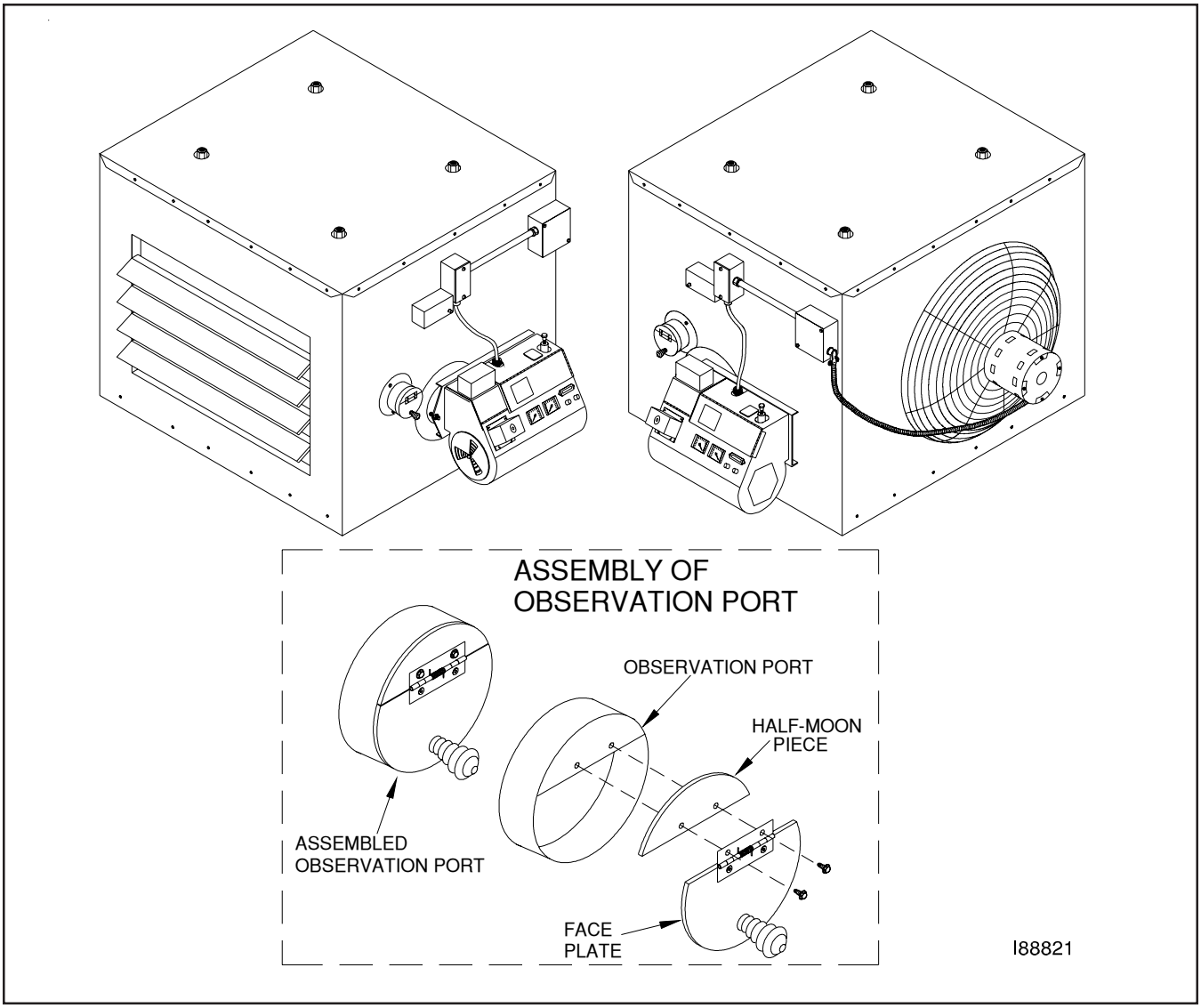


FIGURE 3B - Three-dimensional View - Furnace Completely Assembled

Installing the Fan Assembly

CAUTION: Ducting the CB-1400 Furnace is *not permitted*; it is intended for use as a Unit Heater ONLY.

1. Refer to Figure 3C.
2. Spin the fan blade to check that it spins freely.
3. Remove the cover of the electrical junction box.
4. Attach the fan motor electrical cable to the electrical junction box.
5. Connect the fan motor wires according to the wiring schematic provided in Appendix B at the back of the manual.

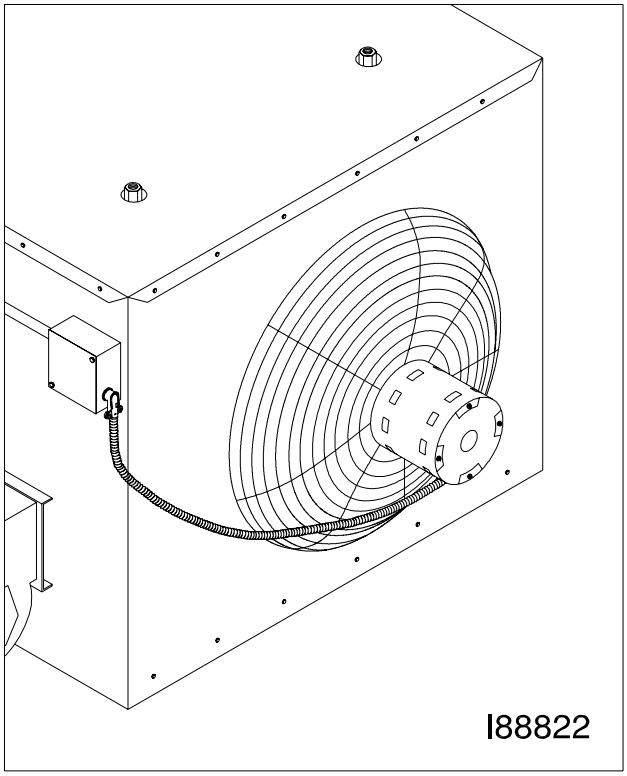


FIGURE 3C - Fan Installed on Furnace Cabinet

Installing the Burner

Checking the Burner Nozzle and Electrodes

NOTE: The burner nozzle, a Delavan 9-5, is factory installed. The nozzle size is indicated on the nozzle as shown in Figure 3D. Refer also to **Appendix A** at the back of the manual for additional specifications/instructions on the burner nozzle.

ATTENTION: Check the electrode settings as specified in Figure 3D. The electrode settings must be correct for your burner to operate properly.

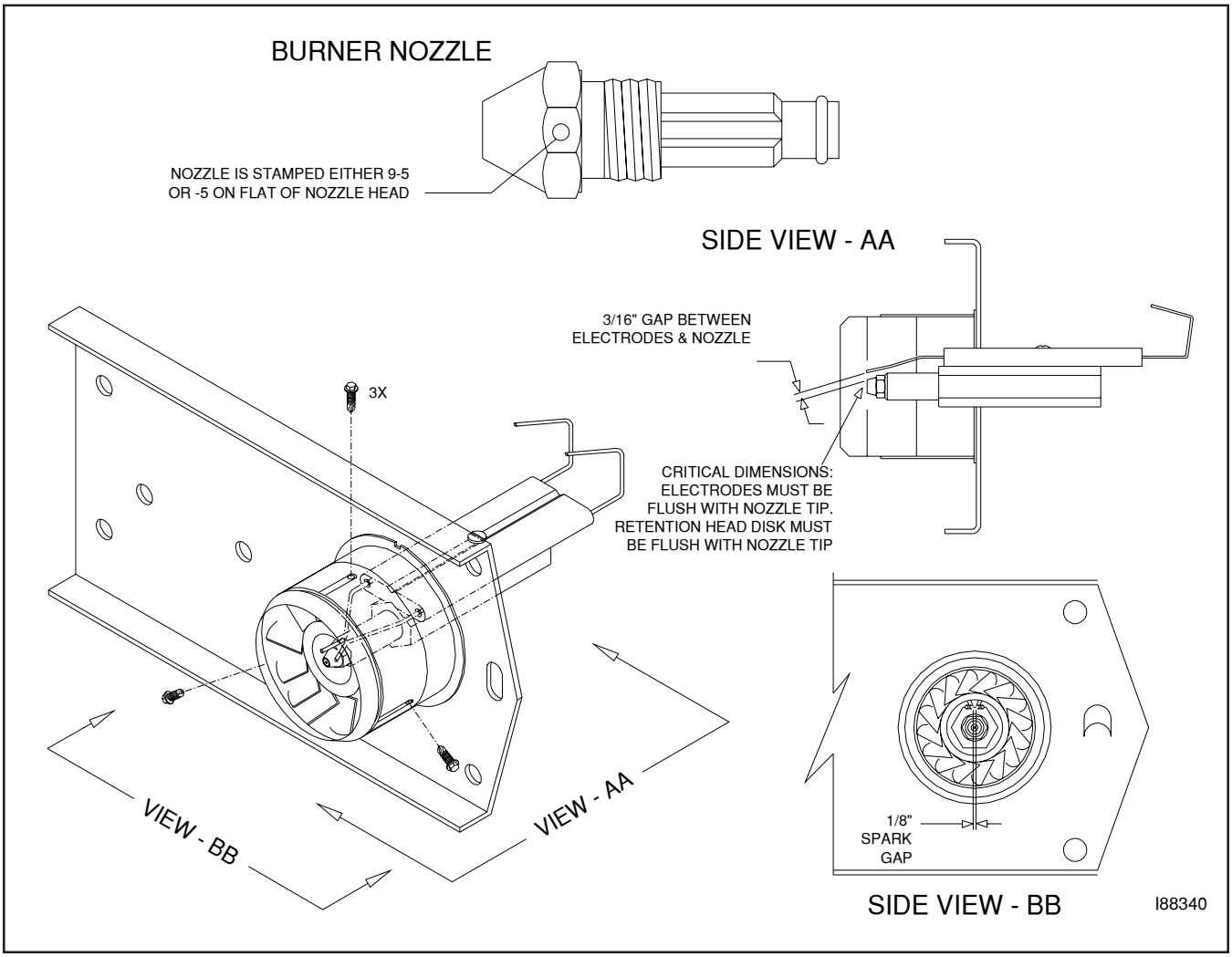


Figure 3D - Burner Nozzle and Electrode Specifications

Installing the Burner (continued)

Mounting the Burner on the Hinge Bracket

ATTENTION: Burner tube components (e.g. electrodes and retention head) are factory set. Handle the burner with extreme care so that burner components are not damaged.

1. Remove the nut from the bolt on the mounting flange of the furnace cabinet with a 9/16" open-end wrench, and set it aside for later use.
2. Lift the burner into position so the burner hinge plate is mounted on the hinge bracket on the furnace cabinet as shown in Figure 3E.
3. Carefully swing the burner so the retention head enters the throat of the furnace.
4. Check the clearance between the retention head and the furnace throat. *There must be at least 1/8" clearance, so the retention head is not "bumped" as you swing the burner into firing position.*

   NOTE: If the retention head "bumps" the furnace throat, adjust the hinge bracket bolts as follows:
   - While supporting the burner, slightly loosen the two (2) hinge bracket bolts.
   - Carefully re-position the burner so it swings freely into its firing position.
   - With the burner in its firing position, re-tighten the hinge bracket bolts.
5. Install and tighten the lock-down nut on the mounting plate bolt to secure the burner in its firing position.

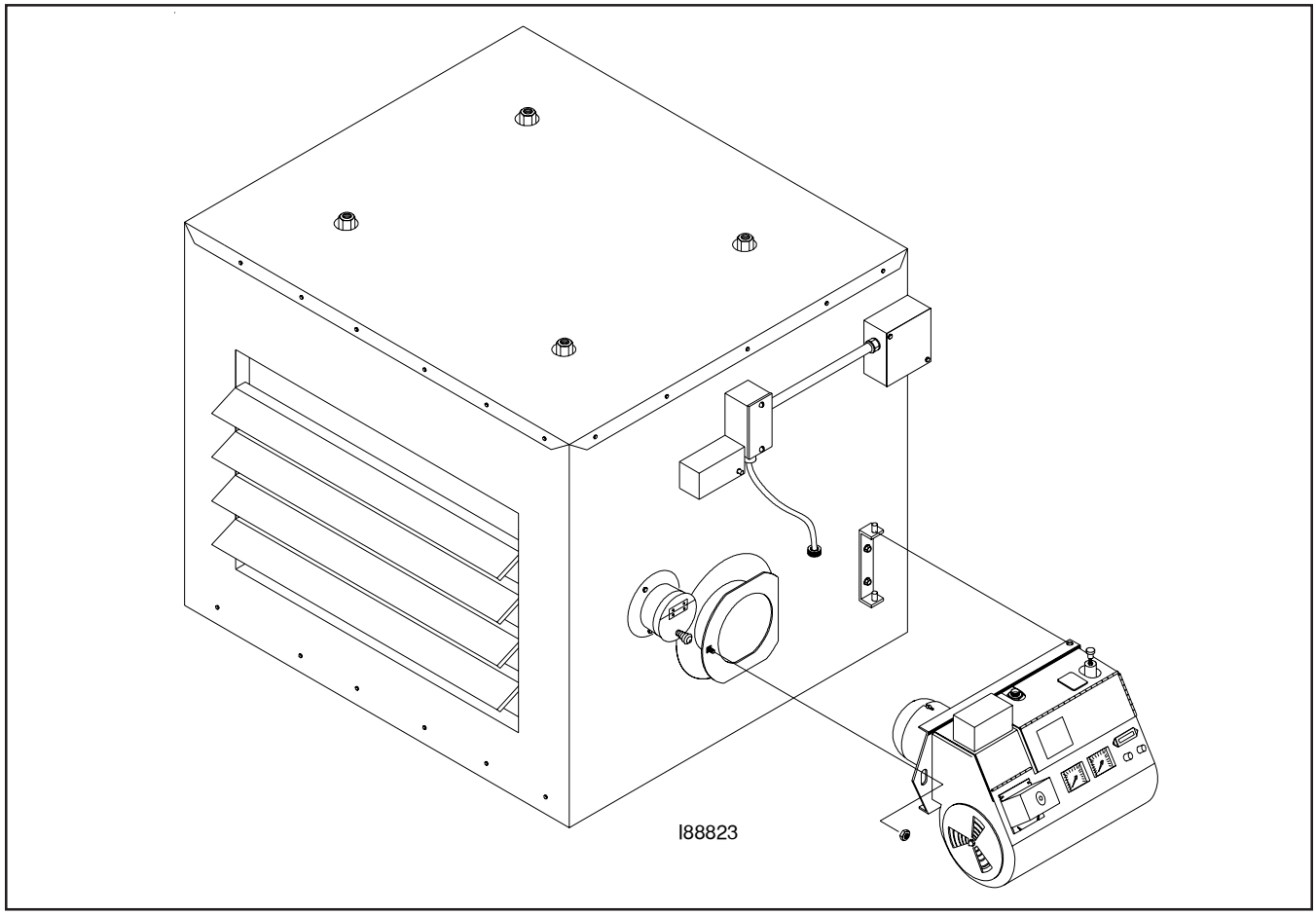


Figure 3E - Mounting the Burner

Installing the Connector Block, Oil Line Tubing, and Air Line Tubing

Installing the Connector Block

1. Refer to Figure 3F.
2. Install the mounting bracket on the furnace cabinet using the two (2) bolts supplied.
3. Install the connector block on the mounting bracket using the two (2) carriage bolts supplied.
4. Remove and discard the red caps and plugs from the fittings and ports on the connector block. DO NOT allow any dirt/debris to enter these components during furnace assembly.

ATTENTION: The connector block includes an accumulator. The accumulator functions like a shock absorber on the oil line to prevent pressure buildup and protect vital burner components. It is important that the connector block is installed as shown so that the accumulator is in a vertical position to prevent sediment from settling in the accumulator. ***Never operate your furnace without the connector block and accumulator properly installed on the furnace, or damage may occur to vital burner components.***

ATTENTION: DO NOT use teflon tape on any fittings. Teflon tape residues will plug vital burner components.

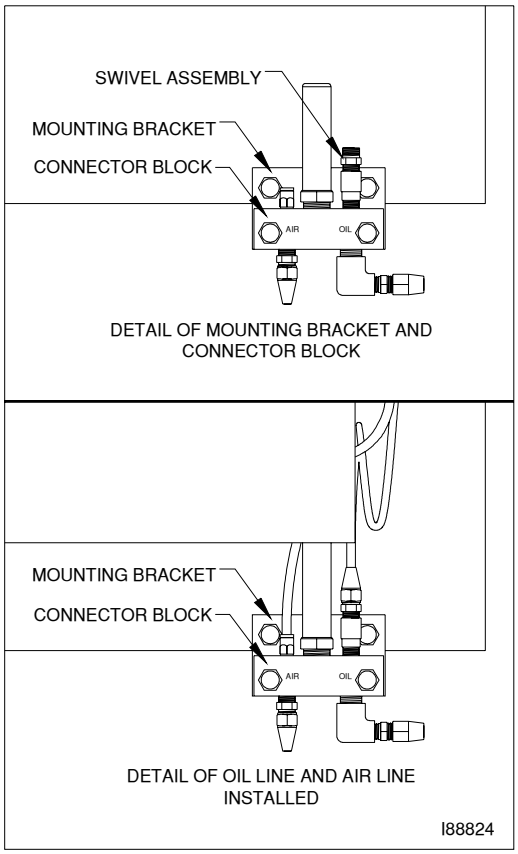


Figure 3F - Installation of Connector Block

Installing the Oil Line Tubing

NOTE: DO NOT disassemble the compression fitting from the swivel fitting. To prevent leaks, the NPT threads of the compression fitting have been sealed with hydraulic sealant during assembly of the fittings at the factory.

1. Remove and discard the red caps from the oil line tubing.
2. Loosely install the oil line tubing into the oil line fitting on the burner.
3. Use a wrench to slightly rotate the oil line fitting on the burner counterclockwise so the tubing lines up with the swivel assembly. Slightly bend the tubing as shown in Figure 3G, if required, to "line up" the oil line.
4. If necessary, use a tubing cutter to cut the tubing to the proper length.
   ATTENTION: Due to adjustment of the burner hinge bracket, the oil line tubing may need to be cut to fit properly. DO NOT lift up on the burner when installing the oil line tubing to compensate for oil line tubing that is too long. This will place the weight of the burner on the swivel fitting and result in leaks at the swivel fitting seal.

Installing the Connector Block, Oil Line Tubing, and Air Line Tubing (continued)

Installing the Oil Line Tubing (continued)

5. Make sure that the curl in the oil line is positioned as shown in Figure 3L so that the burner can swing open correctly.
6. Install the oil line tubing and tighten the nuts on the compression fittings. DO NOT overtighten these fittings to avoid damaging the ferrules.

NOTE: You may also check the positioning of the oil line according to Figure 3H on the next page which provides a larger front view of the connector block assembly.

Installing the Air Line Tubing

1. Remove and discard the red caps from the air line tubing.
2. Refer to Figure 3H. Push the air line tubing into the swivel fitting on the connector block until the tubing bottoms out in the fitting.
3. Repeat this procedure to connect the air line tubing to the air line fitting on the side of the burner.

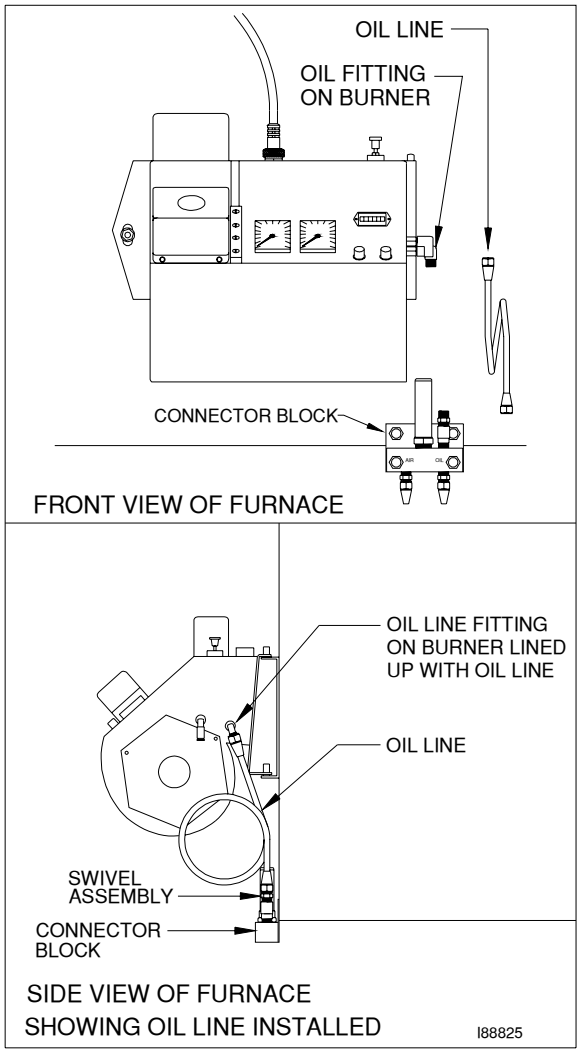


Figure 3G - Installation of Connector Block and Oil Line

NOTE: Your furnace is now assembled and ready for installation. Install the furnace as soon as possible so the burner and/or blower are not "bumped" or damaged. If you must store the furnace for a period of time before installation, make sure it is located in a safe, secure area.

Installing the Connector Block, Oil Line Tubing, and Air Line Tubing (continued)

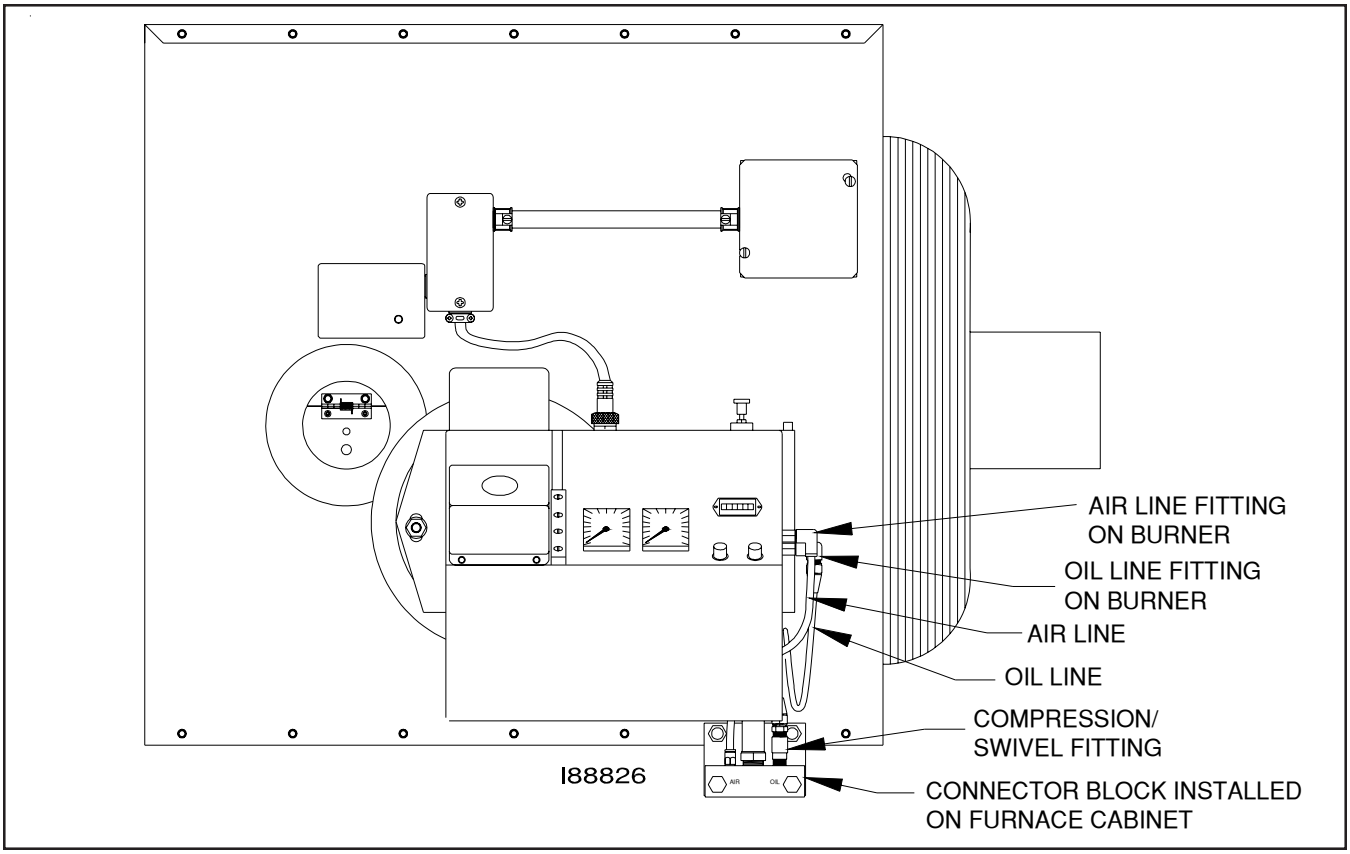


Figure 3H - Installation of Connector Block, Oil Line, and Air Line (Front View)

Locking the Burner into Firing Position

1. Swing the burner into firing position.
2. Install and tighten the lock-down nut on the mounting plate bolt to secure the burner in its firing position.
3. Plug the burner electrical cable into the receptacle on the top of the burner housing.
4. Tighten the locking ring to secure the electrical cable.

NOTE: Be sure to properly align the plug when plugging it into the receptacle. See Fig 3I.

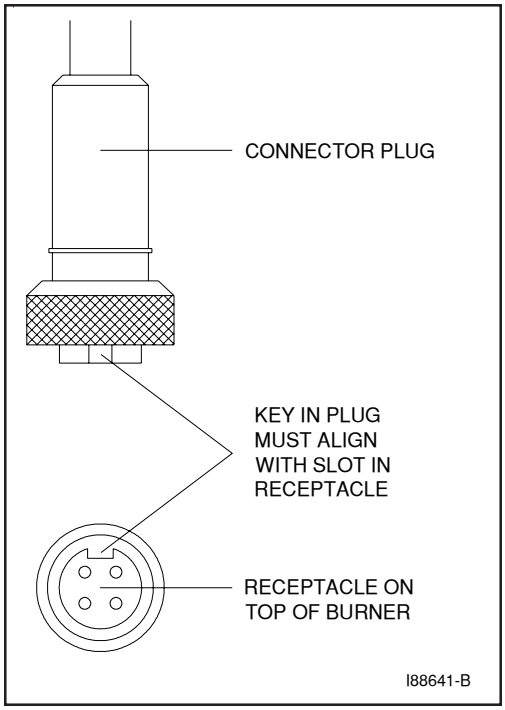


Figure 3I - Detail of Burner Electric Receptacle

SECTION 4: FURNACE INSTALLATION

Understanding Installation

Installing your Clean Burn furnace is a multi-step process which includes:

(1) Selecting a Location
(2) Mounting the Furnace
(3) Oil Tank Specifications (review)
(4) Installing the Metering Pump
(5) Wiring the Furnace and Pump
(6) Installing the Oil Lines
(7) Installing the Compressed Air Line
(8) Installing the Stack
(9) Installing the Wall Thermostat
(10) Inspecting the Installation

Clean Burn recommends that you review all procedures before beginning installation, paying careful attention to safety information statements. Figure 4A provides a general overview of a typical furnace installation and should be reviewed closely before proceeding.

WARNING: The installation, operation, and maintenance of this equipment in the U.S. must be accomplished by qualified personnel and in compliance with the specifications in the Clean Burn Operator's Manual and with all national, state, and local codes or authorities having jurisdiction over environmental control, building inspection and fuel, fire and electrical safety and the following standards of the National Fire Protection Association.

NFPA 30	Flammable and Combustible Liquids Code
NFPA 30A	Automotive and Marine Service Station Code
NFPA 31	Standard for the Installation of Oil Burning Equipment
NFPA 211	Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances
NFPA88A	Parking Structures
NFPA 88B	Repair Garages
NFPA 70	National Electrical Code

The International Mechanical Code
The International Building Code
The International Fire Code
The International Fuel Gas Code

Likewise, the installation, operation, and maintenance of this equipment **in Canada** is to be accomplished by qualified personnel and in compliance with the specifications in the Clean Burn Operator's Manual and in accordance with the regulation of authorities having jurisdiction and the following CSA Standards:

B139	Installation Code for Oil Burning Equipment
B140.0	General Requirements for Oil Burning Equipment
C22.1	Canadian Electrical Code, Part 1

Failure to comply with these standards and requirements may result in equipment damage, fire, explosion, personal injury and/or death.

WARNING: Improper installation can adversely affect the proper, safe operation of your furnace. It is critical that your furnace installer reads and follows the instructions provided in this manual.

WARNING: When installing your furnace, adhere to the minimum clearances from combustible surfaces as stated in Section 4. These clearances also provide adequate space for servicing. Failure to maintain proper clearances may result in fire, explosion, personal injury, or death.

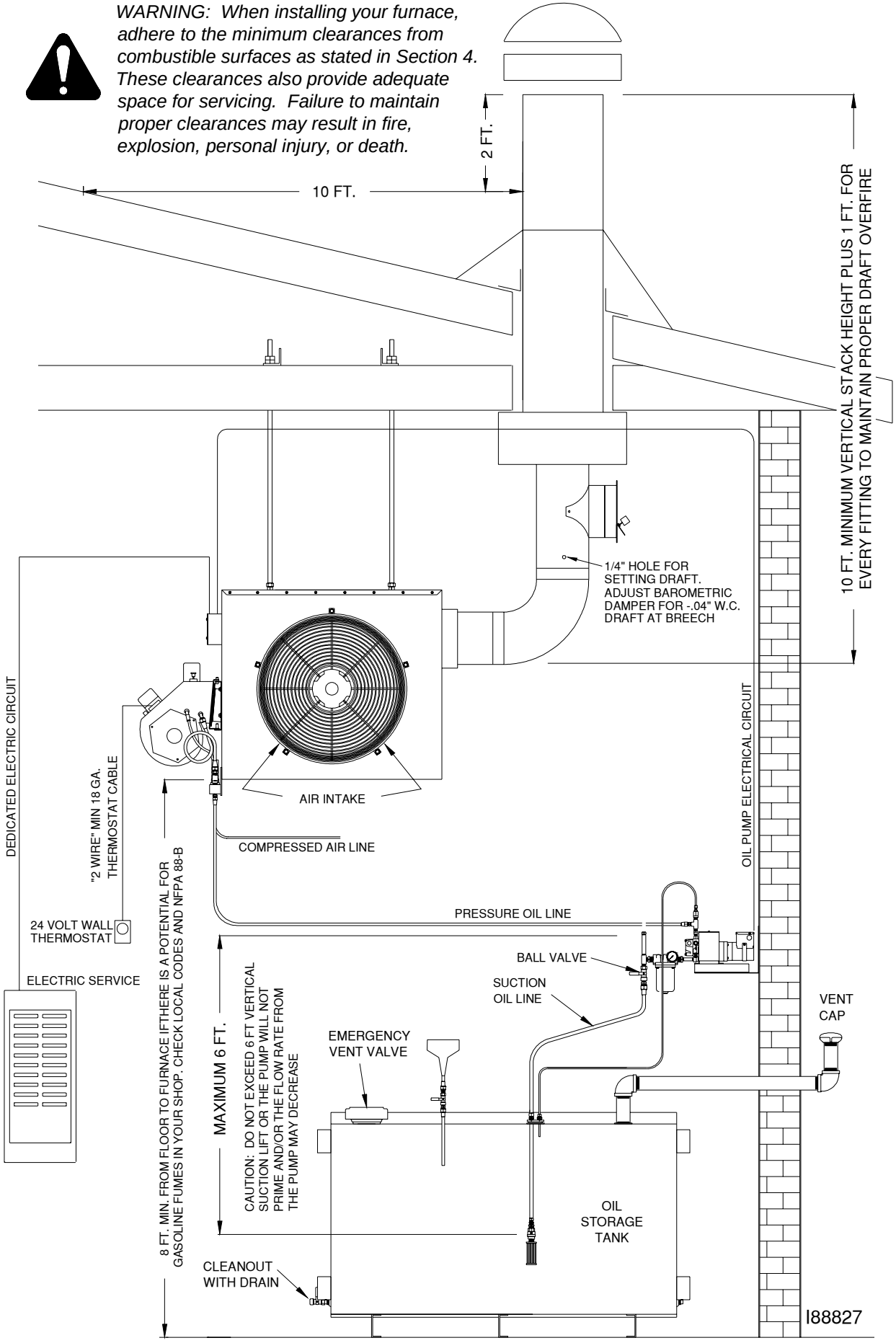


Figure 4A - Typical Furnace Installation

Selecting a Location

Guidelines for Selecting a Location

The location you select for your furnace must allow the following:

- Unobstructed, even heat distribution.
- Safe, easy access for servicing.
- Unobstructed passage for shop vehicles and equipment.
- Proper clearances from combustibles. *Verify according to your local safety codes.*
- Adequate combustion air per local codes.
- Proper stack installation.

WARNING: Adhere to the following *minimum* clearances from combustible surfaces which will also provide adequate clearance for servicing **(Figure 4B)**; failure to maintain proper clearances may result in fire, explosion, personal injury or death.

TOP ..... 18"
FRONT (burner side) ..... 24"
REAR (stack side) ..... 36"
LOUVER SIDE ..... 60"
FAN SIDE ..... 24"
BOTTOM ..... 96"
CHIMNEY CONNECTOR .. 18"

WARNING: National codes require that your furnace is mounted a minimum of eight (8) feet off the ground when installing the furnace in a repair facility. Refer to NFPA-88B, ***Standard for Repair Garages***, Chapter 3, ***Hazards***, Sec. 3-2.3-1.

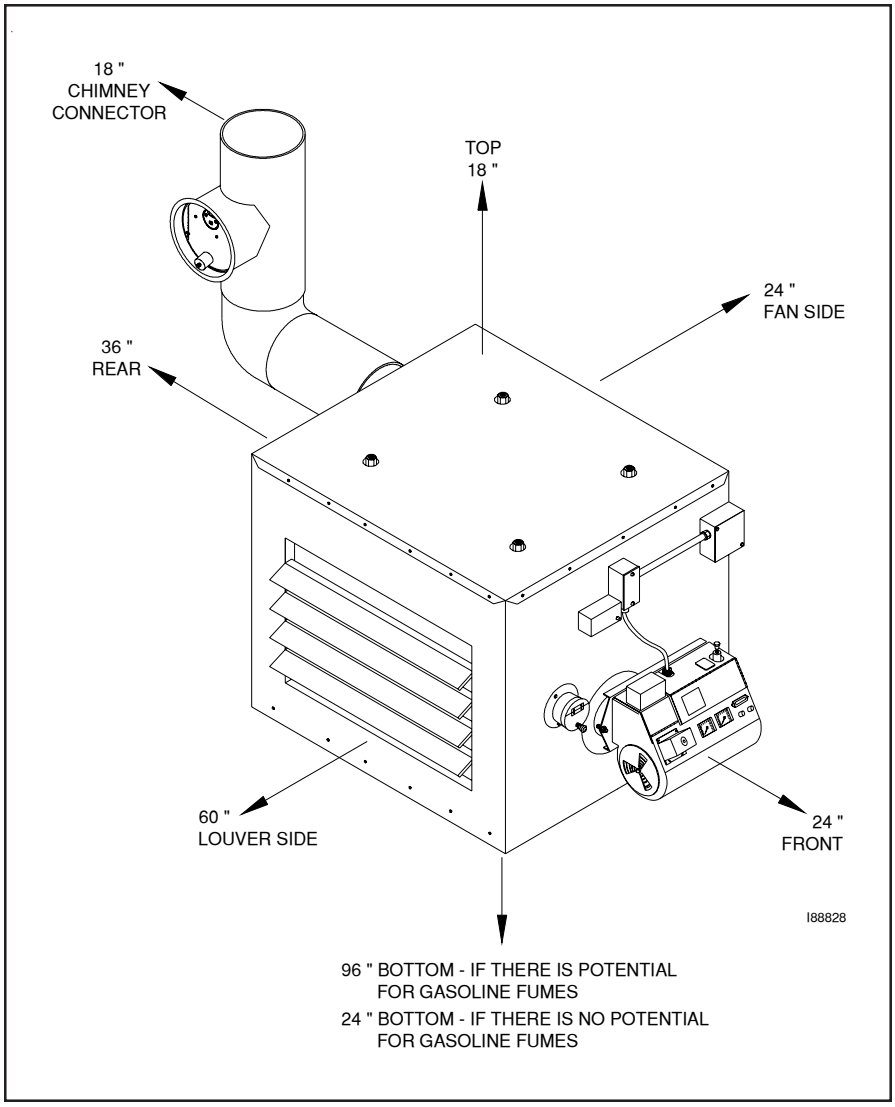


FIGURE 4B - Clearances from Combustibles

Mounting the Furnace

After selecting a safe and appropriate location for your furnace, construct the mounting system as required by the location and the following specifications.

Ceiling Mounting

WARNING: To prevent serious personal injury, ensure that your furnace mounting system can safely bear the suspended weight of the furnace and allow safe servicing of furnace components. Use minimum 2-1/2" x 2-1/2" x 1/4" angle iron beams bridged across sufficient structural members to safely support the furnace.

1. Refer to Figures 4C.
2. Follow the instructions as provided in the diagram.
3. Use a spirit level to make sure the cabinet is level side to side and front to back.

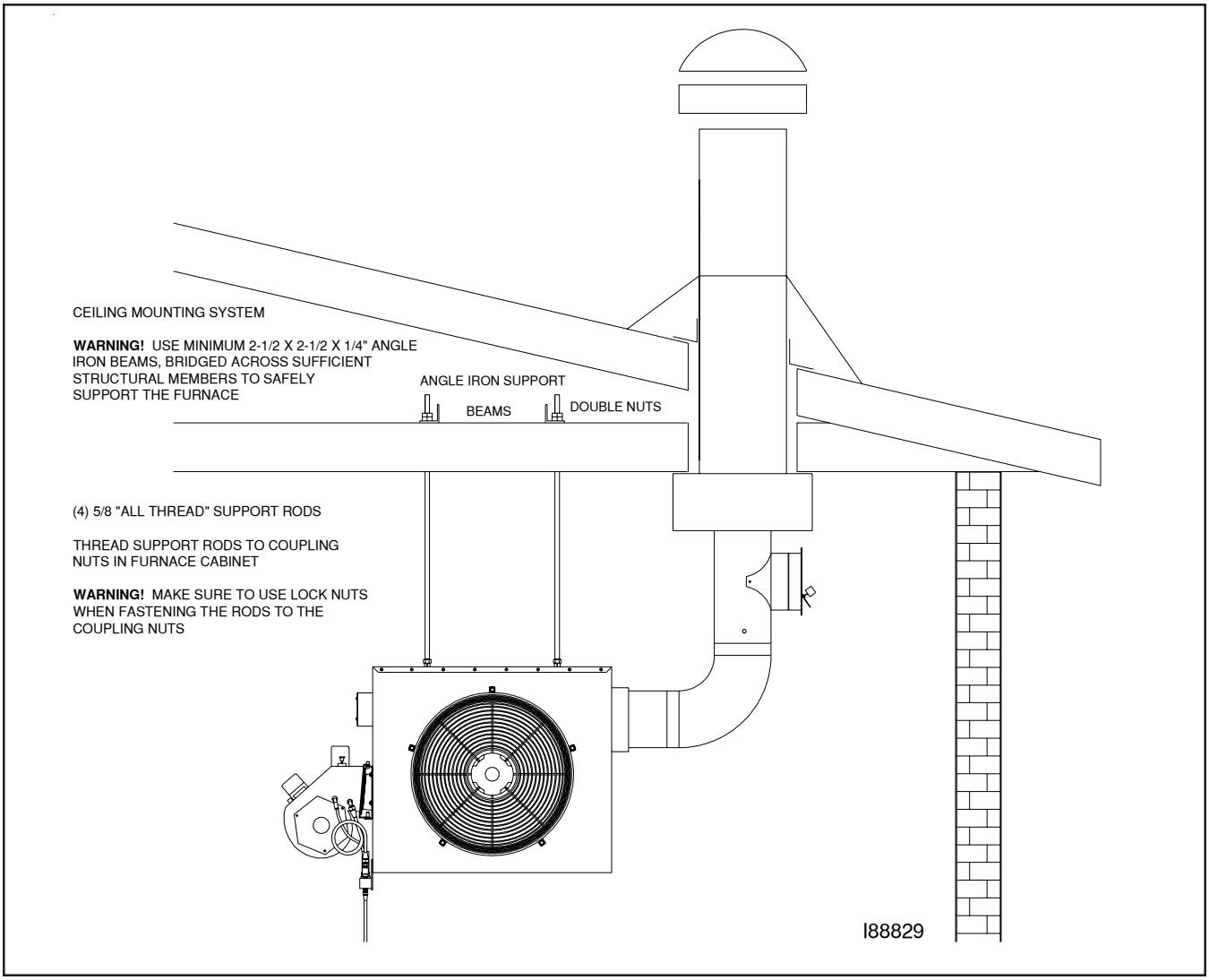


FIGURE 4C - Ceiling Mounting Installation Overview

Mounting the Furnace (continued)

Raised Platform Mounting

WARNING: To prevent serious personal injury, make sure the platform is designed to safely bear the weight of the furnace and allow safe servicing of furnace components. The platform must be constructed of *non-combustible* materials (e.g. steel) and must be securely anchored to an adjacent wall.

1. Refer to Figure 4D and follow the instructions as provided in the diagram.

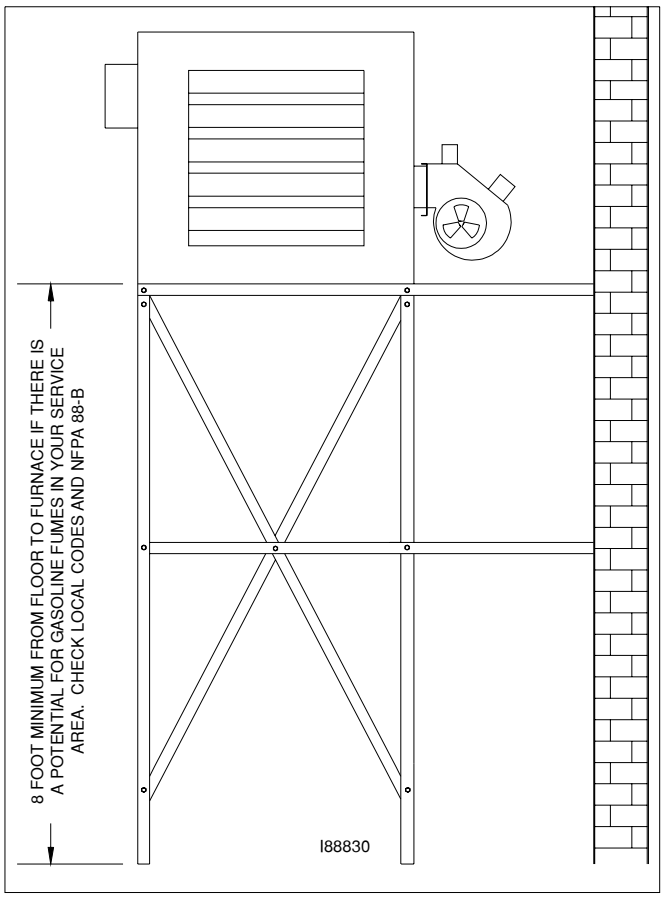


FIGURE 4D - Furnace Installed on Raised Platform

Floor Mounting

WARNING: To prevent serious personal injury, make sure the floor can safely bear the weight of the furnace.

CAUTION: If you are installing your furnace in an area with a combustible floor (e.g. over the top of a parts room or on a mezzanine), you must construct a *non-combustible* floor as shown in Figure 4E. Refer to NFPA-31 or CSA-B-139.

Constructing a Non-Combustible Floor

1. Determine the size of floor you will need to construct:
   - Measure the width and length of the furnace cabinet
   - Add 12" (minimum) to all sides of the cabinet to achieve the total measurement for the non-combustible floor.

   The CB-1400 is approximately 34" x 30"
   34" + 12" + 12" = 58"
   30" + 12" + 12" = 54"
   Therefore your non-combustible floor will need to be 58" x 54"

2. Refer to Figure 4E. Install two (2) pieces of 5/8" sheet rock on top of the combustible material (wooden floor, wooden beams, etc.) The sheet rock must be cut to the size of the total non-combustible floor area.
3. Place a sheet of 24-gauge (minimum) galvanized sheet metal on top of the 5/8" sheet rock; the sheet metal must cover the sheet rock completely.
4. Place 4" thick (minimum) hollow masonry block, end to end, on top of the 24-gauge sheet metal to make a solid foundation. Be sure to add center cross blocking to safely and adequately support the furnace.

Constructing a Non-Combustible Floor (continued)

5. Place a 24-gauge sheet metal pan with a 1" containment lip on top of the masonry blocks. This will provide containment of any oil that may be spilled while working on the furnace.
6. Position the furnace on top of the sheet metal pan; make sure you maintain the extra 12" minimum clearance on all sides of the cabinet.
7. Ensure that the installation adheres to all clearances from combustibles as stated at the beginning of Section 4 in this manual.
8. After positioning the furnace cabinet on the sheet metal pan, install 2" tall (minimum) cinder blocks (4) under each corner of the furnace to elevate the cabinet off the sheet metal pan to allow clearance for installation of fittings on the connector block.

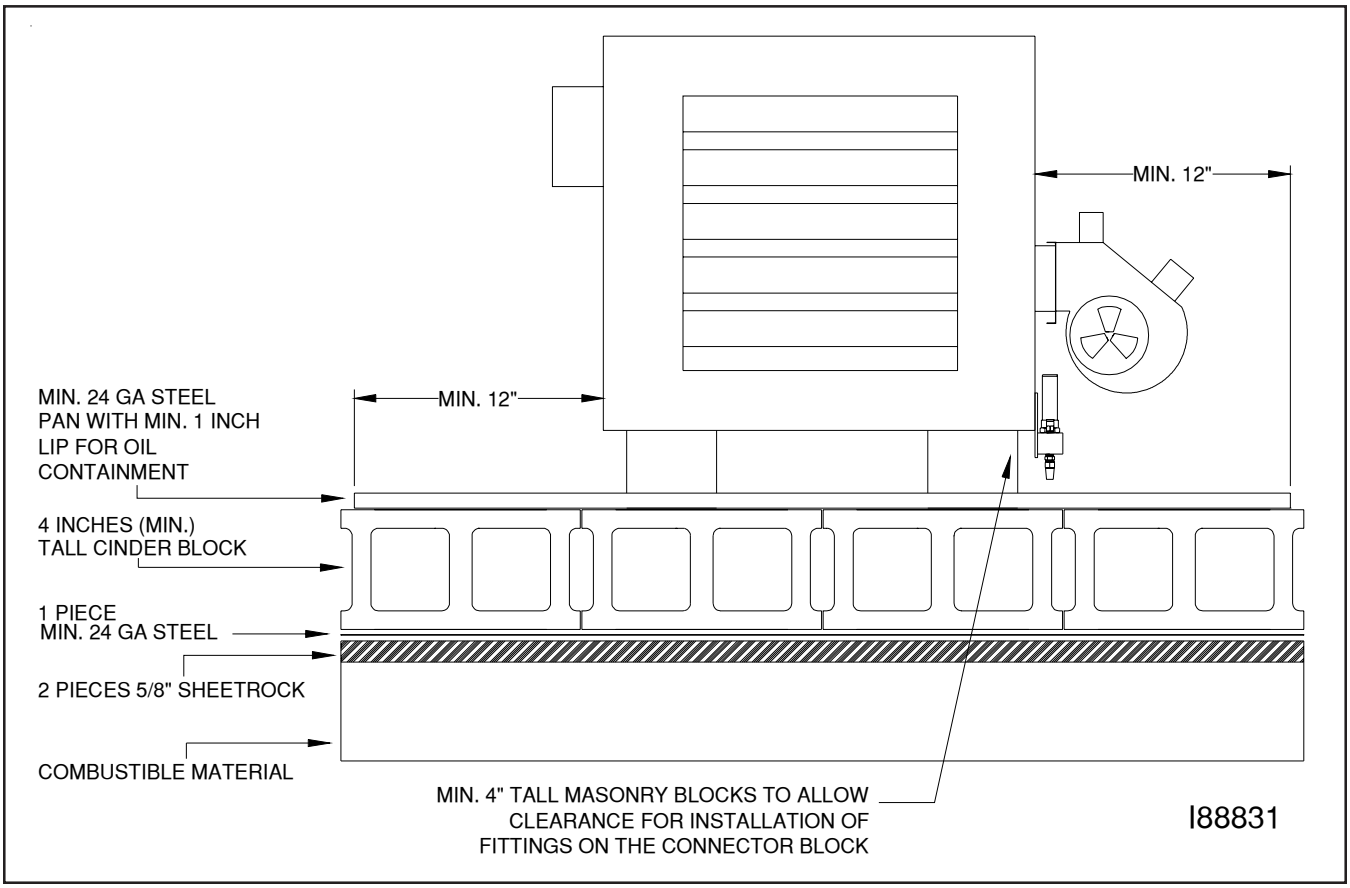


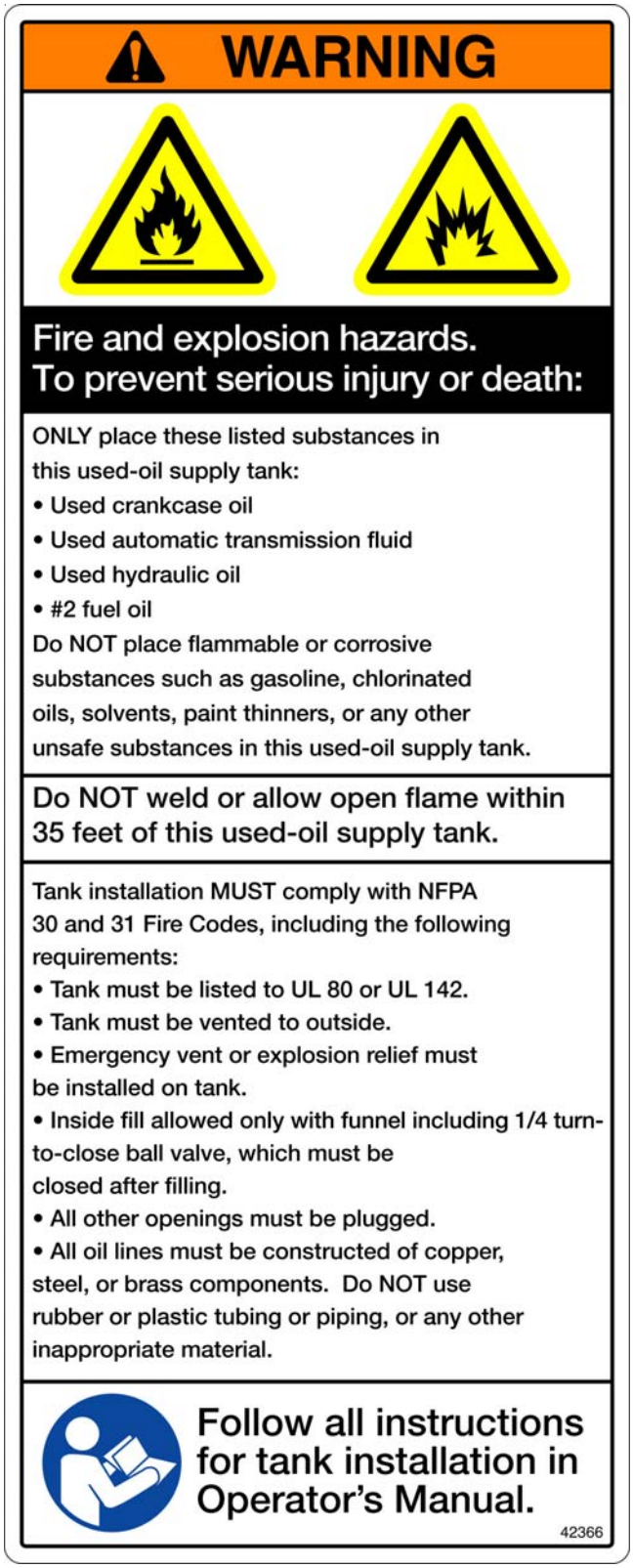
Figure 4E - Furnace Installed on Non-Combustible Floor

Oil Tank Installation Specifications

Ensure that your tank installation adheres to the following safety guidelines as stated here and in **Section 1** of this manual.

The tank safety label (shown at right) also summarizes these important specifications for tank installation and usage. If you do not have a copy of this label, please contact your Clean Burn dealer for a copy, which is to be affixed directly to your used oil supply tank.

- **The tank installation must meet all national and local codes.** Consult your local municipal authorities for more information as necessary.
- The tank must be listed to UL 80 or UL 142.
- Use a **minimum 250-gallon tank.** DO NOT use a 55-gallon drum as a substitute for an appropriate tank. The tank must be large enough to allow water, sludge, etc. to settle out of the used oil.
- The tank must have a **manual shut-off type valve** on the side of the tank to allow the water, sludge, etc. to be drained from the bottom of the tank.
- **All unused openings in the tank must be plugged** or capped off.
- For optimal system functioning, Clean Burn recommends **inside tank installations** as shown in Figures 4A, 4F, and 4J.
- The tank **must be vented to the outside** of the building using iron or steel pipe and fittings with an approved vent cap.
- Carefully review the oil tank and pump installation details as shown in Figures 4A, 4F, and 4J. Pertinent information is also supplied with the metering pump and oil line installation procedures (following in Section 4).
- Ensure that the oil supply tank is **properly maintained**; refer to Section 9 in this manual for related procedures.



ATTENTION: For outside tank installations and/or tanks larger than 500 gallon, contact the Clean Burn Service Department for installation recommendations and specifications.

Oil Tank Installation Specifications (continued)

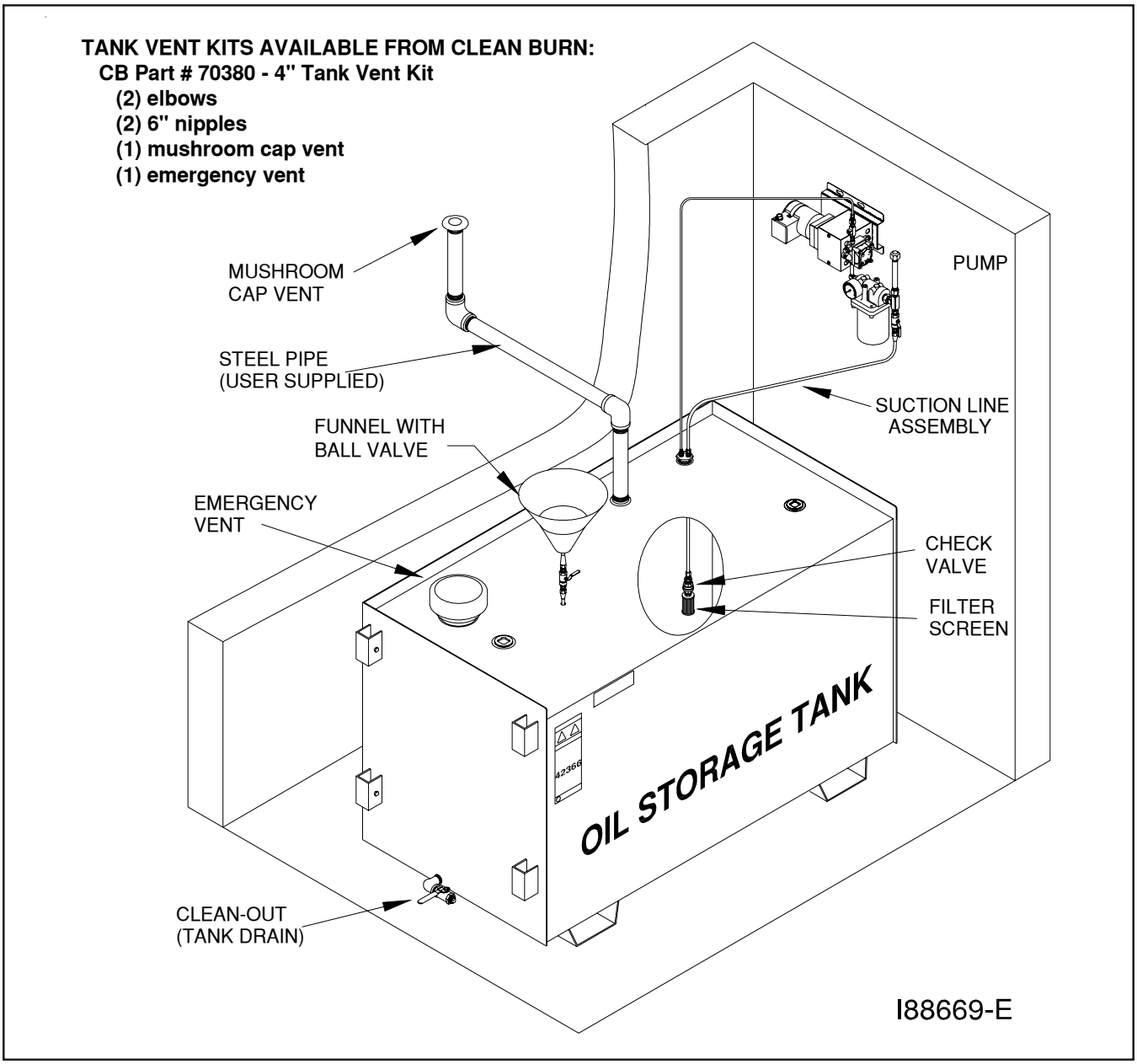


FIGURE 4F - Typical Metering Pump Installation with Inside Tank

Installing the Tank Vent and Emergency Vent

National codes require that you install a tank vent (to the outside) and an emergency vent for your tank as shown in Figure 4F. **Tank Vent Kits** are available from Clean Burn; contact your local Clean Burn dealer to order. Be sure to check your local codes for any additional tank installation requirements, and adhere to the following installation guidelines:

- Install a length of minimum 2" steel pipe (user-supplied) terminating outside with a proper vent cap as shown in Figure 4F. Consult local codes for information and requirements concerning the proper venting of oil storage tanks.
- Install an emergency vent as shown in Figure 4F. Contact your tank manufacturer for information concerning the proper emergency vent for your tank.

Installing the Metering Pump

Preparing for Installation

Before starting installation of the metering pump, review Figure 4G, 4H, and 4I to become familiar with the metering pump components. You will also need to accomplish the following activities:

- Verify that you have the proper metering pump for your furnace model.
- Gather all required tools and materials as needed for installation; as indicated in the following procedures, some materials (e.g. fittings, tubing) are to be user-supplied.
- *Standard mounting* is vertical mounting on a wall; **this pump installation is recommended.** *Alternate mounting* is horizontal mounting on a bracket. Be sure to carefully follow the appropriate procedures/diagrams for pump mounting.
- For optimal metering pump functioning, **ensure that the pump is mounted at a distance not more than four (4) feet from the oil tank.**

Standard Mounting: Vertical Positioning

1. Refer to Figures 4G, 4H, and 4I. Note that the metering pump is shipped with the pump head already positioned for vertical wall mounting.
2. Use the appropriate type of bolts and washers (user-supplied) to securely mount the metering pump to the appropriate wall in your building **at a distance not more than four feet from the tank.**

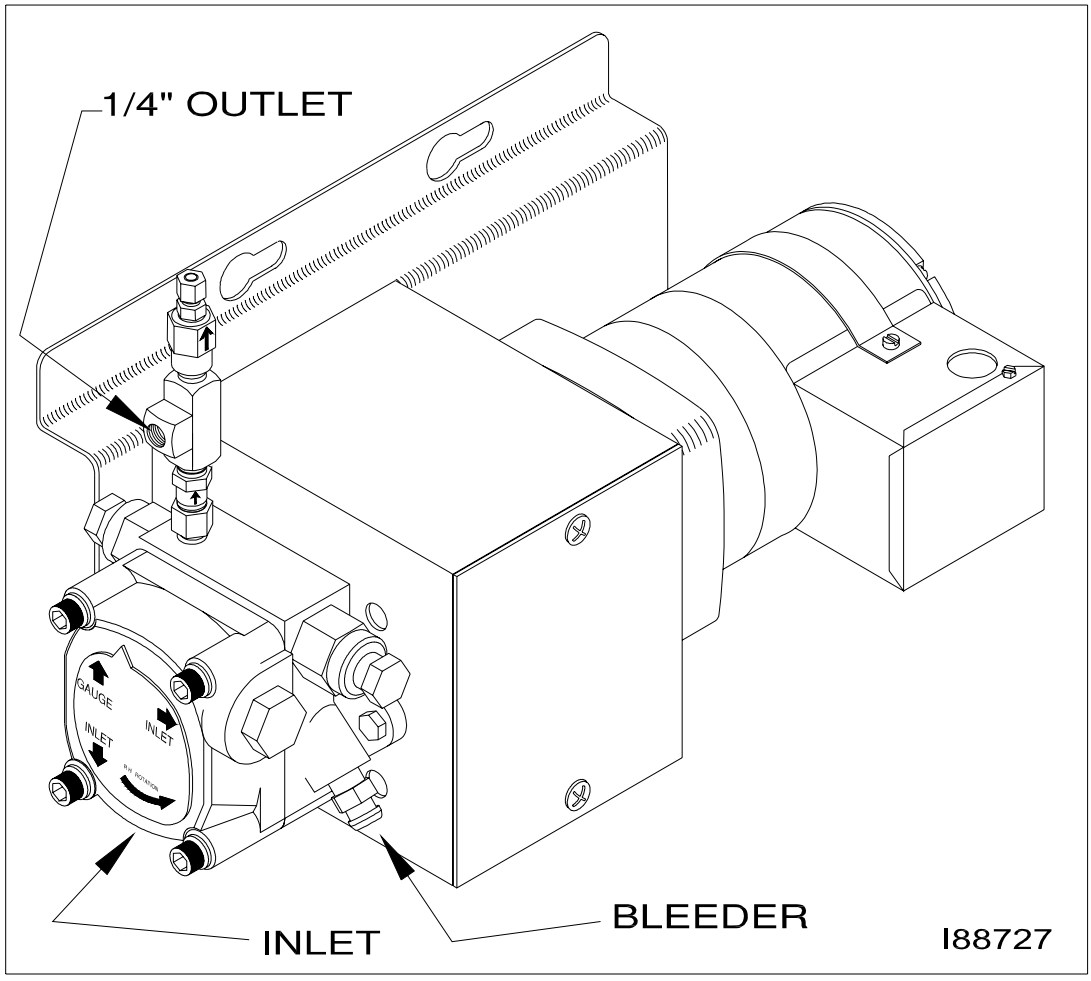
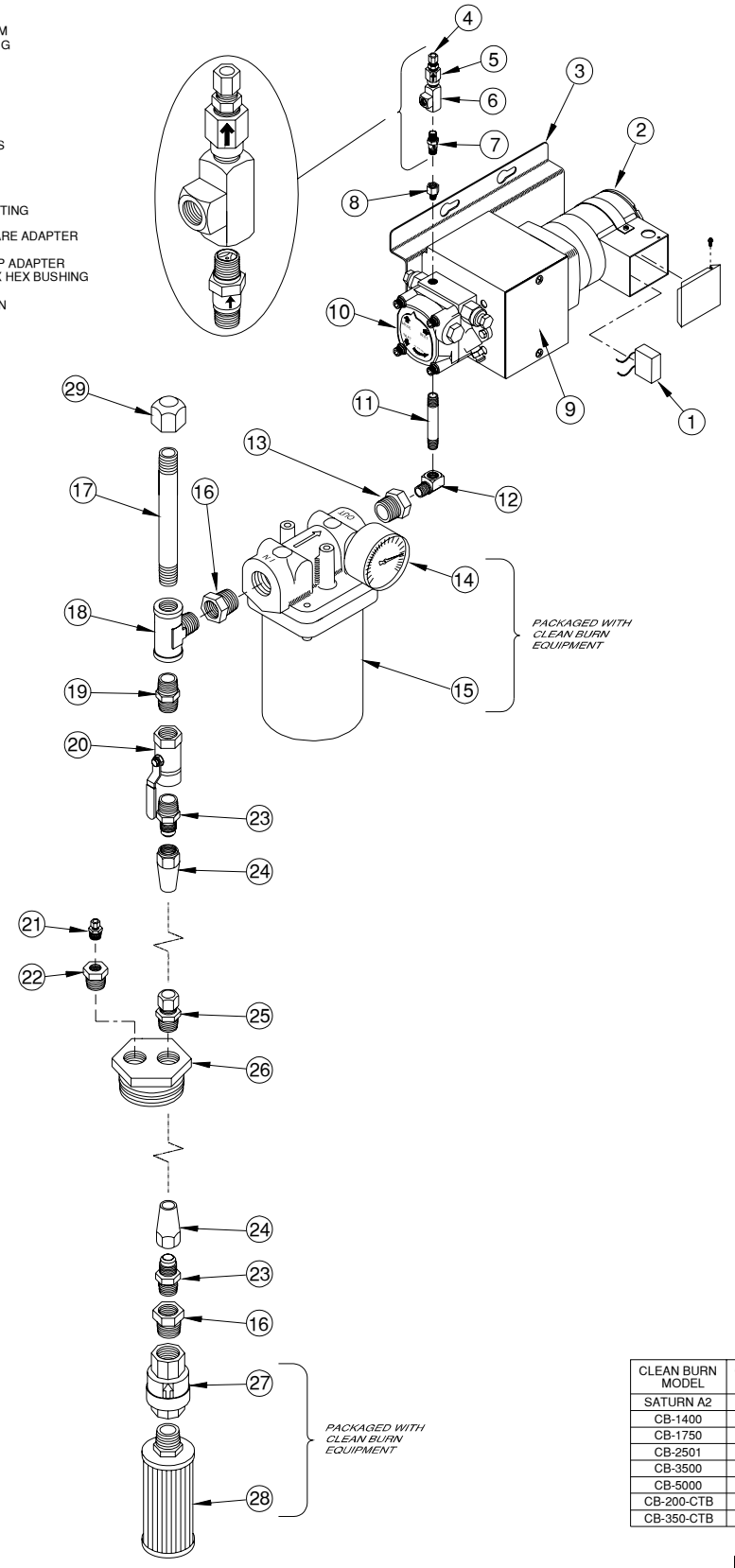


Figure 4G - Vertical Mounting of the Metering Pump

#	PART #	DESCRIPTION
1	33363	CAPACITOR - GEARMOTOR
2	see chart	GEARMOTOR
3	11322	MOUNT - METER PUMP
4	32062	MALE CONNECTOR 1/4" T TO 1/4" NPT
5	32293	RELIEF VALVE
6	32425	1/4" NPT BRASS TEE
7	32424	LOW FLOW CHECK VALVE
8	32335	ADAPTOR PIPE 1/4"F X 1/8"M
9	21119	LID - METER PUMP HOUSING
10	32327	METER PUMP
11	32467	1/4" X 3" NIPPLE
12	32210	1/4" STREET ELBOW
13	32336	1/4" X 3/4" BRASS BUSHING
14	32123	VACUUM GAUGE
15	32127	CANISTER FILTER- LENZ
16	32430	1/2" x 3/4" BUSHING, BRASS
17	32446	1/2" X 5" NIPPLE
18	32429	1/2" STREET TEE, BRASS
19	32137	1/2" HEX NIPPLE
20	32142	1/2" BALL VALVE
21	32062	1/4" NPT x 1/4" TUBING FITTING
22	32443	1/4" x 1/2" BUSHING
23	32141	1/2" NPT x 1/2" TUBING FLARE ADAPTER
24	32140	1/2" LONG NUT
25	32139	1/2" NPT x 1/2" TUBING SLIP ADAPTER
26	32442	2" x 1/2" x 1/2" NPT DUPLEX HEX BUSHING
27	32021	3/4" CHECK VALVE
28	32061	3/4" CHECK VALVE SCREEN
29	32445	1/2" PIPE CAP



CLEAN BURN MODEL	GEARMOTOR PART #
SATURN A2	33291
CB-1400	33291
CB-1750	33353
CB-2501	33354
CB-3500	33355
CB-5000	33356
CB-200-CTB	33507
CB-350-CTB	33295

I88690-G

Figure 4H - Metering Pump Component Detail

Installing the Metering Pump (continued)

Alternate Mounting: Horizontal Positioning

ATTENTION: If the metering pump is to be mounted horizontally or on a bracket as shown in Figure 4I, the pump head must be rotated counterclockwise so that it is aligned in a horizontal position. ***The gauge arrow on the pump head must point up, or the pump will not prime.***

1. Refer to Figures 4H and 4I.
2. Remove the two pump mounting bolts. The coupling is keyed and does not have set screws.
3. Rotate the pump head 180 degrees to the horizontal position as shown in Figure 4I.
4. Re-install and tighten the two pump mounting bolts.
5. Use the appropriate type of bolts and washers (user-supplied) to securely mount the metering pump to the mounting bracket, which is to be installed on the appropriate wall in your building **at a distance not more than four (4) feet from the tank.**

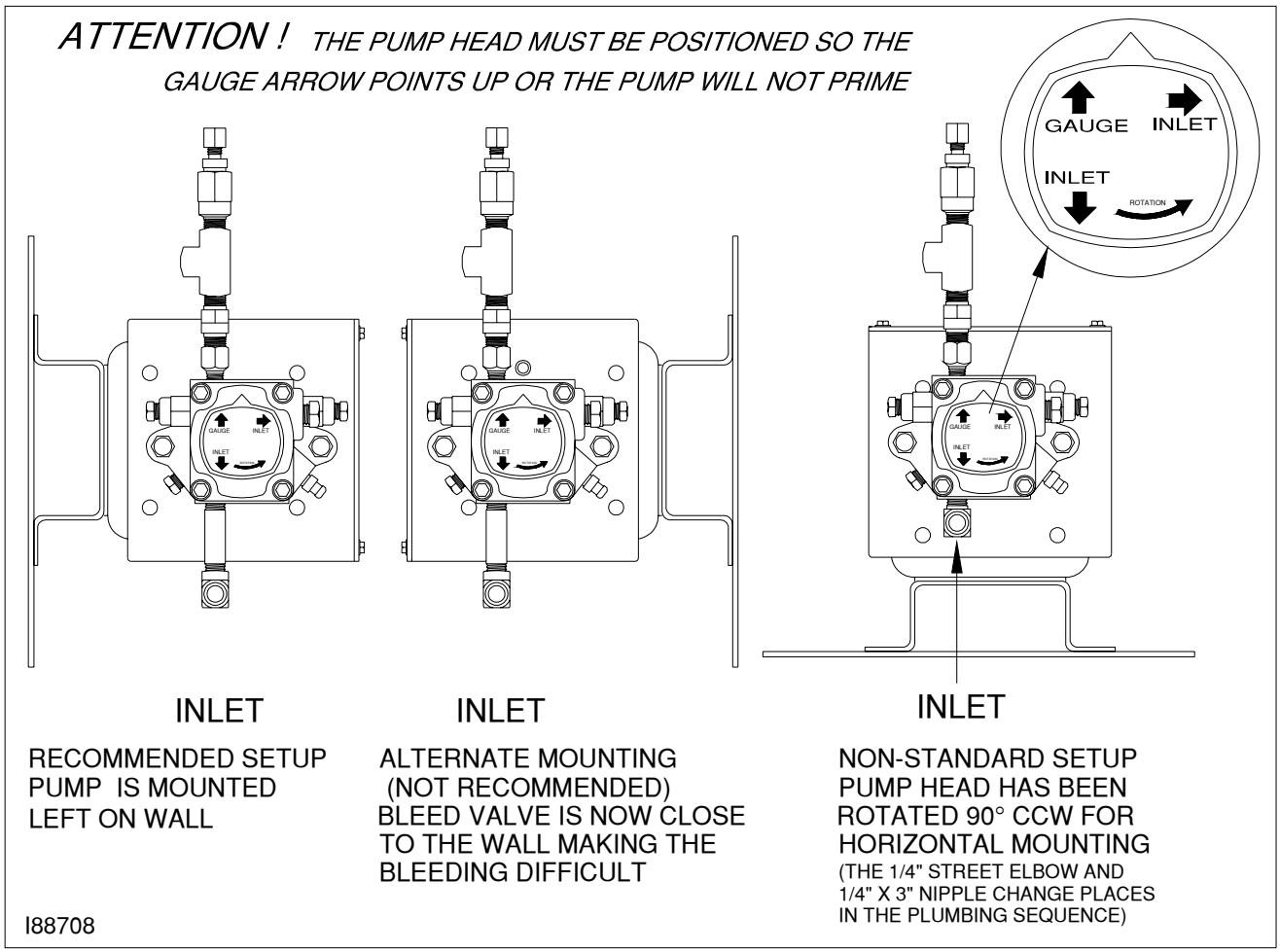


Figure 4I - Proper Positioning of Metering Pump Head

Wiring the Furnace and Pump

WARNING: To avoid electrical shock, make sure that power to the furnace is turned OFF before connecting any wires. A licensed electrician should install all wiring to your furnace. All wiring must be in accordance with the National Uniform Electrical Code and local codes. Properly size all wires and use electrical conduit for all electrical lines.

Wiring your furnace involves the installation of two lines:

(1) A dedicated electrical line to the furnace
(2) A pump electrical circuit from the furnace to the metering pump

Necessary wiring specifications are provided in this section and in the **Wiring Schematics** located in **Appendix B** at the back of the manual.

Wiring to the Furnace

1. Install a dedicated electrical circuit to the electrical junction box on the furnace.

WARNING: DO NOT tie into an existing circuit, or electrical overload may occur.

2. Wire the furnace according to the Wiring Schematic, Figure B1, in Appendix B.
3. Check for correct voltage at the furnace, and refer to the following chart.
   ATTENTION: Incorrect voltage will severely damage the blower motor/furnace components. DO NOT operate your furnace on any non-specification power system.

Model	Voltage	Breaker Size*	Circuit	Hertz
CB-1400	110/120	20 amps	Dedicated	60

***NOTE: Breaker size with optional equipment is 30 amps.** When installing any optional equipment (e.g. air compressor or draft inducer), you must use a 30 amp breaker. Make sure a qualified electrician properly sizes and installs this electrical circuit.

4. DO NOT turn on main power until instructed to do so.

Wiring to the Metering Pump

WARNING: DO NOT wire the pump directly into your building's electrical system. The pump must be activated (receive power) from the burner via the pump electrical circuit. DO NOT wire the pump directly to a wall outlet so that it runs continuously; this will seriously damage your metering pump and/or furnace and may result in a fire or explosion hazard.

1. Install the pump electrical circuit from the furnace to the metering pump location.
2. Wire the pump circuit according to the appropriate Wiring Schematics, Figures B1 and B4 (Appendix B).

Installing the Suction Oil Line Components

ATTENTION: It is critical that you adhere to the following specifications for suction oil line installation *(oil line from the tank to the pump)*. If these specifications are not met, the metering pump will not function correctly and the burner will shut down on reset. The majority of service problems with the metering pump are caused by leaks at fittings in the suction oil line; these problems are eliminated by ensuring a 100% airtight suction oil line which slants up to the pump.

- All suction oil line components must be installed as shown in Figures 4H and 4J. **Suction line size is 1/2" diameter.** Proper installation allows the suction oil line to be filled with used oil during initial priming.

- The suction oil line may NOT exceed **6 feet TOTAL vertical lift AND 4 feet TOTAL horizontal lift** *(which equals 6.0" hg maximum operating vacuum)*. To determine if your suction oil line will meet this specification for maximum operating vacuum, base the calculation for your installation on the following equivalents:

  (1) vertical foot = 0.75" hg (vacuum)
  (4) horizontal feet = 0.75" hg (vacuum)

  NOTE: ALSO ADD 0.75" hg to the final sum to account for every oil filter, shut-off valve, and check valve on the suction side of the pump assembly.
  Sample calculation: (6) vertical feet x 0.75" = 4.50" hg AND (4) horizontal feet = 0.75" hg
  4.50" hg + 0.75" hg + 0.75" hg = 6.00" hg vacuum

- The metering pump must be installed with a **3/4" check valve and screen** at the end of the suction oil line, or the pump will not maintain its prime.

- Use **Permatex #2 non-hardening gasket sealer** on every threaded fitting. DO NOT use teflon tape or teflon pipe dope compounds; the teflon can flake off and cause damage to the pump head.

- **The suction oil line must be 100% airtight for proper system functioning.** Use only high-quality flare fittings for the copper tubing. DO NOT use compression fittings. DO NOT use any steel pipe unions. DO NOT use sweat copper pipe. These types of fittings cause air leaks in the suction oil line and will require re-installation.

- **The suction oil line must slant up to the pump;** any high spots will trap air and will not allow the pump to prime.

1. **Assemble the suction oil line fittings *(from the metering pump to the canister filter)*:**
   a. Refer to Figure 4H for a detailed look at the metering pump components and fittings.
   b. Remove the plug from the 1/4" inlet port of the pump.
   c. Install the 1/4" x 3" brass nipple into the 1/4" inlet port on the pump.
   d. Install the 1/4" brass street elbow onto the 3" brass nipple; turn the fitting onto the nipple until it is tight and faces away from the pump mounting plate.
   e. Prepare the canister filter for installation:
      - Install the 3/4" x 1/4" brass hex bushing into the outlet port of the canister filter. *Check the direction of the arrow for the proper flow.*
      - Install the 3/4" x 1/2" brass bushing into the inlet port of the canister filter.

Installing the Suction Oil Line Components (continued)

(1.) (e.) Prepare the canister filter for installation *(continued):*

- Remove the plug from one of the 1/8" gauge ports in the canister filter and install the vacuum gauge. Seal the threads of the gauge with Permatex #2 non-hardening gasket sealer.
- Install the 1/2" threaded pipe adapter into one side of the 1/2" ball valve.
- Install the 1/2" MPT x 1/2" flare adapter into the other side of the ball valve.
- Install this assembly into one side of the 1/2" brass tee.
- Install the assembled 1/2" tee into the 3/4" x 1/2" brass bushing, which is installed in the inlet port of the canister filter. Make sure that the 1/2" flare adapter is pointing down.
- Install the canister filter assembly onto the 1/4" brass street elbow as shown in Figure 4H. The canister filter must be installed with the arrow pointing towards the pump (direction of oil flow).
- Install the 1/2" x 5" brass nipple into the top side of the 1/2" brass tee assembly.
- Loosely install the 1/2" brass cap onto this nipple; DO NOT tighten the cap at this time.

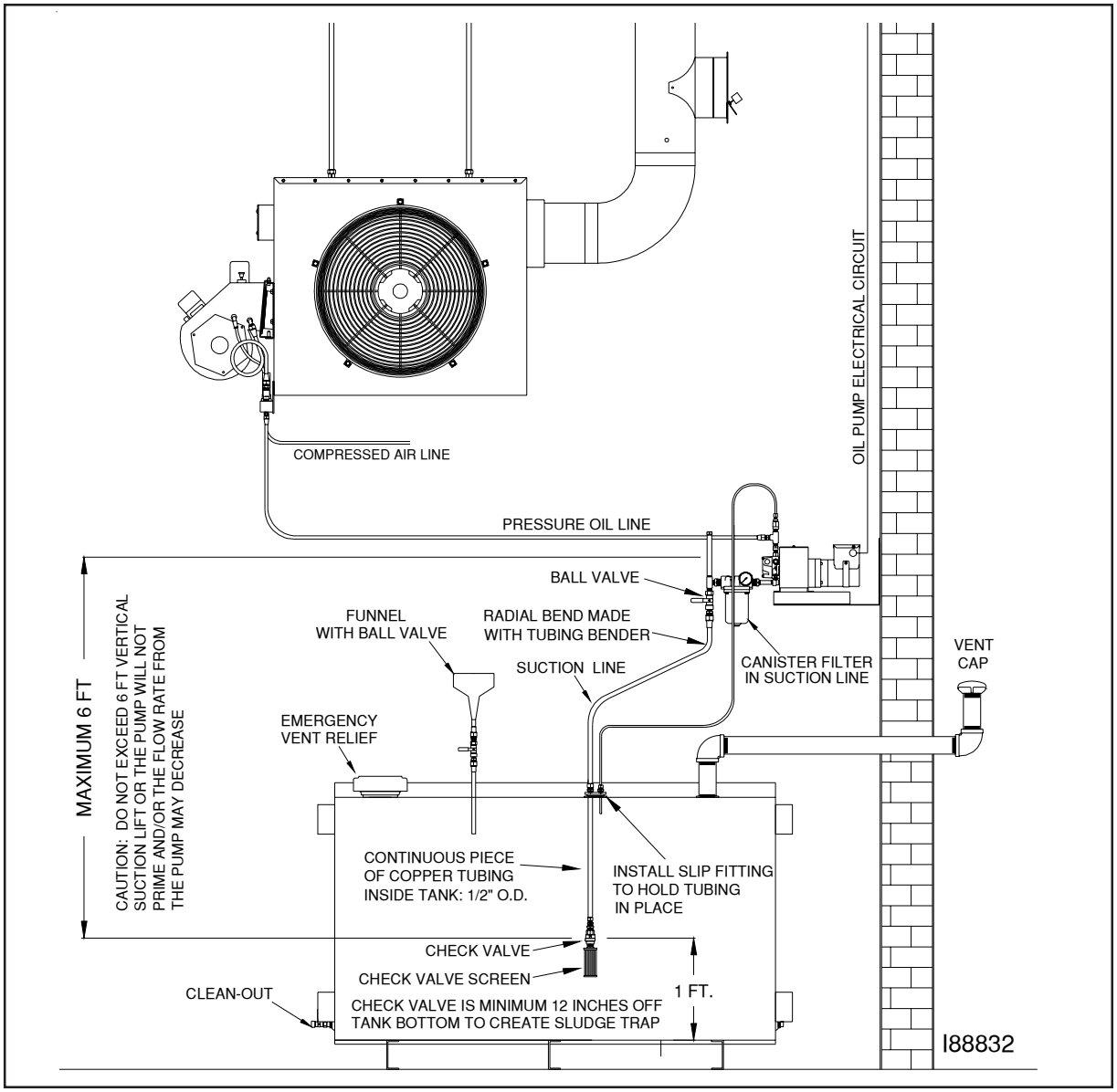


Figure 4J - Oil Line Installation Overview

2. **Install the suction oil line *(from the the tank to the canister filter)*:**
   a. Refer to Figures 4H and 4J. Prepare a piece of 1/2" O.D. copper tubing (user-supplied) which will function as the pick-up line from the tank to the canister filter. This copper tubing must have the following specifications:
      - The tube must be one continuous piece of 1/2" O.D. copper tubing with no kinks or fittings.
      - The tube is to slant up from the tank to the pump with no loops or high points to trap air.

   c. Locate the 2" MPT x 1/2" FPT x 1/2" FPT duplex, slip-thru hex bushing (which will eventually be installed into one of the 2" openings on the tank). *Note that the fitting is marked "S" for suction and "R" for return.*
   d. Install the 1/2" MPT x 1/2" slip fitting into the "S" side of the 2" duplex slip-thru hex bushing.
   e. Install the 1/4" MPT x 1/4" compression fitting into the 1/2" x 1/4" brass bushing.
   f. Install the 1/2" x 1/4" brass bushing into the "R" side of the 2" duplex slip-thru hex bushing.
   g. Measure the height of the oil tank (from the bottom of the tank, NOT the floor) to the 2" opening that you are going to use for the supply oil line. Deduct 12" (305mm) from this measurement and transfer this new measurement onto the 1/2" O.D. copper tubing.
   h. Remove the locking nut and ferrel sleeve connector from the 1/2" slip fitting, and slide them over the copper tubing.
   i. Slide the 1/2" O.D. copper tubing through the 1/2" slip fitting, which is installed in the "S" side of the 2" hex bushing.
   j. Install the screen into one side of the 3/4" check valve (making sure the arrow is pointing away from the screen assembly).
   k. Install the 3/4" x 1/2" brass bushing into the 3/4" check valve.
   l. Install the 1/2" MPT x 1/2" flare adapter into the 3/4" x 1/2" brass bushing.
   m. Slide the 1/2" flare nut over the end of the 1/2" copper tubing, and flare the end of the tubing. **NOTE:** Use a high-quality flaring tool (such as a Ridgid Flaring Tool) to ensure that all flares are made properly (i.e. so they will be 100% airtight).
   n. Install the flared oil line and nut onto the assembled check valve/screen and tighten.
   o. Pick up the assembled oil line, and carefully guide the end of the tubing with the check valve through the 2" tank opening.
   p. Apply Permatex #2 non-hardening gasket sealer (or equivalent) to the threads of the 2" duplex slip-thru tank bushing, and tighten this fitting into the tank.
   q. Pull the 1/2" copper tubing back up through the slip fitting until you see the mark that you put on the tubing earlier. Holding the tubing with one hand, push the ferrel sleeve connector and locking nut down the tubing, then tighten onto the 1/2" slip fitting. The oil line is now installed in the correct position off of the bottom of the tank.
   r. Carefully bend the oil line up to the canister filter; use a spring bender over the oil line while bending the tubing to prevent kinks in the oil line. Allowing for the flare nut, cut off the excess tubing.
   s. Install the 1/2" flare nut onto the tubing, and flare the end of the tubing.
   t. Install the end of the tubing with the flare nut onto the 1/2" flare adapter (on the ball valve assembly at the canister filter).
   u. Install a vent from the tank to the outside of the building according to code. The tank must be properly vented to allow air to enter the tank as oil is pumped out and to safely vent fumes to the outside. See Figure 4J.
   v. Install plugs in all other tank openings as required by code.
   w. Inspect the installation. For proper suction oil line operation, make sure all components are installed and positioned as specified in this manual.

Installing the Pressure Relief and Low-Flow Check Valve

ATTENTION: It is critical that you adhere to the following specifications for pressure relief and low-flow check valve installation; if these specifications are not met, the metering pump will not function correctly and the burner will shut down on reset.

The metering pump requires the installation of a pressure relief and low-flow check valve as shown in Figures 4H, 4J, and 4K.

- The **pressure relief** will open and relieve pressure on the line if there is a restriction in the pressure oil line, clogged nozzle, etc.
- The **low-flow check valve** is a vital component which maintains pressure in the oil pressure line.

Be sure to use Permatex #2 non-hardening gasket sealer to seal every threaded fitting. DO NOT use teflon tape or teflon pipe dope compounds.

1. Refer to Figure 4K.
2. Remove the plug from the gauge port on top of the metering pump head.
3. Install the pressure relief valve assembly in a **vertical position** in the gauge port. Note that the directional arrows on the relief valve must be positioned so that the arrows point away from the pump head (i.e. in the direction of the oil flow).
4. Install 1/4" O.D. copper tubing (user-supplied) from the pressure relief back to the oil tank. Refer to Figure 4J as needed.

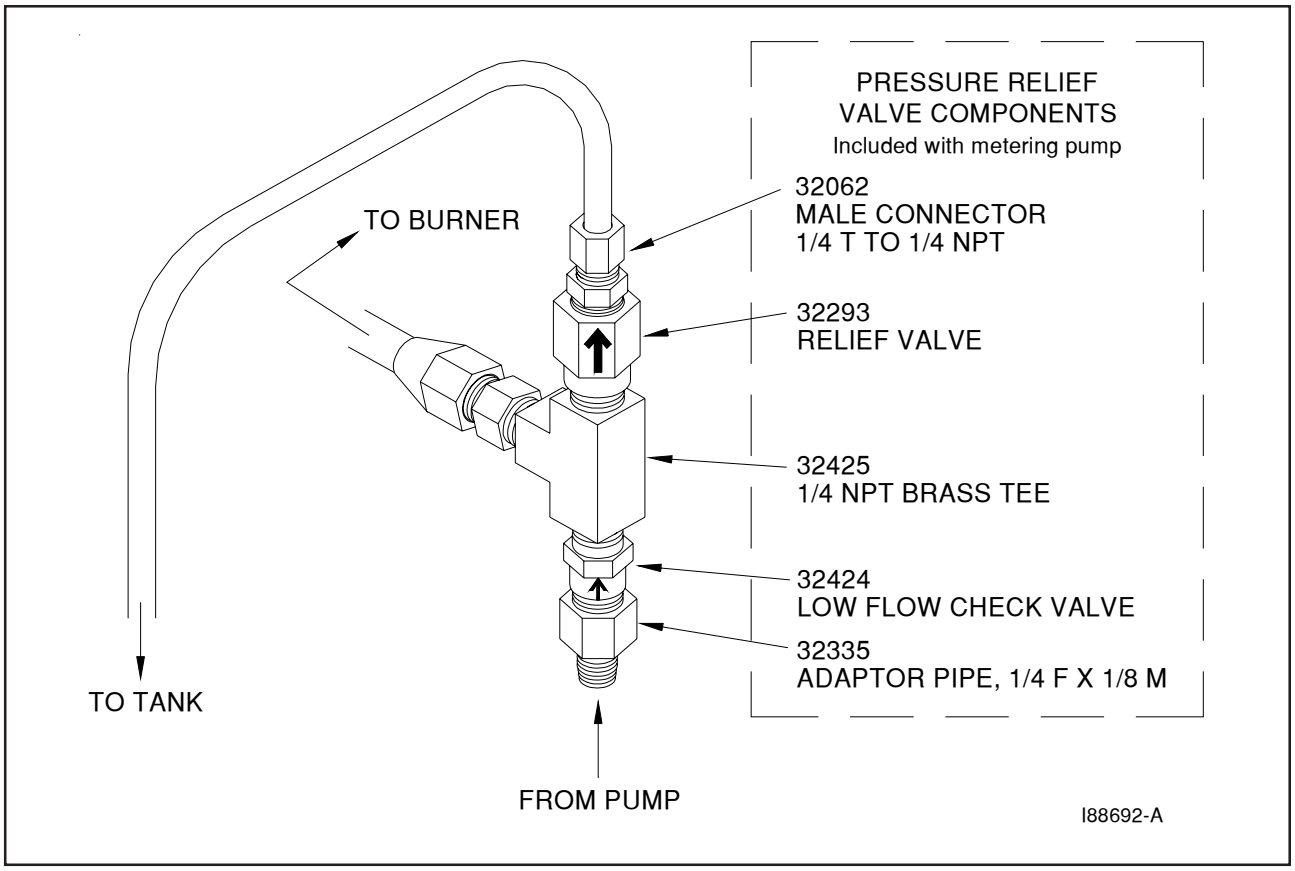


Figure 4K - Pressure Relief Valve Assembly Detail

Installing the Pressure Oil Line Components

ATTENTION: It is critical that you adhere to the following specifications for pressure oil line installation (oil line from the pump to the furnace); if these specifications are not met, the metering pump will not function correctly and the burner will shut down on reset.

- The parameters for pressure oil line installation are:

Length of Pressure Line	**Line Size**
Up to 100 feet	3/8" O.D. copper tubing

- **The pressure oil line must slant up to the burner** with no loops or high points to trap air.

- Local codes may require the installation of an in-line **"Fire-O-Matic" safety valve**. Be sure to check all appropriate codes to ensure compliance.

1. Refer to Figures 4H, 4J, and 4K.
2. Make sure you have purchased all the necessary fittings to complete the installation correctly.
3. Install the fittings and components as shown in the related illustrations. Be sure to use Permatex #2 non-hardening gasket sealer to seal every threaded fitting. DO NOT use teflon tape or teflon pipe dope compounds.

Installing the Compressed Air Line

NOTE: Your air compressor system must supply air pressure to the furnace with the following requirements: **50 psi** and **water trap or dryer.** If you do not have shop air, an optional air compressor is available. Contact your local Clean Burn dealer for more information.

1. Run a compressed air line from your shop air to the connector block on the furnace. Use minimum 1/4" O.D. copper tubing or equivalent for for the compressed air line.
2. Install an easily accessible shut-off valve in the air line so the burner can be serviced without shutting off the shop air in your service area.
3. If necessary, install a pressure regulator (additional to the burner air regulator) in the air line, and set it at 50 psi.

   ATTENTION: DO NOT feed full shop air pressure to the burner or damage to burner components may occur.

4. Install a water trap or extractor/dryer in the air line with an automatic drain so compressed air (rather than water) is supplied to the burner.

   ATTENTION: Water must not be fed to the burner, or the flame will be extinguished and the burner will shut down. Be sure to drain water from your compressor tank on a regular basis to keep water out of the air line.

Installing the Stack

WARNING: Inappropriate stack materials or improper stack design/installation can adversely affect the proper, safe operation of your furnace. Contact your Clean Burn dealer to purchase the proper stack components for your furnace.

Stack designs are generally classified as follows:

(1) "Class A" stack through the ceiling of the building (refer to **Figure 4L**)
(2) "Class A" stack through the sidewall and up the side of the building (refer to **Figure 4M**)

Stack Design and Specifications

ATTENTION: ***The stack design must be single and dedicated for each unit (furnace) according to the following specifications.*** A single stack serving more than one unit MUST be engineered/certified for that specific installation (ref. NFPA 211, 3.3.39 and 10.2.1; NFPA 31 6.5.16-18). Failure to adhere to this rule may result in less than optimal system performance.

Figures 4L and 4M illustrate recommended stack designs. Choose the stack design which is appropriate for your furnace installation and review all specifications provided in the corresponding drawing. When designing your stack, adhere to the following specifications:

- Model CB-1400 requires **minimum 8" I.D. stack components**.
- *Ensure that the vertical stack height is* ***at least 10 feet PLUS one foot for every fitting*** *(e.g. 45 degree, 90 degree, or T) in the stack run.* If needed, increase the vertical length of the stack or install a draft inducer to obtain -.02" W.C. draft over fire. (Section 8 contains details on adjusting the draft.)
- *Keep the horizontal stack run as short as possible*; slant it upward at a minimum of 1/4" per foot of run.
- *Keep the stack design simple.* Complicated stacks (with long runs and many turns) reduce draft and result in poor burner performance. **Your stack may include only one 90 degree turn**. All other stack turns must be at 45 degrees or less to ensure optimal draft and burner performance.

NOTE: If you plan to use an existing masonry chimney, the chimney must be *lined* and *inside* the building. Exterior masonry chimneys chill the stack gases and result in poor draft and poor burner performance.

ATTENTION: If you have an exhaust fan(s) in your shop, ***it is critical that you have adequate make up air (source of fresh air to replace the stale air exhausted by the fan).*** When an exhaust fan is run without adequate make up air, the resultant vacuum in the building will draw combustion products back into the burner. This back draft causes poor burner performance and may damage vital burner components. Refer to Section 8 in this manual for additional information.

Stack components should be installed in the following order:

(1) Inside stack (the stack components from the furnace breach to within 18" of the ceiling, roof, or sidewall of your building)
(2) Barometric damper
(3) "Class A" stack penetration through the ceiling, roof, or sidewall
(4) "Class A" stack on the exterior of the building
(5) "Class A" stack cap

Installing the Stack (continued)

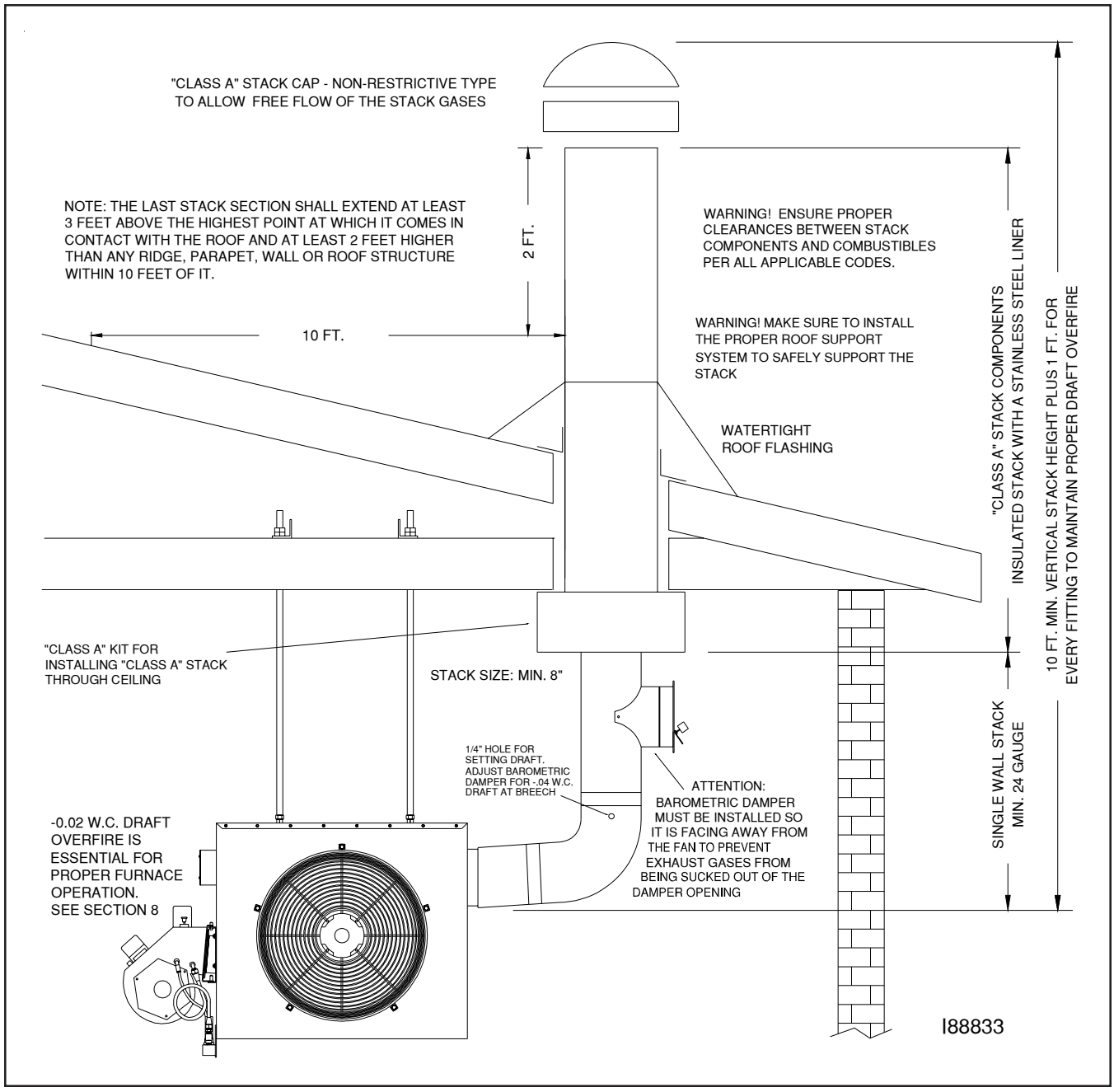


Figure 4L - Installation of "Class A" Stack Through Roof/Ceiling

Installing the Stack (continued)

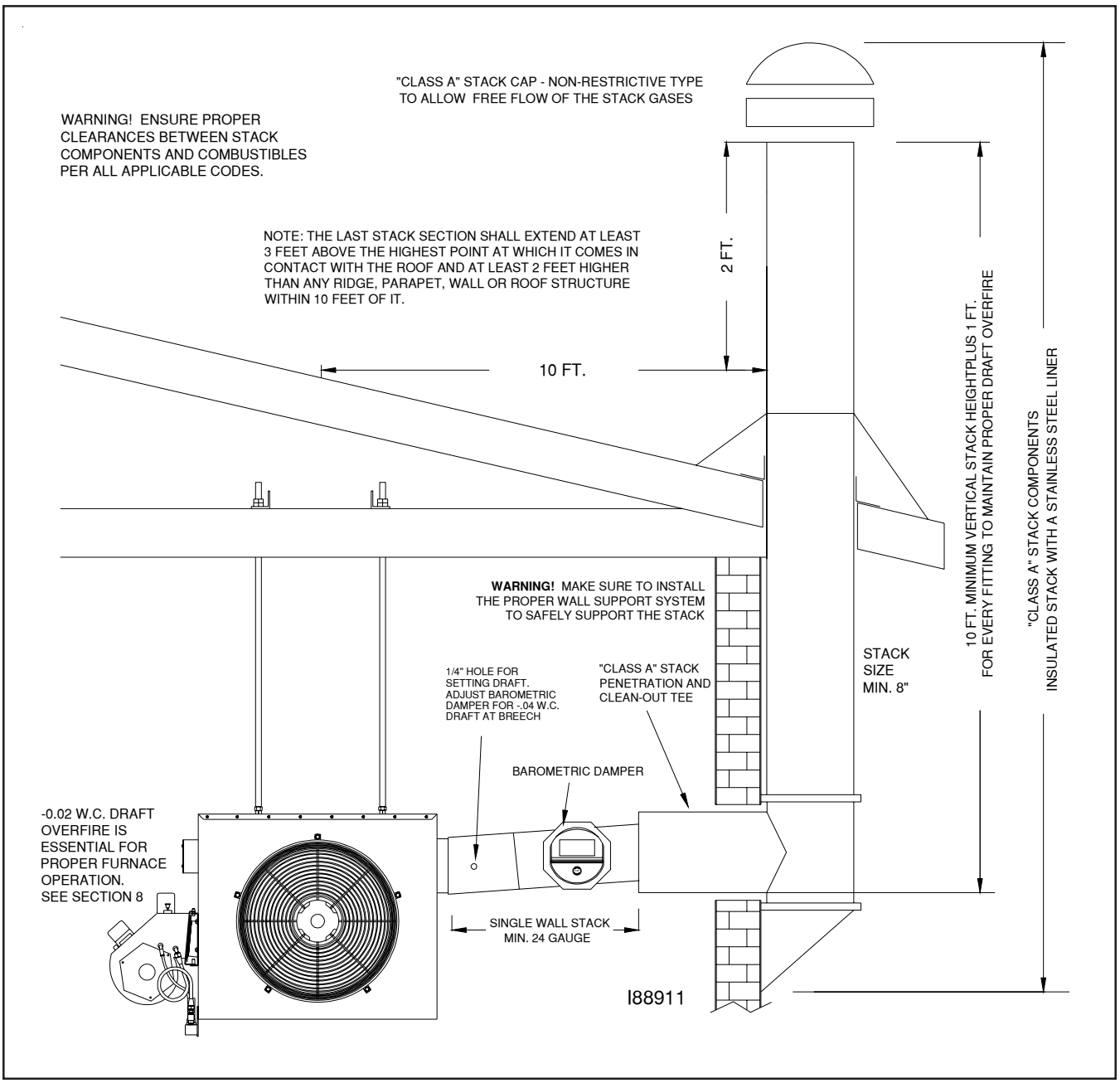


Figure 4M - Installation of "Class A" Stack Through Sidewall

Installing the Interior Stack

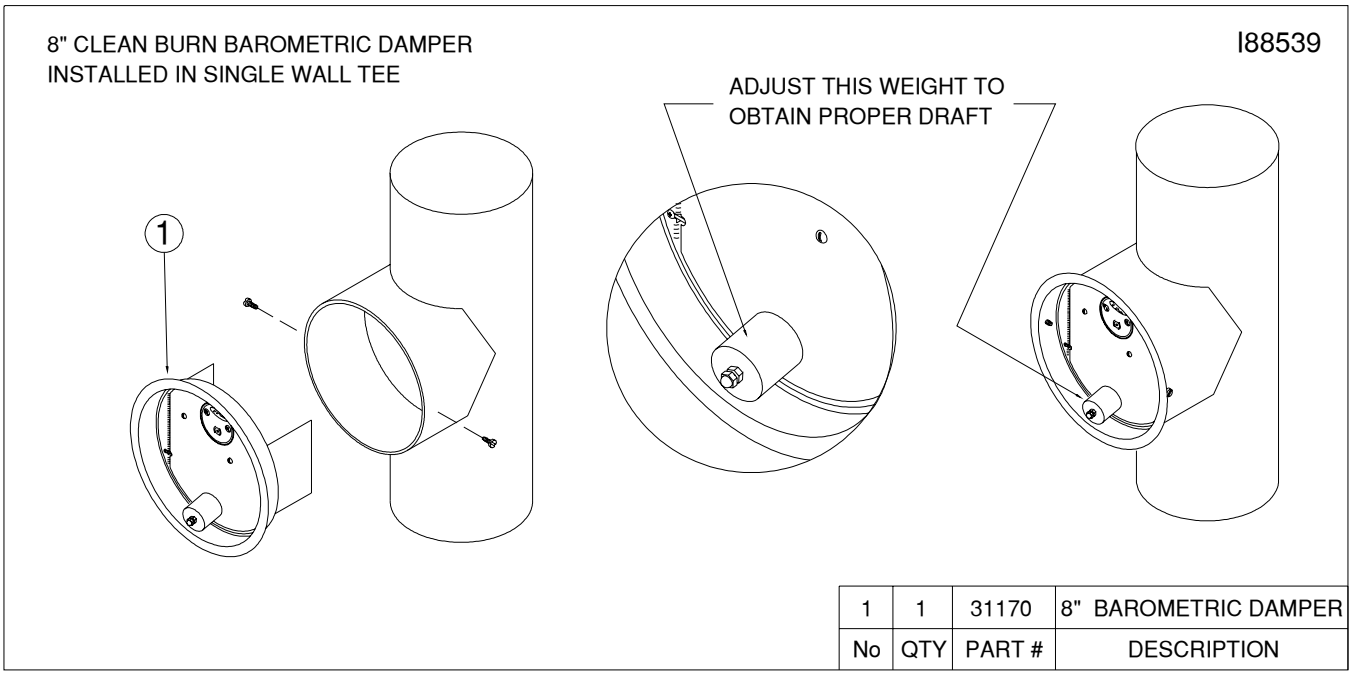
WARNING: Single wall stack components may be used *only* for those portions of the stack which are located inside your building and away from any fire/burn hazards.

1. Install the single wall stack with proper clearances from combustibles. Also ensure that the stack is located a safe distance from all shop personnel.
2. Install an elbow at the junction of the horizontal and vertical stack components to allow for easy cleaning of the stack.
   ATTENTION: Avoid additional 90-degree turns in the stack. Each additional 90-degree turn slows down stack gases, creates back-pressure, and results in repeated burner shutdown and unnecessary service calls. All other turns in the stack should be at a 45-degree (or smaller) angle.
   NOTE: ***IMPORTANT for Canadian Installations*** - Local codes may require the installation of a clean-out tee.

Installing the Barometric Damper

1. Refer to Figure 4L. Install a single wall tee (min. 24 gauge) after the 90 degree elbow in the straight vertical stack section within three to five feet of the furnace breach. For horizontal stack runs (as shown in Figure 4M), install the tee after the first straight section of pipe.
   NOTE: The tee is required to support the barometric damper. You must purchase this tee when you purchase your stack materials (8" single wall tee - CB#70174).
2. Refer to Figure 4N. Install the barometric damper in the opening of the tee. Use a small spirit level to make sure that it is properly level.
3. Install two self-tapping screws as shown in Figure 4N (i.e. one on each side of the barometric damper) to hold the damper in place. DO NOT install a screw at the bottom of the barometric damper, or the flapper of the damper will not operate correctly.

NOTE: Specifications for adjusting the barometric damper for proper draft overfire are provided in **Section 8** of this manual.



No	QTY	PART #	DESCRIPTION
1	1	31170	8" BAROMETRIC DAMPER

Figure 4N - Installation of Barometric Damper

Installing the Stack Safety Switch For Canadian Installations

NOTE: CSA Standards require that all heating equipment must be installed with a stack safety switch. If your heating equipment is being installed in Canada, follow the instructions listed below.

CAUTION: For your safety and the safe operation of your heating equipment, the stack switch must be installed by a qualified installer in accordance with the installation instructions provided here. Wiring must be accomplished in accordance with all applicable codes. Failure to adhere to these safety recommendations may result in serious personal injury and/or equipment damage.

1. Follow the instructions in the ***Operator's Manual, Section 4*** to install a proper stack, including the barometric damper which must be installed within 40 inches of the breach.
   NOTE: The barometric damper must be installed so that it is level and the flapper moves freely.
2. Ensure that main power to the heating equipment is turned OFF.
3. Position the stack safety switch over the lip of the barometric damper as shown in Figure 4O.
4. Drill a 1/8" pilot hole for the mounting screw, and mount the stack safety switch using the mounting screw supplied with the switch.
   NOTE: The mounting screw must not interfere with the free movement of the flapper on the barometric damper.
5. Install the wall thermostat according to the instructions provided in the ***Operator's Manual, Section 4***. Wire the wall thermostat and stack safety switch in series as shown in Figure 4P. Install the wire so that it is secured away from any hot surfaces.
6. When the heating equipment installation is completed, follow the instructions in the ***Operator's Manual, Sections 5 and 6*** to prime the pump and start/adjust the burner.
7. Follow instructions in the ***Operator's Manual, Section 8*** to check the draft; this is crucial for the proper, safe operation of the heating equipment.

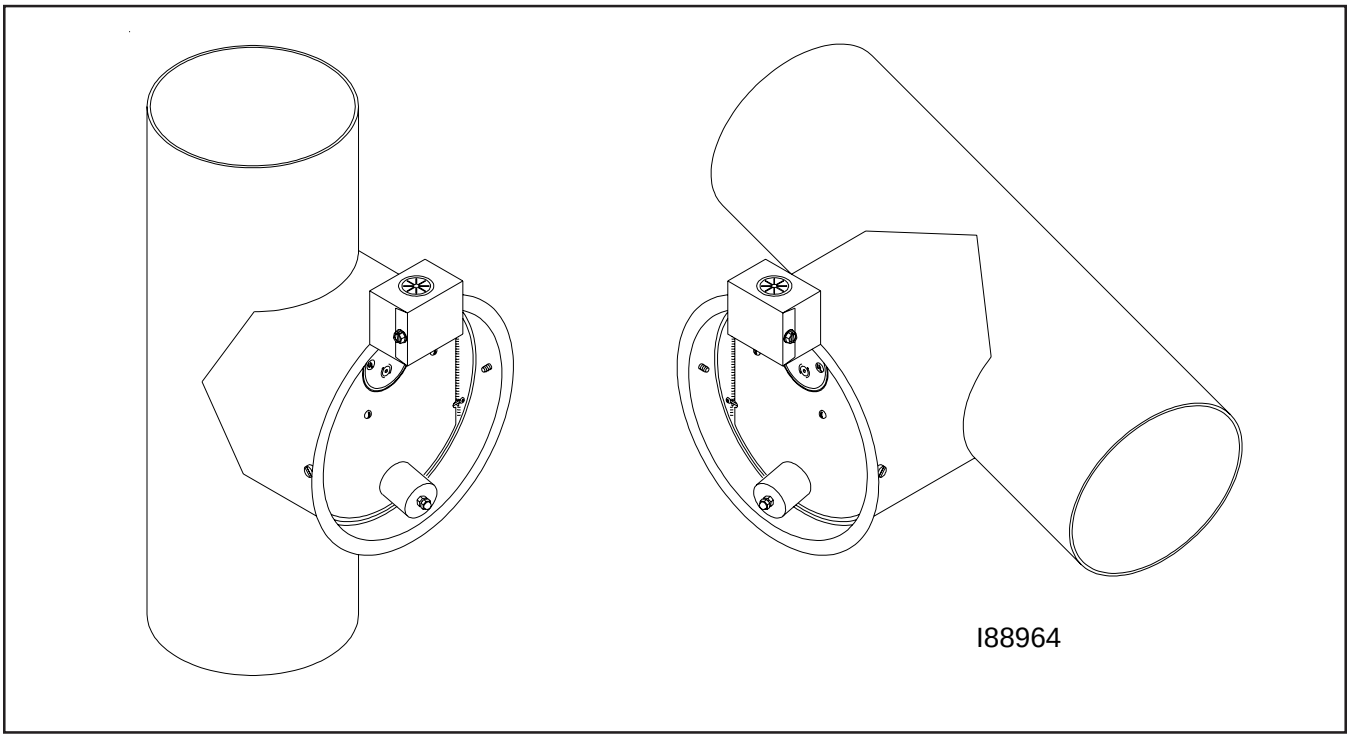


Figure 4O - Stack Safety Switch Installed on the Barometric Damper

Resetting the Stack Safety Switch

WARNING: BURN HAZARD! To prevent serious personal injury, be sure to allow ample time, at least 30 minutes, for the stack, barometric damper, and switch to cool down before attempting to access and service these components. It is crucial to identify the cause of the stack obstruction (e.g. heavy snowfall) and correct it *before* resetting the stack safety switch and re-starting the burner. **DO NOT operate the heating equipment with an obstructed stack**; failure to correct an obstructed stack may result in fire, explosion, and/or burn hazards causing serious personal injury or death.

NOTE: In locations where heavy snowfall occurs, it is critical that the stack remain unobstructed by snow. For safe heating equipment operation, be sure to keep the area surrounding the stack clear of snow.

1. Before resetting the stack safety switch, check the stack to make sure it is clear of any obstructions.
2. Remove the cover from the stack safety switch, and push the small button in the middle of the switch.
3. Pushing the stack safety switch reset button will re-establish the thermostat circuit, and the burner will start (assuming the wall thermostat is calling for heat).

Understanding the Function of the Stack Safety Switch

The **Stack Safety Switch** monitors the temperature at the barometric damper on the stack and is designed to detect the obstruction of the free flow of stack gases from the heating equipment and shut down the burner. Obstruction of the stack results in the "spillage" of stack gases from the barometric damper, which heats up the switch. The switch then opens, disconnecting the thermostat circuit to the burner, and the burner shuts off.

Stack Safety Switch Specifications

Switching Voltage	24 volts
Switch OPEN Temperature	180 degrees F
Switch Type	L180, normally closed, manual reset

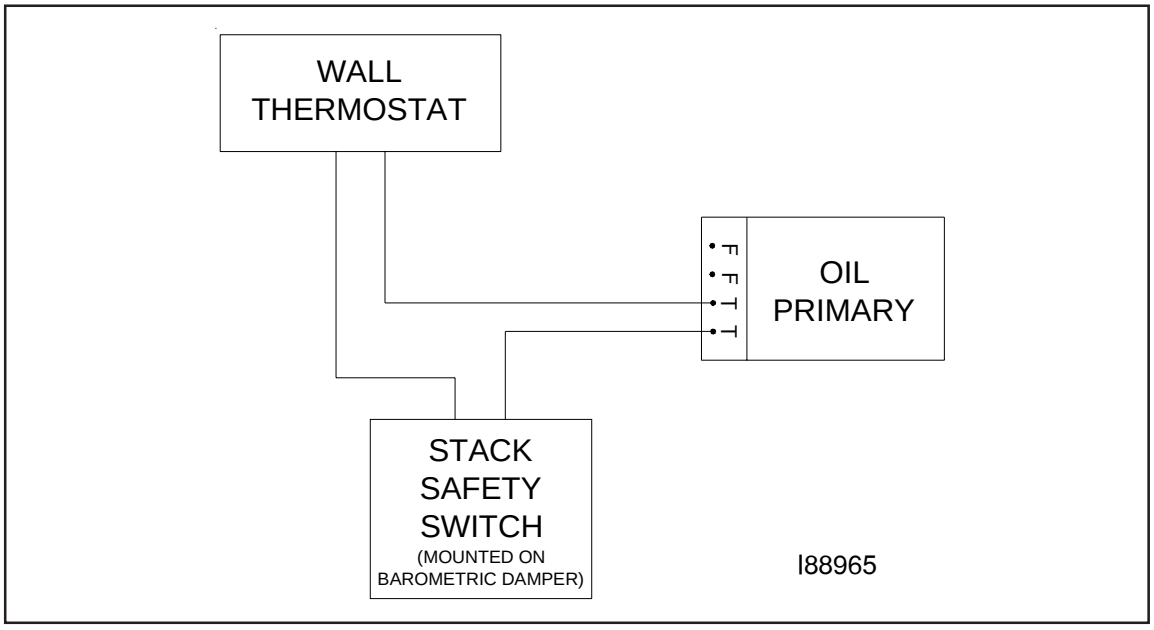


Figure 4P - Stack Safety Switch Wiring Diagram

Installing the Stack Penetration

WARNING: When running the stack through your ceiling, roof, or sidewall, you must use **Class A/UL 103 HT double-wall insulated all-fuel stack components** with a stainless steel liner. DO NOT run single-wall stack through your ceiling, roof or sidewall. NEVER locate a stack joint inside walls or in a joist spacer. Ensure proper clearances from combustibles per all applicable codes.

1. Refer to Figure 4L/4M as needed.
2. Follow the installation instructions provided by the stack manufacturer.

Installing the Exterior Stack

ATTENTION: All exterior stack pieces must be Class A/UL103 HT double-wall insulated all-fuel stack components with a stainless steel liner.

- DO NOT use Class B or BW Vent/double-wall stack components (for gas fired appliances only).
- DO NOT use Type L Vent/double-wall stack components (for approved fuel oil appliances only).
- DO NOT use black stack pipe (for solid fuel burning appliances only).
- DO NOT use single-wall stack for your exterior stack. Single-wall exterior stack chills the stack gases and results in poor draft and poor burner performance.

1. Refer to Figure 4L/4M as needed.
2. Follow the installation instructions provided by the stack manufacturer.
3. Install water-tight roof flashing around the penetration of the exterior stack.
   NOTE: Clean Burn recommends the use of "Dektite" roof flashing (or equivalent) which ensures a water-tight seal when installed properly. Contact your local Clean Burn dealer for details.

Installing the Stack Cap

NOTE: Proper installation of a "Class A" stack cap ensures the free flow of stack gases which is essential for optimal burner performance.

1. Refer to Figure 4L/4M as needed. Your stack cap should be classified as: "Class A" non-restrictive, all-fuel type.
2. Install the stack cap according to the manufacturer's instructions.

Installing the Optional Draft Inducer

ATTENTION: The draft inducer, Field brand model DI-2, is optional equipment and may be installed to ensure proper draft. The Field brand draft inducer has been tested for use on Clean Burn furnaces. DO NOT use other models or brands of draft inducers.

Understanding the Importance of the Draft Inducer

The draft inducer is designed to aid in the removal of the natural draft created by the appliance to vent the combustion gases to the outside of the building. As the paddle wheel turns, a negative pressure is maintained within the stack so that the combustion gases can leave the furnace and travel out of the stack. (See Figure 4Q.) ***Proper sizing, installation, and adjustment of the draft inducer are critical for optimal draft inducer operation.***

Installing the Optional Draft Inducer (continued)

Installing the Draft Inducer

WARNING: Turn OFF the main power to the furnace before proceeding with the installation of the draft inducer.

ATTENTION: It is very important to install the draft inducer on a vertical section of stack to isolate the inducer from excessive heat and ash buildup. Never install the draft inducer on a horizontal section of stack close to the furnace breach where heat and ash will damage the inducer motor.

1. Refer to Figure 4Q. Follow the instructions included with the draft inducer to mount the draft inducer on the section of single-wall vertical stack.
2. Position the draft plate all the way out so that it does not reduce the draft produced by the draft inducer. You will adjust the draft plate later as part of **Adjusting the Draft Overfire** (Section 8).

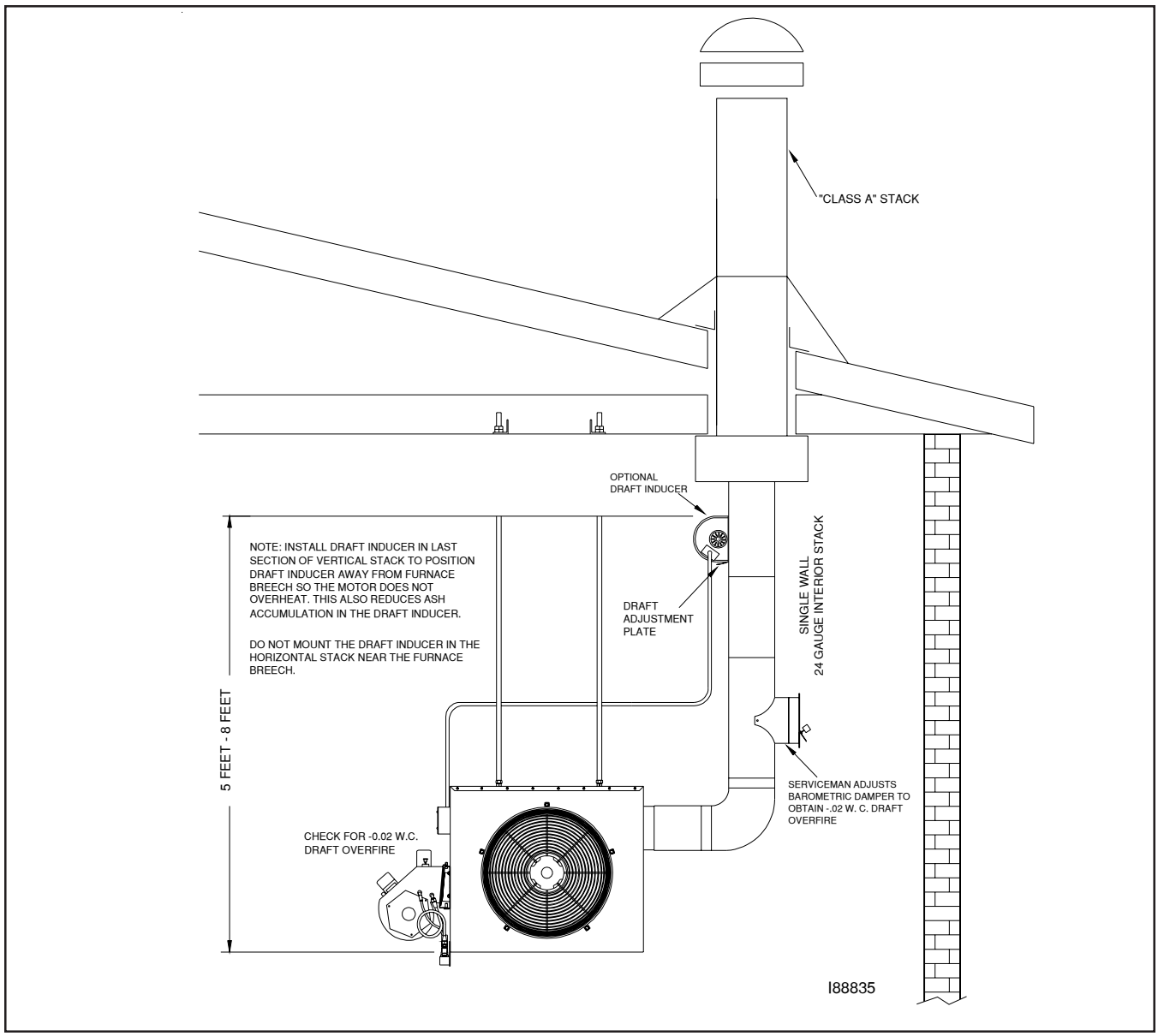


Figure 4Q - Installation of the Optional Draft Inducer

Installing the Optional Draft Inducer (continued)

Wiring the Draft Inducer for Normal Operation*

*(No exhaust fans in the building. Read pages 8-3 to 8-6 if exhaust fans are present.)

1. Wire the draft inducer according to the Furnace Wiring Diagram provided in **Appendix B** at the back of this manual.

Installing the Wall Thermostat

Installing the Wall Thermostat

1. Select a location for the thermostat on an interior wall away from any hot or cold drafts.
2. Remove the top cover from the thermostat by pushing gently on the latch at the top center of the body. (*Hold the thermostat base in one hand, and grasp the body with the other hand; push in on the latch with your thumb, and pull the cover away from the base*.)
   ATTENTION: DO NOT use a screwdriver to pry the cover off the base, or damage may occur.
3. Remove the green paper insert and the black plastic battery isolator from the battery section of the thermostat.
4. Refer to the **Burner Wiring Diagram** in **Appendix B** at the back of this manual. Run two wire, 18-gauge (minimum) thermostat cable from the terminals on the back of the thermostat base to the T/T terminals of the primary control on the burner.
   ATTENTION: NEVER jump between T/T terminals on the primary control without removing one of the wires. Failure to remove one of the wires will burn out the heat anticipator on the thermostat and will cause the thermostat to fail.
5. Mount the thermostat base 60" to 66" from the floor using the hardware provided.
6. Reassemble the thermostat body onto the base. (*Align the hinges at the bottom of the cover with the slots at the bottom of the base, and swing the cover up into place*.)

Replacing the Wall Thermostat Batteries

1. Proper battery level is indicated by the room temperature being displayed on the LCD screen.
2. When the battery level becomes low, a battery icon along with the word "REPLACE" will be displayed in the lower left corner of the LCD screen. Replace the batteries to ensure proper operation, following the previous instructions on the thermostat disassembly procedure.
3. If the batteries are not replaced, the display will slowly become dim and not display any information. The thermostat will eventually not function. If this happens, replace the batteries immediately.

Inspecting the Furnace Installation

Following completion of all installation activities described in this chapter, the furnace should be inspected by qualified personnel before firing. This ensures that your installation meets all applicable national and local codes and allows for any deficiencies to be corrected before furnace startup. *Improper installation may void your warranty.*

SECTION 5: METERING PUMP PRIMING

Understanding Metering Pump Priming

Preparing your Clean Burn furnace for operation begins with priming the metering pump. The procedures in this section must be performed in sequence *without interruption* to properly prime the pump.

ATTENTION: Please note that in order to use the metering pump with the CB-525-S2 burner (and to accomplish pump priming), ***the oil regulator assembly must first be removed from the preheater block assembly.*** The following procedure provides the necessary instructions.

Required Tools and Materials

The following tools and materials are required for oil pump priming and should be gathered before starting any procedures:

- 3/8" open-end wrench
- Rags
- Two containers (minimum one-gallon)
- Medium straight-blade screwdriver

Preparing the Burner for Use with the Metering Pump

WARNING: To avoid electrical shock hazards, turn off all power to the furnace, and unplug the burner before proceeding.

1. Figure 5A shows an exterior view of the burner components. In this procedure, you will be removing the oil regulator from the preheater block assembly to prepare the burner for use with the metering pump.
2. Remove the self-tapping screw with a 1/4" nut driver and swing open the double-hinged lid to expose the heater block assembly.
3. Use a 1/8" Allen wrench to loosen the two locking bolts on the locking bar.
4. Remove the locking bar.
5. Refer to Figure 5B. Use a 5/32" Allen wrench to remove the four (4) bolts and washers holding the surface-mounted oil regulator in place, then carefully remove the oil regulator.
6. Clean the top of the heater block to remove used oil, etc. DO NOT allow any debris to fall into the oil passageways which have been exposed by the removal of the oil regulator.
7. Install the square cap with the o-ring using the four (4) bolts and washers. Tighten the four bolts firmly in a *crisscross pattern* to ensure that there are no leaks.

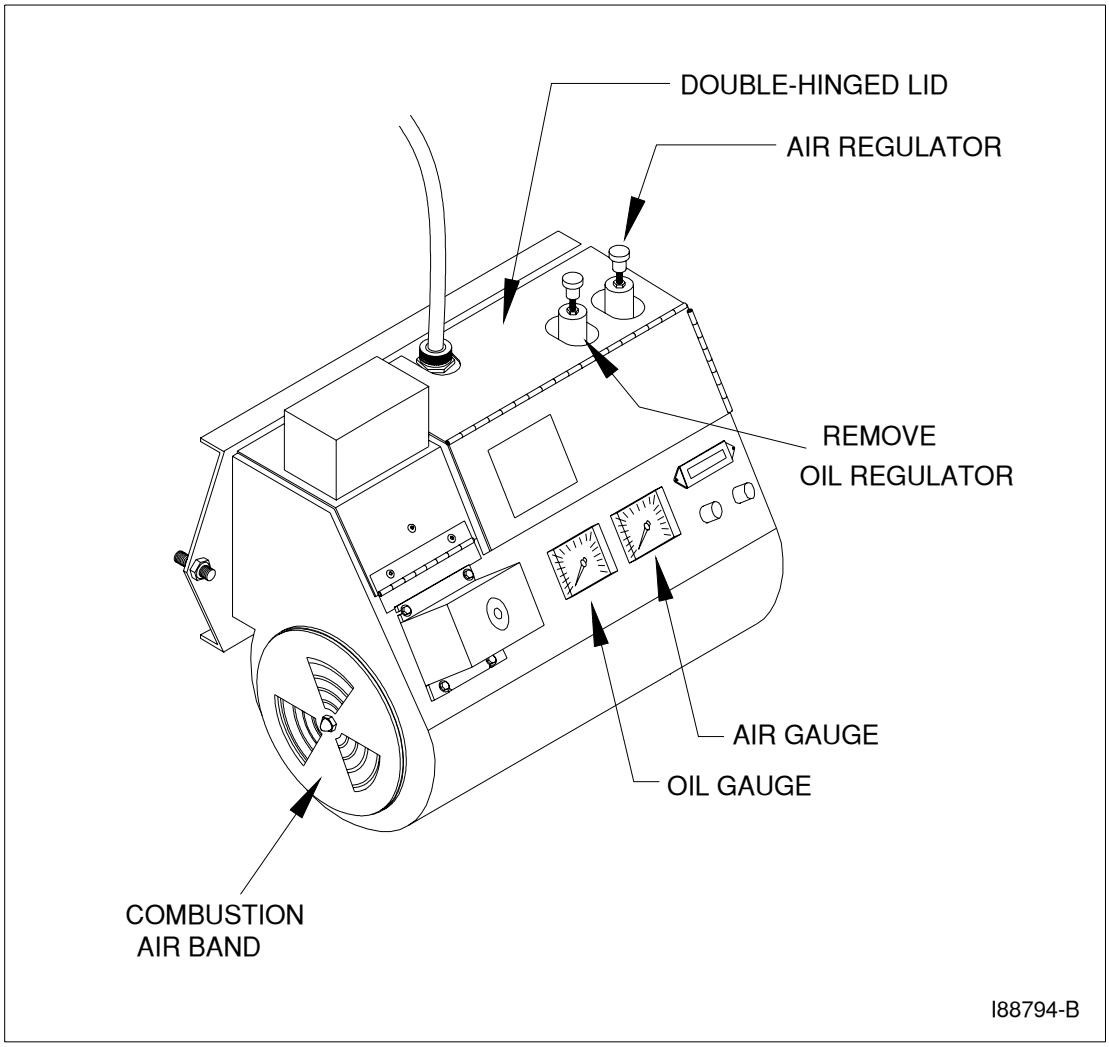


Figure 5A - Detail of Burner Components

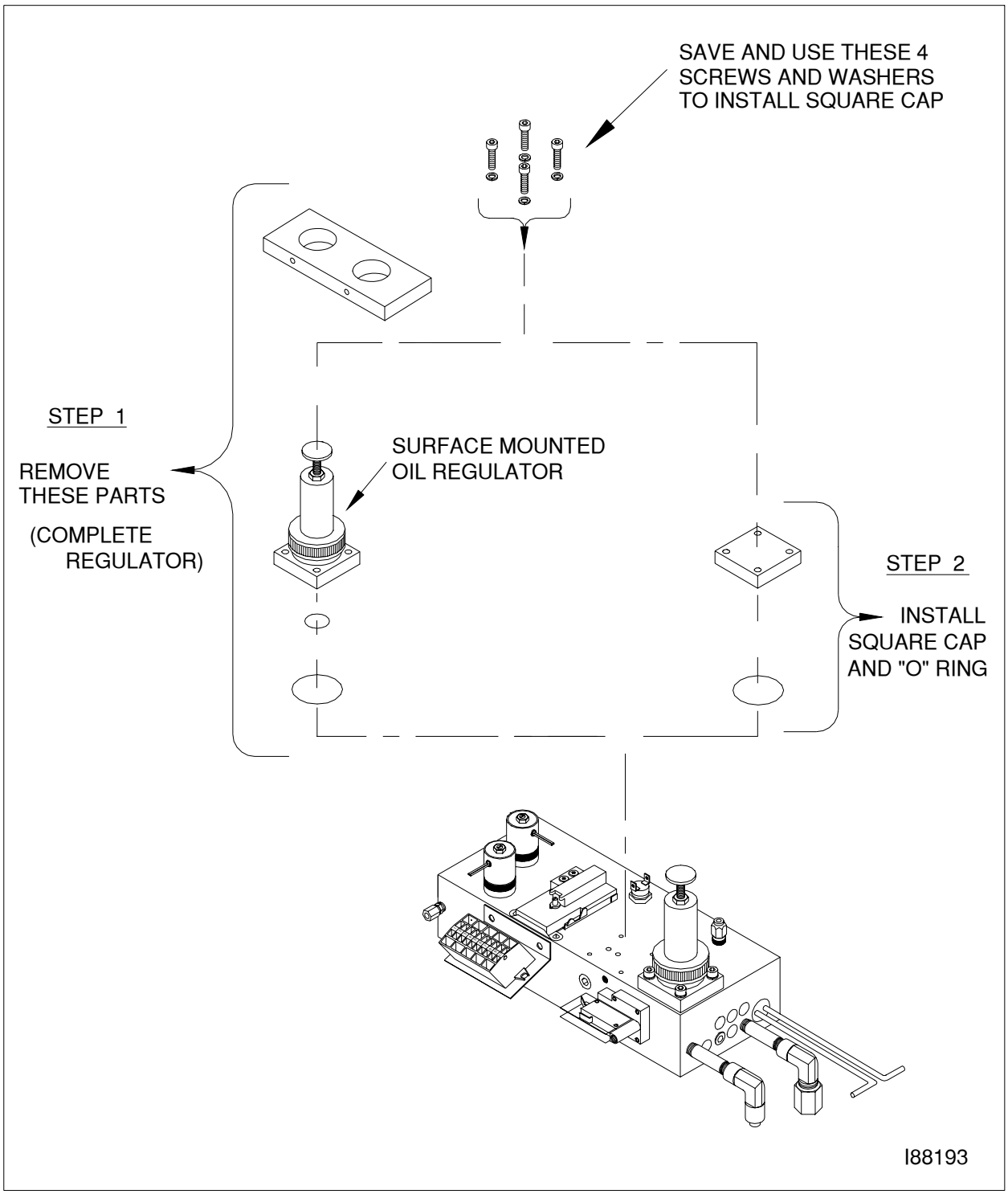


Figure 5B - Detail of Heater Block with Surface-Mounted Oil Regulator

Priming the Metering Pump

ATTENTION: ***The priming process must be done precisely as described in this procedure to ensure that all air is thoroughly bled from the system.*** Failure to bleed all air from the system will result in repeated burner shutdowns on reset.

1. Refer to Figure 5C.
2. Remove the 5/8" plug from the side of the pump head, and set it aside.
3. Remove the 1/2" brass cap from the 1/2" brass nipple. Place a funnel in the opening. Slowly pour used oil into the funnel until oil comes out of the side of the pump head; this will fill the oil line, canister filter, and pump head with oil.
   ATTENTION: Never run the pump head dry (without oil in the pump head); doing so will severely damage the pump.
4. Apply Permatex #2 non-hardening gasket sealer to the threads of the plug (removed from the pump head). Re-install the plug and tighten.
5. Apply Permatex #2 non-hardening gasket sealer to the threads of the 1/2" brass nipple. Re-install the 1/2" brass cap on the brass nipple and tighten.
6. Open the bleeder on the pump two to three (2-3) full turns, and position a container to catch oil which will flow from the bleeder during pump priming.

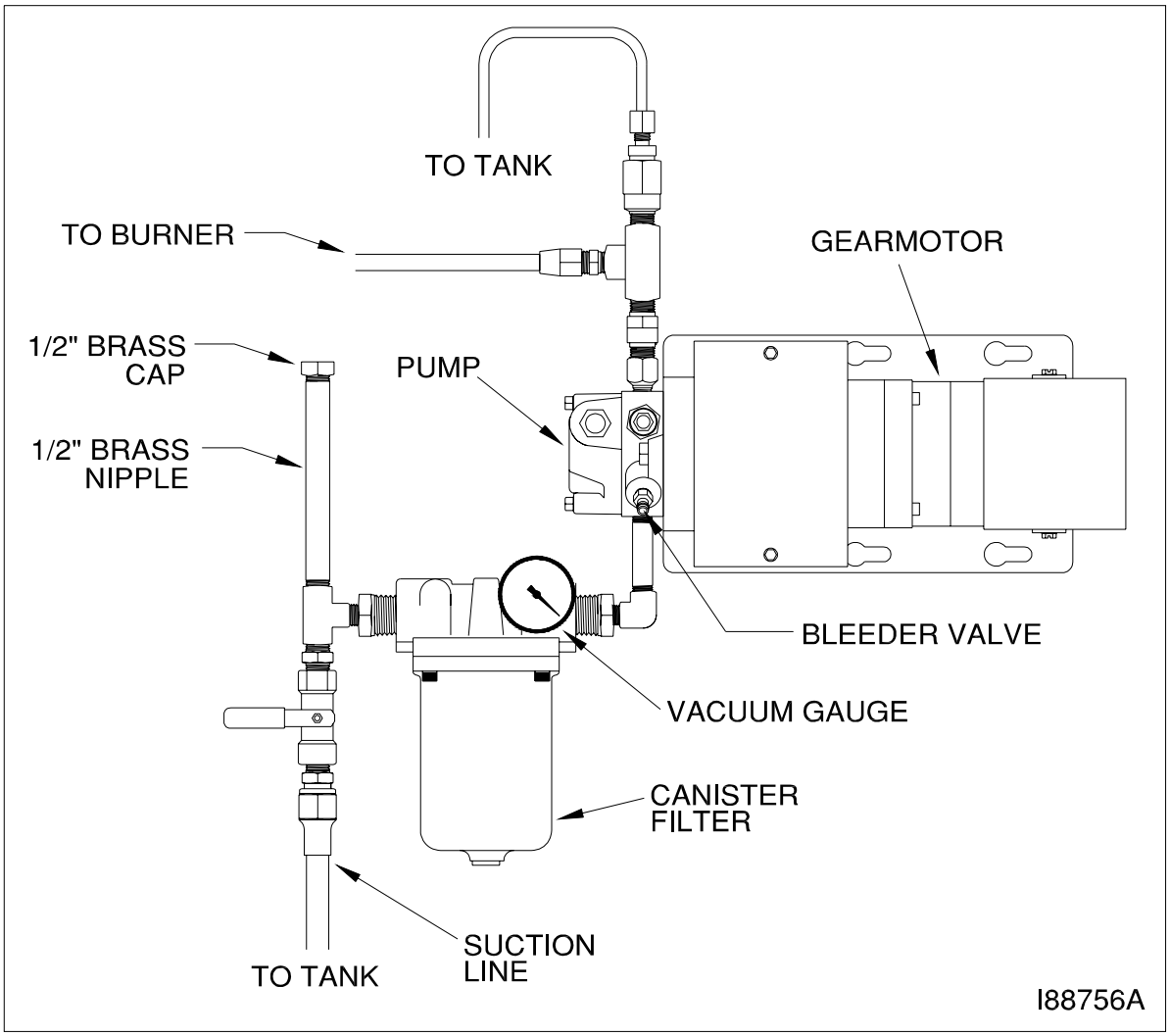


Figure 5C - Priming the Metering Pump

Priming the Metering Pump (continued)

7. **Activating the Pump**

WARNING: Activating the pump for pump priming involves running the burner by jumping the "F" terminals of the oil primary control. This procedure (i.e. jumping the "F" terminals) should be used only for this specific purpose--*never for normal operation.* This procedure is accomplished easily by two people: one at the burner and one at the wall thermostat. **ATTENTION:** When performing this procedure, *never* jump from an "F" terminal to a "T" terminal, or severe damage to the primary control will occur.

a. Refer to Figure 5D, Step 1.

ATTENTION: Ensure that the plastic barrier strip is in place between the "F" and "T" terminals as shown in Figure 5D before proceeding; failure to do so will result in damage to the primary control.

b. Connect a jumper wire to *one* "F" terminal on the primary control.
c. Adjust the thermostat above room temperature. The burner should start running.
d. Immediately turn the knob on the air regulator clockwise until the air gauge registers 10 to 12 psi. You will adjust the air pressure further during burner startup and operation.
   NOTE: No air pressure will register on the air gauge until the burner starts running.
e. The pump should start running.
f. Refer to Figure 5D, Step 2.
g. ***Within ten seconds***, jump the "F" terminals by connecting the jumper wire to the other "F" terminal.

NOTE: If the safety reset on the primary control activates and the burner stops running while performing this procedure, follow the instructions in Section 7 to reset the oil primary control and restart the burner.

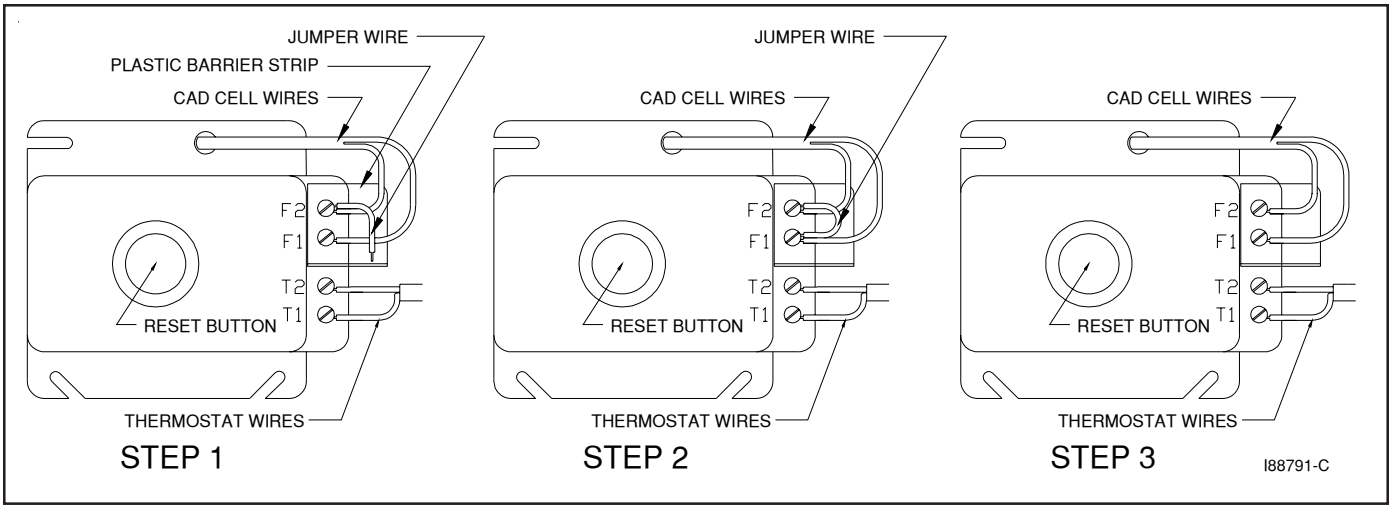


Figure 5D - Jumping the Oil Primary Control

ATTENTION: *Never* touch a jumper wire from an "F" terminal to a "T" terminal on the oil primary control. This will severely damage your primary control. Make sure that the plastic barrier strip is in place between the "F" and "T" terminals as shown in Figure 5D.

Priming the Metering Pump (continued)

8. Run the pump until a solid stream of oil flows from the pump bleeder. This will bleed all air out of the suction line, oil filter and pump head.
   ATTENTION: For the metering pump to operate correctly, it is very important that the system is entirely full of oil and all air is bled out. The burner will shut down if there is any air in the system.
9. Close and tighten the bleeder on the pump.
10. Remove the jumper wire from the primary control; the burner and pump should stop.
11. Disconnect the pressure oil line from the burner, and position a container to catch oil which will flow from the pressure oil line during pump priming.
12. Reset the primary control; the burner should start running. *Within ten seconds*, jump the "F" terminals by connecting the jumper wire to the other "F" terminal. This will start the pump again and allow the oil line to flush out.
13. Run the oil pump until the proper flow of oil has been established, and the oil line has been completely flushed out.
14. Remove the jumper wire from the primary control; the burner and pump should stop.
15. Re-connect the oil line to the connector block.
16. Make sure that the cad cell wires are connected to the "F" terminals as illustrated in Figure 5D, Step 3. Save the jumper wire for future pump priming.

Vacuum Testing the Oil Pump

Vacuum testing the oil pump is a very accurate way to determine the following:

- The condition of the pump -- the ability of the pump to pull a vacuum and suck oil from the tank.
- The condition of the fittings, gaskets and seals from the ball valve to the pump -- these components must all be airtight to avoid suction leaks.

The following procedure provides instructions for vacuum testing the pump and canister filter on systems equipped with a ball valve.

ATTENTION: For the pump to pull and hold vacuum, it is critical that all fittings are airtight. If any of these fittings are loose, the pump may not pull a vacuum or may lose the vacuum rapidly. It is also critical that all fittings in the suction line, including fittings on the canister filter, are 100% airtight.

1. Follow the instructions to prime the pump (previous procedure).
   NOTE: The pump will not pull a vacuum if the pump is dry. There must be oil in the gears of the pump before the pump can pull a vacuum.
2. With the pump running, open the bleeder two to three full turns, and make sure that oil is flowing from the bleeder. DO NOT close the bleeder yet.
3. Refer to Figure 5C. Close the ball valve and observe the vacuum gauge.
   NOTE: The ball valve must have a stainless steel ball and should be pressure tested by the manufacturer to ensure that it does not leak. If the ball valve leaks, the vacuum test will not be accurate.

Vacuum Testing the Oil Pump (continued)

4. The vacuum should increase within 15 seconds to 15 inches of vacuum. When the vacuum gauge reads 15 inches of vacuum, first close and tighten the bleeder, then turn the pump off.
   NOTE: If the pump will not pull at least 15 inches of vacuum, there is a very serious suction leak, or the pump is damaged.
5. If there are no suction leaks, the system will hold vacuum.
   NOTE: It is acceptable for the vacuum to drop one to five inches within one minute as the seal in the pump seats. The vacuum should then hold steady for 15 minutes.

ATTENTION: If the vacuum drops *more than one to five inches within the first minute,* there is one or more leaks somewhere between the pump and the ball valve. Do the following:

- Wipe your finger along the cylinder at the shaft of the pump. If there is oil here, the pump seal is damaged. Replace the pump.
- Disassemble and clean all the fittings from the pump to the ball valve. Properly seal all fittings with Permatex #2 non-hardening gasket sealer or equivalent. Check the condition of the o-ring on the canister filter and tighten the four canister filter bolts in a crisscross pattern.
- Repeat the procedure to vacuum test the system to ensure that the system is air tight.

SECTION 6: STARTING AND ADJUSTING THE BURNER

Understanding Burner Startup and Adjustment

Starting and adjusting the burner involves a series of separate procedures which must be accomplished in sequence without interruption. Review all the procedures before attempting burner startup and adjustment, paying careful attention to safety information statements.

ATTENTION: ***Please verify that the oil regulator has been removed from the burner as shown in Figure 6A. If the oil regulator has not been removed, please refer to Section 5 for the necessary instructions -- Preparing the Burner for Use with the Metering Pump.*** The metering pump will *automatically* supply the correct flow (GPH) of fuel to the burner.

Preparing the Burner for Startup

1. Turn the switch on the wall thermostat OFF.
   NOTE: If your thermostat does not have an OFF setting, disconnect one thermostat wire so the burner will not run.
2. Turn the main power to the furnace ON.
3. Wait at least 15 minutes until the preheater block is thoroughly warmed up. (Feel the back of the burner box to make sure the preheater is sufficiently warm. The proving switch on the preheater block will not allow the burner to start until the block is hot.)
   NOTE: The preheater block will remain warm as long as power is supplied to the burner. If the main power supply is ever turned OFF, you must wait at least 15 minutes until the preheater block is thoroughly warm before starting the burner.
4. Refer to Figure 6A to locate the air regulator. Loosen the locking nut on the air regulator.
5. Turn the adjustment knob on the air regulator counterclockwise until 1/2" of the threads on the knob are exposed. DO NOT back the knob all the way out.

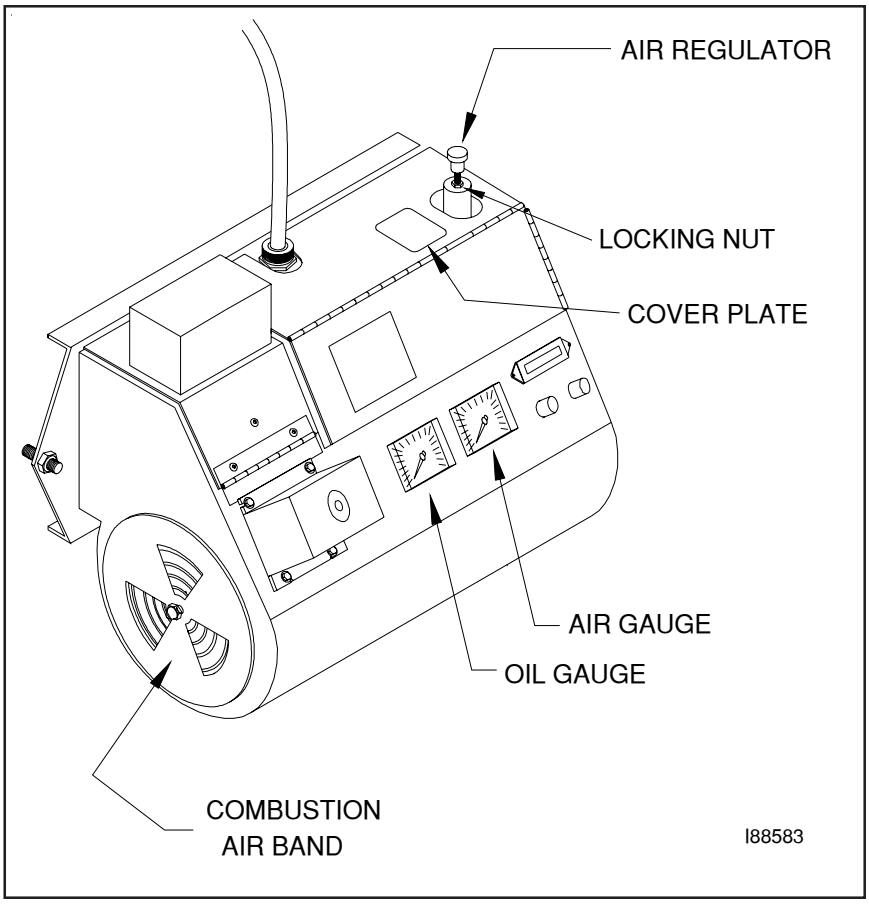


Figure 6A - Component Detail of the CB-525-S2 Burner

Preparing the Burner for Startup (continued)

NOTE: The air gauge will not show any pressure until the burner starts. Before starting the burner for the first time, it is very important to turn the air regulator completely OFF as described.

6. **Initial Adjustment of the Combustion Air Band:**

WARNING: The combustion air band must be properly adjusted to ensure that the burner ignites and burns correctly. DO NOT attempt to start the burner with the combustion air band wide open or completely closed. The burner may not ignite correctly. Failure to heed this warning may result in a fire or explosion hazard.

- Refer to Figure 6A to locate the combustion air band.
- Rotate the combustion air band to adjust it to the appropriate initial slot opening as listed in the following **Initial Adjustment Chart**. Use a ruler to accurately set the slot opening at the widest section of the slot. This initial setting of the combustion air band will allow you to start the burner. You will fine tune the combustion air band further as described later in these instructions.

ATTENTION: The settings shown in the chart below are only *initial* adjustments. ***Final adjustments must be done by inspecting the flame length according to the illustrations provided on the following page.***

NOTE: ***The oil pressure is automatically adjusted by the metering pump. The approximate oil pressure range during initial startup is 1 to 4 psi for Model CB-1400.***

Initial Adjustments for CB-1400
Maximum Input = 140,000 BTUH @ 1.0 GPH with CB525-S2 Burner

Oil Type	Oil PSI / Flame Length	Air PSI	Air Band	Nozzle
#2 Fuel Oil*	***check flame length***	12-16	1/4"	9-5
Used Crankcase Oil	***check flame length***	12-16	1/4"	9-5
Used ATF*	***check flame length***	12-16	1/4"	9-5
Used Hydraulic Oil*	***check flame length***	12-16	1/4"	9-5
#4 and #5 Fuel Oils	***check flame length***	12-16	1/4"	9-5

*If you are burning light viscosity oils, it may be necessary to install a smaller nozzle. Call your Clean Burn dealer for more information.

Starting the Burner

1. Adjust the thermostat setting above room temperature to start the burner.
2. **Adjusting the Air Regulator:**
   As soon as the burner starts running, turn the knob on the air regulator clockwise to achieve proper operating air pressure. Refer to the **Initial Adjustment Charts**.
   NOTE: If the safety reset on the primary control is activated and the burner stops running, see Section 7 for further instructions on restarting your burner.

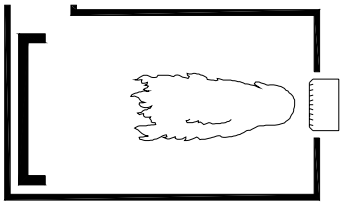
3. **Observing the Flame Length:**
   Visually inspect the flame length through the observation port. Refer to Figure 6B for an illustration of the desired flame length. The flame should extend no more than one-half of the way down the combustion chamber.

CAUTION
WHEN OPENING INSPECTION PORT

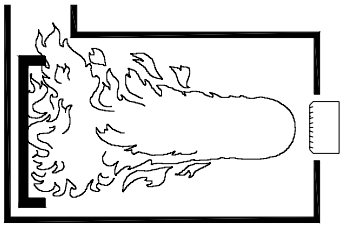
PORT MAY BE HOT
PROTECT HANDS
WEAR SAFETY GOGGLES
KEEP FACE AWAY
OPEN PORT SLOWLY

WARNING: The observation port gets hot as the burner fires. To avoid personal injury, always wear heavy work gloves and safety glasses when opening the port and viewing the flame.

Correct Maximum Flame Adjustment
(Proper Oil and Air Pressure with correct supply of Combustion Air):
- Flame goes half of the way down the combustion chamber.
- Flame does not touch back or walls of combustion chamber.



Incorrect Flame Adjustment
(Not Enough Combustion Air):
- Flame must not touch back or walls of combustion chamber.
- Increase combustion air by opening the air band on the side of the burner.



Incorrect Flame Adjustment
(Air Pressure Too High):
- Ensure proper air pressure setting.

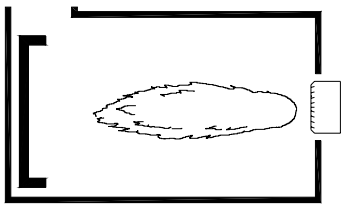


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Figure 6B - Flame Length Adjustment

4. Check the flame length after the burner has fired for 15 minutes.
5. Tighten the locking nut on the air regulator.

Starting the Burner (continued)

6. **Fine Tuning the Combustion Air Band:**

NOTE: The initial setting of the combustion air band may require additional adjustment.

- Refer to Figure 6A to identify the combustion air band location on the burner.
- Observe the flame. The flame should be yellow-white with sharp tips and no "sparkles."
- If the flame is orange in color or the flame length is too long, the oil you are burning requires MORE combustion air. OPEN the air band 1/8" to 1/4", and recheck the flame for the proper characteristics.
- Recheck the flame after five minutes. You should see a yellow-white flame with sharp tips and no "sparkles", and the flame should extend half the way down the combustion chamber.

7. **Checking for a Smokeless Burn:**

Check for a smokeless burn by observing the stack while the burner is running. If you see any smoke, repeat the previous steps for setting the combustion air band and adjusting the air regulator. After adjusting the combustion air band, re-check the flame length.

NOTE: Check for a smokeless burn periodically (as you do the flame length). Immediately readjust the burner if you ever see smoke coming from the stack. Smoke indicates improper air/fuel adjustment.

NOTE: When using instruments to adjust the burner for a smokeless burn, the following readings should be achieved:

- Draft over fire should be -.02 inch w.c.
- Adjust for a smoke spot of a trace to 2
- Adjust for a CO2 reading of 8 to 10% or an O2 reading of 7 to 9%
- Cad cell reading below 500 ohms

Checking the Operation of the Fan Motor

NOTE: It is important to verify that the fan motor operates correctly to ensure that the fan limit control is properly cycling the fan motor as described below. Also refer to Appendix A (A-10) at the back of the manual for additional information on the fan limit control.

1. Start the burner and adjust it as described previously in this section.
2. The fan motor will not start until the burner has been running for 5 to 15 minutes to heat up the combustion chamber and heat exchanger. At this point, the fan limit control will activate the fan motor.
3. Once the fan motor has activated, turn the burner off by turning the wall thermostat to OFF.
4. With the burner off, the fan motor should continue to run for 5 to 10 minutes until the combustion chamber is cooled down. The fan limit control will then shut off the motor.

 **WARNING:** If the fan motor does not operate as described, immediately shut down your furnace to avoid potential equipment damage and/or fire hazard. Contact your Clean Burn dealer immediately.

SECTION 7: RESETTING THE OIL PRIMARY CONTROL

Understanding the Oil Primary Control

NOTE: The CB-1400 primary controller (CB Part #33400) is a recycle type control, which features interrupted ignition operation.

The oil primary control will go into safety lockout and shut the burner off when it detects flame-out during burner operation. The oil primary control will then wait approximately one to two minutes and attempt to re-ignite the burner (recycle mode). If the burner does not re-ignite, the control will shut the burner off on safety. The following procedure explains what should be done when this occurs. *It is very important that you follow these instructions precisely when resetting the safety on the primary control and restarting the burner.*

Using the Reset Button

DANGER! DO NOT push the reset button more than once! DO NOT push the reset button if oil mist is present in the combustion chamber or when the combustion chamber is hot! DO NOT operate your furnace if excess oil, oil vapor or fumes have accumulated in or near your furnace. As with any oil burning furnace, improper operation may result in a fire or explosion hazard.

1. Refer to Figure 7A.
2. Check the combustion chamber for fuel mist by shining a flashlight through the observation port. If you see fog (fuel mist) in the chamber, DO NOT push the reset button.
3. If the combustion chamber is hot, allow the furnace to cool for at least 30 minutes. DO NOT push the reset button.
4. When you are sure all mist has been cleared from the chamber and the combustion chamber is cool, depress the red button on the primary control for a minimum of three (3) seconds, then release. Reset the control ONCE ONLY.
5. If the burner will not restart, call your Clean Burn dealer immediately.

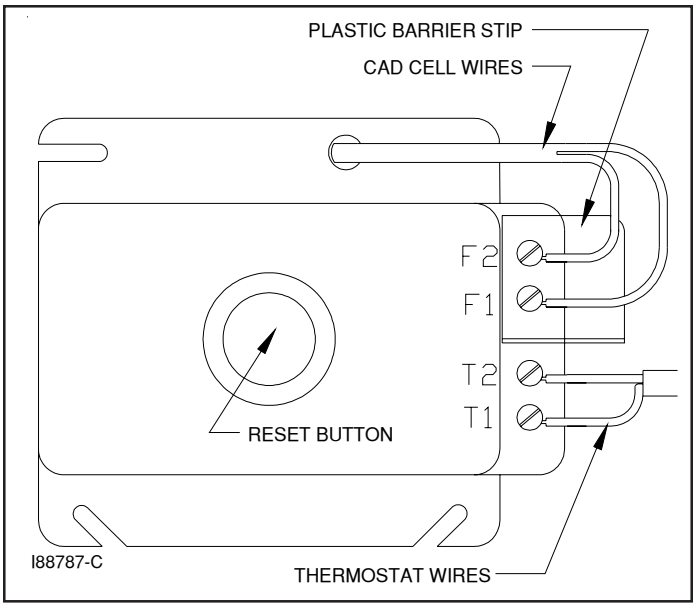


FIGURE 7A - Oil Primary Control

ATTENTION: *Never* touch a jumper wire from an "F" terminal to a "T" terminal on the oil primary control. This will severely damage your primary control. Make sure the plastic barrier strip is in place between the "F" and "T" terminals as shown in Figure 7A.

SECTION 8: ADJUSTING THE DRAFT OVERFIRE

Understanding the Importance of Draft

Draft in the furnace is created as the hot combustion gases rise up the stack, creating a negative pressure inside the stack and the furnace. This negative pressure is measured as inches of water column (W.C.) of draft. A proper draft overfire of -.02 to -.04 w.c. is essential so that all combustion products travel away from the burner, down the combustion chamber, through the furnace flues and up the stack.

Checking for Correct Draft Overfire

WARNING: Correct draft overfire is *essential* for the proper and safe operation of your furnace.

Your furnace is equipped with an observation/ draft reading port to check draft overfire. *A qualified serviceman with proper equipment must check/adjust your furnace for proper draft.* Contact your Clean Burn dealer for this service.

1. Insert the probe of the draft gauge instrument into the draft reading port in the observation port as shown in Figure 8A.
   NOTE: Follow the directions with the draft gauge to use your specific type of gauge.
2. Note the draft overfire reading on the draft gauge.
   ATTENTION: The draft reading should be in the -.02 to -.04 w.c. range. Poor draft (i.e. -.01 to +.08) results in back pressure in the furnace and poor burner performance. Too much draft overfire (i.e. *greater than* -.04) sucks the heat from the furnace and results in abnormally high stack temperature.

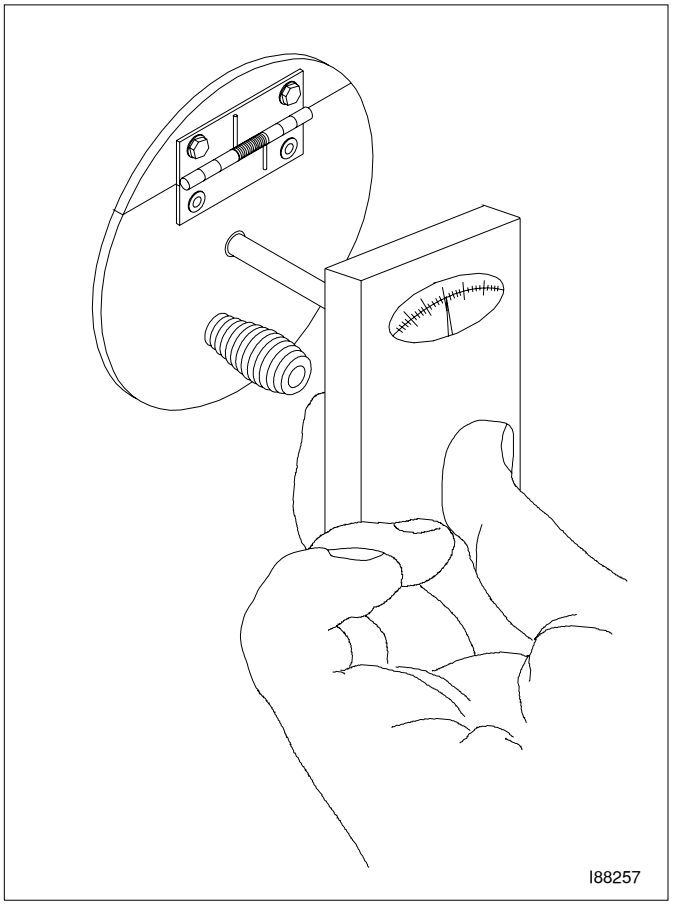


Figure 8A - Checking for Proper Draft Overfire

Adjusting the Barometric Damper

NOTE: If the draft overfire is not in the -.02 to -.04 w.c. range, it is necessary to adjust the barometric damper.

1. Before starting the burner, turn the weight on the flapper COUNTERCLOCKWISE until the flapper remains closed. This will provide maximum draft for the furnace.
2. Follow the directions in Section 6 to start and adjust the burner.
3. With the burner running, check the draft overfire with a draft gauge.
4. As shown in Figure 8B, adjust the weight on the flapper to obtain a consistent -.02 w.c. draft overfire. Turn the weight COUNTERCLOCKWISE to increase draft (i.e. draft increases as the flapper closes). Turn the weight CLOCKWISE to decrease draft (i.e. draft decreases as the flapper opens).
5. Tighten the locking nut to securely hold the weight in position.

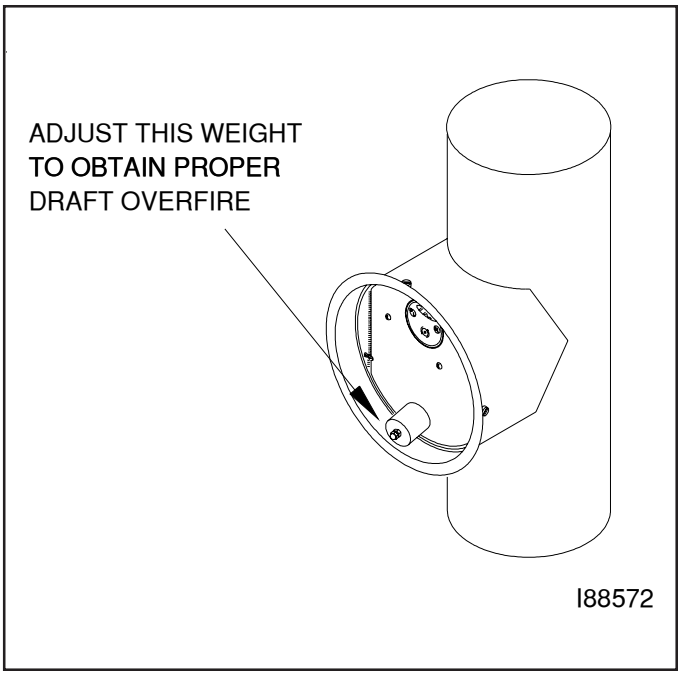


Figure 8B - Adjustment of Barometric Damper

Solving Draft Overfire Problems

WARNING! If you cannot achieve proper draft overfire, do not operate your furnace! Contact your Clean Burn dealer for assistance.

ATTENTION: Backdraft must be resolved or your furnace will not operate correctly!
Under backdraft conditions, draft overfire readings will show positive pressure in the combustion chamber. ***Backdraft*** *means that oil spray, combustion products, and heat are blown back against the burner. Backdraft results in oil-fouled retention heads and electrodes. Severe backdraft will force heat back against the burner and result in heat damage to the cad cell and transformer.*

Backdraft is caused by the following conditions:

- Poor draft caused by improper stack design. (See Section 4.)
- Poor draft caused by improper adjustment of the barometric damper. (See Above)
- Incorrect combustion air band setting on the burner. (See Section 6.)
- Furnace flues are plugged with ash. (See Section 9.)
- Clean-out gasket on Clean-out door is out of position (See Section 9).
- Exhaust fans in your building are sucking gases down the stack. (See following pages)

Understanding the Effect of Exhaust Fans on Draft

Any type of exhaust fan, paint booth, or exhaust system in a building will create negative pressure in the building unless there is a source of make-up air (i.e. fresh air which enters the building and replaces the air removed by the exhaust fans.) Refer to Figure 8C.

If there is insufficient make-up air, the exhaust fan will suck air and combustion gases down the furnace stack and create backdraft in the furnace. Even if the exhaust fan is on another level of the building or in another room away from the furnace, the exhaust fan will still create backdraft at the furnace.

Checking Draft Overfire to Determine Severity of Backdraft

The following procedure is an accurate method of determining how much backdraft is created by the exhaust fans. Once this is determined, you can select the correct method for resolving the backdraft. Refer to Figure 8C as needed.

1. Turn off ALL exhaust fans and close ALL doors and windows in the building (any open door or window will allow make-up air to enter the building and will negate the test).
2. Start the furnace and adjust the barometric damper so that the draft overfire is -.02 w.c.
3. Check the draft overfire again. Now have someone start the exhaust fans.
4. Note how much the draft overfire has changed.
   ATTENTION: If the draft overfire changed towards positive, it is mandatory that make-up air is provided to the building or severe damage to the furnace and burner will occur (voiding the warranty). If the draft overfire remained constant at -.02 w.c., there is sufficient make-up air entering the building, and the exhaust fan is not adversely affecting the draft.

Special Note to Service Personnel

To arrive at proper draft measurements be sure that all fans within the building are running while adjusting the draft to final levels!

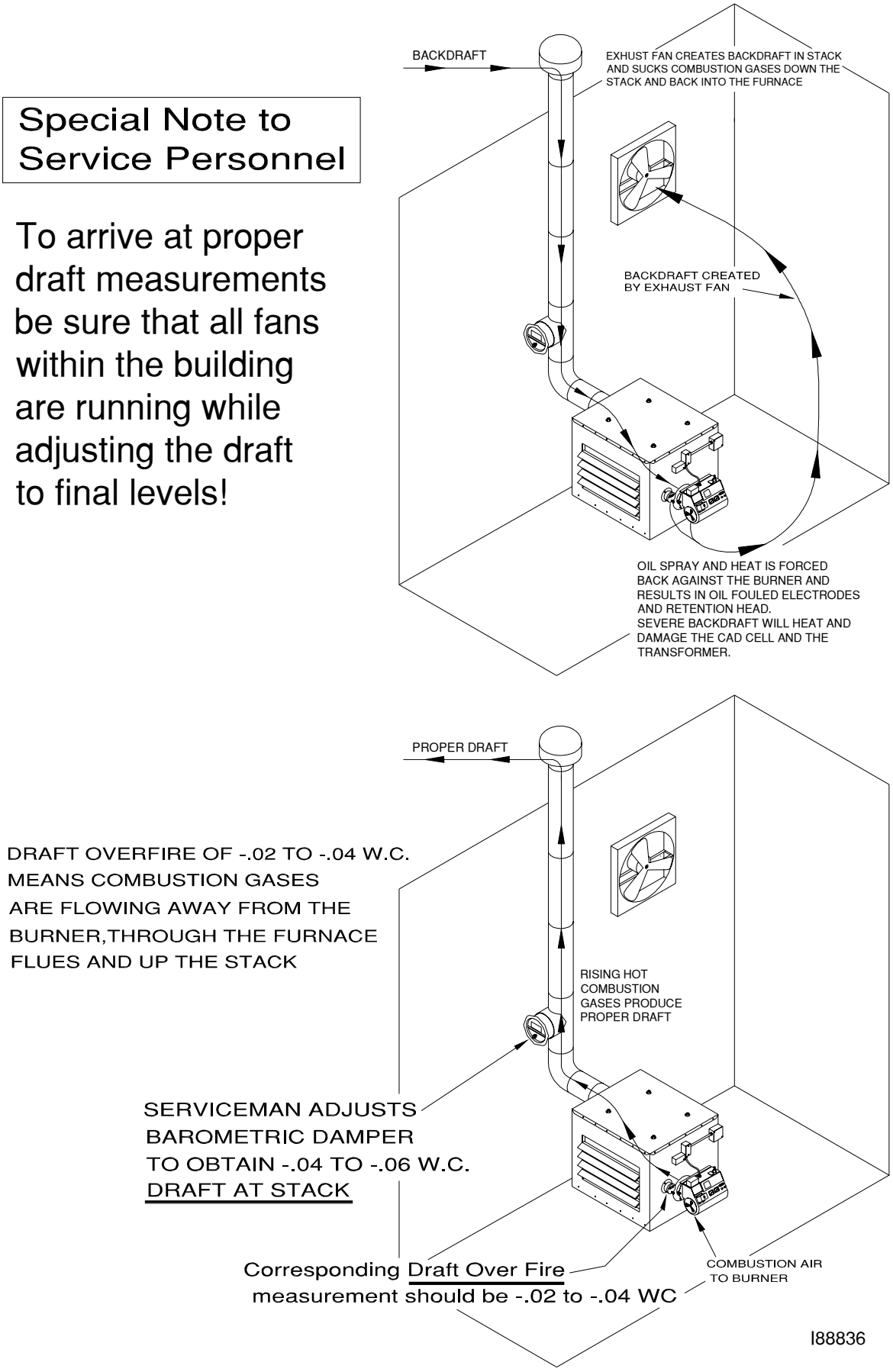


Figure 8C - Proper Draft vs. Backdraft

Installing a Make-up Air Louver

Exhaust Fans and Make-up Air Louvers

When exhaust fans are operated in tight buildings, there is little or no source of fresh air to replace the air removed from the building by the exhaust fan. This results in negative pressure (vacuum) in the building which creates severe backdraft problems at the furnace.

Properly sized make-up air louvers are designed to allow adequate fresh air to enter the building during operation of the exhaust fans. The louvers automatically open under the vacuum created by the exhaust fans. The louvers open just enough to provide the correct CFM of fresh air. The louvers automatically close when the exhaust fans are turned off.

Sizing the Make-up Air Louver

IMPORTANT NOTE: When using louvers and grills, and the actual free area of the louver or grill is not known, it is understood that wooden louvers/grills will have a free area of 25%, while metal louvers/grills will have a free area of 75%. ("Free area" translates into the actual space allowing air to flow through.)

Procedure 1:
(a) Determine the CFM rating of the exhaust fan. This information should be stamped on a label on the exhaust fan. Make sure to add up the total CFM if more than one exhaust fan exists in the building.
(b) Select the correct size of make-up air louver to provide the required CFM of fresh air.

If you cannot determine the CFM rating of the exhaust fan, use the following procedure.

Procedure 2:
(a) Count the total number of exhaust fans in the building.
(b) Close all of the doors and windows in the building *except* for one overhead garage door.
(c) Start the furnace and allow it to run for 15 minutes to bring it up to temperature.
(d) Set the draft-over-fire for -.02" to -.04" W.C.
(e) Turn ON all of the exhaust fans in the building.
(f) Now close the opened overhead garage door *slowly*, just until the draft gauge moves down into a positive (+) draft reading; as soon as it reaches this point, STOP the door at that position.
(g) Slowly open the door back up, just until the draft reading comes back up to the -.02" to -.04 W.C.
(h) Measure the size of the door opening, rounding this measurement off to the *next largest even foot.*

Example of Calculations for Sizing Make-up Air Louver

Measured door opening: 12 ft. wide x 9 in. high

- Round off to 12 ft. wide x 1 ft. high
- Convert to square feet (in this case it equals 12 ft^2)
- Multiply by 1.1 correction factor (12 ft^2 x 1.1 = 13.2 ft^2)
- Multiply by free area factor (13.2 ft^2 x 1.25 = 16.5 ft^2)
- Refer to sizing chart (following page) - required grill size would be (1) 54 in^2 grill

Installing a Make-up Air Louver (continued)

Calculated Opening Size (Square Feet)	Required Louver / Grill Size (Inches)
From 0.000 to 0.569	10 x 10
From 0.570 to 0.900	12 x 12
From 0.901 to 1.556	16 x 16
From 1.557 to 2.070	18 x 18
From 2.071 to 2.574	20 x 20
From 2.575 to 3.408	24 x 24
From 3.409 to 5.133	30 x 30
From 5.134 to 7.696	36 x 36
From 7.697 to 9.883	42 x 42
From 9.884 to 13.299	48 x 48
From 13.300 to 16.683	54 x 54
From 13.684 to 21.152	60 x 60

Installing the Make-up Air Louver

All louvers and grills, regardless of the material from which they are made, must be FIXED in the OPEN position OR be interlocked with the appliance so that they will open automatically during the operation of the appliance. The interlock must be placed on the driven member.

NOTE: It is very important to follow these instructions carefully to ensure proper performance of the louver.

1. The louver must not be close to the furnace. The fresh air should travel at least 40 to 50 feet before reaching the furnace, so the air warms up. The furnace will not heat well if it is receiving cold return air.
2. The louver must be high in the sidewall of the building so the cold fresh air does not blow across the floor level and chill the service personnel.
3. The louver should be installed in the opposite wall from the location of the exhaust fan. This will quickly vent diesel exhaust from the top of the building and reduce the amount of run time for the exhaust fan.

SECTION 9: MAINTENANCE

Understanding Maintenance

Servicing your Clean Burn furnace in a timely manner is very important to keep your furnace running in peak condition. Just as an automobile requires periodic maintenance such as oil changes, engine tune-ups, etc. your Clean Burn furnace also requires regularly scheduled service.

WARNING: *Failure to maintain and/or improper servicing by unqualified personnel may adversely affect the proper, safe operation of your furnace, may reduce the service life of your furnace, and may void your warranty.*

The following chart summarizes all the service intervals which are required to maintain your furnace. Service instructions/procedures for these activities are included in this chapter.

Maintenance Activity	**Interval**
Periodic Burner Inspection	Monthly
Cleaning the canister filter	***Before*** vacuum gauge reads 10" HG of vacuum
Servicing the metering pump	At least once a year
Cleaning the check valve/screen	At least once a year
Cleaning water/sludge out of tank	At least once a year
Cleaning out ash	Approx. 700 hours as indicated on the burner hour meter*
Annual burner tune-up	At least once a year

***It is very important to clean ash from the furnace on schedule.** Normal use of the furnace requires clean-out at least twice during the heating season. Heavy, around-the-clock usage requires more frequent clean-out. For instance, *one month* of continual running of the furnace is *720 hours* (24 hours x 30 days = 720 hours).

NOTE: *IMPORTANT!* Record all maintenance activities in the Maintenance Record provided in Appendix C.

Periodic Burner Inspection

Following initial start up of the burner, you should inspect the operation of the burner periodically--ideally on a monthly basis. Doing so ensures that the system is functioning efficiently and safely.

Follow these guidelines for inspecting the operation of the burner:

- Visually inspect the flame length through the observation port; the flame should extend no more than one-half of the way down the combustion chamber.
  - -If the flame is diminishing or displays wide variations, clean the canister filter and check valve/screen (procedures provided in this section).
  - -If the flame is firing too strongly (i.e. flame touches back and/or side walls of the combustion chamber), check the air pressure setting (see following guideline).

CAUTION
WHEN OPENING INSPECTION PORT

PORT MAY BE HOT
PROTECT HANDS
WEAR SAFETY GOGGLES
KEEP FACE AWAY
OPEN PORT SLOWLY

- Check the air pressure by observing the air gauge; proper air pressure settings are provided in Section 6. DO NOT overfire the burner; doing so on a continual basis will damage the furnace.
- Check the combustion air band setting for the proper opening and clean away any dust/debris as necessary. Note that the air band should NEVER be set fully open or closed.
- Check the draft over fire reading as specified in Section 8.

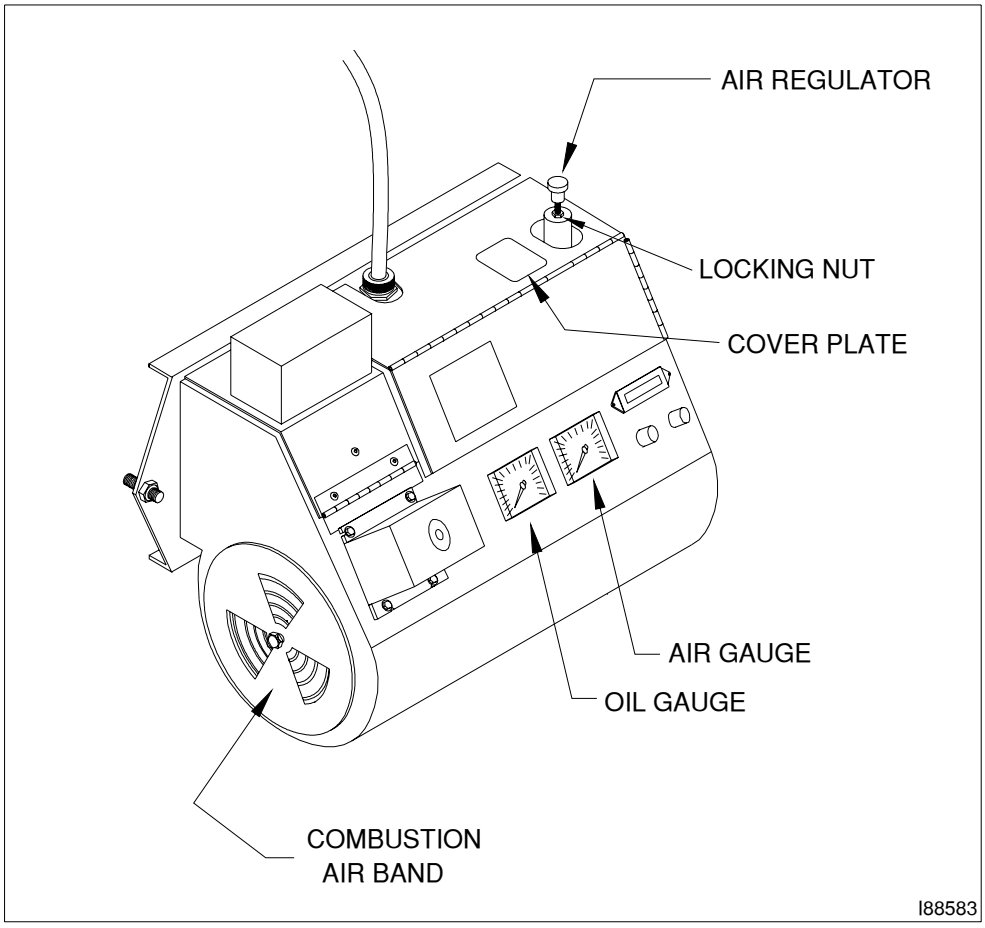


Figure 9A - Component Detail of the CB-525-S2 Burner

Cleaning the Canister Filter

ATTENTION: Never operate your furnace with more than 10" HG of vacuum on the suction side of the pump. High vacuum separates air from the oil and results in erratic burner operation.

The following protective gear should be worn when cleaning the filter:

- Rubber gloves
- Safety goggles

1. Close the ball valve adjacent to the filter.
2. Position a container under the filter.
3. Unscrew the four bolts to drain the oil from the canister.
4. Remove the canister bowl.
5. Clean the screen and the bowl in a parts washer.
6. Referring to Figure 9B, examine the filter components as you reassemble them.
7. Check the condition of the O-rings. Replace any that are cracked or worn.
8. Ensure that the canister filter is 100% airtight by firmly tightening the four bolts.
9. After the pump head screen is serviced as well (page 9-4) open the ball valve and refer to Sections 5 and 6 for instructions on priming the pump and starting the burner.

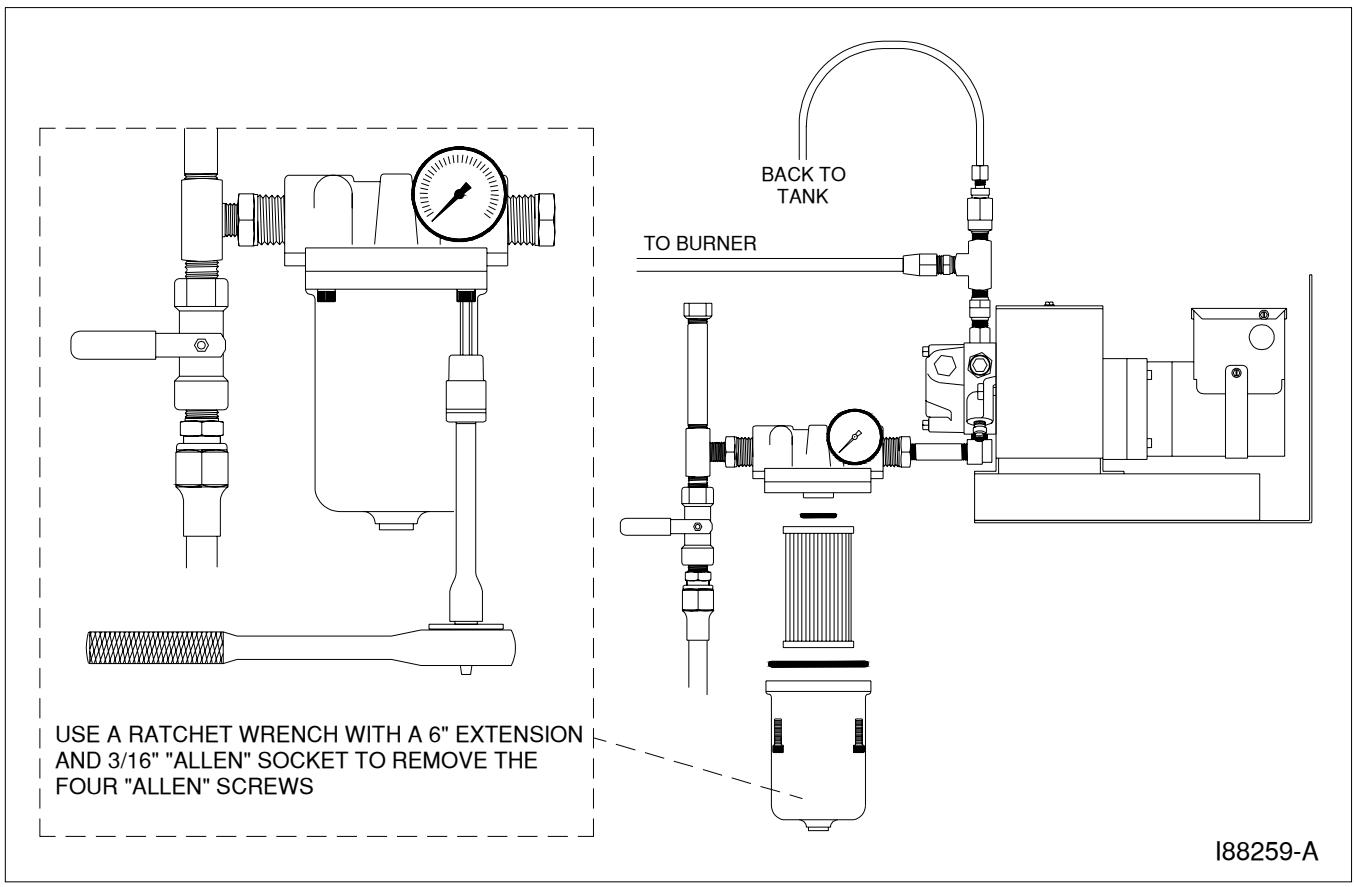


Figure 9B - Canister Filter Component Detail

Servicing the Metering Pump

1. Refer to Figure 9C.
2. Remove the pump head cover (part 1).
3. Remove the screen (part 2) and wash it.
4. Remove and discard the used gasket (part 3).
5. Install a new gasket (Clean Burn Part #32422).
6. Replace the screen and pump head cover.

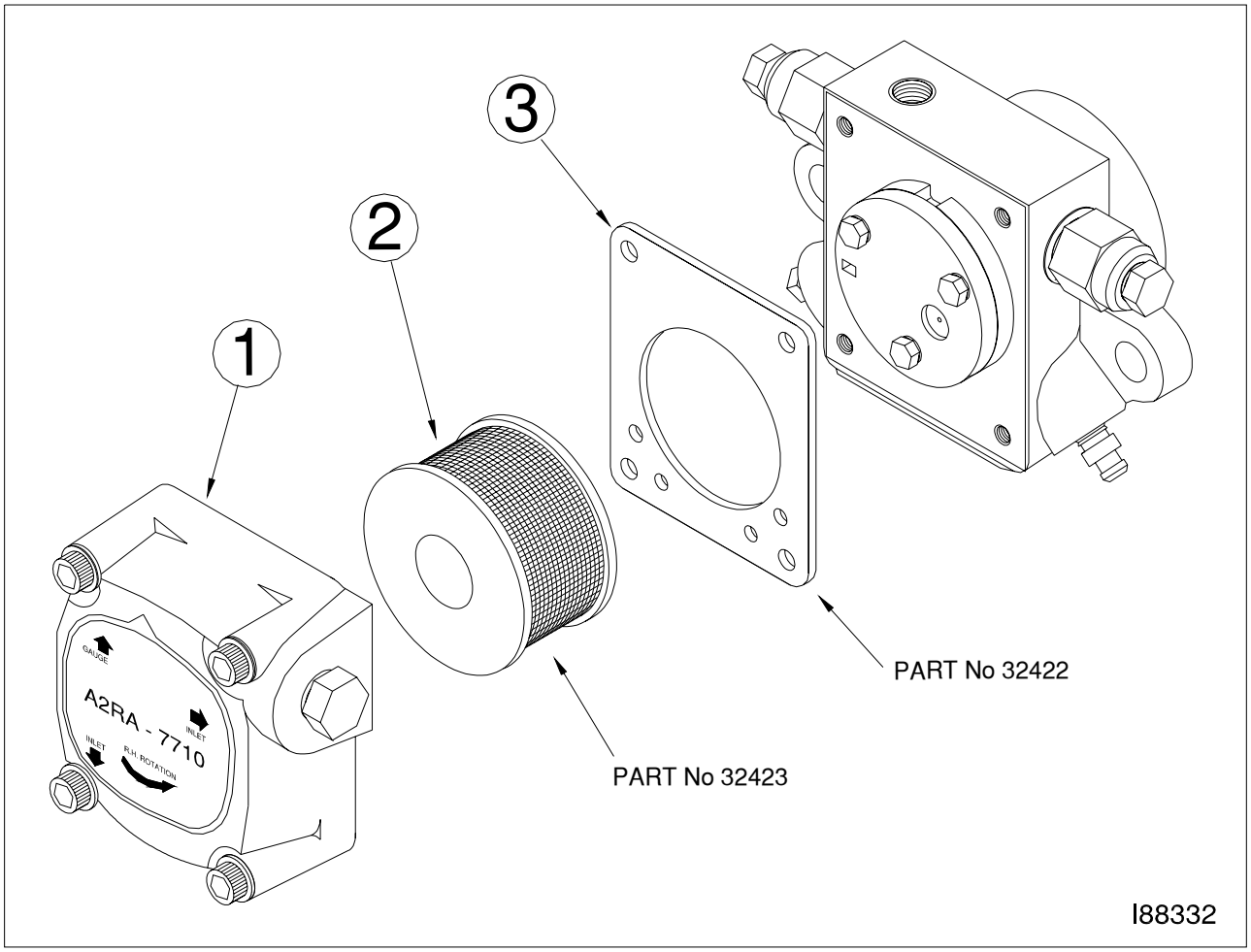


Figure 9C - Servicing the Metering Pump

Cleaning the Check Valve And Check Valve Screen

This procedure applies to furnace installations with inside and outside tanks. The following protective gear should be worn when cleaning the check valve/screen:

- Rubber gloves
- Safety goggles

1. Refer to Figure 9D. Remove the one-piece suction oil line from the tank.
2. Remove the check valve and screen. Clean these components in a parts washer.
3. Check the operation of the check valve. The valve must seat so it is airtight to hold pump prime.
4. Re-assemble and re-install the components. Apply Permatex #2 non-hardening gasket sealer or equivalent to the threaded fittings. Firmly tighten all connections so the suction line is 100% airtight.
5. Follow pump priming instructions in Section 5 to re-establish prime.

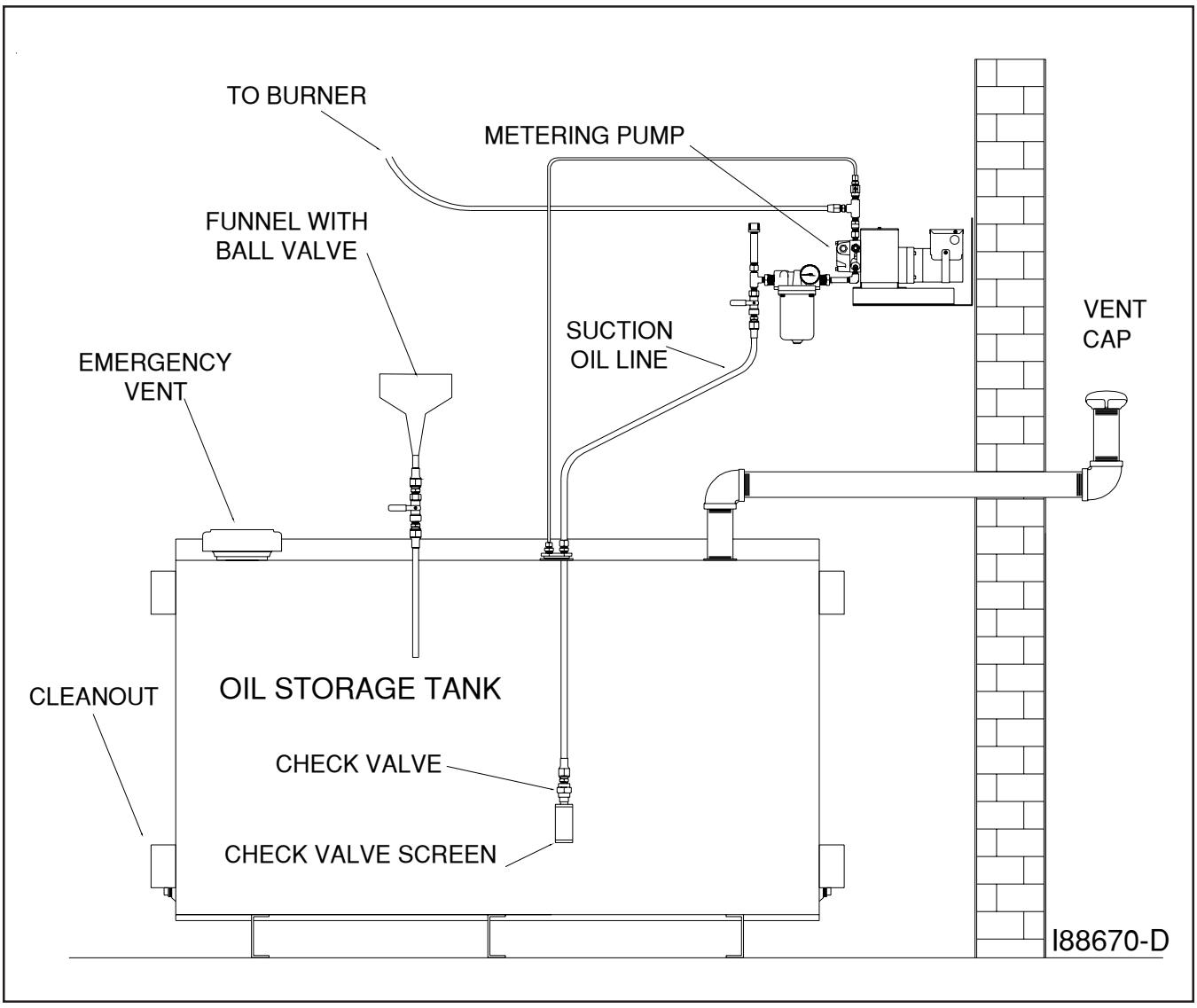


Figure 9D - Check Valve Detail

Cleaning the Tank

DO NOT allow water, sludge, or other debris to accumulate in your oil supply tank to the point that non-combustible or harmful materials are drawn into the pump or burner.

Drain water and sludge from the bottom of your tank at least once a year, and more frequently with water accumulation.

NOTE: If your used oil tank has not been cleaned on a regular basis, a considerable amount of sludge, etc. may have accumulated on the bottom of the tank. Under these circumstances, it is advisable for you to hire your used oil hauler to pump the tank. Make sure the tank is pumped to the bottom to remove all sludge, etc. from the tank (your used oil hauler may charge an additional fee for this type of service). The best time to pump the used oil tank is at the end of the heating season when the tank is low. This allows sufficient time to refill the tank with used oil (generated by your company over the summer months) so that you have adequate fuel for the heating season.

Cleaning Ash from the Furnace

NOTE: The maintenance interval for cleaning ash from the furnace is approximately 700 hours of operation as indicated on the hour meter on the burner (refer to the servicing intervals at the beginning of this chapter). ***Be sure to clean the ash from your furnace at least twice during the heating season. Your furnace may require more frequent clean out of the ash due to contaminants in the oil or heavy use.*** As ash accumulates, furnace heat output declines, and the stack temperature rises. 1/8" of ash has the insulating capacity of one inch of fiberglass insulation and reduces heat transfer significantly. ***Never allow more than 1/4" of ash to accumulate in the combustion chamber, heat exchanger flues, or stack.***

CAUTION: Be aware that used oils may contain heavy metallic compounds or foreign materials. When burned, these compounds are deposited within the furnace, necessitating *careful* cleaning. The following protective gear should be worn when cleaning the ash:

- Respirator for fine particles (a dust mask is not acceptable)
- Safety goggles
- Rubber gloves
- Protective clothing

CAUTION: Make sure you use a sturdy ladder or scaffolding for safe access to ceiling-hung furnaces.

NOTE: When cleaning the furnace, static electricity may build up in the shop vac hose. If this occurs, use #12 copper wire wrapped around the hose with the other end connected to the furnace (or other ground source) to eliminate the static.

Cleaning Ash from the Furnace (continued)

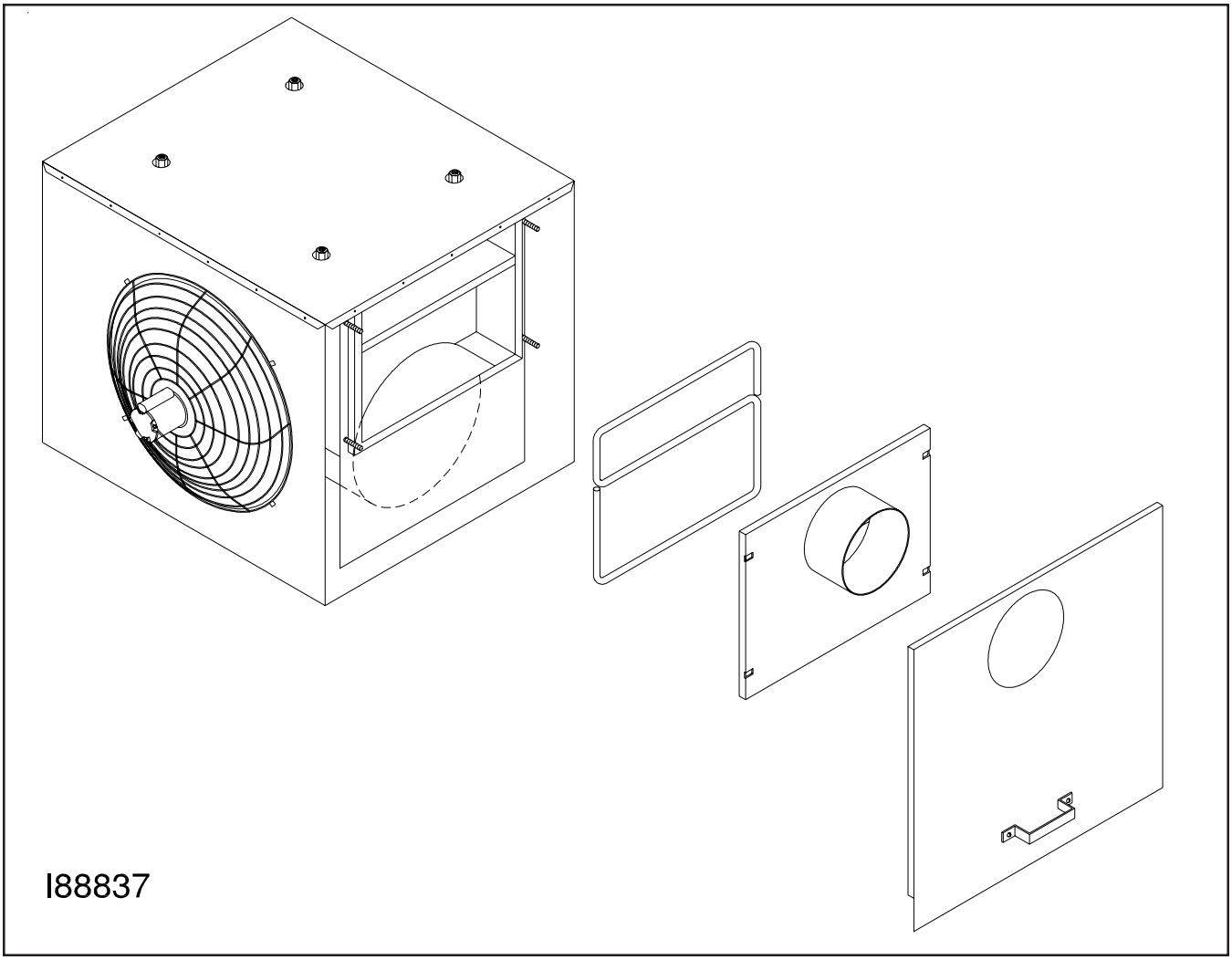


Figure 9E - Accessing the Combustion Chamber for Cleaning

1. Ensure that power has been turned OFF, and all "hot" components have been allowed to cool sufficiently. Allow at least one hour for the target to cool.
2. Clean out the burner throat:
   a. Disconnect the burner power cable.
   b. Remove the lock-down nut and swing the burner open.
   c. Clean out the burner throat using a small scraper to remove the residues.

   ATTENTION: Keep the burner open (swung out) so that you do not knock or bend burner components when cleaning out the combustion chamber.
3. Clean the ash from the stack components:
   a. Brush accumulated ash from the stack cap.
   b. Lightly tap the stack components to loosen the ash.
   c. Allow ash and dust to settle in the clean-out tee or elbow.
   d. Vacuum ash from the clean-out tee, or disconnect the stack and vacuum ash from the elbow.

Cleaning Ash from the Furnace (continued)

4. Remove the clean-out door to clean ash from inside the combustion chamber (see Figure 9E):
   a. Disconnect the stack from the furnace breach.
   b. Remove the clean-out panel from the back of the furnace.
   c. Remove the clean-out door to expose the heat exchanger flues and the combustion chamber.
   d. Check the color of the ash--it should be light gray or tan.
      ATTENTION: White ash indicates excessive air pressure. Black ash or soot indicates lack of combustion air. If these conditions exist, call your Clean Burn dealer. DO NOT overfire your furnace by turning up the compressed air pressure. Overfiring will damage the combustion chamber and heat exchanger and will void your warranty.
   f. Use your shop vac to vacuum ash from the flues.
      NOTE: Avoid "packing" the ash in the back of the tubes by first vacuuming the flues before pushing the flue brush down the flues.
   g. Use a flue brush to thoroughly clean the flues.
   h. Thoroughly vacuum any remaining ash residue from the flues.
   i. Check the flues for rust.
      ATTENTION: The presence of rust in the flues indicates that chlorinated materials are being burned. Burning chlorinated materials will severely damage your heat exchanger and void your warranty. Contact your Clean Burn dealer for instructions to test your oil for chlorine contamination before firing your furnace.
   j. Inspect the fiberglass rope gasket.
      NOTE: Make sure the fiberglass rope gasket is in good condition and the clean-out door seals tightly. If the door does not seal tightly, replace damaged components.
   k. Re-install the furnace components: clean-out door, clean-out panel, and stack.
      NOTE: You may need to bleed air from the oil line before starting the burner. See Section 5 for the pertinent instructions.
   l. Swing the burner into firing position. Install the lock-down nut and plug in the burner power cable.

Annual Burner Tune-up

Your Clean Burn furnace requires annual periodic maintenance. The burner requires an annual tune-up --similar to an automotive tune-up--to keep it running in peak condition. *The burner tune-up should be performed by a qualified Clean Burn service technician who has the necessary parts and expertise.*

Contact your local Clean Burn dealer to schedule the annual periodic maintenance which is usually (preferably) performed during warm weather to prepare the furnace for the next heating season. Various levels of service are provided to fit your particular need.

End of Season Maintenance

ATTENTION: Turn main power to your furnace OFF at the end of the heating season. This will prevent the oil from being "cooked" in the pre-heater block when it is not in use. Failure to do so may result in carbon build up in the burner preheater block which will block oil flow.

ATTENTION: EPA regulations allow your used oil to be burned only for "heat recovery." DO NOT operate your furnace during warm weather just to burn oil, or severe damage to the combustion chamber/heat exchanger may occur.

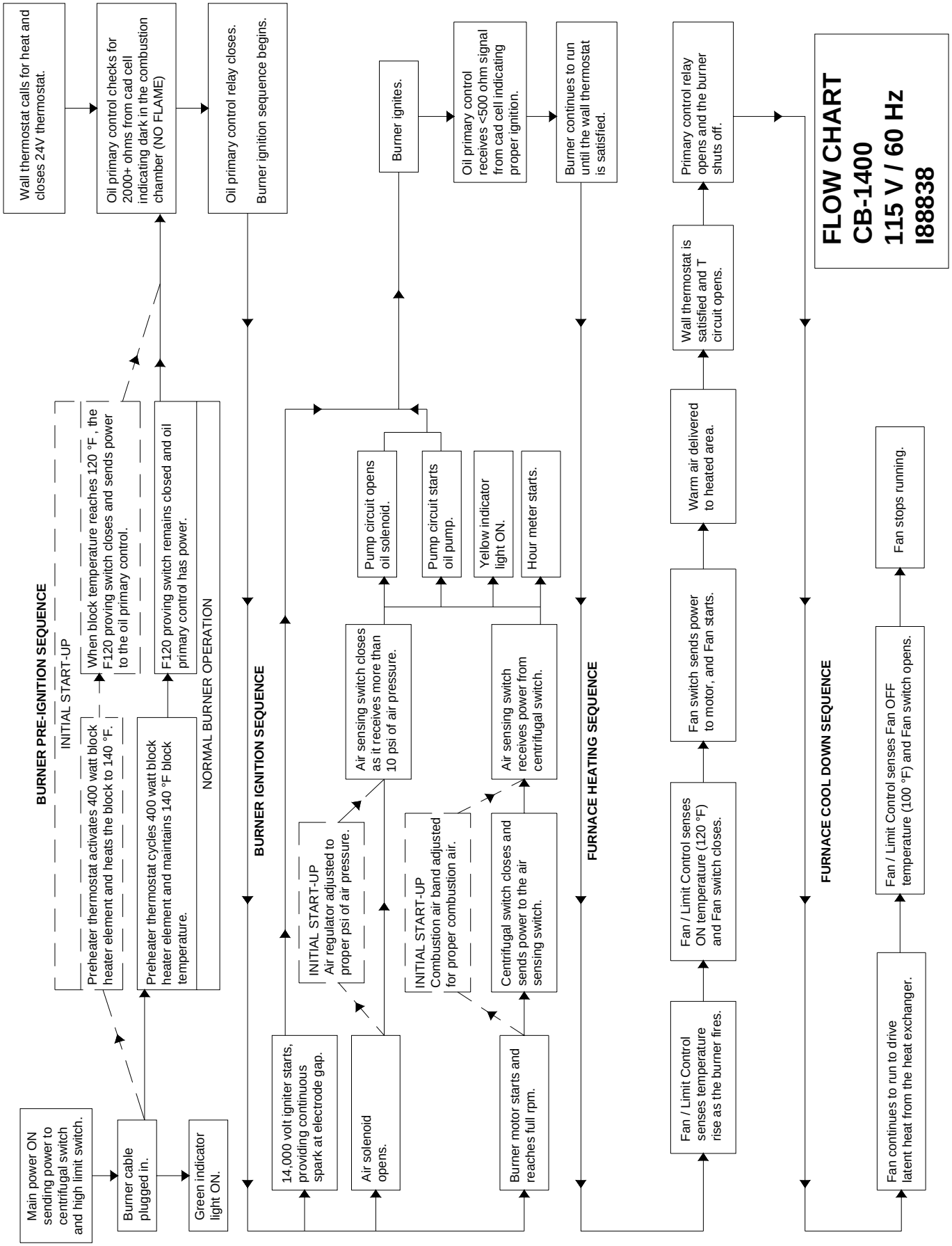
Contact your local Clean Burn dealer to schedule your annual burner tune-up. Allow only trained, authorized service personnel to service your burner.

SECTION 10: TROUBLESHOOTING

The following charts and tables are provided for reference in troubleshooting any difficulties encountered in furnace operation and adjustment.

- The **Flow Chart** outlines the proper sequence of events in furnace operation -- use this chart to help diagnose where a problem may be occurring.

- More specific troubleshooting information is provided in the **Troubleshooting Tables** following the flow charts. Each table lists a **Problem**, **Possible Cause**, and **Possible Action(s)** to fix the problem.


FLOW CHART
CB-1400
115 V / 60 Hz
I88838
BURNER PRE-IGNITION SEQUENCE
INITIAL START-UP
Preheater thermostat activates 400 watt block heater element and heats the block to 140 °F.
When block temperature reaches 120 °F , the F120 proving switch closes and sends power to the oil primary control.
Preheater thermostat cycles 400 watt block heater element and maintains 140 °F block temperature.
F120 proving switch remains closed and oil primary control has power.
NORMAL BURNER OPERATION
Wall thermostat calls for heat and closes 24V thermostat.
Oil primary control checks for 2000+ ohms from cad cell indicating dark in the combustion chamber (NO FLAME)
Oil primary control relay closes.
Burner ignition sequence begins.
Main power ON sending power to centrifugal switch and high limit switch.
Burner cable plugged in.
Green indicator light ON.
BURNER IGNITION SEQUENCE
14,000 volt igniter starts, providing continuous spark at electrode gap.
INITIAL START-UP
Air regulator adjusted to proper psi of air pressure.
Air solenoid opens.
INITIAL START-UP
Combustion air band adjusted for proper combustion air.
Burner motor starts and reaches full rpm.
Centrifugal switch closes and sends power to the air sensing switch.
Air sensing switch closes as it receives more than 10 psi of air pressure.
Air sensing switch receives power from centrifugal switch.
Pump circuit opens oil solenoid.
Pump circuit starts oil pump.
Yellow indicator light ON.
Hour meter starts.
Burner ignites.
Oil primary control receives <500 ohm signal from cad cell indicating proper ignition.
Burner continues to run until the wall thermostat is satisfied.
FURNACE HEATING SEQUENCE
Fan / Limit Control senses temperature rise as the burner fires.
Fan / Limit Control senses ON temperature (120 °F) and Fan switch closes.
Fan switch sends power to motor, and Fan starts.
Warm air delivered to heated area.
Wall thermostat is satisfied and T circuit opens.
Primary control relay opens and the burner shuts off.
FURNACE COOL DOWN SEQUENCE
Fan continues to run to drive latent heat from the heat exchanger.
Fan / Limit Control senses Fan OFF temperature (100 °F) and Fan switch opens.
Fan stops running.

Troubleshooting Tables

PROBLEM	POSSIBLE CAUSE	POSSIBLE ACTION(S)
Burner won't run at all *and* Green power light is NOT ON.	1. Circuit breaker/main switch open. 2. Fuse/breaker blown. 3. Burner cable is damaged or not plugged in properly.	1. Close circuit breaker/switch. 2. Electrician should check out electrical system. 3. Check burner cable.
Burner won't run at all *and* Green power light is ON.	1. Oil primary control has shut down on safety reset. 2. Wall thermostat is not operating. 3. Heater block is not heating up. 4. F-120 proving switch has not closed. 5. Oil primary control terminals are not wired correctly. 6. Oil primary control is damaged. 7. The High Limit Switch on the Fan / Limit Control has activated.	1. Follow the directions in Section 7 to reset the oil primary control. 2. Check the wall thermostat and thermostat cable. 3. Feel the back of the burner; it should be 140 degrees F. If the heater block is NOT HOT: (a) Wait 15 minutes for the heater block to heat up and re-check the back of the burner, and (b) Check the block heater thermostat and block heater element. Refer to the wiring diagram and ladder schematic in Appendix B. 4. If the block is HOT: (a) Check the red wire at the F-120 proving switch for power. If there is NO power at the red wire, refer to the wiring diagram and ladder schematic in Appendix B to troubleshoot the circuit that provides power to the proving switch. (b) If there is power at the red wire at the proving switch, check for power at the black wire. If there is NO power at the black wire, replace the F-120 proving switch. 5. Check the oil primary control: (a) Check that the "F" terminals are NOT jumped. (b) Check that the two yellow cad cell wires are connected to the "F" terminals. (c) Check that the two thermostat wires are connected to the "T" terminals. 6. Replace oil primary control: (a) Check voltage – it must be 115 volts. 7. Refer to Appendix A for instructions on the Fan / Limit Control.

Troubleshooting Tables (continued)

PROBLEM	POSSIBLE CAUSE	POSSIBLE ACTION(S)
Burner ignites, but will not stay running *and* Burner shuts off on reset within 15 seconds.	1. There is a fuel delivery problem. 2. The cad cell is dirty. 3. Cad cell wires are loose. 4. Cad cell / cad cell wires are damaged. 5. The primary control is not receiving the proper ohm signal from the cad cell.	1. Follow the procedures listed in the next problem. 2. Clean and check the condition of the cad cell and cad cell wires. 3. Check that the yellow wires are connected properly at the "F" terminals on the oil primary control. 4. Replace the cad cell and cad cell wires. If the cad cell is heat damaged: (a) Clean your furnace, including the combustion chamber, flues and stack. Refer to instructions in Section 9. (b) Check for backdraft caused by exhaust fans in your building. Follow instructions in Section 8. 5. Disconnect the yellow wires from the "F" terminals. Start the burner and check the ohm reading from the cad cell. You have 10 seconds to perform this test before the burner shuts off on reset. Refer to Section 7 to reset the oil primary control. If the ohm reading is above 500 ohms: (a) Check the position of the cad cell; the cad cell must "look" straight through the central hole in the retention head. (b) Check the position of the retention head according to Appendix A.
Burner ignites and runs properly, but the burner shuts off on reset periodically (e.g. the burner goes off on reset during the night and requires resetting in the morning).	1. There is air in the suction oil line due to leaks at the fittings . 2. There is air trapped in a high point in the pressure oil line.	1. Follow the procedures in Section 5 to vacuum test the pump. Re-install and properly seal the suction line fittings to eliminate air leaks. 2. Follow instructions in Section 4 to bleed the air out of the pressure oil line.

Troubleshooting Tables (continued)

PROBLEM	POSSIBLE CAUSE	POSSIBLE ACTION(S)
Burner ignites *and* Burner shuts off on reset sometime later during the day or night.	1. There is air in the fuel supply.	1. Prime the pump. If the pump will not prime or there is air in the oil stream from the pump bleeder, follow the steps in the next problem ("Pump will not prime.")
	2. The primary control is not receiving the proper ohm signal from the cad cell.	2. Check for proper ohm signal. Follow the procedures in the previous problem (top, page 10-4)
	3. There is insufficient air pressure.	3. Follow the instructions in Section 5 to adjust the air regulator for proper air pressure. DO NOT turn the air compressor off while the furnace is operating. If you turn the air compressor off at night, turn the wall thermostat to OFF so the burner will not run.
	4. The heater block is cold.	4. DO NOT shut off power to the furnace overnight, or the heater block will cool down, and the burner will not re-start the next morning. To turn the furnace "off" overnight, turn the wall thermostat to OFF. The heater block will stay hot.
	5. The electrodes are fouled.	5. If oil residues have built up on the electrodes and retention head, follow the instructions in Section 8 to check for proper draft overfire. Clean the electrodes and retention head.

Troubleshooting Tables (continued)

PROBLEM	POSSIBLE CAUSE	POSSIBLE ACTION(S)
Pump will not prime *and* Pump motor is running.	1. There is a leak(s) in the suction line.	1. Follow the specifications in Section 4 to make sure the suction line is installed properly and that all fittings are 100% airtight.
	2. The pump is not installed so it will fill with oil during the priming process.	2. Make sure the pump head is filled with oil prior to starting the pump. See Section 5.
	3. The pump gears are dry.	3. Follow the procedure in Section 5 to fill the oil line and prime the pump.
	4. The pump seal is damaged.	4. With the pump not running, wipe your finger along the bottom of the cylinder at the pump shaft. If there is oil at the pump shaft, the seal is damaged. Replace the pump, or replace the seal. NOTE: Some oils will expand as they warm up. Because there is a check valve in the suction line, the expanding oil may build up pressure and damage the oil seal. Install a mini-accumulator in the 1/8" port of the canister filter to prevent the pressure build-up.
	5. The ball valve is closed.	5. Open the ball valve on the suction line.
	6. The canister filter is dirty.	6. Refer to Section 9 to clean the canister filter.
	7. The check valve is dirty.	7. Refer to Section 9 to clean the check valve.
	8. The pump is damaged or worn out.	8. Replace the pump.

Troubleshooting Tables (continued)

PROBLEM	POSSIBLE CAUSE	POSSIBLE ACTION(S)
Pump will not prime *and* Pump motor is NOT running.	1. There is NO power on the pump circuit from the burner.	1. Start the burner and adjust the air pressure regulator to 15 PSI. (a) If the amber "pump" light on the burner comes ON, the pump circuit on the burner has activated properly. Refer to the wiring diagram and ladder schematic in Appendix B to troubleshoot the pump circuit from the burner to the pump. (b) If the amber "pump" light on the burner does NOT come ON, there is a problem with pump circuit in the burner. With the burner running, check for power at the brown wire on the air pressure switch. If there is NO power at the brown wire, replace the burner motor. If there is power at the brown wire, replace the air sensing switch.
	2. The pump motor has shut off on thermal overload.	2. (a) The pump motor is too hot—the internal thermal protection switch shut the motor off. Wait for the motor to cool down; the thermal switch will automatically reset. Check voltage and amperage draw of the pump motor. Call your dealer if the problem persists. (b) The coupling is not adjusted properly, keeping the shafts of the motor and pump from turning freely. Re-position the coupling so that both shafts turn freely. (c) The shaft on the motor or oil pump will not turn freely. If you can't turn the shafts, replace the faulty part(s).
Fan motor runs all the time.	1. Fan motor circuit is wired incorrectly.	1. Refer to wiring diagram and ladder schematic in Appendix B to troubleshoot the fan circuit.
Fan motor will not run.	1. The fan motor is not wired correctly.	1. Check the fan motor wiring. Refer to the wiring diagram and ladder schematic in Appendix B. Follow the directions in Section 6 to test for proper fan operation. If the fan does not operate, shut OFF power to the furnace and call your Clean Burn dealer for service.
	2. The Fan / Limit switch is defective.	2. Replace the Fan / Limit switch.
	3. The fan motor has overheated and shut down on thermal reset.	3. The fan motor is too hot – the internal thermal protection switch shut the motor off. Wait for the motor to cool down; the thermal switch will automatically reset. Check voltage and amperage draw of the fan motor. Call your dealer if the problem persists.

APPENDIX A

Detailed Furnace Specifications

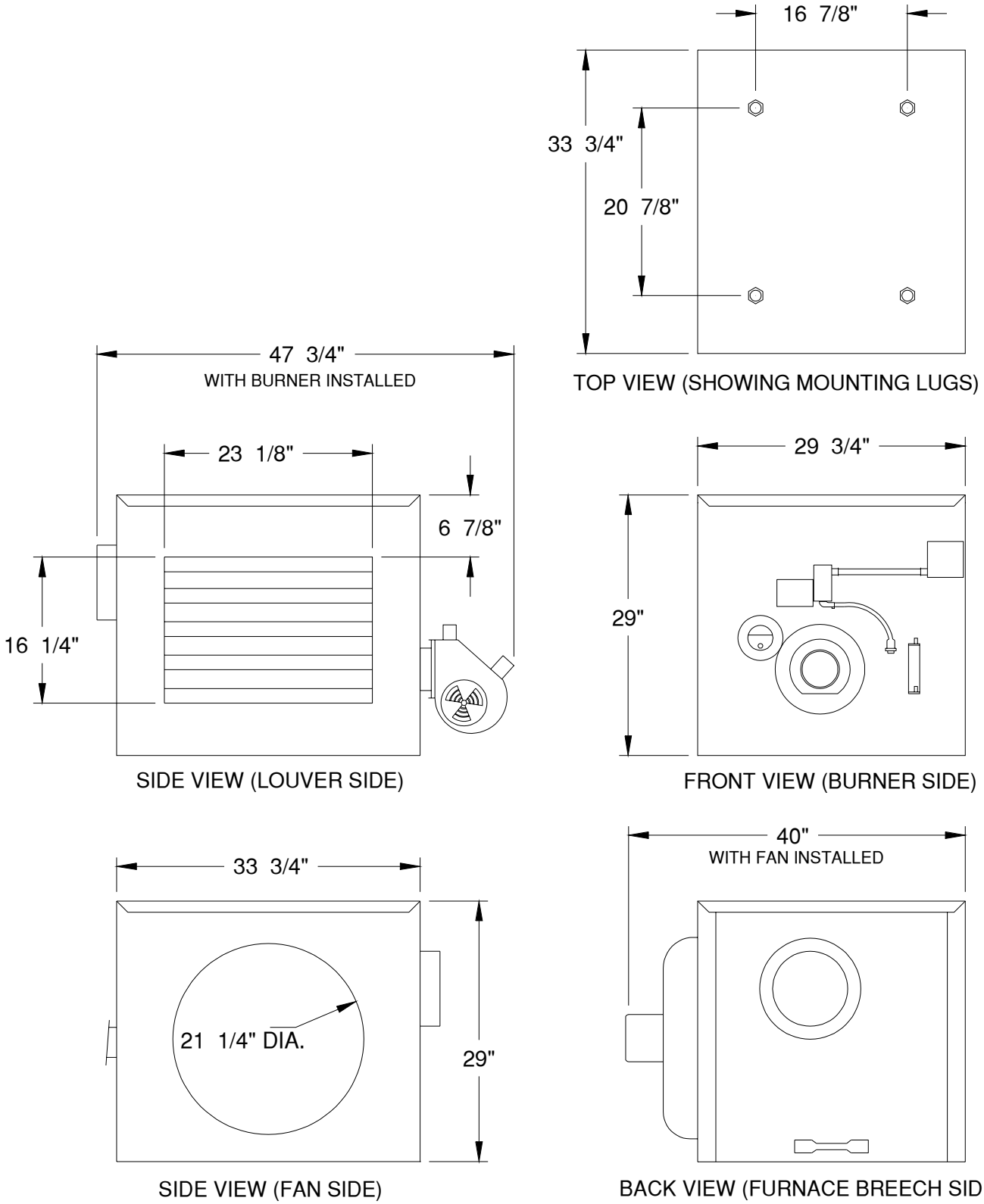
Furnace Technical Specifications

SPECIFICATIONS	CB-1400
BTUH Input	140,000 @ 1.0 GPH
Listed Fuels	#2, #4 Fuel Oils Used Crankcase Oil Used ATF Used Hydraulic Oil
Cabinet Dimensions (L x W x H, inches)	33 ¾ x 29 ¾ x 29
Furnace Dimensions with Fan & Burner (L x W x H, inches)	47 ¾ x 40 ¾ x 29
Approximate Weight (lbs.)	320
Mounting	Ceiling Hung Bench Tank Kit Non-combustible Platform
Electrical Requirements	110/120 Volts, 60 Hz
Circuit Breaker for Unit Heater	20 Amps
Circuit Breaker for Furnace with Optional Accessories	Refer to specifications included with optional accessories
Wall Thermostat	24 Volt
Oil Pump	Suntec A2RA-7710 (CB# 32327)
Pump Motor	Bison gear motor (CB# 33291)
Pump Motor Rotation	CCW shaft end
Canister Filter	Lenz DH 750-100
Stack Size	8”
Fan Motor HP	1/3
Fan Blade / Pitch	Three Blade / 21°
Fan Limit Control	Honeywell L4064B 8” Probe
Fan Limit Settings	Hi-Limit – 200 Fan ON – 120 Fan OFF – 100

Burner Technical Specifications

Burner	CB-525-S2
Ignition Transformer	Carlin Transformer 14,000 Volts
Nozzle	Delavan 9-5
Burner Motor	1/10 HP 3200 RPM with centrifugal switch
Burner Motor Rotation	CCW shaft end
Compressed Air Requirements	2.0 CFM @ 50 PSI
Oil Primary Control	Carlin Oil Primary
Heater Element in Preheater Block	400 Watts
Air Pressure Switch	MPL 808
Setting for Preheater Thermostat	140 ^{o}F

Furnace Dimensions



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Burner Components (CB-525-S2)

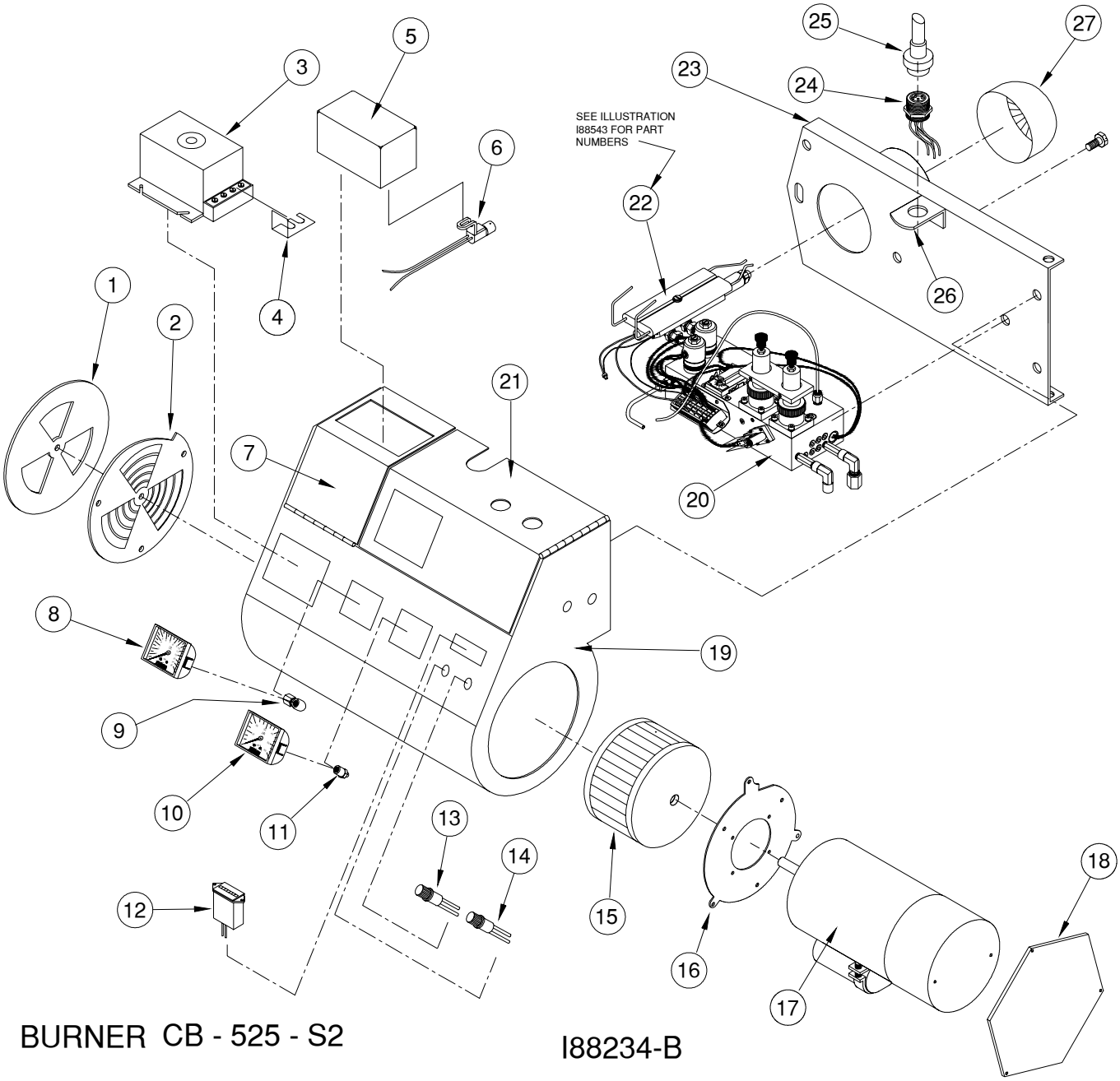


Figure A1 - CB-525-S2 Burner Component Detail

Burner Components (CB-525-S2) (continued)

Item#	Clean Burn Part#	Qty.	Component Description
1	26103	1	AIR INTAKE OUTER PLATE
2	11359	1	AIR INTAKE INNER PLATE
3	33188	1	CARLIN PRIMARY CONTROL
4	33335	1	ISOLATOR
5	33189	1	CARLIN IGNITER (TRANSFORMER)
6	33116	1	CAD CELL
7	11243	1	TRANSFORMER PLATE
8	32178	1	OIL GAUGE 0-15 PSI
9	32235	1	FEMALE ELBOW (3/16 T x 1/8 NPT)
10	32179	1	AIR GAUGE 0-60 PSI
11	32253	1	FEMALE ELBOW (1/8 TP x 1/8 NPT)
12	33297	1	HOUR METER (60 Hz)
13	33169	1	GREEN LIGHT (POWER)
14	33168	1	AMBER LIGHT (PUMP)
15	31113	1	FAN SQUIRREL CAGE
16	26044	1	MOTOR MOUNT PLATE
17	33175	1	BLOWER MOTOR
18	26053	1	RIGHT SIDE COVER
19	11335	1	HOUSING (INCLUDES ITEM 23)
20	13148	1	HEATER BLOCK ASSEMBLY
21	11265	1	COVER-HINGED
22	SEE NOTE ON DRAWING		NOZZLE ADAPTER ASSEMBLY
23	11334	1	HINGE MOUNTING PLATE
24	33149	1	CONNECTOR RECEPTACLE
25	33150	1	CONNECTOR PLUG
26	26052	1	LATCH BRACKET
27	11308	1	RETENTION HEAD

Burner Components (continued)

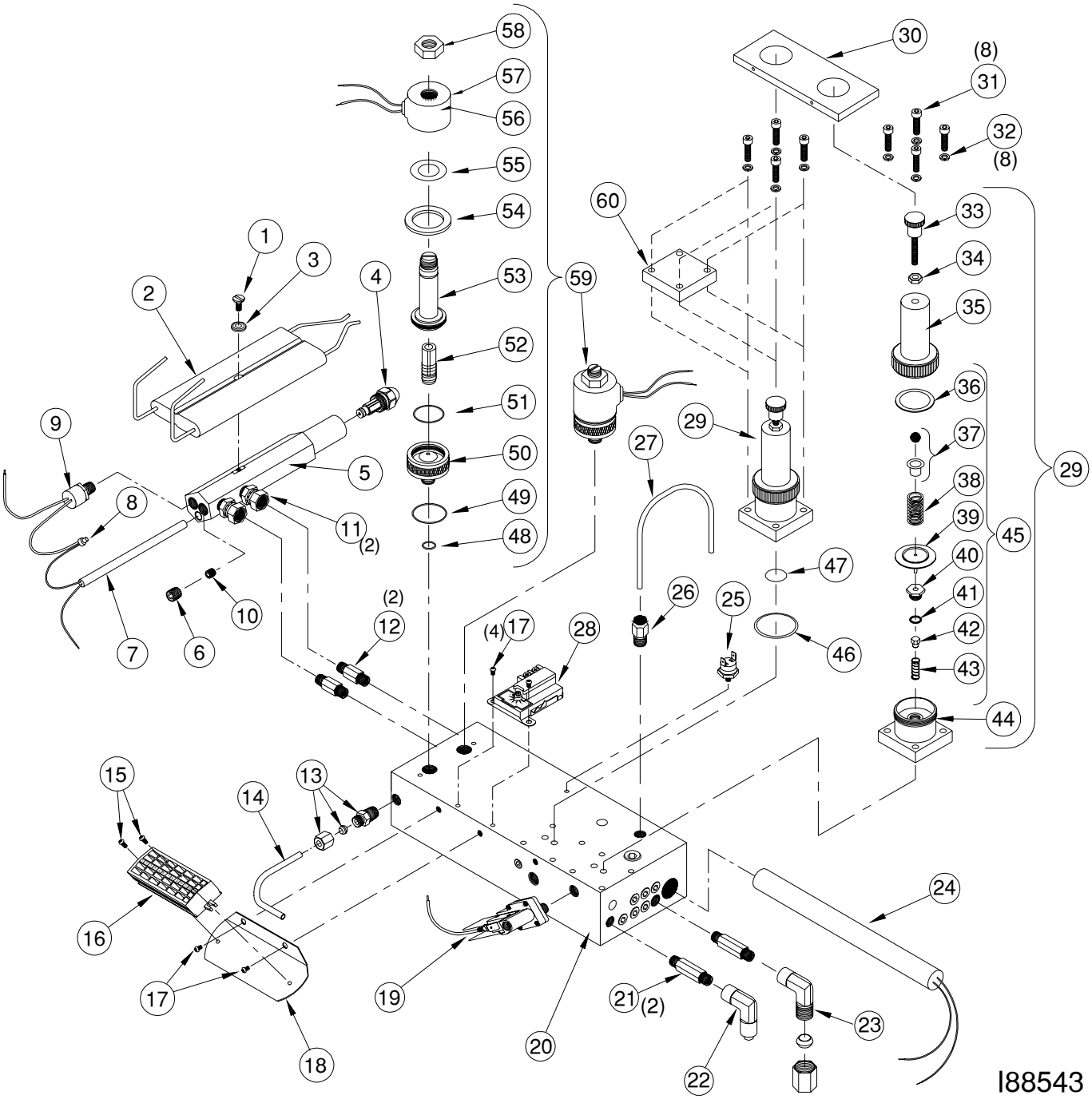


Figure A2 - Preheater Block Assembly Component Detail

Burner Components (continued)

Item#	C.B. Part#	Qty.	Component Description
1	34169	1	ELECTRODE SCREW - 10-32 x 3/4
2	33183	1	SINGLE PIECE ELECTRODE
3	34165	1	WASHER
4	32000	1	9 - 5 NOZZLE
5	13150	1	NOZZLE ADAPTOR
6	32007	1	PLUG - 1/8 NPT
7	33298	1	140 WATTS HEATER
8	33381	1	INSULATED CAP CRIMP CONNECTOR
9	33418	1	THERMOSTAT L-130
10	32199	1	PLUG - 1/16 NPT
11	32050	2	SWIVEL FITTING
12	32189	2	HEX NIPPLE - 1/8 NPT x 1-1/2
13	32043	1	MALE CONNECTOR - 3/16T x 1/8 NPT
14	54020	1	3/16 COPPER TUBING(OIL GAUGE LINE)
15	32201	2	MACH. SCREW PHILLIPS HD. 6-32 x 3/8 Z
16	33247	1	TERMINAL BLOCK
17	34036	4	MACH. SCREW PHILLIPS HD. 6-32 x 1/4 Z
18	26059	1	TERMINAL BLOCK BRACKET
19	33057	1	AIR PRESSURE SWITCH
20	26090	1	HEATER BLOCK
21	32190	2	HEX NIPPLE - 1/8 NPT x 2
22	32202	1	FEMALE ELBOW (FOR 1/4" AIR LINE)
23	32201	1	FEMALE ELBOW (FOR 3/8" OIL LINE)
24	33173	1	PRE-HEATER ELEMENT (400 WATTS)
25	33041	1	PROVING SWITCH (NORMALLY OPEN)
26	32325	1	MALE ELBOW 1/8 x 1/8 NPT (FOR AIR GAUGE LINE)
27	54020	1	3/16 COPPER TUBING(OIL GAUGE LINE)
28	33011	1	HEATER BLOCK THERMOSTAT(NORMALLY CLOSED)
29	32359	2	REGULATOR SURFACE MOUNT
30	14090	1	REGULATOR LOCK PLATE
31	34148	8	REGULATOR MOUNTING SCREW
32	34114	8	LOCK WASHER #8 Z
33	34147	2	REGULATOR THREADED STEM
34	34022	2	HEX NU T - 10-32 Z
35	32306	2	BONNET
36	32226	2	DIAPHRAM RING
37	32364	2	CAP AND BALL ASSEMBLY
38	32227	2	COMPRESSION SPRING
39	32360	2	DIAPHRAM
40	32361	2	BRASS POPPET SEAT
41	32223	2	POPPET ‘O” RING
42	32222	2	POPPET VALVE
43	32221	2	POPPET SPRING
44	32362	2	BASE
45	13142	2	REGULATOR KIT COMPONENTS
46	32308	2	REGULATOR OUTER “O” RING
47	32309	2	REGULATOR INNER “O” RING
48	33311	2	SOLENOID INNER “O” RING
49	33312	2	SOLENOID OUTER “O” RING
50	33313	2	MANIFOLD MOUNT SOLENOID BODY
51	33314	2	BODY “O” RING
52	33315	2	PLUNGER ASSEMBLY
53	33316	2	PLUNGER GUIDE ASSEMBLY
54	33317	2	FLUX PLATE
55	33318	2	WASHER SEAL
56	33319	2	COIL
57	33320	2	COIL HOUSING
58	33321	2	NUT
59	32322	2	AIR/OIL SOLENOID ASSEMBLY
60	26107	1	REG. SQUARE CAP

Burner Components (continued)

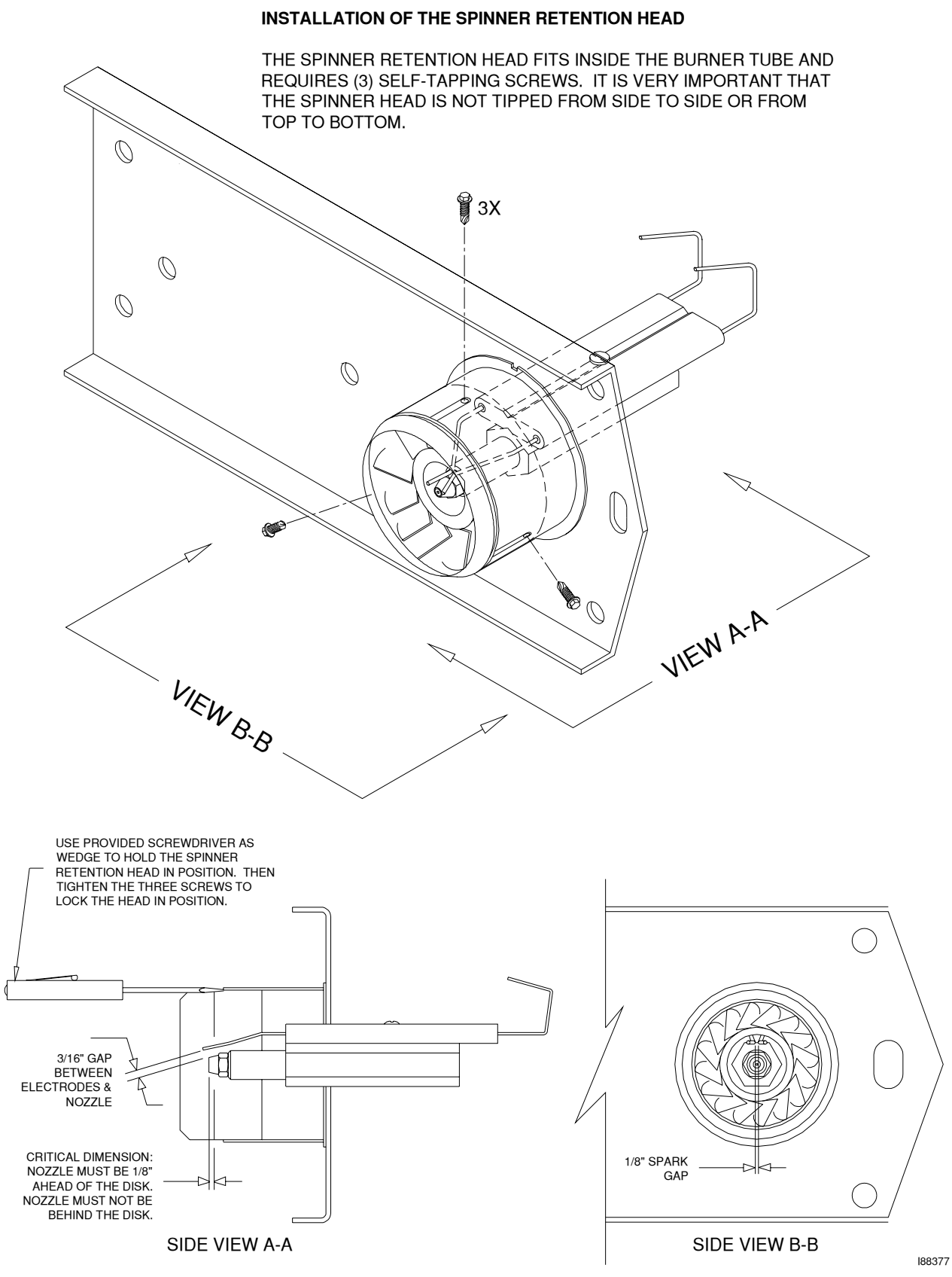
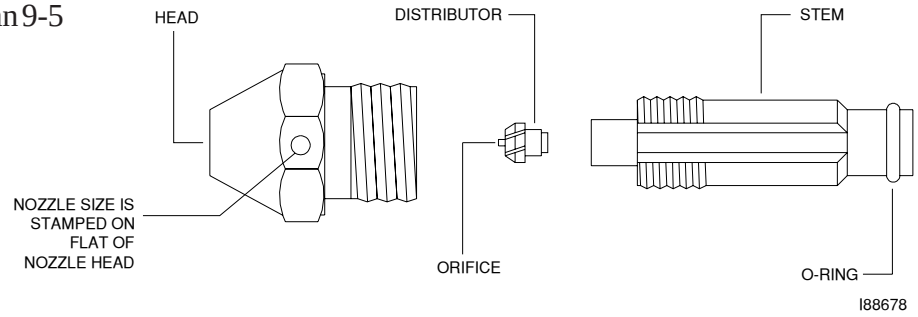


Figure A3 - Burner Electrode Specifications with Spinner Retention Head

Burner Components (continued)

Model	Nozzle Size
CB-1400	Delavan 9-5



Removing the Nozzle for Cleaning:

NOTE: Due to swivel fittings on the air and oil lines, it is not necessary to disconnect these lines when swinging the burner open.

1. Remove the lock-down nut on the mounting flange bolt.
2. Disconnect the burner power cable.
3. Carefully swing the burner open to its maintenance position.
4. Remove the nozzle from the nozzle adapter with a 5/8" socket.

Cleaning the Nozzle:

1. Unscrew the stem from the nozzle head.
2. Spray WD-40 or equivalent through the orifice to thoroughly remove any blockage. **CAUTION:** DO NOT damage or deform the nozzle orifice; DO NOT use a torch tip cleaner or other inappropriate device to clean the orifice. If the blockage is a "tarry" material or a hard, black material, call your Clean Burn dealer for service.
3. Flush all components with WD-40 to remove oil residues.
4. Reassemble the nozzle components. When tightening the stem, just barely "snug" it down. DO NOT overtighten.
5. Check the O-ring on the nozzle stem. Replace the O-ring if it is in the least bit cut or deformed.
6. Lubricate the O-ring on the nozzle stem with a couple of drops of new motor oil, then re-install the nozzle.
7. Check the electrodes for proper gap and clearances. (Figure A3)
8. Re-install the burner and adjust for optimal performance as described in Section 6.

NOTE: If the nozzle plugs within a few days after cleaning, call your Clean Burn Dealer for service.

Figure A4 - Cleaning the Nozzle

Fan Limit Control

Understanding the Operation of the Fan Limit Control

The fan limit control senses air temperature within the furnace cabinet. This control contains two switches: the limit switch and the fan switch.

Fan Switch: The fan switch is normally open and provides power to the fan. When the fan limit control senses "Fan On" temperature, the fan switch closes and starts the fan. When the wall thermostat is satisfied and the burner shuts off, the fan continues to run until the fan limit control senses the "Fan Off" temperature. At this temperature, the fan switch opens and shuts off the fan.

NOTE: The fan limit control has a white fan switch button. Make sure the white button is pulled OUT for automatic (normal) operation. When the button is pushed in (manual setting), the fan will run continuously.

Limit Switch: The limit switch is normally closed and provides power to the oil primary control on the burner. If the fan limit control senses 200 degrees F, the limit switch opens and shuts off power to the oil primary control and the burner stops running. The fan continues to run. Once the fan limit control senses 170 degrees F, the limit switch automatically resets and restarts the burner.

NOTE: It is very important to avoid cycling the burner on hi limit as described above. If the hi limit activates, immediately check and re-adjust burner settings.

ATTENTION: DO NOT change the fan limit settings from the specified settings, or severe damage to the furnace cabinet may occur.

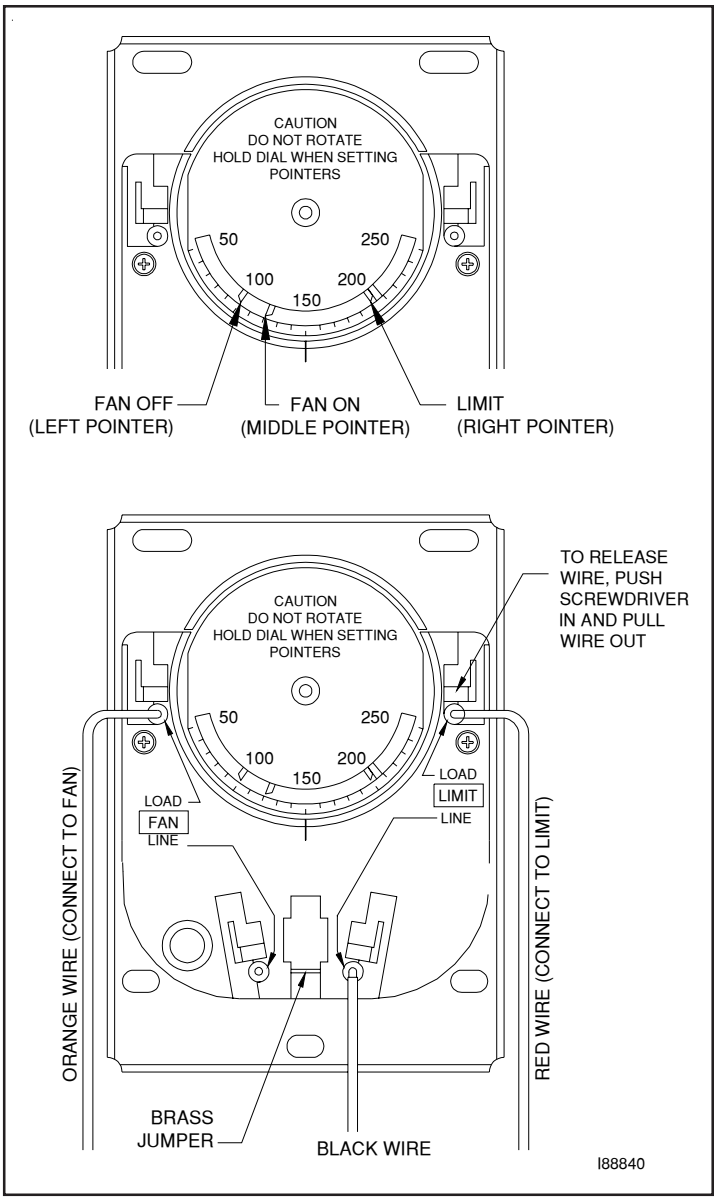


FIGURE A5 - Fan Limit Control Components

To Set Pointers on the Fan Limit Dial

1. Turn OFF main power to the furnace.
2. Remove the fan limit control cover.
3. While holding the dial securely in place with your thumb, move the pointer to the desired setting.

ATTENTION: DO NOT rotate the dial when setting the pointers. This severely damages the control.

Fan Limit Control Settings: CB-1400

Fan Off:	100
Fan On:	120
Limit:	200

APPENDIX B

Wiring Diagrams

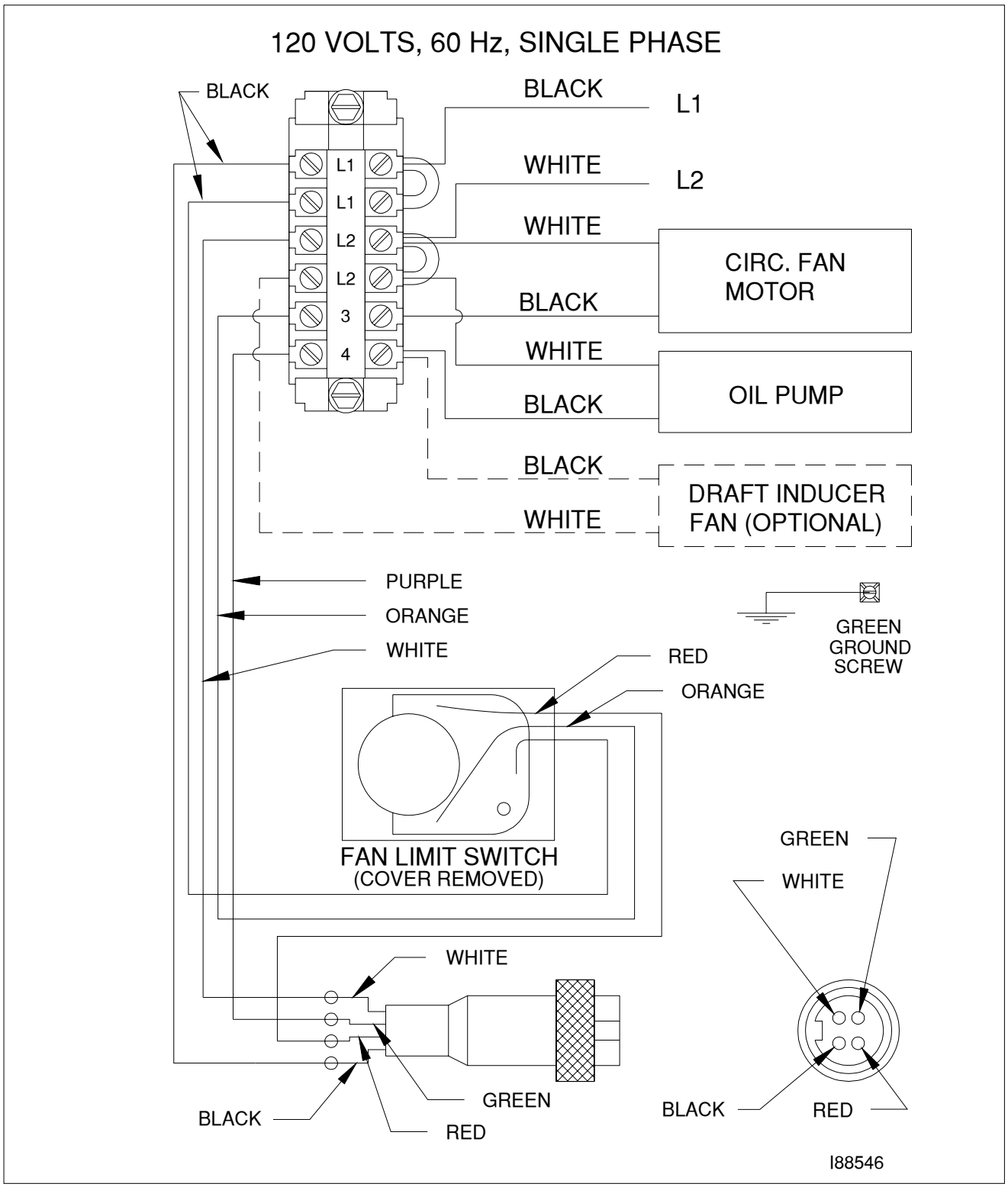


FIGURE B1 - Furnace Wiring Diagram

Wiring Diagrams (continued)

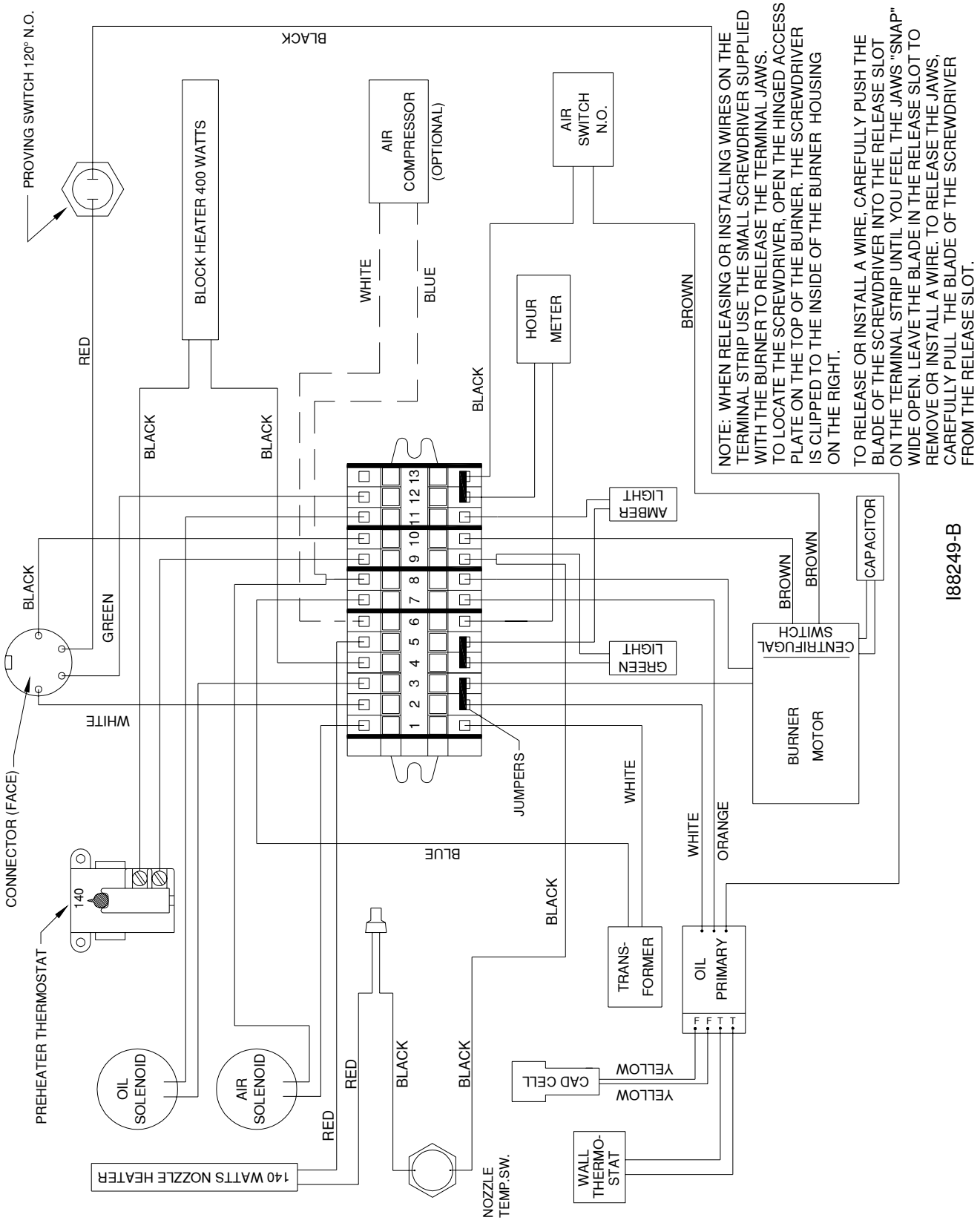


FIGURE B2 - Burner Wiring Diagram

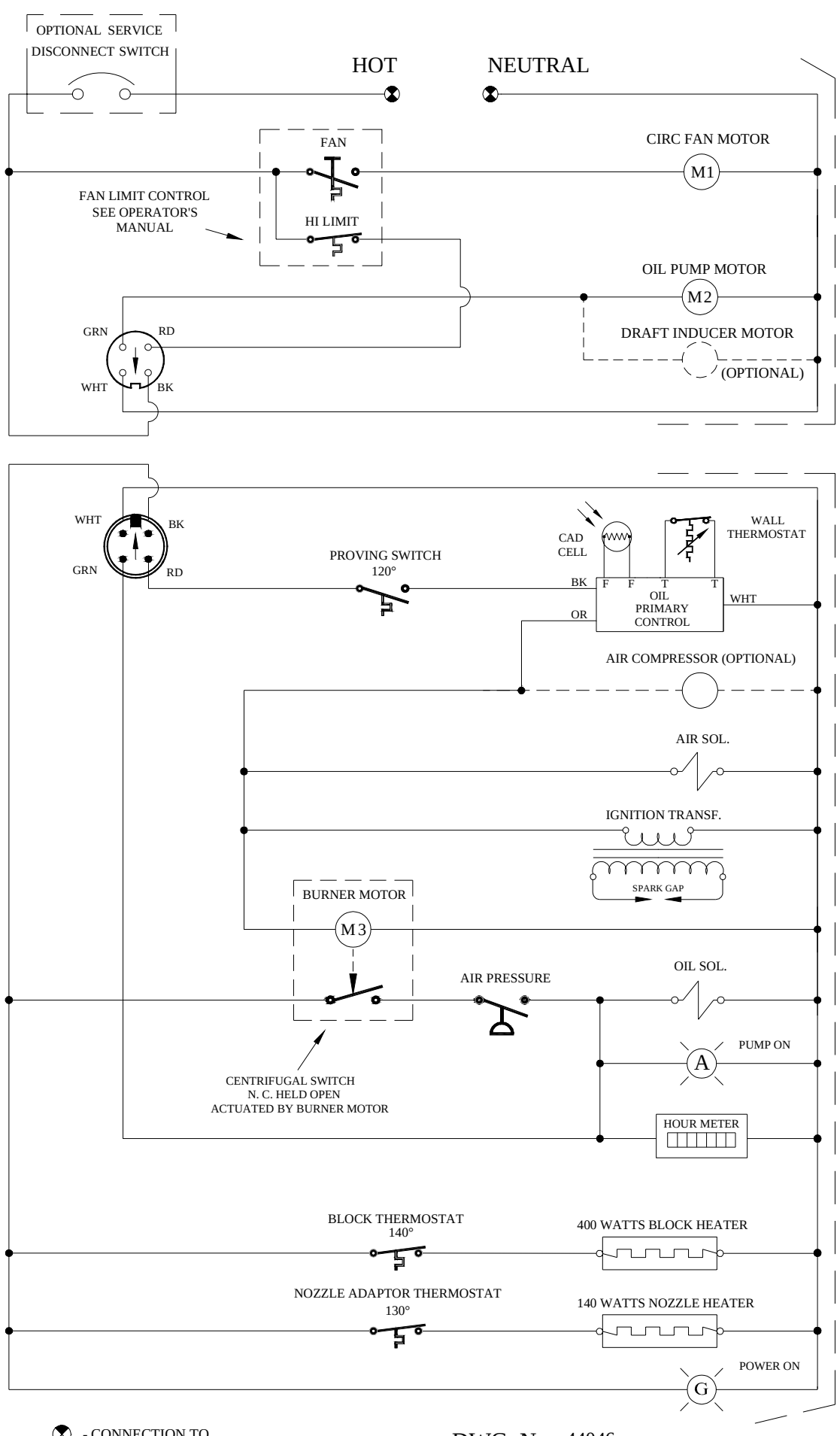


FIGURE B3 - Ladder Schematic for Model CB-1400 (120 Volts / 60 Hz)

Wiring Diagrams (continued)

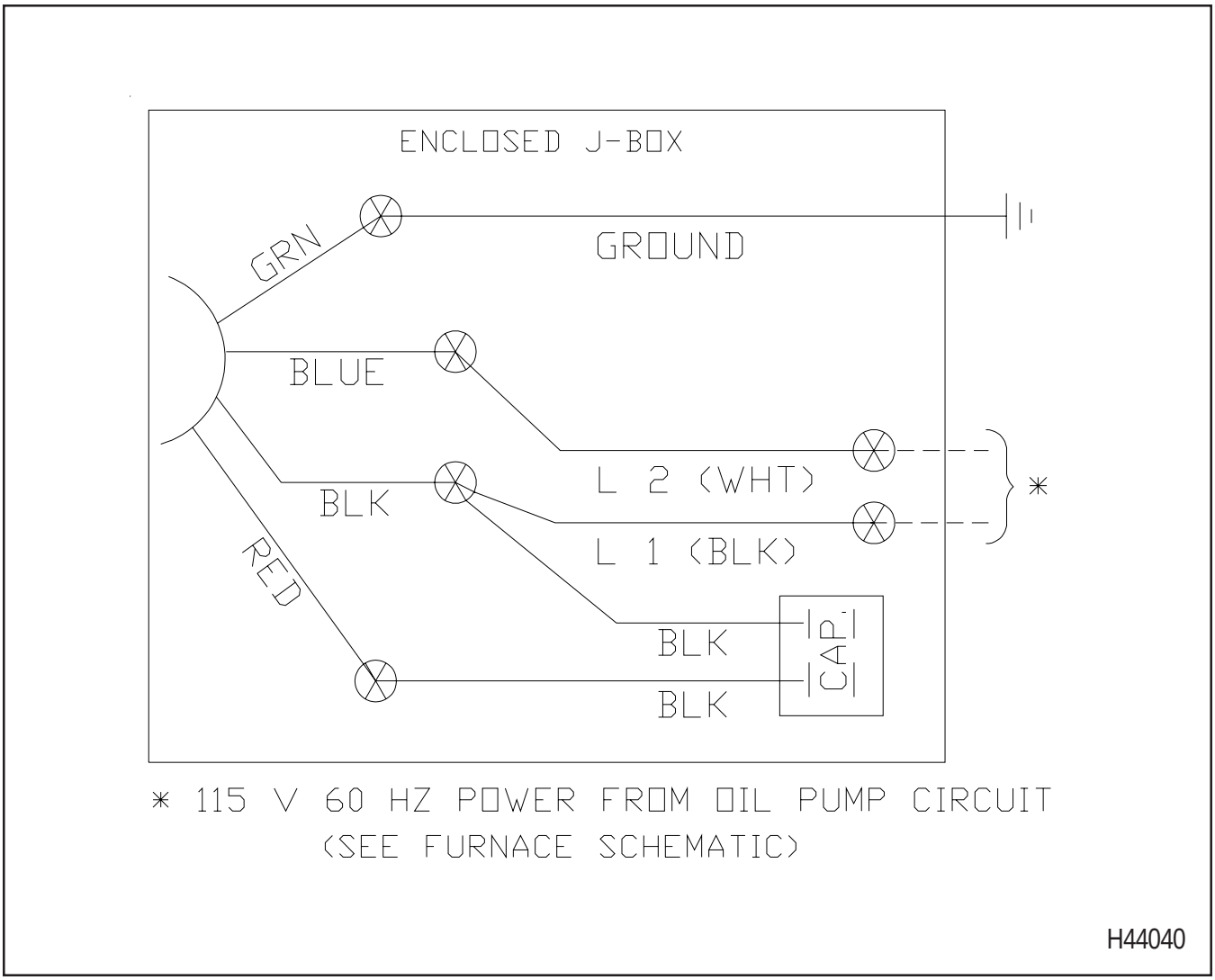


Figure B4 - Metering Pump Wiring Schematic

APPENDIX C

Furnace Service Record

Furnace Purchased: Date _____ From (name/phone)_____

Furnace Installed: Date _____ By (name/phone)_____

Furnace Inspected: Date _____ By (name/phone)_____

Draft Readings (date / reading)			**Service Record** (date / initials of serviceman)				
Burner	**Stack**		**Canister Filter**	**Chamber & Flues**	**Stack**	**Oil Tank**	**A.P.M.***

*A.P.M. = Annual Preventative Maintenance of Burner (Burner Tune-up)