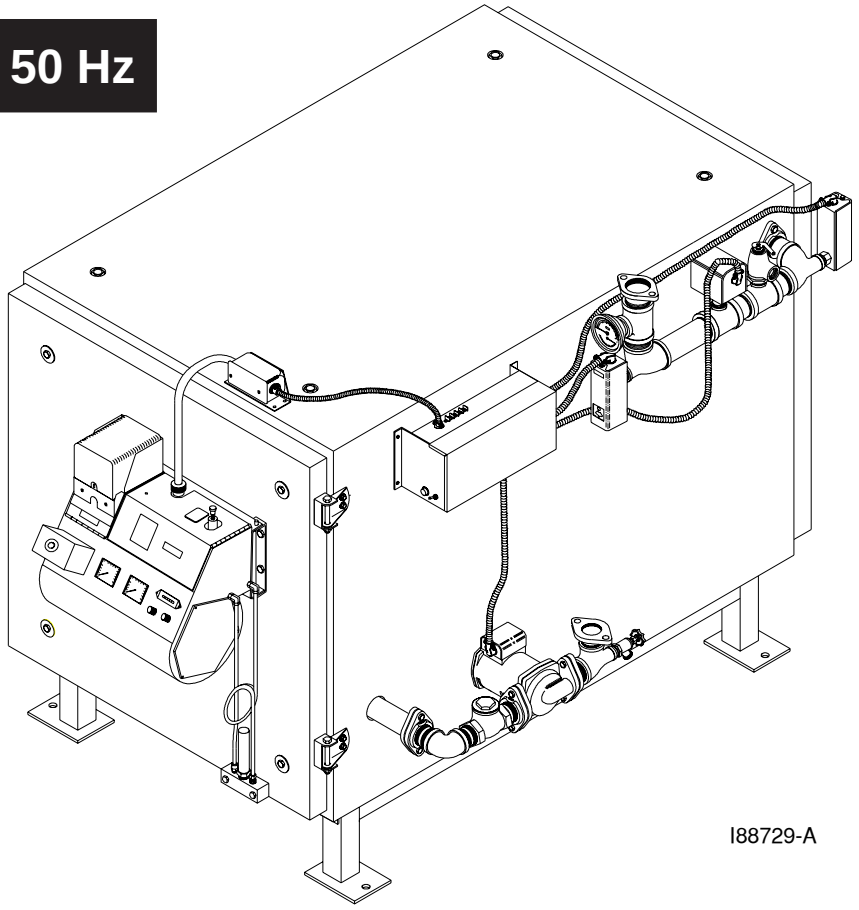
OPERATOR'S MANUAL

CLEAN BURN COIL TUBE BOILER MODELS:
CB-200-CTB and CB-350-CTB
with CB-500 Series Burner & Metering Pump

230 V / 50 Hz



PUBLICATION DATE: 4/7/06, Rev. 4 **CLEAN BURN PART #43186**

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.

DECLARATION OF CONFORMITY

Manufacturer:	Clean Burn Inc. 34 Zimmerman Rd. Leola, PA USA
European Representative:	TUV Rheinland North America 12 Commerce Rd. Newtown CT. 06470 USA
Equipment:	CTB-350-I #90192 CTB-200-I #90201
EMC Competent Body:	TÜV Rheinland Product Safety GmbH Am Grauenstein D-51105 Köln

I hereby declare that the above named machinery complies with Essential Health and Safety Requirements of the Industrial Machinery Directive (IMD - 98/37/EEC) as amended, with the Low Voltage Directive (LVD – 73/23/EEC) as amended, and with the Electromagnetic Compatibility Directive (EMC – 89/336/EEC) as amended.

Safety Standard:

EN 230: 1990	Monobloc Oil Burners – Safety, Control, and Regulation Devices and Safety Times.
EN 292-1:1991	Safety of machinery - Basic concepts, general principles for design - Part 1 : Basic terminology, methodology.
EN 292-2:1991+A1	Safety of machinery - Basic concepts, general principles for design - Part 2 : Technical principles and specifications
EN 60204-1:2000	Safety of machinery. Electrical equipment of machines. General requirements.

EMC Standards:

EN 55014-1: 2000	Electromagnetic Compatibility – Requirements for Household Appliances, Electric Tools, and Similar Apparatus. Part 1: Emission.
EN 55014-2: 2000	Electromagnetic Compatibility – Requirements for Household Appliances, Electric Tools, and Similar Apparatus. Part 2: Immunity.
EN 50165: 1997	Electrical Equipment of Non-Electric Appliances for Household and Similar Purposes. Safety Requirements.

Note: Above equipment is subject to an EMC Technical Construction File and Competent Body Certificate Number AV 72032554 0001.

MICHAEL SHIRK

20 December, 2005

Michael Shirk, PE
Director of Operations

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SECTION 1: INTRODUCTION

Guide to this Manual

This manual contains all the information necessary to safely install and operate the Clean Burn Coil Tube Boilers (CTB), Models CB-200-CTB and CB-350-CTB. 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 the Clean Burn CTB involves six basic activities as outlined here:

- **UNPACKING & PRE-INSTALLATION CONSIDERATIONS ..... (Section 2)**
- **ASSEMBLY ..... (Section 3)**
- **INSTALLATION ..... (Section 4)**
- **OPERATION**
  - **Oil Pump Priming ..... (Section 5)**
  - **Starting and Adjusting the Burner ..... (Section 6)**
  - **Resetting the Oil Primary Control ..... (Section 7)**
  - **Adjusting the Draft ..... (Section 8)**
- **MAINTENANCE ..... (Section 9)**
- **THE CTB HYDRONICS SYSTEM ..... (Section 10)**

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 following safety information--before beginning any installation/ operation procedures; doing so ensures your safety and the optimal performance of your Clean Burn Coil Tube Boiler.

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 boiler 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 boiler.

DANGER! DO NOT operate your CTB if excess oil, oil vapor or fumes have accumulated in or near your boiler. As with any oil burning appliance, 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 CTB. Instruct your personnel to *never* add hazardous materials to your used oil.

For Your Safety... (continued)

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

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

WARNING: For the safe installation and operation of the CTB, the boiler cannot be raised above the floor level, suspended from the ceiling, installed on a raised platform, or placed over top of any equipment, office space, parts room, etc. or installed in any other manner than directly on a concrete floor.

WARNING: Electrical installation of the boiler is to be performed only by qualified personnel (i.e. licensed electrician/engineer). Improper electrical installation can adversely affect the proper, safe operation of the boiler and may cause serious personal injury/death.

WARNING: Install the boiler in an area away from the main shop traffic. ***It is essential for personal safety that only manufacturer-trained, qualified personnel have access to operate and maintain the boiler.***

WARNING: DO NOT operate your boiler when the ambient temperature is above 35° C (95° F).

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 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.

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 Coil Tube Boiler Usage

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

- This boiler is designed to burn the following fuels:
    - Used crankcase oil up to 50 SAE
    - Used transmission fluid
    - Used hydraulic oils
    - #2, #4, and #5 fuel oils

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

- Make sure you comply with all environmental regulations concerning the use of your boiler. These 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 boiler in warm weather just to burn oil.

  Contact your Clean Burn dealer for current environmental regulations.

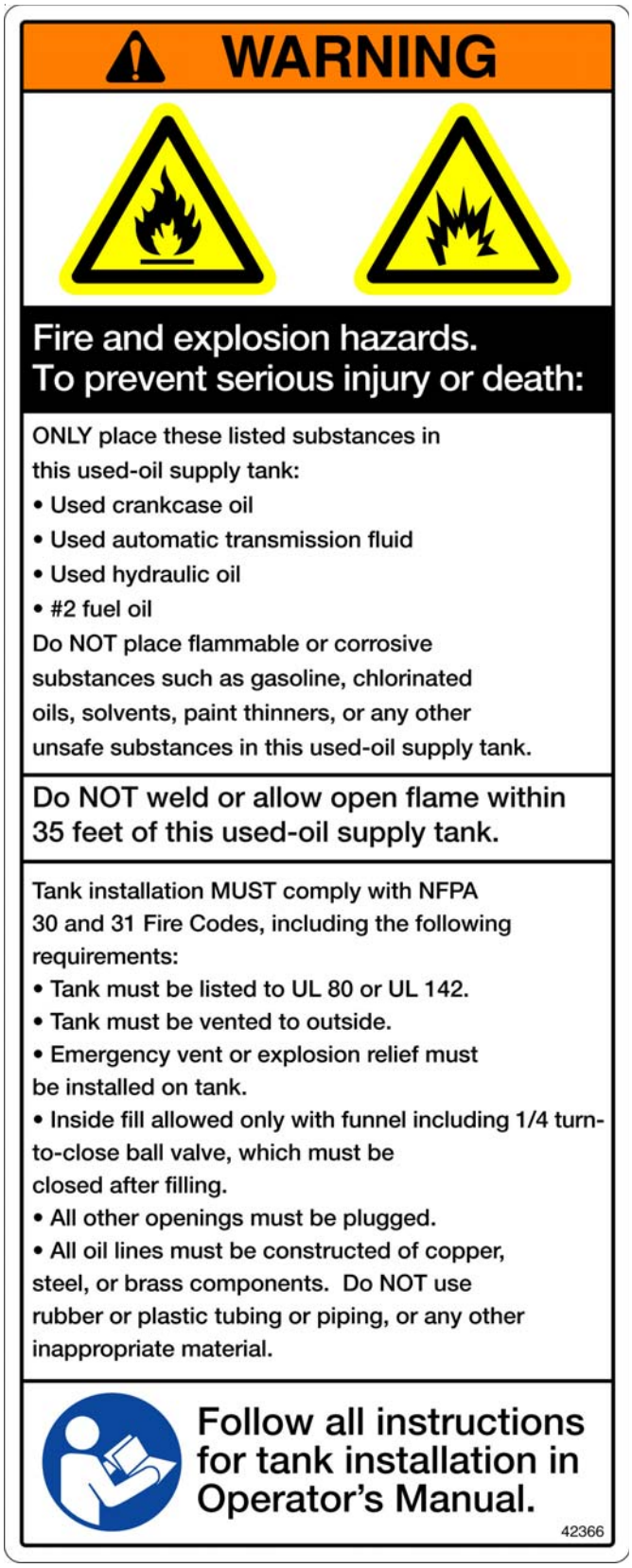
- If your CTB ever requires service, call your Clean Burn dealer. DO NOT allow untrained, unauthorized personnel to service your CTB. Make sure that your boiler receives annual preventative maintenance to ensure optimal performance.

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 boiler 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

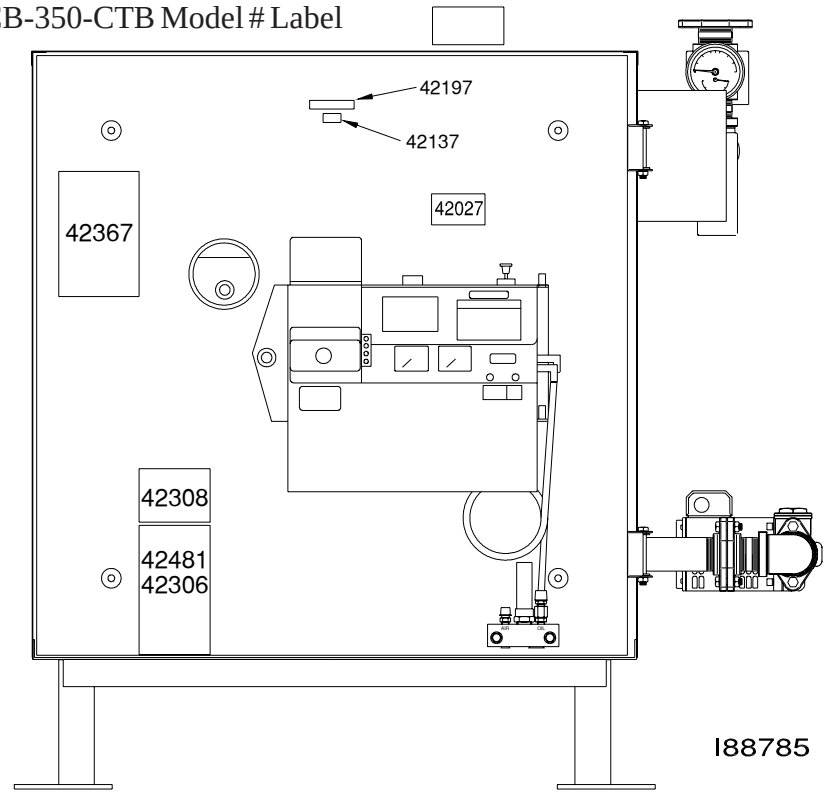
Following are the locations and descriptions of all labels on your CTB. The following illustrations show the location of ALL labels on your boiler. Please note that some labels denote model number, model description, etc. while others contain important safety messages.

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 CTB, review all labels and heed all safety messages as printed on the labels.

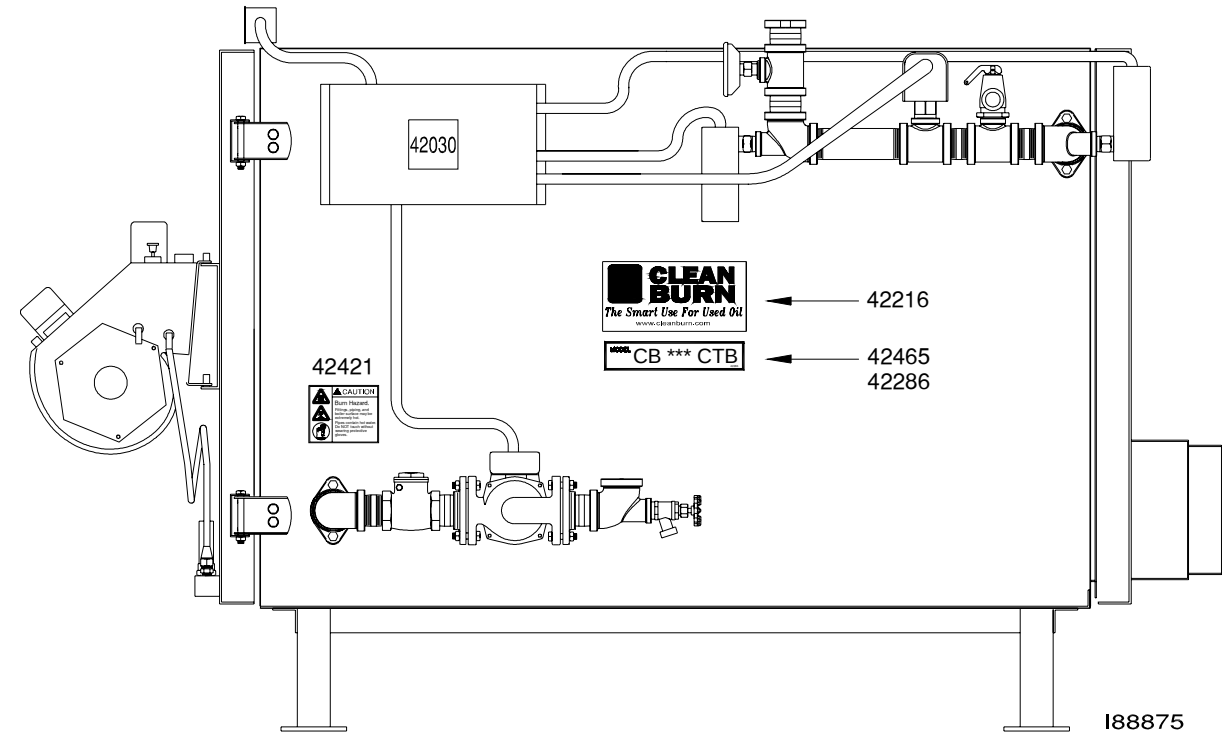
If any labels on your Clean Burn CTB ever become worn, lost or painted over, please call your Clean Burn dealer for free replacements.

CB-200-CTB and CB-350-CTB Cabinet Labels

Label Part #	Description
42367	C.B. Safety Warning Label (multiple messages - fire/shock/burn hazards)
42197	Patent Pending Label
42137	Date Code Label
42027	Burn Hazard / Hazardous Voltage Warning Label
42308	Header Label
42481	CB-200-CTB Data Label
42306	CB-350-CTB Data Label
42030	Electrical Shock Hazard Warning Label
42421	CTB Hot Water Caution Label
42216	C.B. Logo Label
42465	CB-200-CTB Model # Label
42286	CB-350-CTB Model # Label



CB-350-CTB Cabinet Labels (continued)



CB-350-CTB Cabinet *Safety* Labels

⚠ WARNING

Hazardous voltage.

To prevent serious injury, shut OFF main power to unit before removing cover.

Line voltage is present on most subbase terminals when power is ON. If the furnace is not wired correctly, fire, shock or damage could result.

- ONLY a qualified electrician should wire this furnace.
- ONLY use copper conductors.

42030

⚠ WARNING

Burn Hazard.
Hazardous Voltage.

Burner may fire at any time. Disconnect burner power cord before swinging open burner or clean-out door.

42027

⚠ WARNING

Fire, explosion and burn hazards:

Maintain clearances from combustibles as listed on unit. ONLY burn used crankcase oil, automatic transmission fluid, hydraulic oil, or #2 fuel oil. NEVER burn any other substances in this unit.

Hot gases and ash may be released when inspection port is opened.

- Wear safety goggles and hand protection when opening inspection port.
- Keep face away and open port slowly.

To avoid possible injury, death, or equipment damage, read and understand operator's manuals and all safety precautions before installing, operating, or servicing this equipment.

42367

For Your Safety... (continued)

CB-350-CTB Cabinet *Safety* Labels (continued)

CLEAN BURN, INC.
LEOLA, PA

USED-OIL BURNING APPLIANCE
NO.

MULTI-OIL HEATING SYSTEM

CE

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.

42308

MODEL NO. CTB-200-CE

INPUT RATING W/NO 2 FUEL OIL (KW/HR) 58.6

LISTED FUELS	INPUT -LPH-	ATOM AIR PRESS -PSIG-	ATOM AIR PRESS -BAR-	OIL PRESS -PSIG-	OIL PRESS -BAR-
NO 2 OIL	3.8	14	.96	2.5	.17
USED					
CRANKCASE OIL	3.8	14	.96	2.7	.19
HYDRAULIC OIL	3.8	14	.96	2.5	.17
ATF	3.8	18	1.24	3.4	.23
NO 4 OIL	3.8	18	1.24	4.0	.28
NO 5 OIL	3.8	18	1.24	4.0	.28

MAX. FLUE DRAFT IN W.C. -.06 (1.5 mm)

INSTALL ON NONCOMBUSTIBLE FLOOR
MINIMUM CLEARANCE TO COMBUSTIBLE SURFACES (in/cm)
CLEARANCES MAY BE INCREASED FOR SERVICE

TOP	6/15	CHIMNEY	18/46	SIDE	6/15
FRONT	24/61	REAR	6/15	SERVICE SIDE	30/76

	POWER	VOLTS	AMPS	HZ
OIL PUMP MOTOR HP.	1/20	230	.40	50
BURNER MOTOR HP.	1/10	230	.56	50
BURNER HEATER WATTS	400	230	1.65	50
CIRCULATOR BOILER (OPT)	1/6	230	1.05	50
CIRCULATOR LOAD (OPT) MAX.		230	1.5	50
DRAFT IND. (OPT) HP	1/4	230	1.3	50
AIR COMPRESS. (OPT) HP.	1/3	230	2	50
TOTAL CIRCUIT AMPACITY			10	
MAXIMUM FUSE SIZE / WITH OPTIONS			20	

BURNER REQUIRES A MINIMUM AIR SOURCE OF 2.0 S.C.F.M. (57 L/MIN) AT 25 P.S.I (1.72 bar). 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.

42481

MODEL NO. CB 350-I CTB

INPUT RATING W/NO 2 FUEL OIL — BTU/HR 350,000 — KW 103

LISTED FUELS	INPUT -GPH-	INPUT -L/HR-	AIR PRESS -PSIG-	AIR PRESS -KPA-	OIL PRESS -PSIG-	OIL PRESS -KPA-
NO 2 OIL	2.5	9.5	16.0	110	6.0	41
USED						
CRANKCASE OIL	2.5	9.5	16	110	7	48
HYDRAULIC OIL	2.5	9.5	16	110	7	48
ATF	2.5	9.5	18	124	9.5	65
NO 4 OIL	2.5	9.5	20	138	9.5	65
NO 5 OIL	2.5	9.5	20	138	9.5	65

FLUE DRAFT IN W.C. -.06 (1.5 mm)

INSTALL ON NONCOMBUSTIBLE FLOOR
MINIMUM CLEARANCE TO COMBUSTIBLE SURFACES (IN./CM)
CLEARANCES MAY BE INCREASED FOR SERVICE

TOP	6/15	CHIMNEY	18/46	SIDE	6/15
FRONT	24/61	REAR	6/15	SERVICE SIDE	30/76

	POWER	VOLTS	AMPS	HZ
OIL PUMP MOTOR HP.	1/6	230	1.3	50
BURNER MOTOR HP.	1/10	230	0.45	50
BURNER HEATER WATTS	450	230	1.7	50
CIRCULATOR LOOP (OPT) HP.	1/6	230	1.1	50
CIRCULATOR LOAD (OPT) MAX.		230	1.3	50
DRAFT IND. (OPT) HP	1/4	230	1.3	50
AIR COMPRESS. (OPT) HP.	1/2	230	3.0	50
TOTAL CIRCUIT AMPACITY			10.0	
MAXIMUM FUSE SIZE / WITH OPTIONS			20	

BURNER REQUIRES A MINIMUM AIR SOURCE OF 2.0 S.C.F.M. (57 L/MIN) AT 25 P.S.I (175 KPA). INSTALL AND USE ONLY IN ACCORDANCE WITH THE MFR'S INSTALLATION AND OPERATING INSTRUCTIONS. FOR COMMERCIAL OR INDUSTRIAL USE ONLY.

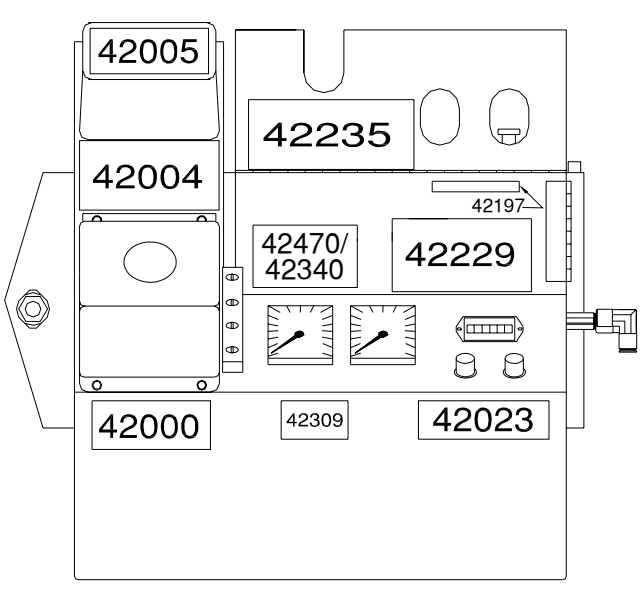
AUTHORITIES HAVING JURISDICTION SHOULD BE CONSULTED PRIOR TO INSTALLATION.

42306

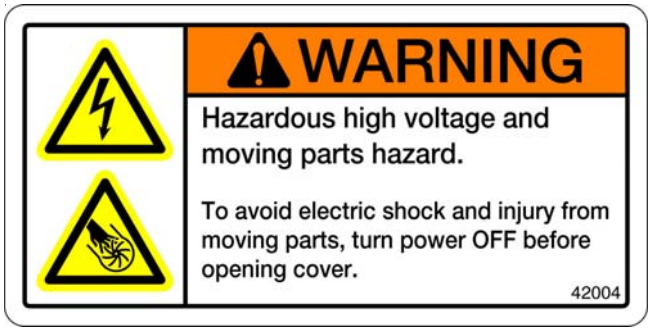
For Your Safety... (continued)

CB-350-CTB Burner Labels

Label Part #	Description
42005	Sold/Serviced By Label
42004	Burner Safety Warning Label (High Voltage/Moving Parts Hazard)
42235	Burner Safety Warning Label (Fire/Explosion Hazard - Burner Installation and Service)
42470	CB-500-CE-5W Burner Model/Serial Number
42340	CB-551-CE Burner Model/Serial Number
42229	C.B. Logo/Burner Description Label
42000	Burner Safety Warning Label (Fire/Explosion Hazard - Reset Button)
42309	CE Mark Label
42023	Burner Power Label



CB-200-CTB and CB-350-CTB Burner*Safety* Labels



SECTION 2: UNPACKING & PRE-INSTALLATION CONSIDERATIONS

Before assembling your coil tube boiler (CTB) , you must accomplish the following activities described in this section:

- Removing the Shipping Crate
- Unpacking and Inspecting All Components
- Warranty Registration
- Review the Pre-Installation Considerations

Removing the Shipping Crate

1. Carefully remove the top boards of the shipping crate. Then remove the front, back, and side panels.
2. Remove the bolts holding the boiler on the shipping pallet.
3. Carefully lift the CTB off the shipping pallet with a fork lift.

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

Unpacking and Inspection

Following is an itemized list of all components you should have received in your Clean Burn Coil Tube Boiler 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 CTB assembly and installation.

Model CB-200-CTB and CB-350-CTB Component List

- Coil Tube Boiler with factory-installed controls
  (including operating aquastat, high temperature cut-off, flow switch, relief valve, and check valve)
  Components packed inside boiler:
  - Ceramic combustion chamber sleeves (one (1) sleeve for 200-CTB)
  - Two (2) combustion chamber sleeve mounting stands (one (1) stand for 200-CTB)
  - Ceramic target (pre-mounted)
  - Canister filter
  - Vacuum gauge
  - Check valve with screen (for tank)
  - Boiler gauge
  - Tube sealant
  - Burner hook-up kit
  - 8" Barometric damper
- Burner
- Oil pump (metering pump)
- CTB base stand with hardware

Pre-Installation Considerations

The following information is critical to the proper installation of your Clean Burn Coil Tube Boiler system; read this section carefully before starting any other procedures.

Determining the CTB System Setup

Before installing the CTB, you must determine the following which relate to your installation:

(1) The **type of oil storage tank** you will be using (related information in Section 4)**
(2) The **positioning of your oil pump** (related information in Section 4)
(3) The **appropriate size for your oil lines** (related information in Section 4)
(4) The **electrical requirements** for your CTB installation (related information in Section 4)
(5) The type of **hydronic installation** you will be using (related information in Section 10)

****IMPORTANT NOTE:** If you are installing an inside oil tank in the same room as the boiler, you must allow a 1.5 m (5 ft) minimum clearance between the tank and the boiler. ***The oil tank should be set and installed in position BEFORE the boiler is installed.***

Selecting a Location

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

- Installation in a dedicated boiler/mechanical room with a minimum fire rating of two (2) hours.
- Installation on a substantial, level, non-combustible concrete floor (minimum 10 cm / 4" thick).
- Proper clearances from combustibles. *Verify according to your local safety codes.*
- Safe, easy access for servicing.
- Adequate combustion air per national and local codes.
- Proper stack installation and materials.

WARNING: For the safe installation and operation of the CTB, the boiler cannot be raised above the floor level, suspended from the ceiling, installed on a raised platform, or placed over top of any equipment, office space, parts room, etc. or installed in any other manner than directly on a concrete floor.

Selecting a Location (continued)

Adhere to the following *minimum* clearances from combustible surfaces. Specifications are also provided for servicing clearance. Be sure to check local codes which may differ from these specifications. Refer to Figures 2A and 2C for a single CTB and Figures 2B and 2D for dual-stacked CTB boilers.

Fig. 2A and 2B	Description	Clearance from Combustibles	Clearance for Service
A	Above	46 cm (18")	46 cm (18")
B	Front	122 cm (48")	122 cm (48")
C	Stack	46 cm (18")	46 cm (18")
D	Rear	137 cm (54")	137 cm (54")
E	L.H. Side	15 cm (6") *	15 cm (6") *
F	R.H. Side	91 cm (36")	91 cm (36")
G	Bottom	15 cm (6")	15 cm (6")

** 91 cm (36") may be required*

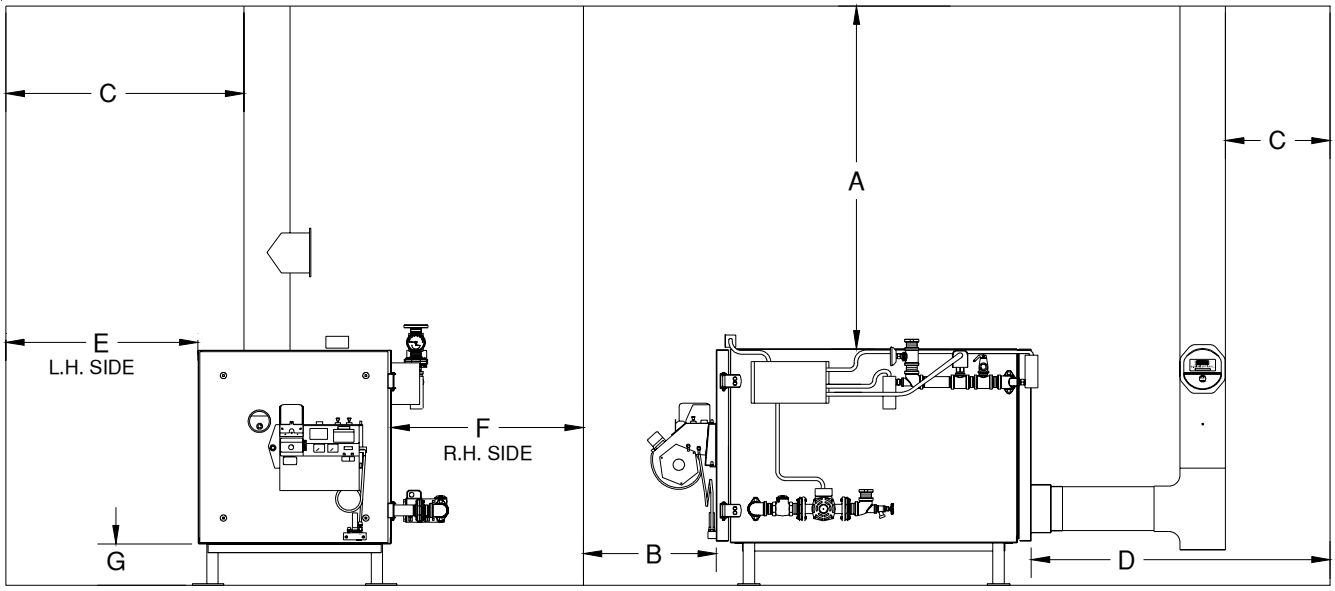


Figure 2A - Single Boiler Minimum Installation Clearances

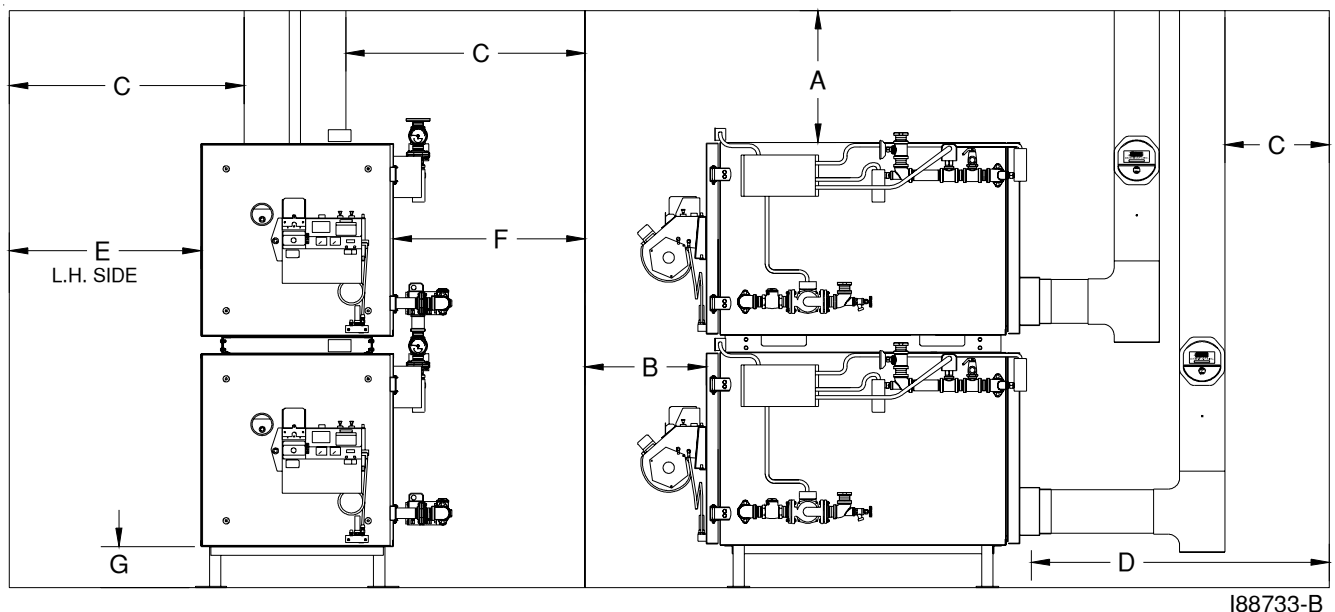


Figure 2B - Dual-Stacked Boilers Minimum Installation Clearances

Pre-Installation Considerations (continued)

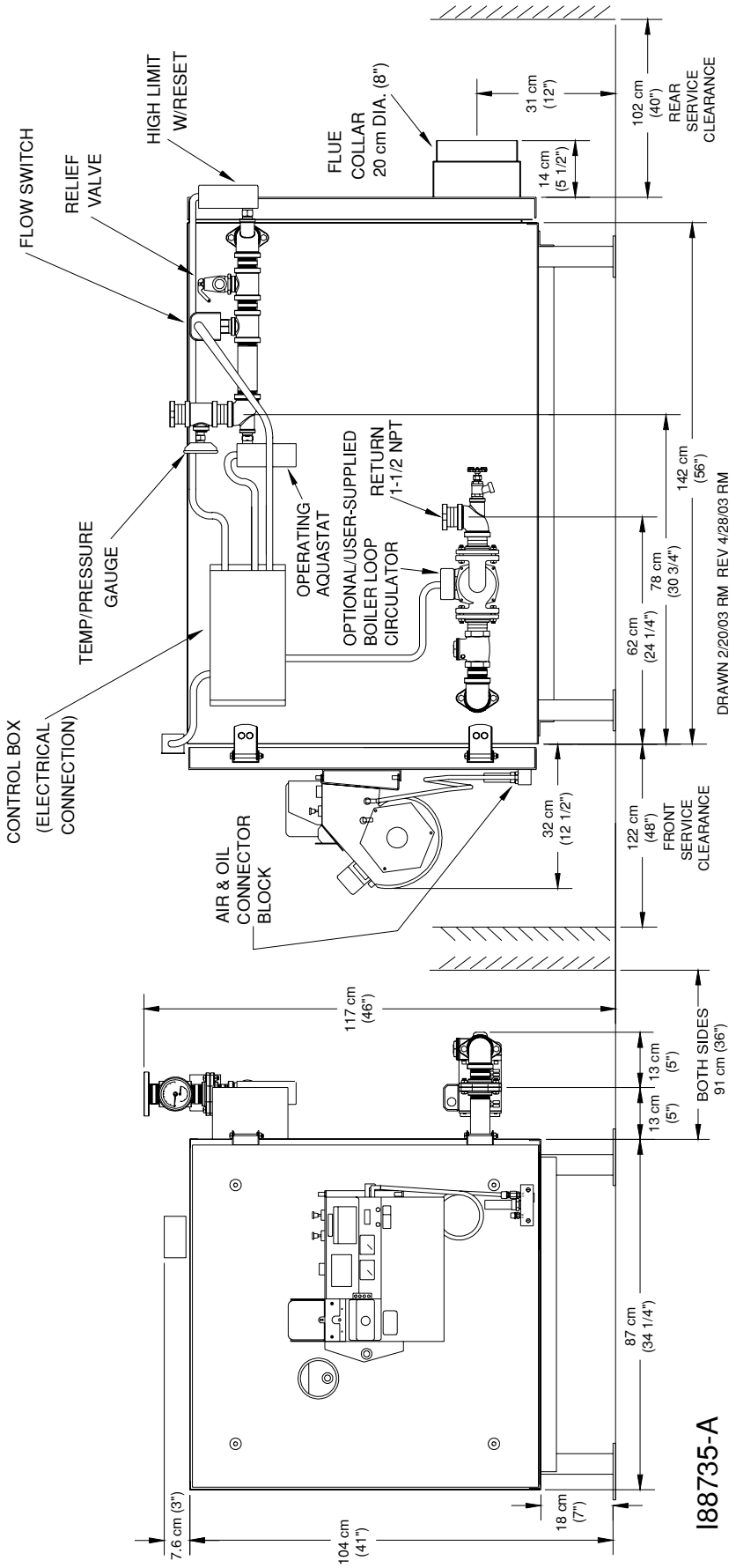


Figure 2C - Single Model CB-350-CTB Recommended Clearances for Servicing (Clearances are the Same for the CB-200-CTB)

Pre-Installation Considerations (continued)

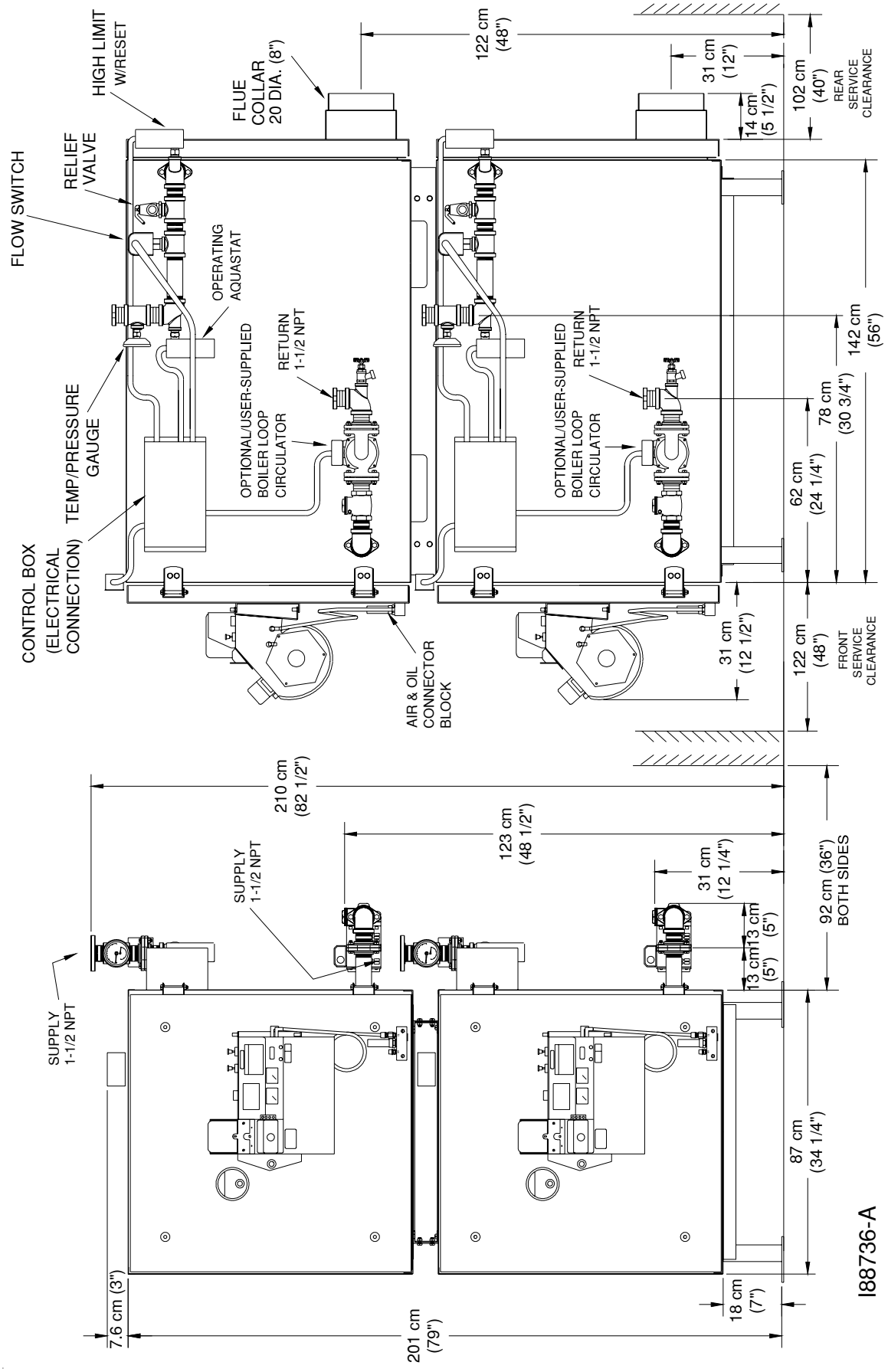


Figure 2D - Dual-Stacked CB-350-CTB Recommended Clearances for Servicing (Clearances are the Same for the CB-200-CTB)

SECTION 3: COIL TUBE BOILER ASSEMBLY

Understanding Assembly

Assembling your Clean Burn Coil Tube Boiler (CTB) is a multi-step process. Note that some assembly procedures apply only to certain CTB installations or configurations (i.e. single model or dual-stacked boilers); the assembly procedures are outlined below as they appear in this section.

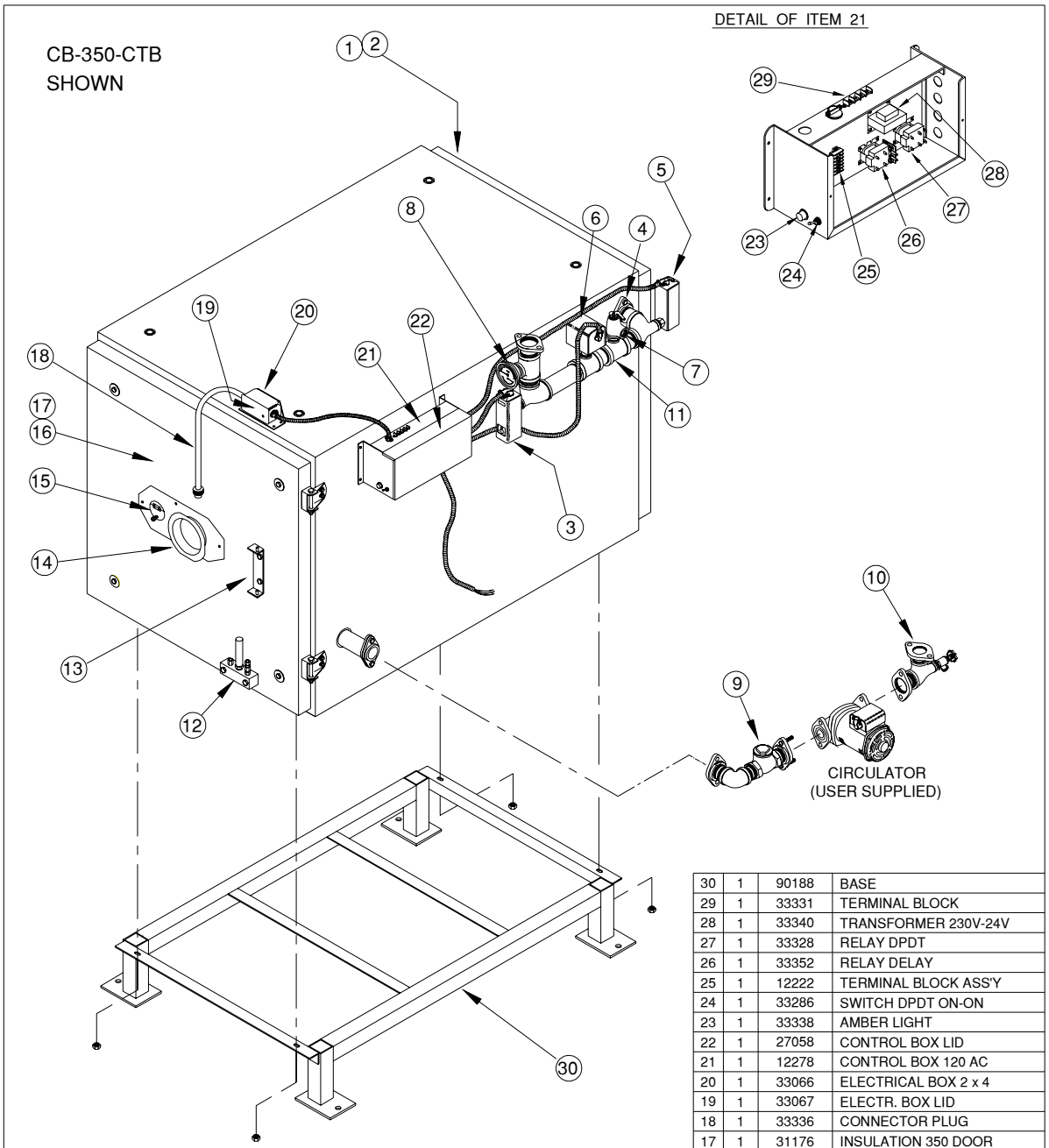
Be sure to refer to the appropriate instructions for your CTB configuration.

Single Boiler Assembly Only
- Installing the CTB on the Support Stand

Dual-Stacked Boiler Assembly Only
- Assembling the Dual-Stacked Boiler

Assembly For All Boilers
- Connecting the CTB
- Installing the Ceramic Sleeve
- Checking the Burner Nozzle and Electrodes
- Installing the Connector Block on the CTB Door
- Installing the Oil Line Tubing
- Installing the Air Line Tubing
- Locking the Burner into Firing Position

Single Boiler Assembly



PARTS THAT DIFFER ON THE CB-200-CTB

NO	QTY	PART	DESCRIPTION
30	1	90200	BASE
20	1	27158	L - BRACKET
19	-	N/A	NOT USED
18	1	33534	CONNECTOR PLUG
17	1	31216	INSULATION 200 DOOR
16	1	11540	DOOR W.A.
11	1	14300	UPPER PIPE ASS'Y
10	-	N/A	NOT USED
9	1	14298	CHECK VALVE & PIPE ASS'Y
4	1	35079	FLANGE SET 1-1/4 NPT
2	1	31215	INSULATION PANEL
1	1	11539	PANEL LH 200 W.A.

NO	QTY	PART	DESCRIPTION
30	1	90188	BASE
29	1	33331	TERMINAL BLOCK
28	1	33340	TRANSFORMER 230V-24V
27	1	33328	RELAY DPDT
26	1	33352	RELAY DELAY
25	1	12222	TERMINAL BLOCK ASS'Y
24	1	33286	SWITCH DPDT ON-ON
23	1	33338	AMBER LIGHT
22	1	27058	CONTROL BOX LID
21	1	12278	CONTROL BOX 120 AC
20	1	33066	ELECTRICAL BOX 2 x 4
19	1	33067	ELECTR. BOX LID
18	1	33336	CONNECTOR PLUG
17	1	31176	INSULATION 350 DOOR
16	1	11405	DOOR W.A.
15	1	21077	PORT LID
14	1	11407	BURNER MOUNT CTB W.A.
13	1	11033	HINGE BRACKET W. A.
12	1	13141	ACCUMULATOR BLOCK ASS'Y
11	1	14292	UPPER PIPE ASS'Y INTERNAT.
10	1	14293	DRAIN PIPE ASS'Y INTERNAT.
9	1	14204	CHECK VALVE & PIPE ASS'Y
8	1	33330	GAUGE BOILER TEMP/PRESS
7	1	35048	RELIEF VALVE 3/4 M
6	1	33332	FLOW SWITCH
5	1	28149	HIGH TEMP CUT-OFF
4	1	35061	FLANGE SET 1-1/2 NPT
3	1	28150	AQUASTAT
2	1	31166	INSULATION PANEL
1	1	11380	PANEL REAR 350 WA

Figure 3A - Single Boiler Assembly Component Detail

Single Boiler Assembly

Installing the CTB on the Support Stand

WARNING: Use extreme caution when moving and lifting the CTB (with a forklift) into place on the support stand. One CTB weighs approximately 560 kg (1240 pounds). Clean Burn recommends placing safety blocking underneath the unit until it is properly installed and secured on the support stand. ***Failure to follow these basic safety guidelines may result in serious personal injury and/or damage to the unit.***

1. Refer to Figure 3A to become familiar with the components required for CTB assembly.
2. Assemble the CTB support stand as shown in Figure 3B, using the hardware provided.
3. Move the support stand into the approximate position where the CTB is to be installed, and place blocks (approximately 254 mm / 10 inches high) inside the stand to provide safety support for the boiler.
4. Use a forklift to carefully lift the CTB into position over top of the support stand.

WARNING: Secure the boiler to the forklift prior to lifting to prevent possible equipment damage or personal injury.

5. Lower the boiler down onto the safety blocks positioned inside the support stand.
6. Insert bolts (provided) into the keyhole slots in the boiler, and then lift the stand in position against the bottom of the boiler.
7. Tighten the bolts to firmly attach the stand to the bottom of the boiler.
8. Carefully lift the assembled boiler (with stand) off the safety blocks and move the unit into place.
9. Proceed with the remainder of boiler assembly procedures marked for **ALL CTB Models.**

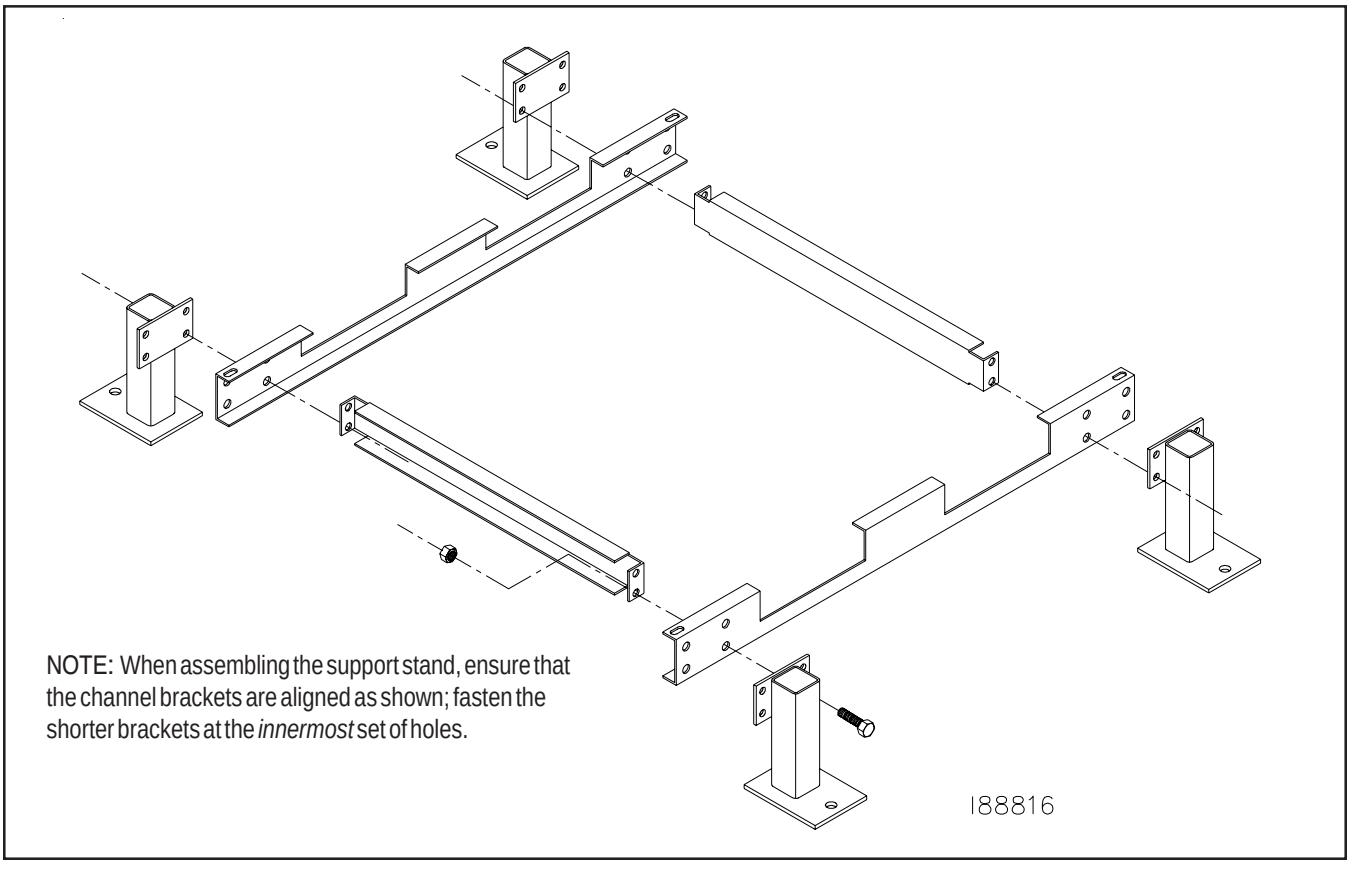


Figure 3B - Assembling the Support Stand

Dual-Stacked Boiler Assembly

Assembling the Dual-Stacked Boiler

WARNING: Use extreme caution when moving and lifting one of the CTB's (with a forklift) into place on the support stand. One CTB weighs approximately 560 kg (1240 pounds). Clean Burn recommends placing safety blocking underneath the unit until it is properly installed and secured on the support stand. ***Failure to follow these basic safety guidelines may result in serious personal injury and/or damage to the unit.***

ATTENTION: Dual-stacked units may be installed in several combinations: two (2) CB-200-CTB boilers, two (2) CB-350-CTB boilers, or one (1) CB-350-CTB and one (1) CB-200-CTB. For optimal system functioning and to prevent system damage, ***each*** boiler must be installed/piped individually as shown in Figure 3C.

1. Refer to Figures 3C and 3D. Move the support stand into the approximate position where the dual-stacked boiler is to be installed, and place blocks (approximately 25 cm (10") high) inside the stand to provide safety support for the boiler.
   NOTE: If the support stand has not been assembled, refer to Figure 3B.
2. Use a forklift to carefully lift one CTB into position over top of the support stand.
   WARNING: Secure the boiler to the forklift prior to lifting to prevent possible equipment damage or personal injury.
3. Lower the boiler down onto the safety blocks positioned inside the support stand.
4. Insert bolts (provided) into the keyhole slots in the boiler, and then lift the stand in position against the bottom of the boiler.
5. Tighten the bolts to firmly attach the stand to the bottom of the boiler.
6. Carefully lift the assembled boiler (with stand) off the safety blocks and move the unit into place for the rest of assembly.
   NOTE: This boiler will be referred to as the "bottom" boiler for the remainder of this procedure.

(Procedure continued on page 3-6.)

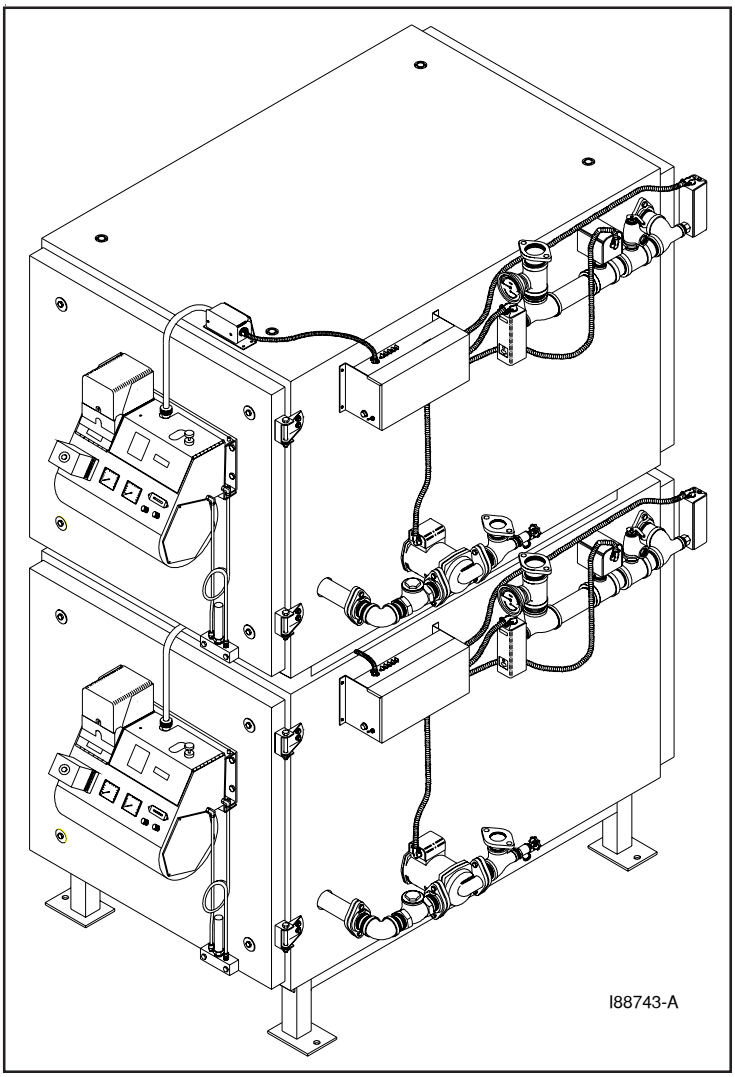


Figure 3C - Dual-Stacked Boilers (Completely Assembled)

Dual-Stacked Boiler Assembly

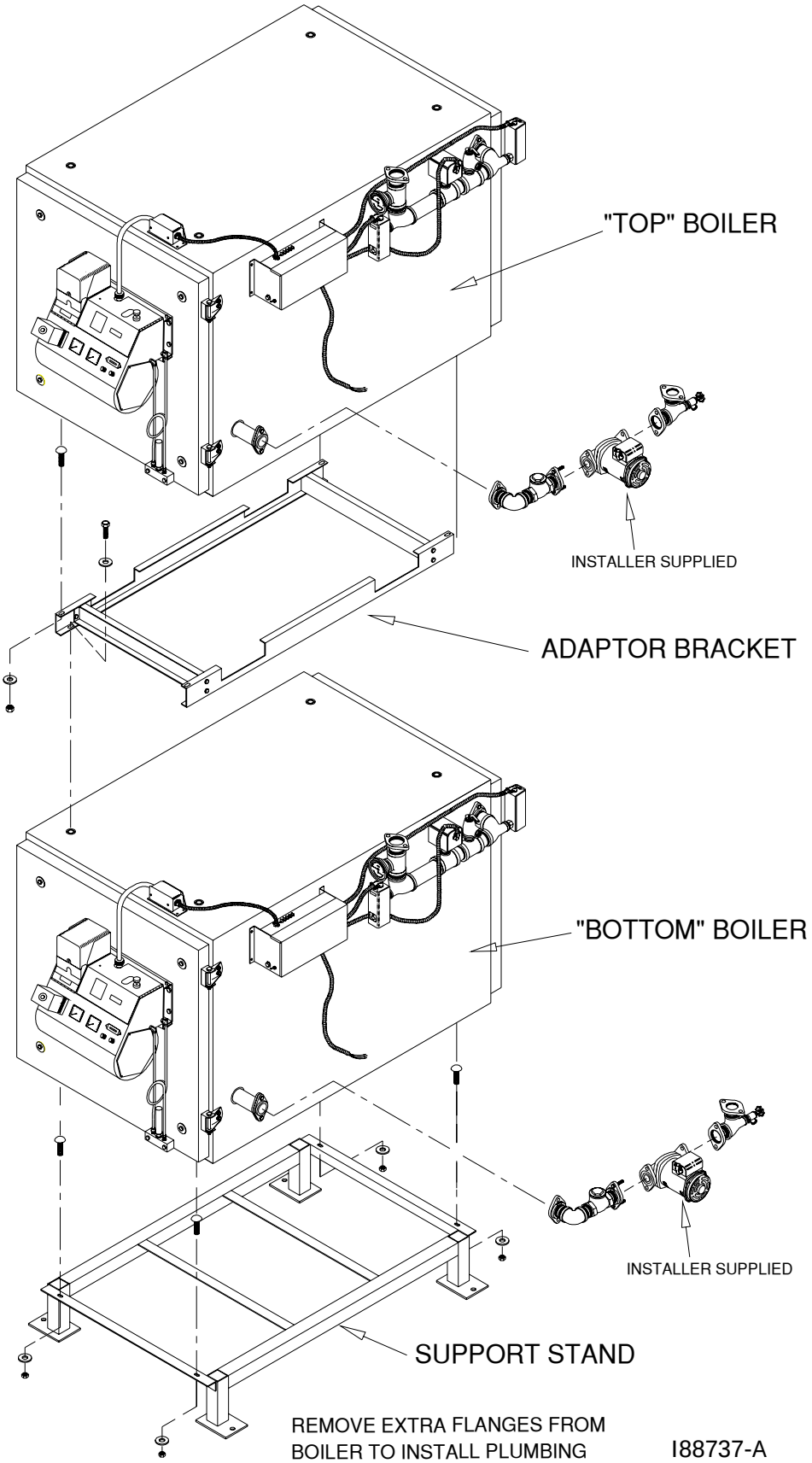


Figure 3D - Dual-Stacked Boiler Assembly Detail

Dual-Stacked Boiler Assembly

Assembling the Dual-Stacked Boiler (continued)

7. Refer to Figures 3D and 3E. Assemble the adaptor bracket using 1" x 3/8" carriage bolts.
   NOTE: The adaptor bracket is installed between the two boilers; it is fastened to the underside of the "top" boiler unit.
8. If you have not already done so, remove the pre-assembled hardware from the top of the "bottom" boiler. You will use this hardware to fasten the adaptor bracket.
9. Use a forklift to carefully lift the "top" boiler unit from underneath *(see safety warning at the beginning of this procedure)*.
10. Attach the adaptor bracket to the bottom of the boiler using the 1" x 3/8" carriage bolts provided. DO NOT completely tighten the bolts until the two units are assembled together.
    NOTE: The notches on the adaptor bracket are designed to fit around standard forklift forks.
11. After the bracket has been attached to the underside of the "top" boiler unit, move the "top" unit into position over the "bottom" unit.
12. Carefully lower the "top" boiler down onto the "bottom" boiler, watching for alignment of the bracket holes and the holes in the top of the boiler below.
13. Install the hardware through the lower set of holes in the adaptor bracket into the top of the "bottom" boiler while checking for proper alignment of the two units. Ensure that ALL hardware is securely tightened.

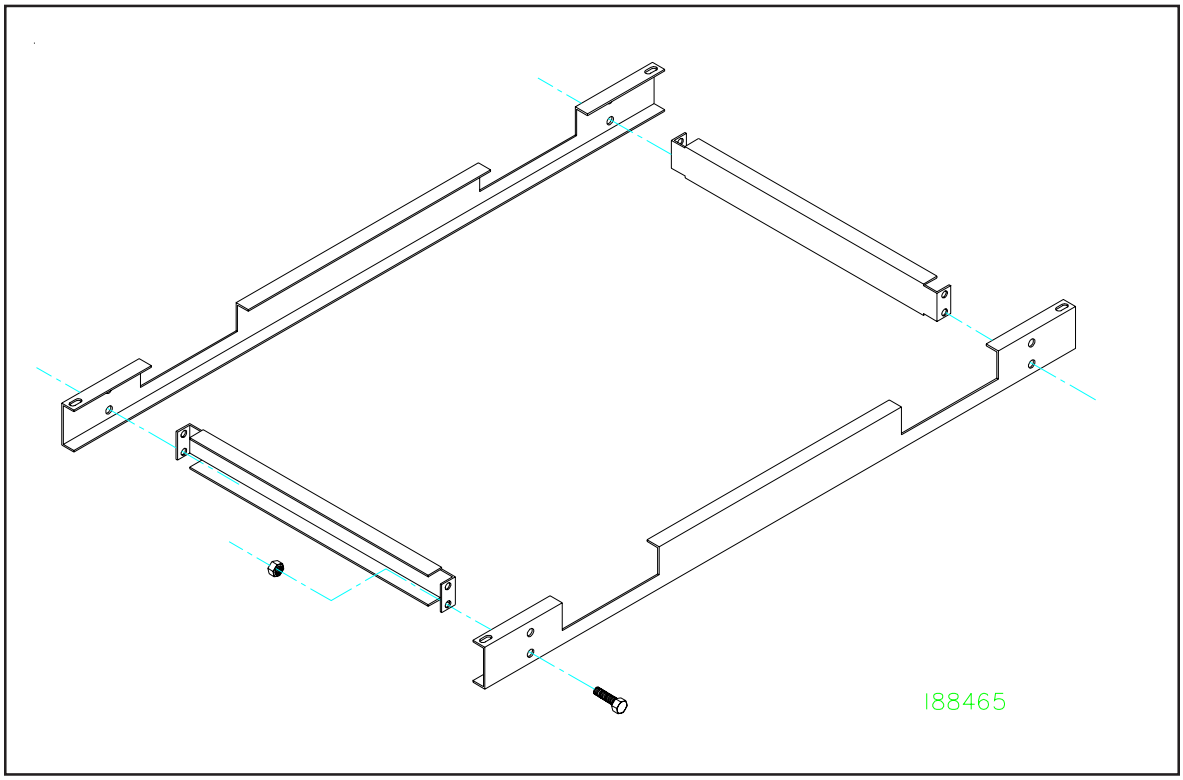


Figure 3E - Dual-Stacked Boiler Adaptor Bracket

Assembly for ALL Boilers

Connecting the CTB

Refer to Figures 3A, 3C, and 3D. Connecting the boiler involves three activities:

- Supply Side Connections
- Return Side Connections
- Wiring

NOTE: If you are installing dual-stacked boilers, each boiler must be installed in the same manner according to the following guidelines for connections/wiring.

Supply Side Connections

- Install the temperature/pressure gauge into the first tee (the 1/2" tapping). Be sure to use pipe dope on the threads of the gauge. Tighten the gauge into the tee.
- All other components on the supply side are factory installed and pre-wired for operation.

Return Side Connections

***Optional components (user-supplied)* - Boiler circulator**

NOTE: Installation instructions are provided for both required and optional components.

- Mount the boiler circulator *(optional)* onto the flanged check valve assembly mounted on the boiler. Place a gasket between the two flanges and tighten.
- Install the return piping assembly onto the other side of the circulator flange. Place a gasket between the two flanges and tighten.

Wiring

- For *each* boiler, connect the wire from the CTB control box to the circulator. Refer to the CTB wiring diagram in Appendix B as needed. If necessary, excess length may be trimmed from the circulator wires.

Assembly for ALL Boilers

Installing the Ceramic Sleeve in the CB-350-CTB

NOTE: The ceramic target is factory-installed.

1. Refer to Figures 3F and 3G.
2. Swing open the clean-out door on the CTB front to gain access to the combustion chamber.
3. Install the stand for the ceramic sleeve as detailed in Figure 3F. Position the rear stand (the shorter one) on the coils approximately 35 cm (14") in from the door opening. Position the front stand (the taller one) against the first turn of the coil as shown in Figure 3F.
4. Install the lower half of the ceramic sleeve in the combustion chamber, positioning the sleeve against the door. Hold a straight edge across the door opening to ensure proper positioning.
   NOTE: ***As shown in Figure 3F, the lower half of the ceramic sleeve (when installed properly) will have a slight slope away from the door (see points "A" and "B" on the figure). At the bottom, the sleeve should just barely touch the door opening. At the top, the sleeve should be approximately 3 mm (1/8") from the opening. The opposite end of the lower sleeve half should extend beyond the rear stand approximately 2 1/2 to 5 cm (1 to 2 inches).***

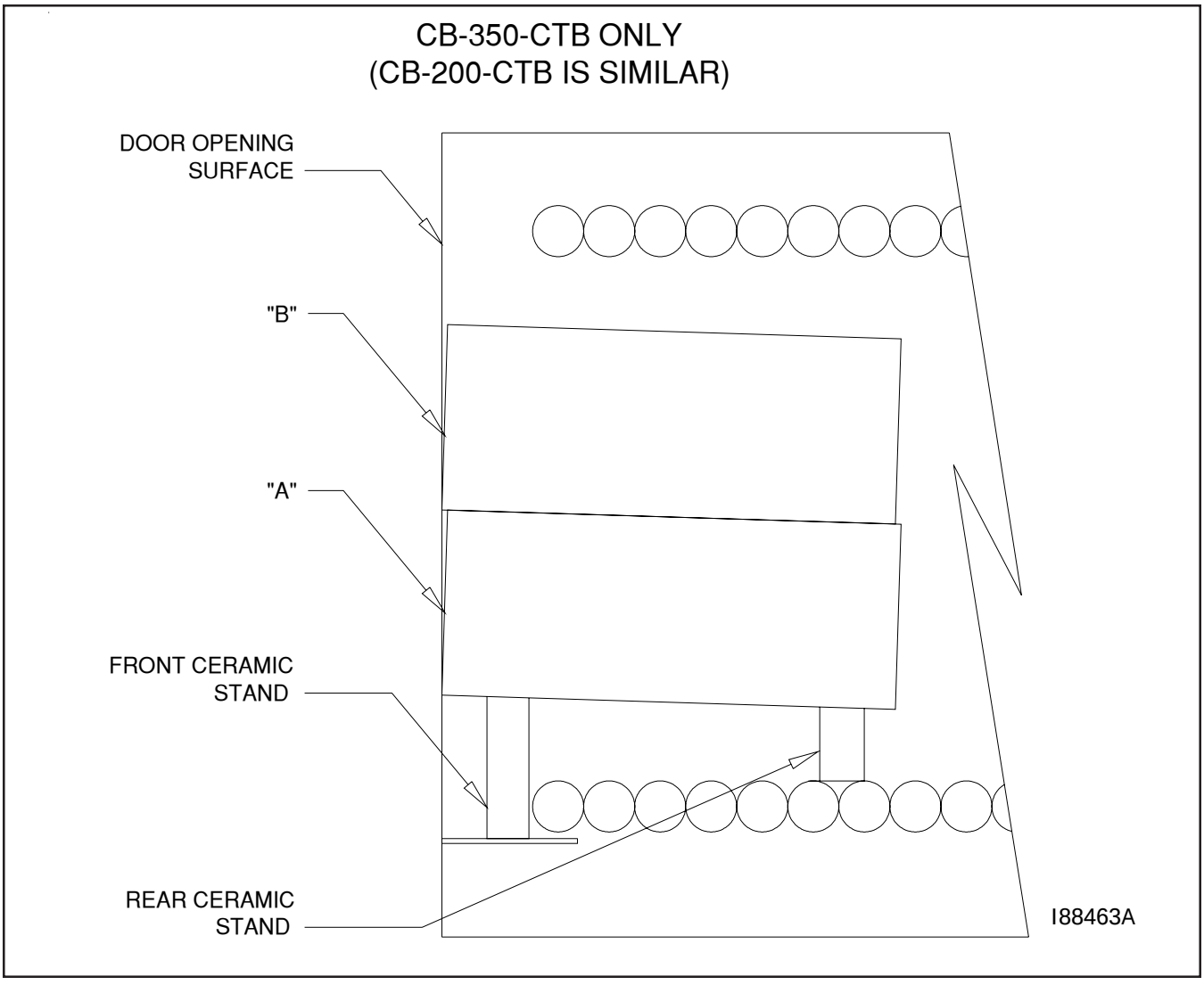


Figure 3F -Positioning of the Ceramic Stand and Ceramic Sleeve

Assembly for ALL Boilers

Installing the Ceramic Sleeve (continued)

5. Invert the top ceramic sleeve and slide into the combustion chamber on top of the lower half (so that the two form a cylinder). Use a straight edge across the door opening to ensure proper positioning.
   NOTE: ***The two halves of the sleeve will be offset in the front because of the similar bottom-to-top slopes of each piece (with a 3mm (1/8") gap at the top as shown in Figure 3F).***
6. After the ceramic sleeve has been installed and positioned properly, close the clean-out door.
7. Tighten the four (4) lock nuts in a criss-cross pattern until all are snug.

Installing the Ceramic Sleeve in the CB-200-CTB

NOTE: The Ceramic Sleeve and Stand on the CB-200-CTB are single piece entities and are installed in the same way as the sleeve and stand for the CB-350-CTB. The CB-200-CTB ceramic sleeve needs to seat firmly against the door insulation for proper combustion. Carefully position the ceramic sleeve on the stand so that it extends out slightly beyond the door opening, so that the door will push the ceramic sleeve in place as it is closed.

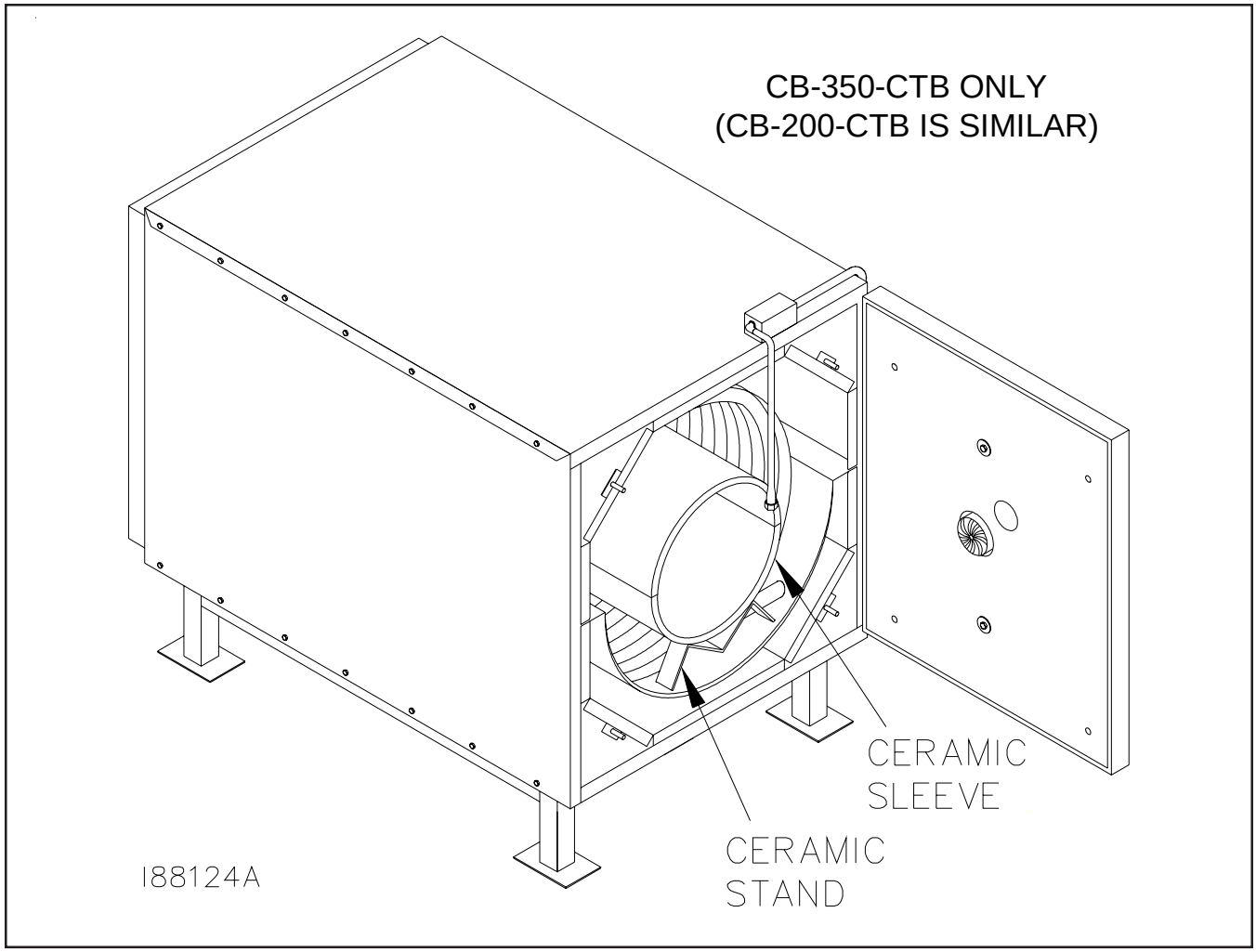


Figure 3G - Ceramic Stand and Sleeve Installed in the Combustion Chamber

Assembly for ALL Boilers

Checking the Burner Nozzle and Electrodes

NOTE: The burner nozzle is factory installed. Both models (CB-200-CTB and CB-350-CTB) use a Delavan 9-5 nozzle. The nozzle size is indicated on the nozzles as shown in Figure 3H. Refer also to **Appendix A** at the back of the manual for additional specifications on the burner nozzle.

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

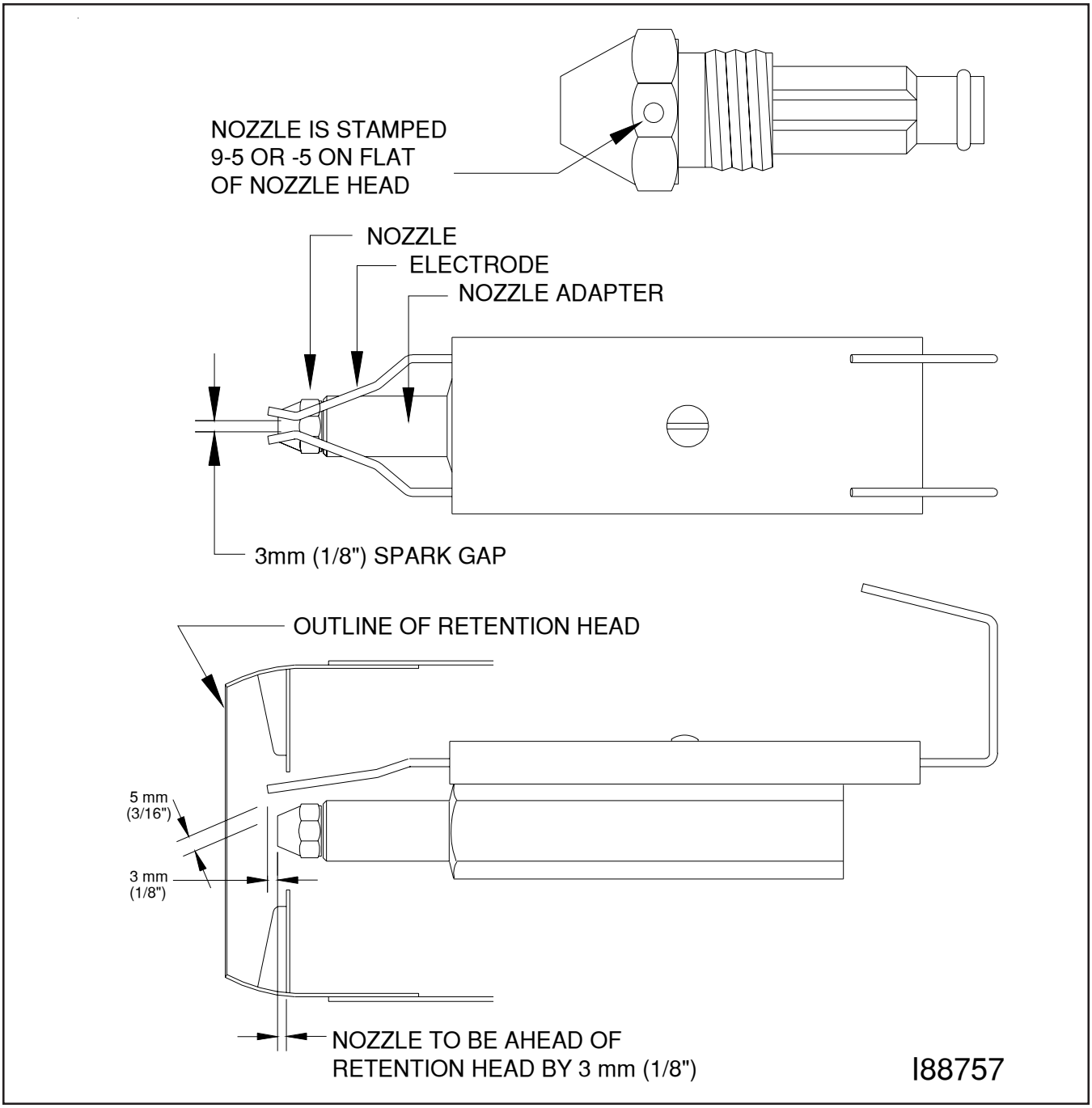


Figure 3H - Burner Nozzle and Electrode Specifications

Assembly for ALL Boilers

Mounting the Burner on the Hinge Bracket

NOTE: The burner may have been mounted on the CTB at the factory. If this is the case, simply check the clearance between the retention head and the boiler to make sure the burner swings freely into firing position. If adjustments are necessary, follow the procedure below to adjust the hinge bracket bolts.

1. Remove the nut from the burner mounting flange on the boiler cabinet, and set it aside for later use.
2. Lift the burner into position and mount it on the hinge bracket of the boiler cabinet.
3. Carefully swing the burner and check the clearance between the retention head and the boiler throat. There must be at least 3 mm (1/8") clearance, so the retention head is not "bumped" as you swing the burner into firing position.

If the retention head "bumps" the boiler 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.

Installing the Connector Block on the CTB Door

1. Refer to Figure 3I on the next page.
2. Use the two (2) bolts to install the aluminum connector block onto the CTB cabinet.
3. 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 CTB 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 CTB without the connector block and accumulator properly installed on the boiler, or damage may occur to vital burner components.***

ATTENTION: DO NOT use teflon tape or teflon pipe dope products on any fittings; teflon residue will plug vital burner components. Non-hardening pipe dope compounds are recommended.

Assembly for ALL Boilers

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 outer red protective 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 3I, if required, to "line up" the oil line.
4. Make sure that the curl in the oil line is positioned as shown in Figure 3I so that the burner can swing open correctly.
5. 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 3J on the next page which provides a larger front view of the connector block assembly.

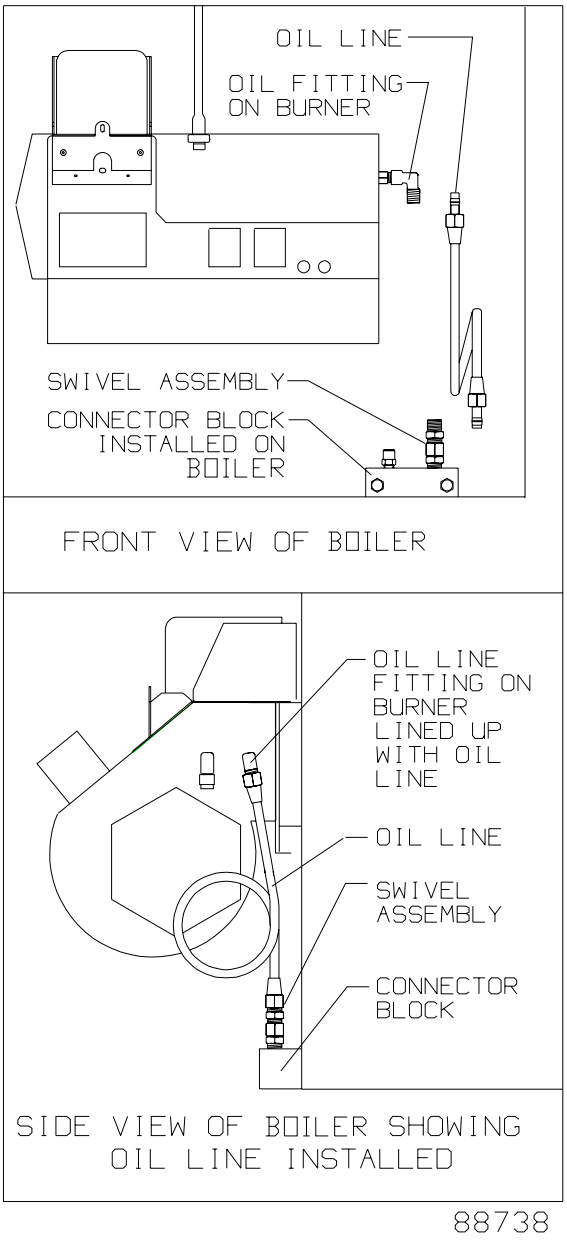


Figure 3I - Installation of Connector Block and Oil Line

Assembly for ALL Boilers

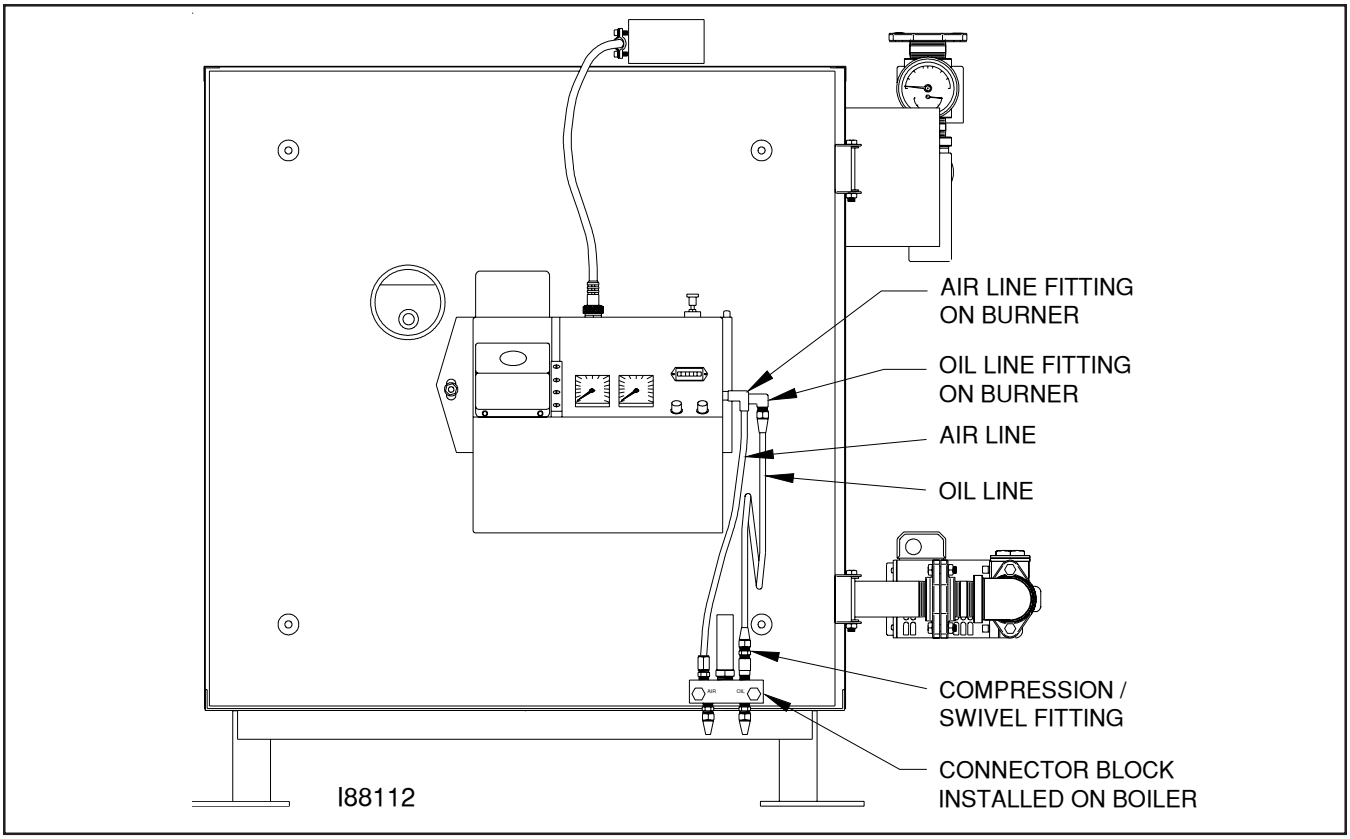


Figure 3J - Installation of Connector Block, Oil Line and Air Line (Front View)

Installing the Air Line Tubing

1. Remove and discard the outer red protective caps from the air line tubing.
2. Refer to Figure 3J. Push the air line tubing into the 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.

Locking the Burner into Firing Position

1. Swing the burner into firing position.
2. Install and tighten the lock 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 3K.

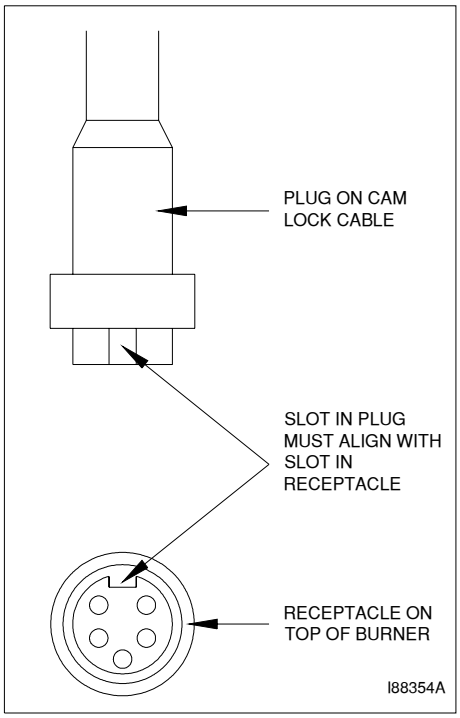


Figure 3K - Detail of Burner Electric Receptacle

SECTION 4: COIL TUBE BOILER INSTALLATION

Understanding Installation

Installing your Clean Burn Coil Tube Boiler (CTB) is a multi-step process which includes:

(1) Oil Tank Installation Specifications
(2) Installing the Metering Pump*
(3) Connecting Water to the CTB
(4) Installing the Oil Lines
(5) Installing the Compressed Air Line
(6) Wiring the CTB and Pump
(7) Installing the Stack
(8) Inspecting the Installation

NOTE:** This manual provides information for the installation of a metering pump with the CTB. If you ordered a J-pump, please also refer to the separate ***J-Pump Installation Manual included with your shipment.

Clean Burn recommends that you review all procedures before beginning installation, paying careful attention to safety information statements. **Figures 4A / 4B provide a general overview of a typical coil tube boiler installation and should be reviewed closely before proceeding.**

WARNING: Improper installation can adversely affect the proper, safe operation of your CTB. It is critical that your boiler installer reads and follows the instructions provided in this manual. Access to the boiler must be restricted; only trained, qualified personnel should be permitted to perform installation and operation procedures.

Important Safety Guidelines for Safe Installation

General installation of the appliance shall be in accordance with the manufacturer's literature, in addition to complying with the following:

BS5410 **Code of Practice for Oil Firing**

1997: Installation up to 45 KW output capacity for space heating and hot water supply purposes.
1998: Installation of 44 KW and above capacity for space heating, hot water and steam supply purposes.
1978: Installation for furnaces, kilns, ovens and other industrial purposes.

The Building Regulations:

England and Wales: Approved Document J: Heat Producing Appliances (1991).
Scotland: Technical standards for compliance with the Building Standard (Scotland) Regulations 1990, Part F: Heat Producing Installations and Storage of Liquid and Gaseous Fuels.
Northern Ireland: The Building Regulations (Northern Ireland) 1990. Technical Booklet L - Heat Producing Appliances, July 1991.
Republic of Ireland: The Building Regulations of Ireland 1997, Part J: Heat Producing Appliances.
Isle of Man, Jersey and Guernsey: The Building Bylaws - BS 7671: 1992 IEE Wiring Regulations 16th Edition.

Important Safety Guidelines for Safe Installation (continued)

The Environmental Protection Act 1990, Part 1: Processes prescribed for air pollution control by local enforcing authorities PG1/1 (95).

Secretary of State's Guidance: Waste Oil Burners, less than 0.4 MW net rated thermal input. November 1995 (Appendix A of OFTEC OFSA 103).

OFTEC Guidelines: Document OFG100 for externally serviced oil fired appliances.

Important Notes to the Electrician

WARNING: Electrical installation of the boiler is to be performed only by qualified personnel (i.e. licensed electrician/engineer). Improper electrical installation can adversely affect the proper, safe operation of the boiler and may cause serious personal injury/death.

WARNING: Before completing any boiler wiring, refer to the wiring diagrams in Appendix B at the back of the manual. Carefully review the wiring assignments and colors, noting that the Clean Burn wire colors may not be "standard" or familiar.

WARNING: High earth leakage current / earth connection is essential and must be established before connecting the main power supply.

WARNING: Low voltage terminals are only protected by basic insulation--caution is required.

CAUTION: Use only approved wire conduit and connectors when wiring the Clean Burn boiler. An emergency stop device (i.e. "panic button") must be installed at ground level in the mains cable to the boiler to ensure the safety of boiler operators and service personnel. The external disconnect device must employ a contact separation of 3mm in all poles; the external breaker must be an approved type.

CAUTION: The mains cable must be introduced into the control box using conduit connectors which provide adequate strain relief. The mains cable installation must be accomplished using suitably rated and approved wiring (BASEC or HAR) or appropriate current-carrying capacity. The wires should have a minimum rating of 90 °C (194 °F).

NOTE: According to Clause 4A of 61000-3-11 (International Electrical Standard), the user must determine, in consultation with the supply authority, that the boiler is connected only to a supply with an impedance of $3.773 \times 10^{-3} + 2.358 \times 10^{-3}$ or less.

Typical Installation Diagrams

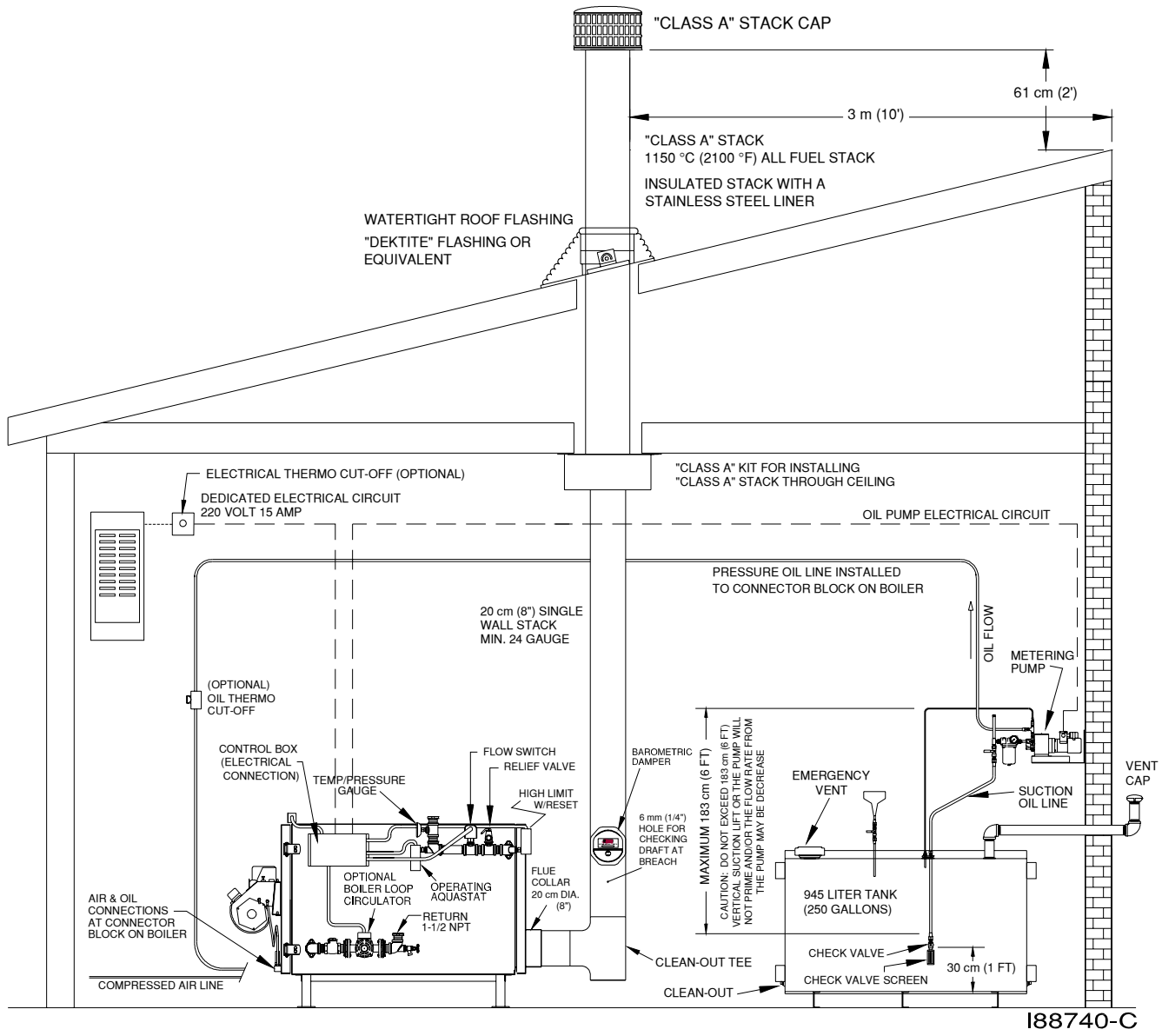


Figure 4A - Typical Single Boiler Installation Diagram

Typical Installation Diagrams (continued)

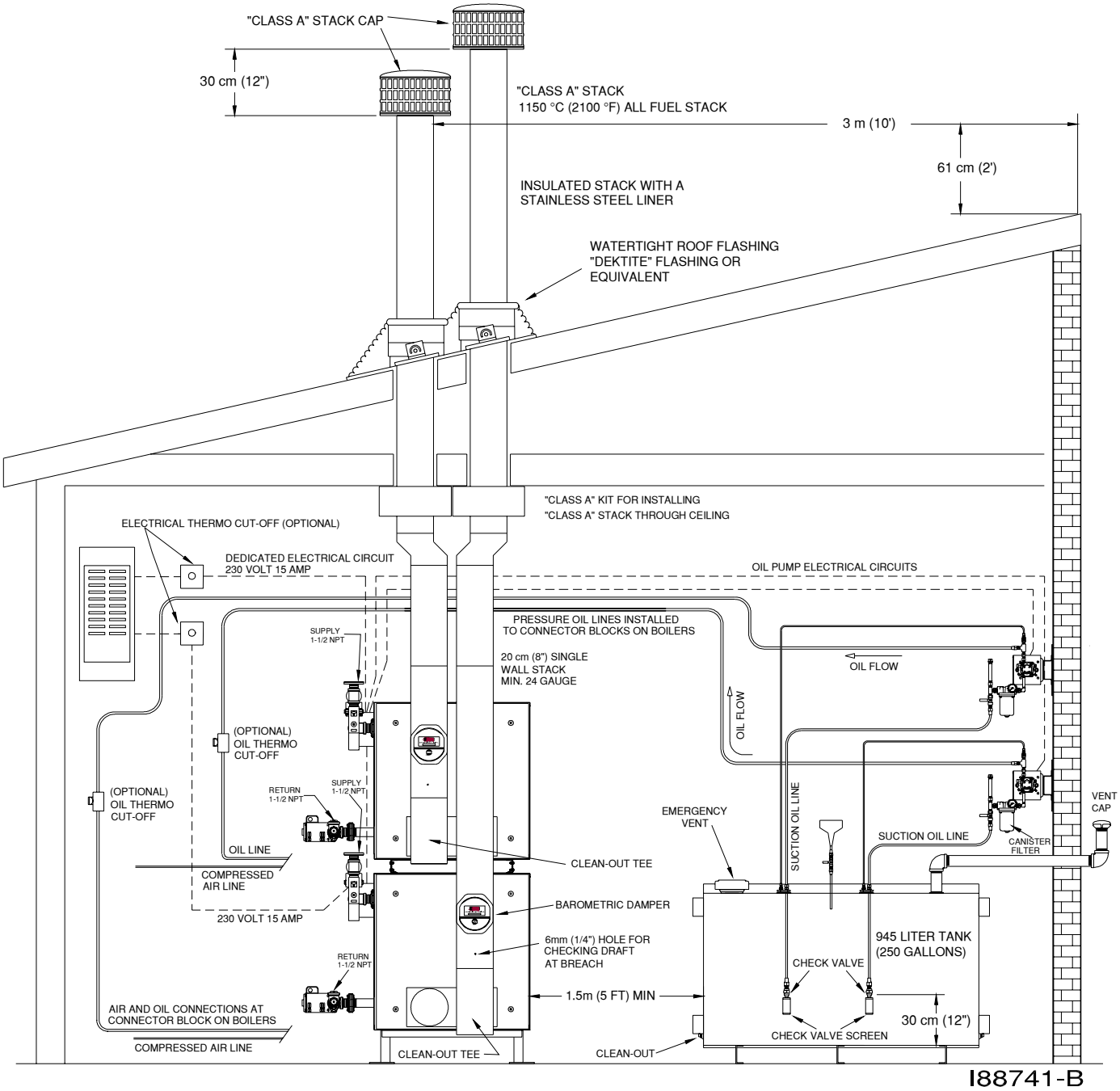


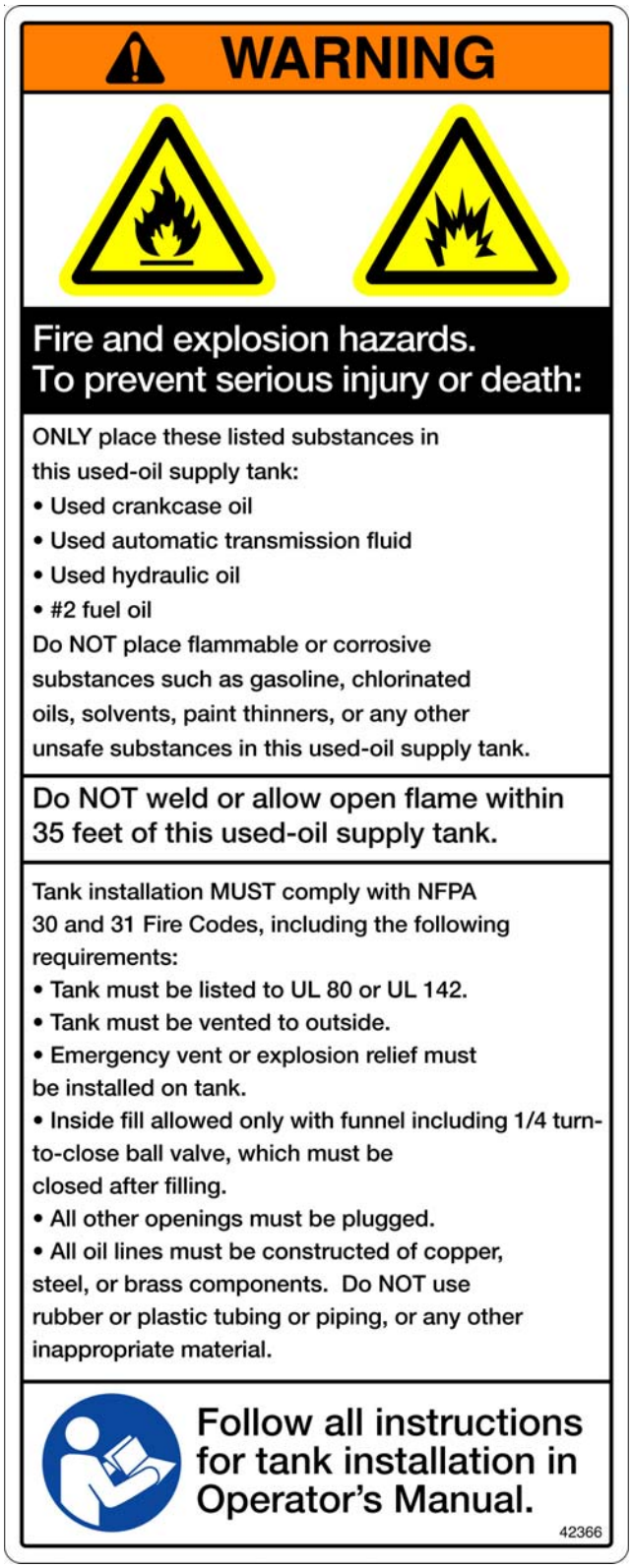
Figure 4B - Typical Dual-Stacked Boiler Installation Diagram

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.
- Use a minimum **945 liter (250 gallon) tank**. DO NOT use a 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 and 4B.
- 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, 4B, and 4C, including the metering pump installation and specifications for the oil line installation. (Procedures for installing these components can be found in the following pages.)



IMPORTANT NOTE: If you are installing an inside oil tank in the same room as the boiler, you must allow a 1.5 m (5 foot) minimum clearance between the tank and the boiler. The oil tank should be set and installed in position BEFORE the boiler is installed.

Oil Tank Installation Specifications (continued)

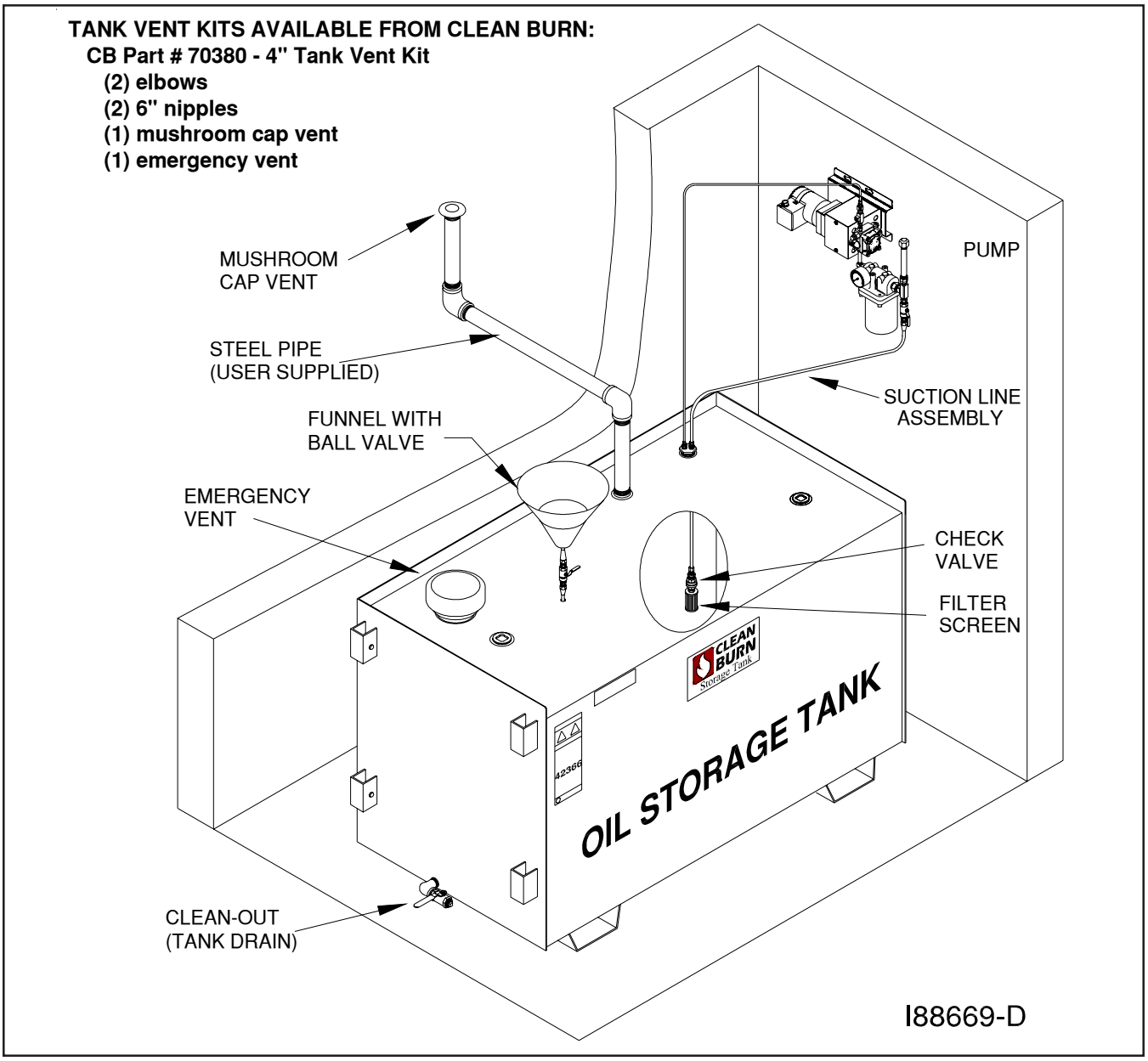


Figure 4C - Typical Metering Pump Installation with Inside Tank

Installing the Tank Vent and Emergency Vent

Codes require that you install a tank vent (to the outside) and an emergency vent for your tank as shown in Figure 4C. **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 50 mm (2") steel pipe (user-supplied) terminating outside with a proper vent cap as shown in Figure 4C. Consult local codes for information and requirements concerning the proper venting of oil storage tanks.
- Install an emergency vent as shown in Figure 4C. 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 Figures 4D, 4E, and 4F 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 boiler (note the specific gear motor part numbers shown in Figure 4E).
- 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 122 cm (4') from the oil tank.***

Standard Mounting: Vertical Positioning

1. Refer to Figures 4D, 4E, and 4F. Note that the metering pump is shipped with the pump head already positioned for the standard 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 122 cm (4') from the tank.***

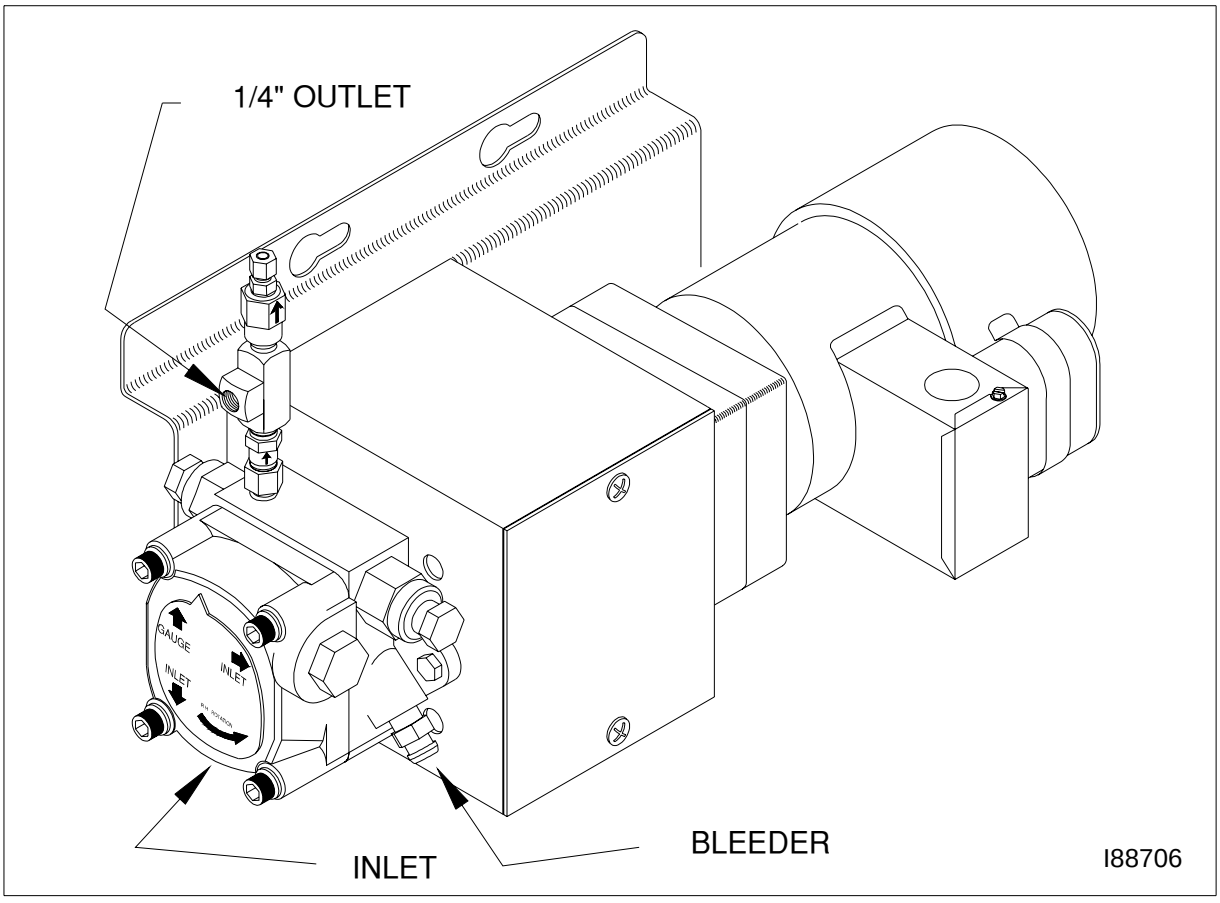
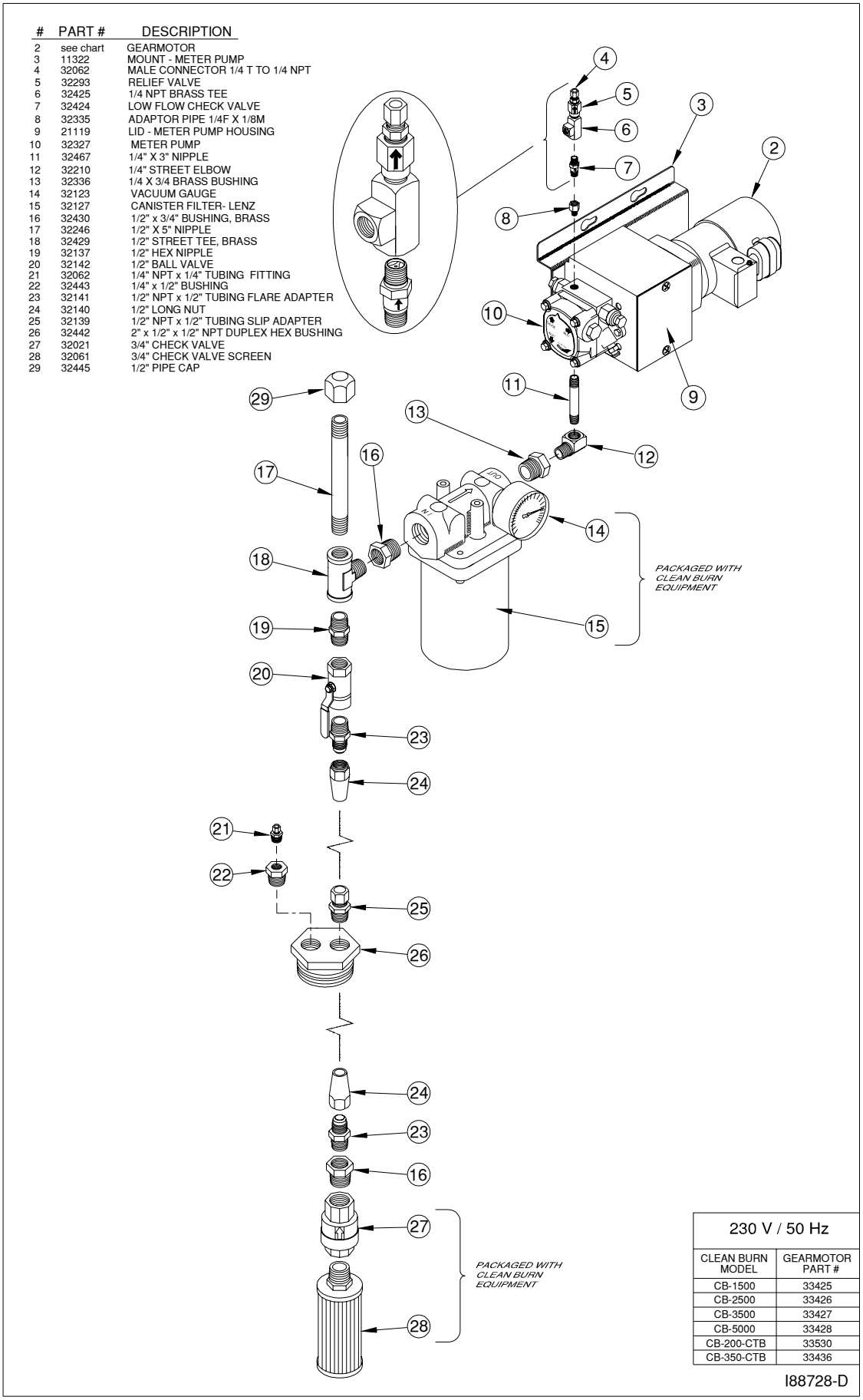


Figure 4D - Standard (Recommended) Vertical Mounting of the Metering Pump

#	PART #	DESCRIPTION
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 1/4F X 1/8M
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	32246	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



230 V / 50 Hz	
CLEAN BURN MODEL	GEARMOTOR PART #
CB-1500	33425
CB-2500	33426
CB-3500	33427
CB-5000	33428
CB-200-CTB	33530
CB-350-CTB	33436

I88728-D

Figure 4E - Metering Pump Component Detail

Alternate Mounting: Horizontal Positioning

ATTENTION: If the metering pump is to be mounted horizontally or on a bracket as shown in Figure 4F, 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 4E and 4F.
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 4F.
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 122 cm (4') from the oil tank.***

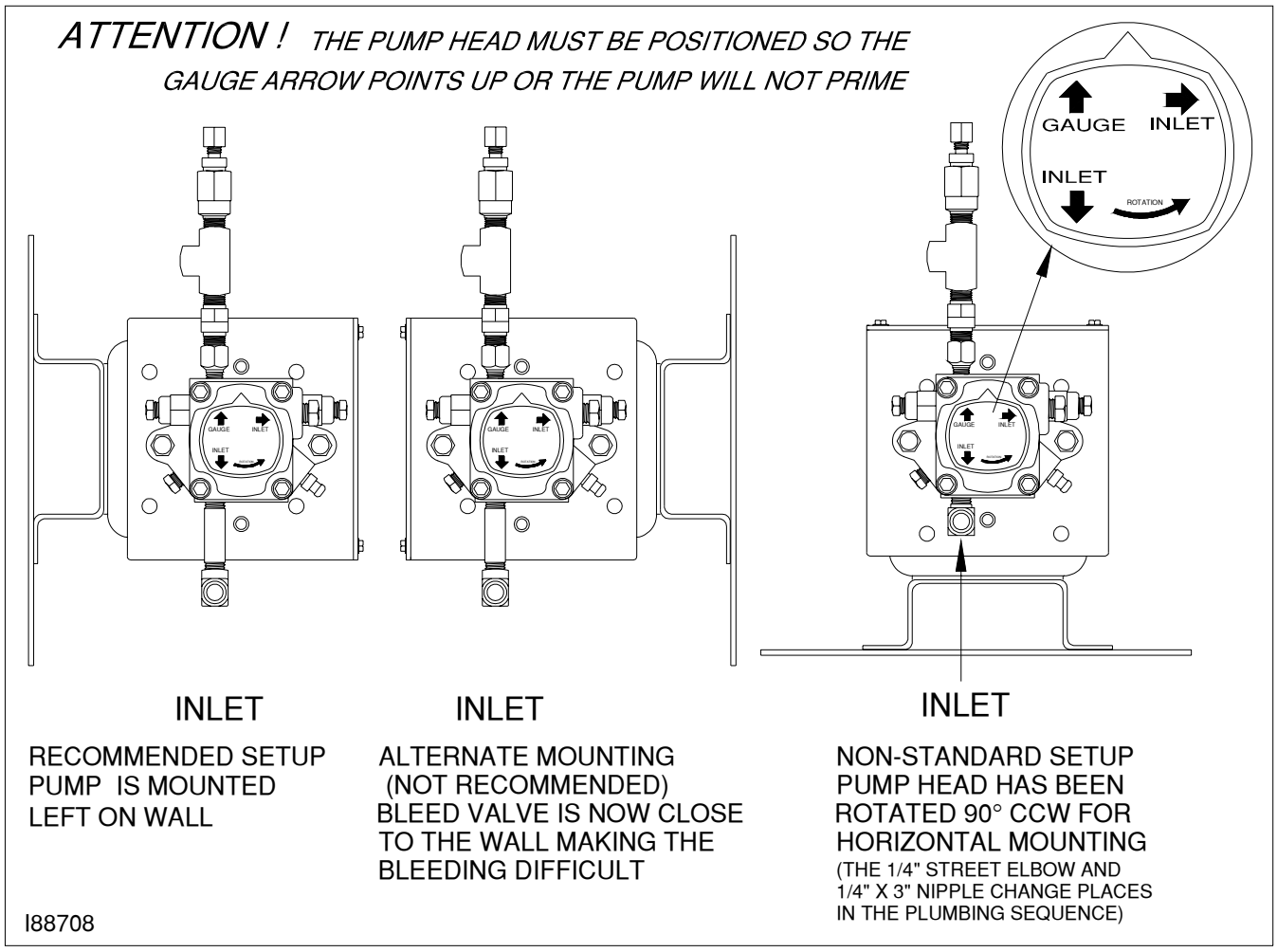


Figure 4F - Proper Positioning of Metering Pump Head

Connecting Water to the Coil Tube Boiler

IMPORTANT NOTE! Detailed information on the installation and operation of the hydronics system is provided in Section 10 of this manual. The instructions provided here are abbreviated and serve only to indicate *when* these procedures should be performed; consult Section 10 for the detailed version.

1. Connect the desired header supply and return lines to the CTB.
2. Have the water trim installed by a certified hydronics technician. Heat exchangers must be used for domestic water heater installations.
3. For air separation and elimination, Clean Burn recommends the Enhanced Spiral-Type Air Separator which can be supplied by your local Clean Burn dealer. Installing an air separator helps ensure that air is purged from the boiler, which is necessary for optimal startup and operation of the burner.
4. The relief valve discharge must be piped to within four inches of the floor or to a floor drain. Be sure to allow for clearance to remove the back panel for servicing.

Filling the Coil Tube Boiler with Water

ATTENTION: ***It is necessary to fill the CTB with water prior to wiring and turning the CTB ON.*** The boiler circulator bearings are water lubricated and should not be allowed to operate dry. Filling the CTB with water provides immediate lubrication of the bearings. Purging air from the water is also critical; doing so enables proper startup of the burner.

1. Fill the CTB with clean tap water.
   ATTENTION: To prevent damage to the CTB, DO NOT fill the boiler with water when the boiler is hot.
2. The pressure gauge should read 0.8 bar (12 psig). If a different operating pressure is needed, contact the Clean Burn Service Department for additional instructions.)
3. **Refer to Section 10, The CTB Hydronic System, for additional information.**

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 4A, 4B, and 4E. **Suction line size is 1/2" (12.7 mm) diameter.** Proper installation allows the suction oil line to be filled with used oil during initial priming.

- The suction oil line may NOT exceed **183 cm (6') TOTAL vertical lift AND 122 cm (4') 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:

  30 cm (1') vertical = 0.75" hg (vacuum)
  122 cm (4') horizontal = 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: 183 cm / 30 vertical cm feet x 0.75" = 4.50" hg AND
  122 horizontal cm = 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 4E 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)

(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 4E. 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.

2. **Install the suction oil line *(from the the tank to the canister filter)*:**

a. Refer to Figures 4A, 4B, and/or 4E.

b. 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 30 cm (12") from this measurement and transfer this new measurement onto the 1/2" O.D. coppper 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.

Installing the Suction Oil Line Components (continued)

(2.) **Install the suction oil line *(continued))*:**

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 Figures 4A/4B.

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 4E and 4G.

- 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 4G.
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. See Figures 4A/4B as needed.
5. Refer to the following procedure for instructions on installing the pressure oil line (from the pump to the connector block on the boiler).

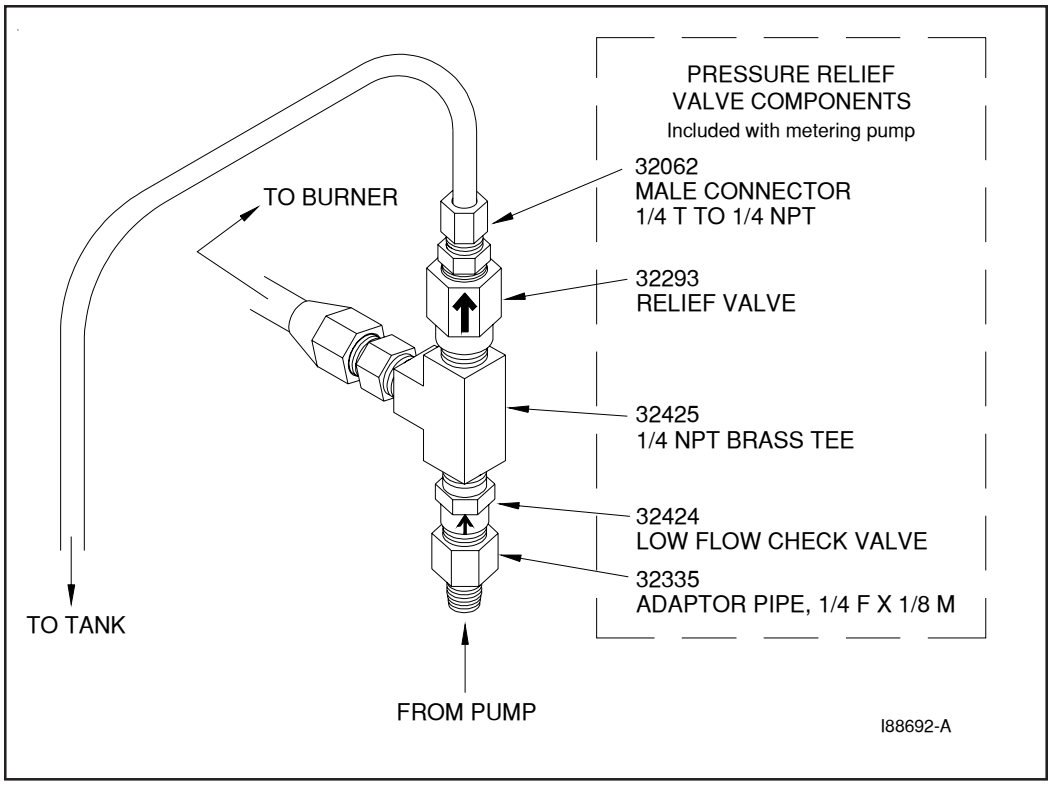


Figure 4G - Installing the Pressure Relief Valve Assembly

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 boiler); 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 30 meters (100')	9.5 mm (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 4A/4B, and 4G.
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 boiler with the following requirements: **3.5 bar (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 boiler. Use minimum 1/4" O.D. copper tubing or equivalent 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 3.5 bar (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.

Wiring the Coil Tube Boiler

WARNING: To avoid electrical shock, make sure that power to the CTB is turned OFF before connecting any wires. A licensed electrician should install all wiring to your furnace. All wiring must be in accordance with national and local codes. Properly size all wires and use electrical conduit for all electrical lines. Specific wiring schematics are provided in **Appendix B** at the back of this manual. **For safe and proper operation of the boiler, DO NOT alter factory installed wiring.**

Wiring your boiler requires the installation of the following lines/circuits:

(1) A dedicated electrical line to the CTB (see IMPORTANT NOTE below)
(2) A pump electrical circuit from the CTB to the oil pump (see IMPORTANT NOTE below)
(3) A separate circuit for the load loop circulator

IMPORTANT NOTE: Separate, dedicated lines/circuits must be wired ***for each boiler*** in the dual-stacked unit.

Wiring to the Coil Tube Boiler

WARNING: A fuse-protected disconnect must be mounted in a readily accessible location for the installation of the unit. This device can also be used for a disconnect in case of an emergency.

1. Install a ***dedicated electrical circuit*** to the electrical junction box on the CTB. Note that a dual-stacked boiler will require two circuits.
   CAUTION: DO NOT tie into an *existing* circuit, or electrical overload may occur.
2. Wire the CTB according to the Wiring Schematic in Appendix B. ***Ensure that the ground wire is attached to the GREEN ground screw on the boiler junction box.***
3. Check for correct voltage at the CTB and refer to the following chart.
   ATTENTION: Incorrect voltage may damage the CTB components.

Total Amp Draw Per Burner & Circulator: 9.4 amps
Load Circulator Ampacity: 2.5 amps (when wired through the CTB control box)

Model	Voltage	Breaker Qty. & Size*	Phase	Hertz
CB-200-CTB (single)	230	(1) @ 20 amps	Single	50
CB-200-CTB (Dual-Stacked)	230	(2) @ 20 amps	Single	50
CB-350-CTB (single)	230	(1) @ 20 amps	Single	50
CB-350-CTB (Dual-Stacked)	230	(2) @ 20 amps	Single	50

***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. Note that minimum wire size with a 30 amp breaker is 10-gauge copper wire.

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

Wiring to the Metering Pump

WARNING: DO NOT wire the oil pump directly into your building's electrical system. The oil 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 boiler and may result in a fire or explosion hazard.

1. Install the oil pump electrical circuit from the CTB to the oil pump location using approved electrical conduit (refer to Figures 4A/4B).
2. Wire the oil pump circuit according to the wiring schematic provided (Appendix B).

Wiring the Load Loop Circulator

NOTE: To reduce the amount of cold water returned to the boiler (and to protect the boiler from thermal shock), an optional circulator aquastat can be supplied by your Clean Burn Dealer.

1. Refer to the related information and illustrations in Section 10 and the CTB Wiring Diagram in Appendix B to locate and understand the wiring for the load loop circulator.

2. The cold water return in your CTB system installation should not be below 60 °C (140 °F).

   NOTE: For installations where cold water return is a risk, Clean Burn recommends installation of a blending loop. If a blending loop is installed in your CTB system, the load loop circulator should be wired separately from the CTB control box. Refer to Section 10 for additional information.

Installing the Stack

WARNING: Inappropriate stack materials or improper stack design/installation can adversely affect the proper, safe operation of your coil tube boiler.

Stack designs are generally classified as follows:

(1) "Class A" stack through the ceiling of the building
(2) "Class A" stack through the sidewall and up the side of the building

Stack Design and Specifications

ATTENTION: ***The stack design must be single and dedicated for each unit (boiler) according to the following specifications***. Failure to adhere to this rule may result in less than optimal system performance.

Figure 4H illustrates the through-the-ceiling stack design for a single boiler; this stack design is preferable and is more commonly used. Refer to Figure 4I for the dual-stacked boiler stack design. When designing your stack, adhere to the following specifications:

- Models CB-200-CTB and CB-350-CTB require **20 cm (8" I.D.) stack components.**
- Dual-stacked units require two (2) 20 cm (8" I.D.) stack runs as single stacks.
- *Ensure that the vertical stack height is* ***at least 3m (10') PLUS 45 cm (1.5') 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 6 mm (1/4") per 30 cm (12") 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 be located 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 resulting 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 concerning exhaust fans and proper make up air.

Stack components should be installed in the following order:

(1) Inside stack (the stack components from the coil tube boiler breach to within 457 mm / 18" of the ceiling, roof, or sidewall of your building)
(2) Barometric damper(s)
(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

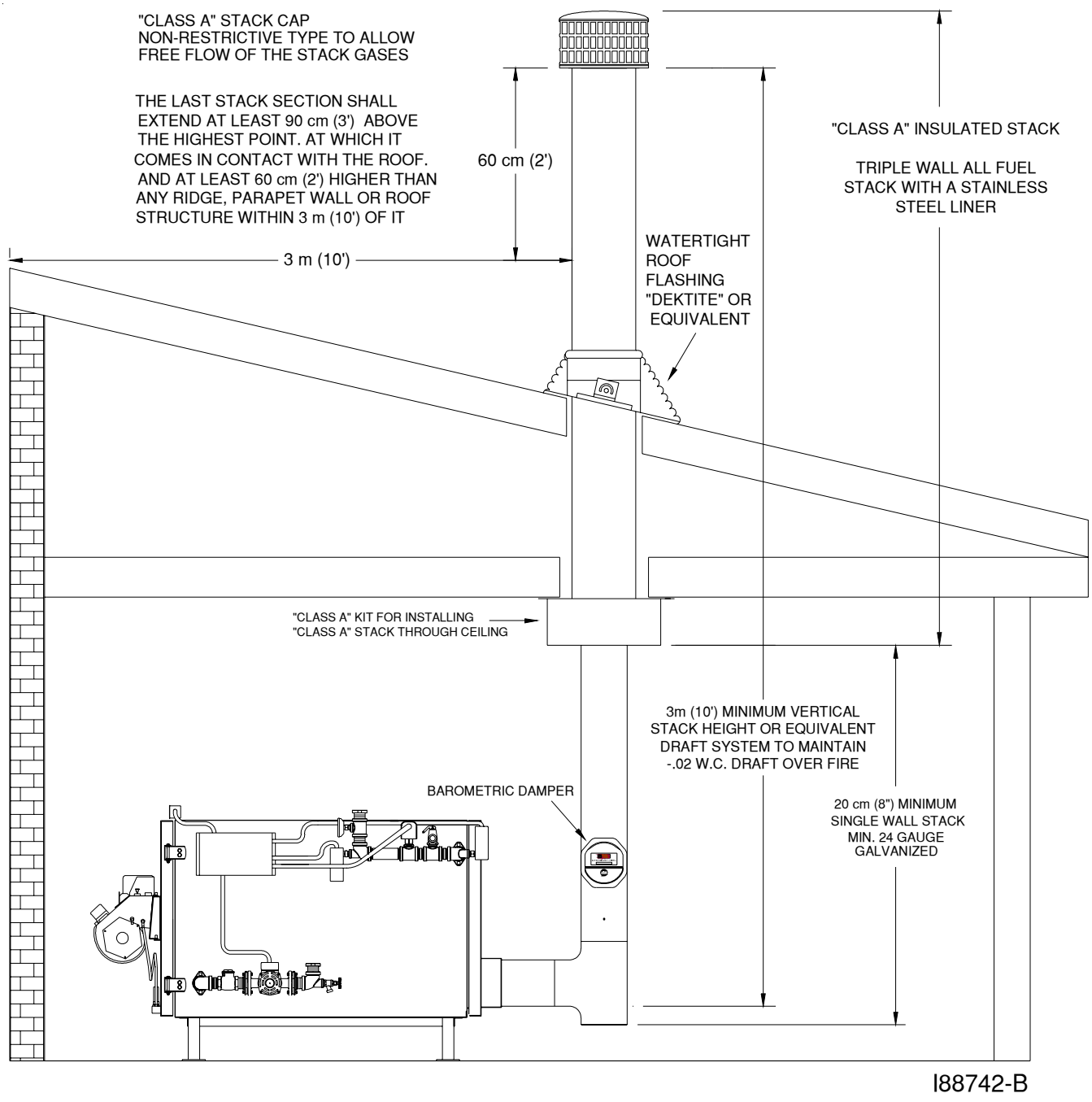


Figure 4H - Installation of "Class A" Stack Through Roof/Ceiling (Single Boiler)

Installing the Stack (continued)

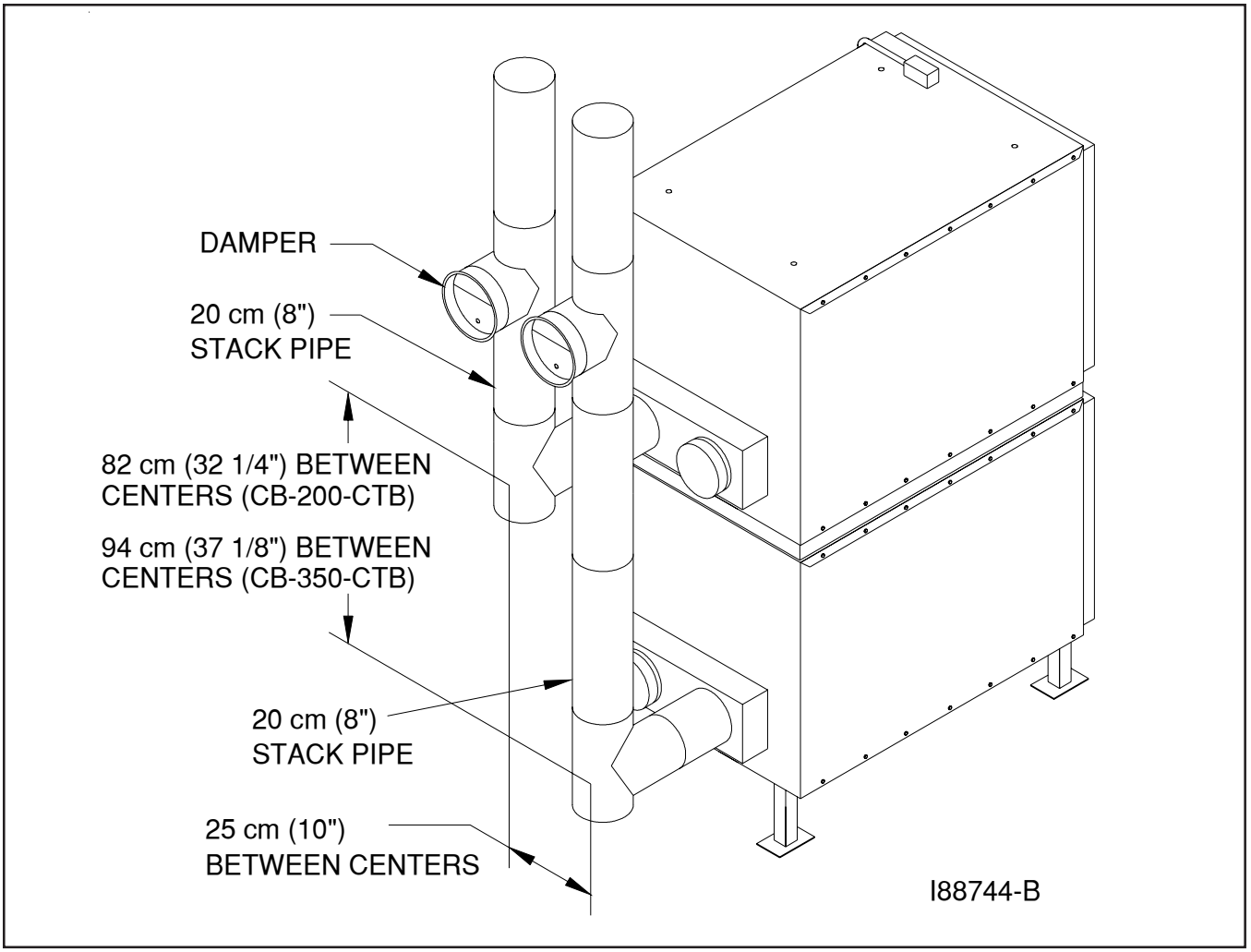


Figure 4I - Detail of Dual-Stacked Boiler Stack Installation

Installing the Interior Stack

CAUTION: 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.

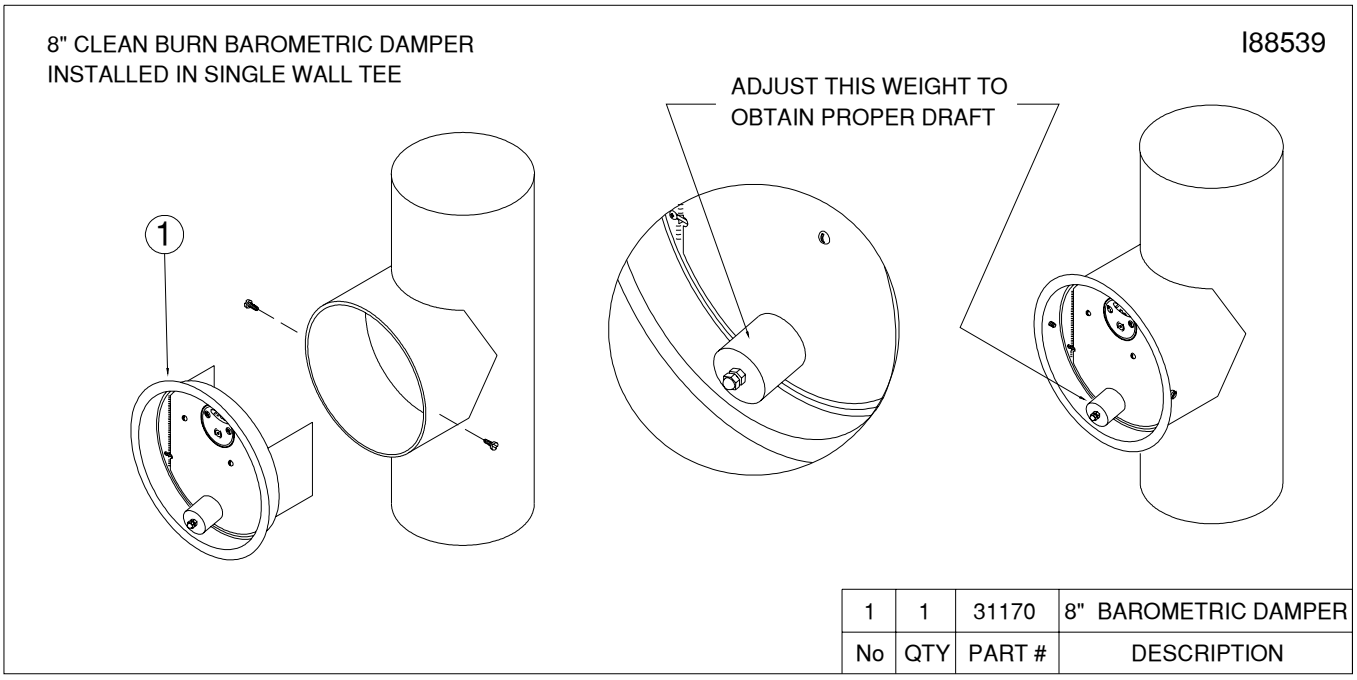
1. The stack can be installed from either side of the smoke hood breach. Install the 20 cm (8") smoke cap onto the unused smoke hood breach ring assembly.
2. Install a piece of the single-wall 24-gauge galvanized stack (minimum 45 cm (18") in length) onto the smoke hood breach.
3. Install an elbow or clean-out tee (with a smoke cap installed in the bottom) onto the extension piece from the boiler smoke hood breach.
4. Install a smoke pipe tee onto this elbow or clean-out tee (for the installation of the barometric damper).

   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.

Installing the Barometric Damper(s)

1. Refer to Figure 4J. Install a single wall tee (min. 24 gauge) on the first straight vertical or horizontal stack section within three feet of the CTB breach.
   NOTE: This 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).
   ATTENTION: ***For Dual-Stacked CTB Units Only*** - You are required by code to install two dampers (provided) - one for each boiler. DO NOT attempt to substitute other types of dampers--they will not allow the unit to function properly and may void your warranty.
2. 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 4J (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 4J - Installation of Barometric Damper

Installing the Stack Penetration

WARNING: When running the stack through your ceiling, roof, or sidewall, you must use **"Class A" 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 4H 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" double-wall insulated all-fuel stack components** with a stainless steel liner.

- DO NOT use Class B Vent/double-wall stack components (i.e. for gas fired appliances only).
- DO NOT use Type L Vent/double-wall stack components (for approved fuel oil 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 4H 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 4H 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 Wall Thermostat

IMPORTANT NOTE: The wall thermostat is available separately from Clean Burn (i.e. it is not included with the CTB). Refer to Appendix A in this manual for additional information on remote temperature sensing controls available from Clean Burn for your CTB system installation.

230 VAC Thermostat for the CB-200-CTB with the Danfoss Oil Primary Control	#33532
24 VAC Thermostat for the CB-350-CTB with the Honeywell Oil Primary Control	#33506

1. Select a location for the thermostat on an interior wall away from any hot or cold drafts.
2. Mount the thermostat according to the manufacturers instructions 1.5 m to 1.7 m (60" to 66") from the floor.
3. Wire the thermostat to the CTB following the wire schematics in Appendix B of this manual and according to the manufacturers instructions included with the wall thermostat.

Inspecting the Coil Tube Boiler Installation

Following the completion of all installation activities described in this chapter, the CTB 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 in the installation to be corrected before CTB startup. *Improper installation will void your warranty.*

NOTE: ***Important!*** During the inspection, be sure to **check the aquastat settings**. Initial settings are listed here:

- Operating Aquastat 71 °C (160 °F) minimum
- Hi-limit Aquastat (with manual reset) 115 °C (240 °F)

Refer to Section 6 for burner startup and final adjustments of the aquastat.

Any changes to these settings should be made only by a qualified hydronics technician. See Section 10, The CTB Hydronics System, for more information.

SECTION 5: METERING PUMP PRIMING

Understanding Metering Pump Priming

Preparing your Clean Burn boiler 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-500 Series 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.

IMPORTANT NOTE FOR DUAL-STACKED UNITS: The priming procedures will have to be performed for one burner, and then repeated for the other burner (i.e. get one burner running first before attempting priming of the other burner.) Be sure to perform the ***Preparing the Burner for Use with the Metering Pump*** procedure for ***both*** units.

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 4 liters / one-gallon each)
- 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 boiler, 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.
   NOTE: Keep the oil regulator assembly in a safe place in case a standard J-type oil transfer pump is installed at a later date. (You would then need to re-install the oil regulator assembly.)
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.

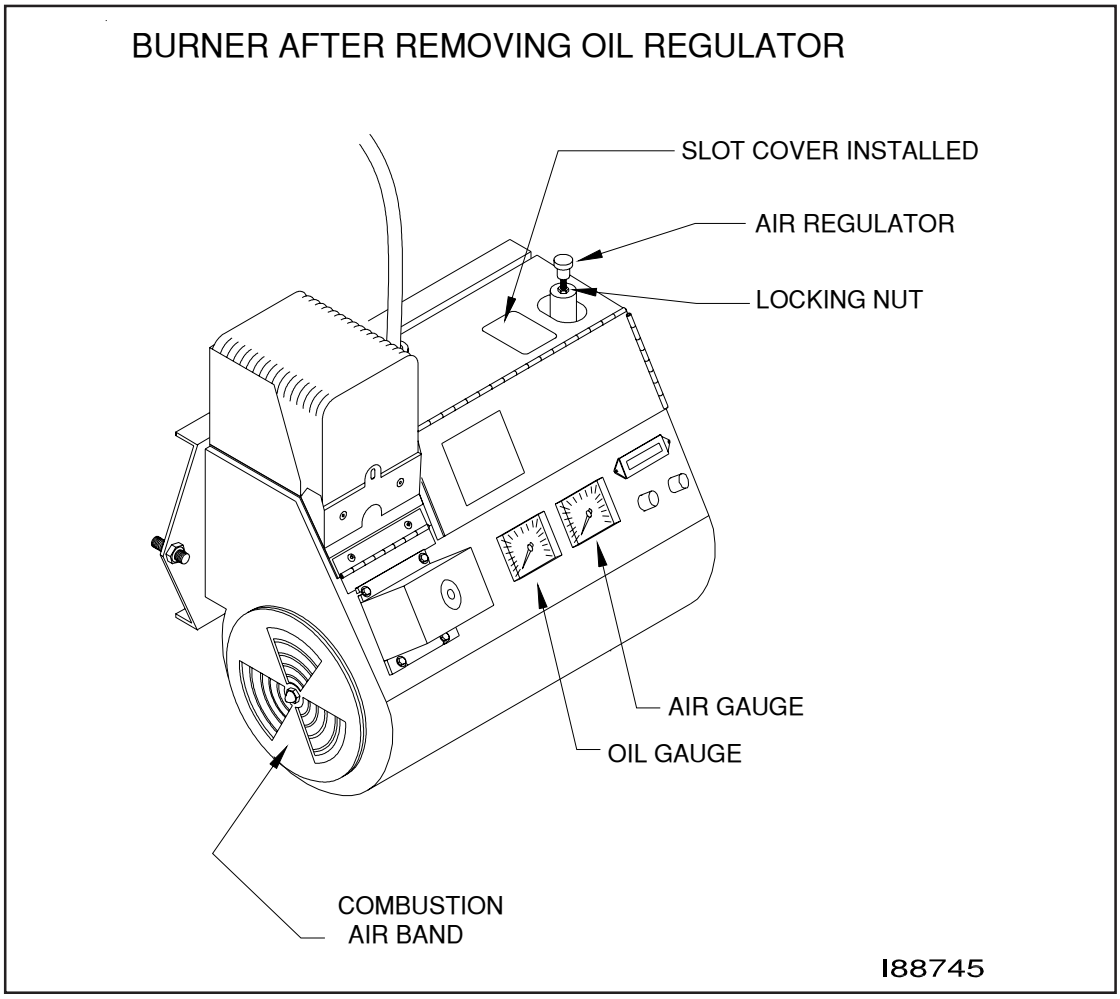


Figure 5A - Detail of Burner Components

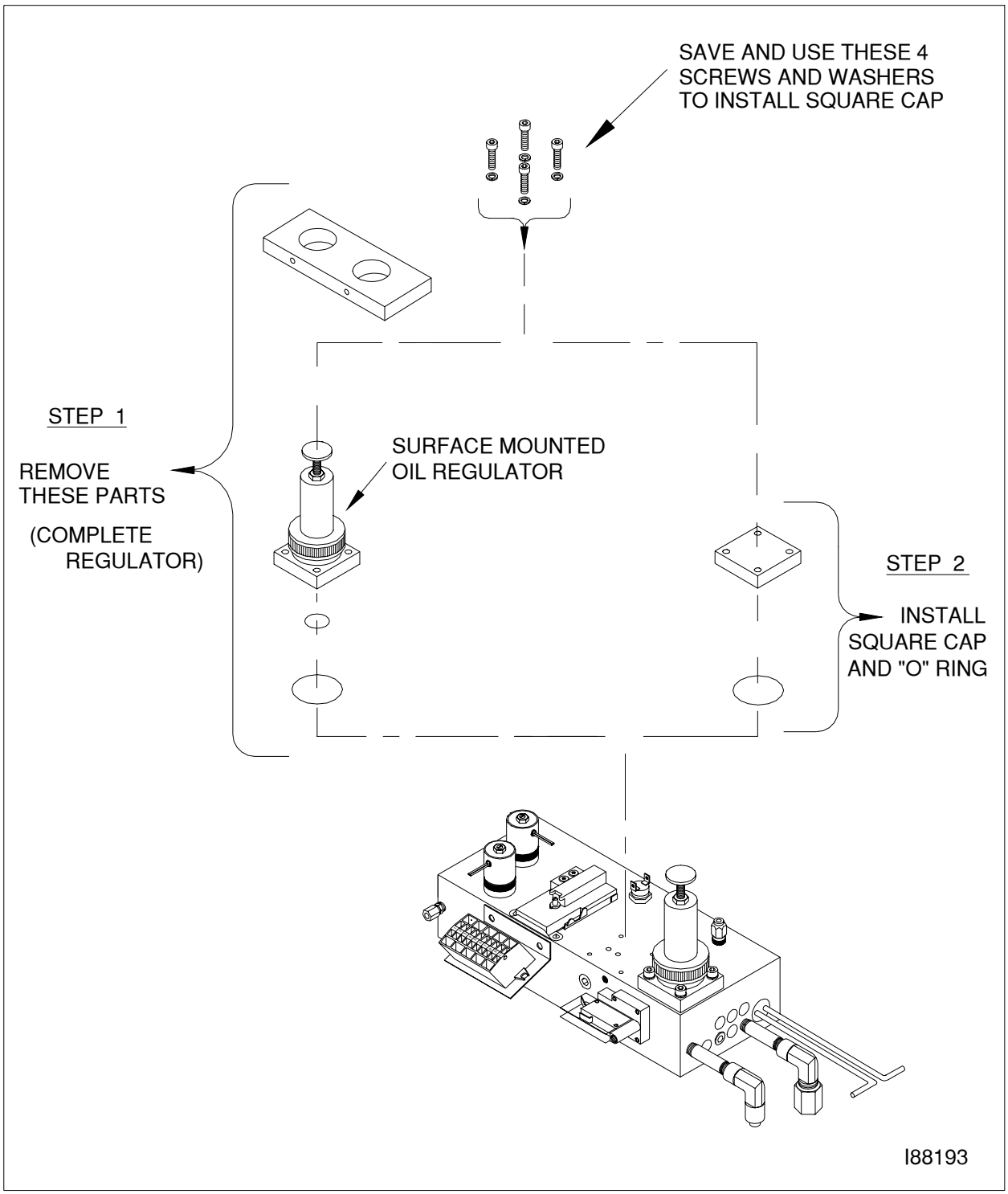


Figure 5B - Detail of Heater Block with Surface-Mounted Oil Regulator

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 (i.e. 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.

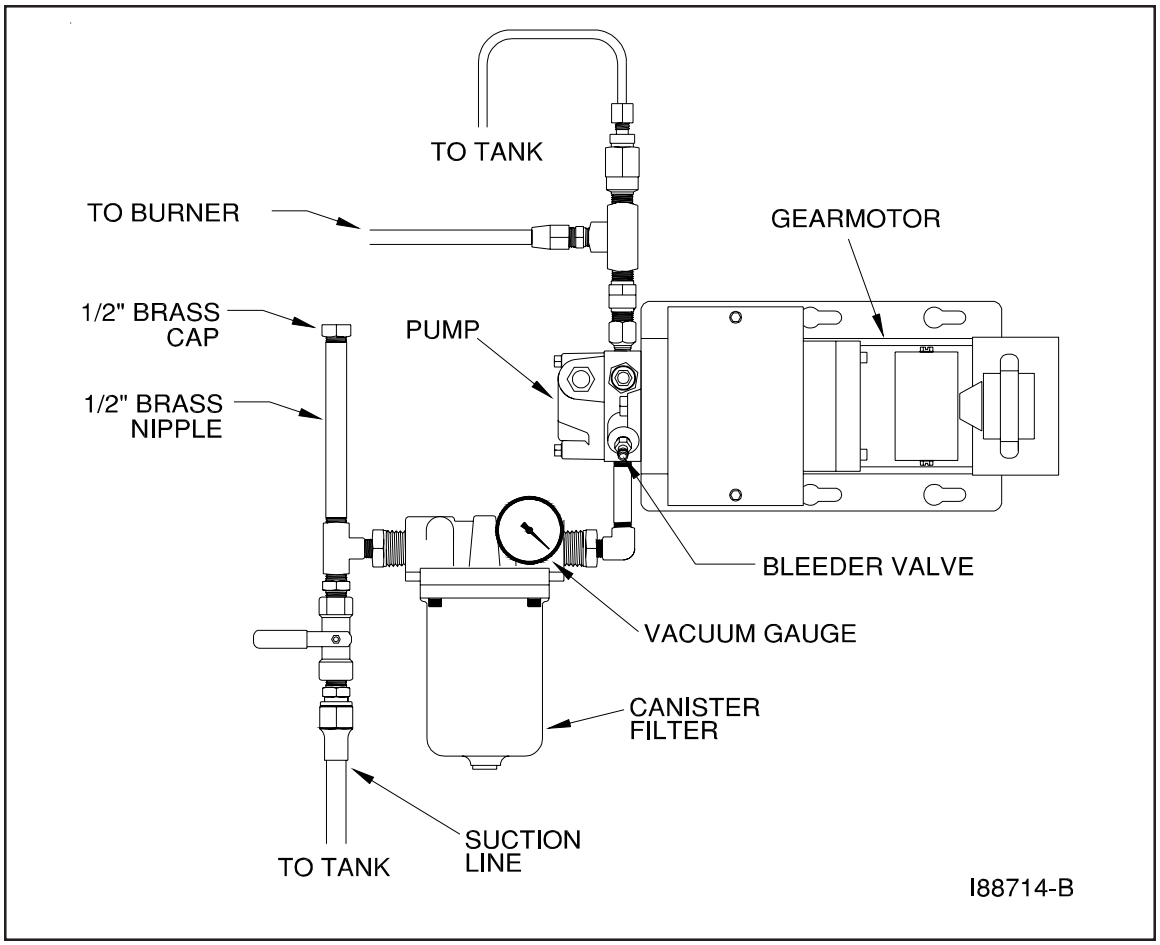


Figure 5C - Priming the Metering Pump

Priming the Metering Pump (continued)

7. **Activating the Pump**

NOTE: The coil tube boiler features a priming switch which is mounted on the left-hand side of the electrical junction box on the front of the boiler cabinet. The priming switch has two positions:

- **PRIME (switch is in the UP position / orange indicator light is ON):** this is used only for pump priming. When the switch is in the UP position, the pump circuit is activated for priming. The pump will continue to run as long as the switch is in this position. The oil primary control circuit is de-activated so the burner cannot run while the switch is in the UP position.
- **BURNER (switch is in the DOWN position):** this is used for normal burner operation. When the switch is in the DOWN position, the burner controls the operation of the pump. The pump will only run while the burner is running.

a. Refer to Figure 5D to locate the priming switch.
b. Turn the priming switch to the UP position. The pump should immediately start running.
c. Run the oil pump until proper oil flow has been established and the oil lines have been completely flushed out. (The following steps provide specific instructions.)

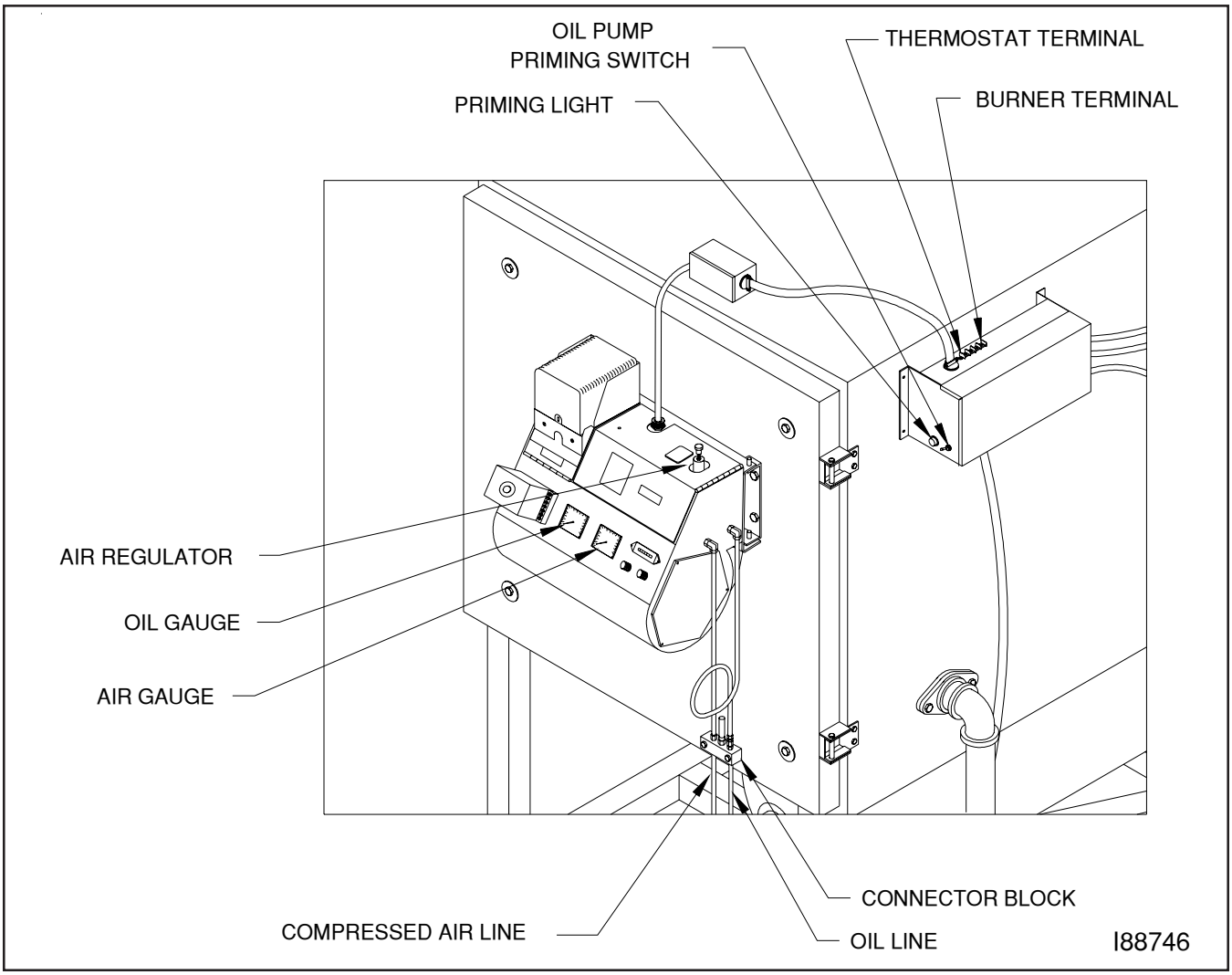


Figure 5D - Detail of Burner Connections/Components

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. Turn the priming switch to the DOWN position so that the pump stops running.
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. Turn the priming switch to the UP position. The pump should start running immediately .
13. Run the oil pump until the proper flow of oil has been established, and the oil line has been completely flushed out.
14. Turn the priming switch to the DOWN position so that the pump stops running.
15. Re-connect the oil line to the connector block.

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.
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.

Vacuum Testing the Oil Pump (continued)

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

ATTENTION: Before starting the burner, you must fill the coil tube boiler with water. Refer to Section 10 in this manual for more information on the hydronics system. ***DO NOT bypass the CTB controls to operate the burner!***

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 (LPH) of fuel to the burner.

FOR DUAL-STACKED UNITS ONLY: Clean Burn recommends that you complete burner startup and adjustment for one burner before starting the second burner.

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.

Preparing the Hydronics System for Burner Startup

The following procedure should be performed prior to burner startup to ensure that all key components of the hydronics system are functioning properly. Ensure that air is purged from the system. If the CTB circulator becomes air-bound, it will not produce sufficient flow to activate the flow switch, and the burner will not start properly.

1. Turn the load temperature controller (i.e. thermostat or aquastat) OFF.
2. Set the operating aquastat (on the CTB) at 71 to 93 °C (160 to 200 °F).

Preparing the Burner for Startup

1. If you have not already done so, disconnect one wire from the terminal block at the "thermostat" connection. (This prevents the burner from running.) A wiring diagram is provided in Appendix D.
2. Turn the main power to the CTB ON (the green power light on the burner should be 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 at least 48 °C (120 °F).

   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.

(Continued)

Preparing the Burner for Startup (continued)

4. Refer to Figure 6A. Loosen the locking nuts on the air regulator.
5. Turn the adjustment knobs on the air regulator counterclockwise until 13 mm (1/2") of the threads on the knob are exposed. DO NOT back the knob all the way out. **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**
   Rotate the combustion air band to adjust it to the appropriate slot opening as listed in the following **Initial Adjustment Charts**. Use a ruler to accurately set the slot opening at the widest section of the slot.

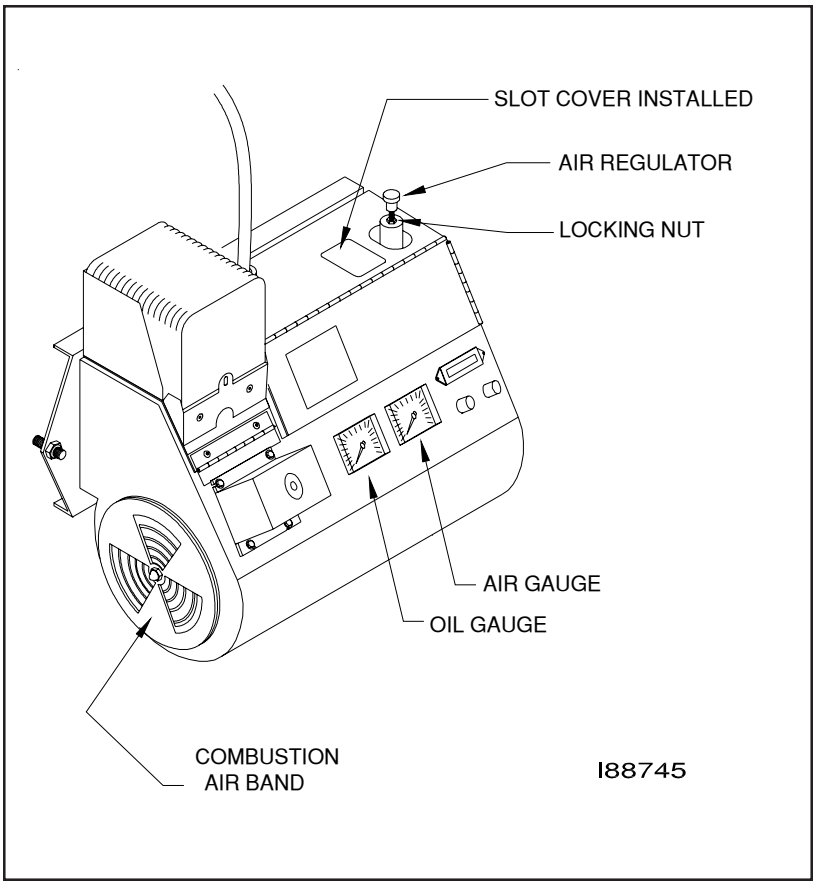


Figure 6A - Component Detail of the CB-500 Series Burner

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.

IMPORTANT NOTE: 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 charts 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.***

Initial Adjustments for CB-200-CTB

NOTE: Only Gearmotor part #33530 may be used with the CB-200-CTB.

Maximum Input = 59 KW (200,000 BTUH) @ 5.3 LPH (1.4 GPH) *per* CB-500 Series Burner

Oil Type	Oil Pressure/Flame Length	Air Bar	(PSI)	Air Band	Nozzle
#2 Fuel Oil*	***check flame length***	0.8-1.1	(12-16)	10 mm (3/8")	9-5
Used Crankcase Oil	***check flame length***	0.8-1.1	(12-16)	10 mm (3/8")	9-5
Used ATF	***check flame length***	0.8-1.1	(12-16)	10 mm (3/8")	9-5
Used Hydraulic Oil	***check flame length***	0.8-1.1	(12-16)	10 mm (3/8")	9-5
#4 and #5 Fuel Oils	***check flame length***	0.8-1.1	(12-16)	10 mm (3/8")	9-5

Preparing the Burner for Startup (continued)

Initial Adjustments for CB-350-CTB
NOTE: Only Gearmotor part # 33436 may be used with the CB-350-CTB.

Maximum Input = 103 KW (350,000 BTUH) @ 9.5 LPH (2.5 GPH) *per* CB-500 Series Burner

Oil Type	Oil Pressure/Flame Length	Air Bar	(PSI)	Air Band	Nozzle
#2 Fuel Oil*	***check flame length***	0.8-1.1	(12-16)	12 mm (1/2")	9-5
Used Crankcase Oil	***check flame length***	0.8-1.1	(12-16)	12 mm (1/2")	9-5
Used ATF	***check flame length***	0.8-1.1	(12-16)	12 mm (1/2")	9-5
Used Hydraulic Oil	***check flame length***	0.8-1.1	(12-16)	12 mm (1/2")	9-5
#4 and #5 Fuel Oils	***check flame length***	0.8-1.1	(12-16)	12 mm (1/2")	9-5

* If you are burning light viscosity oils such as #2 fuel oil, it may be necessary to install a smaller nozzle. Call your Clean Burn dealer for more information.

Starting the Burner

1. Re-connect the control wire. Turn the aquastat to call for heat (to start the burner).
   If the burner refuses to start, review the ***Preparing the Burner for Startup*** procedure. If, after repeating this procedure, the burner still refuses to start, check the following system components for proper functioning:
   - Verify that the red wire (per the burner wiring diagram) is energized to 230VAC.
   - Reset the hi-limit switch.
   - If the flow switch is not closing, the circulator is air-locked. Air must be purged from the system.
   - Verify that the prime switch (on the control box) is set to RUN (DOWN position).

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 you 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.

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.

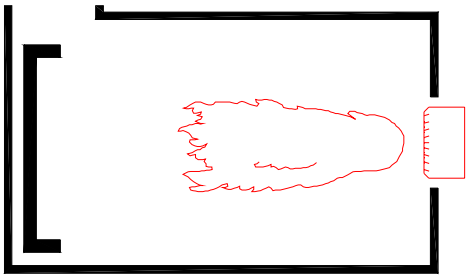
CAUTION
WHEN OPENING INSPECTION PORT

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

Starting the Burner (continued)

Correct Maximum Flame Adjustment (Proper Oil and Air Pressure)

- Flame goes half of the way down the combustion chamber.
- Flame does not touch back of 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

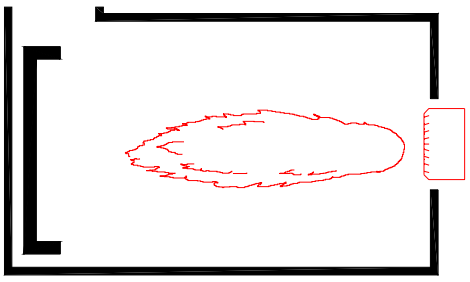


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Figure 6B - Flame Length Adjustment

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

Starting the Burner (continued)

6. **Checking for Proper CTB System Operation:**
   Observe the boiler temperature and water pressure.
7. After the burner stops running when the operating aquastat set temperature is reached, check the following:
   - air has been purged from water lines
   - water pressure is satisfactory (i.e. not greater than 1.5 bar (22 psi); normal pressure is 0.8 bar (12 psi)
   - all system controls functioning properly
8. Reset the operating aquastat to the normal operating range; 82 - 93 °C (180 - 200 °F) and repeat steps 6 and 7, observing the CTB operation.
9. Reset the load temperature controller (i.e. thermostat or aquastat) to the normal operating temperature.
10. As the CTB temperature drops, the burner will start running. Continue observing the CTB operation through several burner ON/OFF cycles to ensure proper system performance.
11. **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 3 mm (1/8") to 6 mm (1/4"), and re-check the flame for the proper characteristics.
    - Re-check the flame after five minutes. You should see a yellow-white flame with sharp tips and no "sparkles", and the flame should extend half of the way down the combustion chamber.
12. **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
    - For the CB-350-CTB adjust for a CO_2 reading of 8 to 10% or an O_2 reading of 9 to 7%
    - For the CB-200-CTB adjust for a CO_2 reading of 9 to 11.7% or an O_2 reading of 8 to 5%
    - Cad cell reading of 200 to 500 ohms

    NOTE: On the CB-200-CTB the flame can not be observed through the inspection door. The CB-200-CTB must be adjusted with instruments for proper combustion. Obtain the above settings by adjusting the air band 10 mm (3/8") to 13 mm (1/2"). The metering pump will deliver a constant oil flow and set the flame length.

SECTION 7: RESETTING THE OIL PRIMARY CONTROL

Understanding the Danfoss Oil Primary Control (CB-200-CTB)

The oil primary control will shut the oil pump and oil solenoid off when it detects flame-out during burner operation. The oil primary control will then wait approximately 15 seconds (while the burner motor, air solenoid, and transformer are energized) 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 lock-out. 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.*

Resetting the Danfoss Oil Primary Control (CB-200-CTB)

DANGER! DO NOT reset the oil primary control if oil mist is present in the combustion chamber or when the combustion chamber is hot! DO NOT operate your CTB if excess oil, oil vapor or fumes have accumulated in or near your boiler. As with any oil burning appliance, improper operation may result in a fire or explosion hazard.

1. Refer to Figure 7A.
2. Allow 5 to 10 minutes for all fuel mist to exhaust from the combustion chamber.
3. If the combustion chamber is hot, allow the boiler to cool for at least 30 minutes. DO NOT push the reset button.
4. When you are sure that all fuel mist has cleared and the boiler has cooled, push in and hold the reset button for three seconds, then release. This will reset the control at any time during its operation.
5. If the burner will not restart, call your Clean Burn dealer immediately.

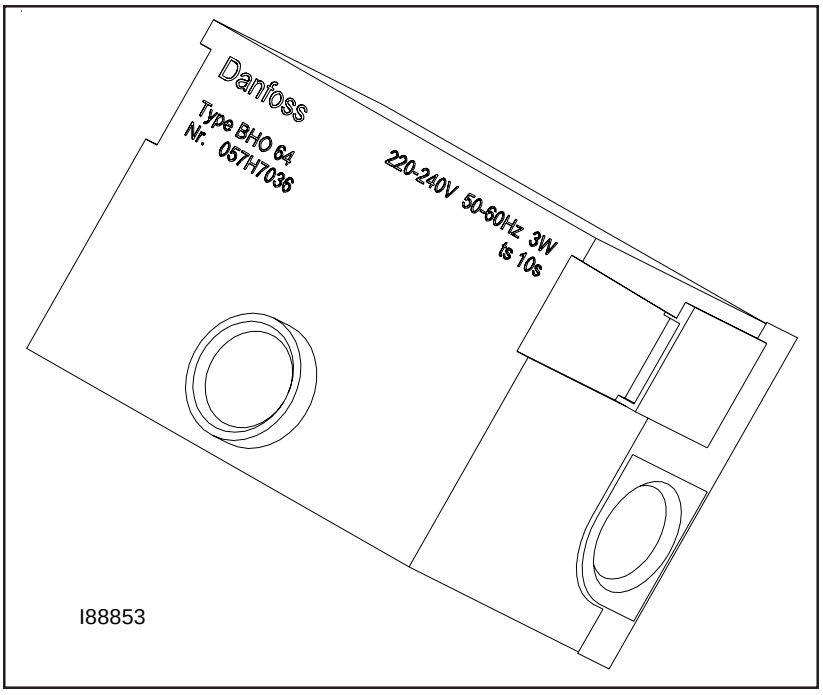


Figure 7A - Danfoss Oil Primary Control CB-500-CE-5W Burner (CB-200-CTB)

Understanding the Honeywell Oil Primary Control (CB-350-CTB)

The oil primary control will go into safety lock-out and shut the burner off when it detects flame-out during burner operation. 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.*

Resetting the Honeywell Oil Primary Control (CB-350-CTB)

DANGER! DO NOT reset the oil primary control if oil mist is present in the combustion chamber or when the combustion chamber is hot! DO NOT operate your CTB if excess oil, oil vapor or fumes have accumulated in or near your boiler. As with any oil burning appliance, improper operation may result in a fire or explosion hazard.

1. Refer to Figure 7B.
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 that all fuel mist has cleared and the boiler has cooled, push in and hold the reset button for three seconds, then release. This will reset the control at any time during its operation.
5. If the burner will not restart, call your Clean Burn dealer immediately.

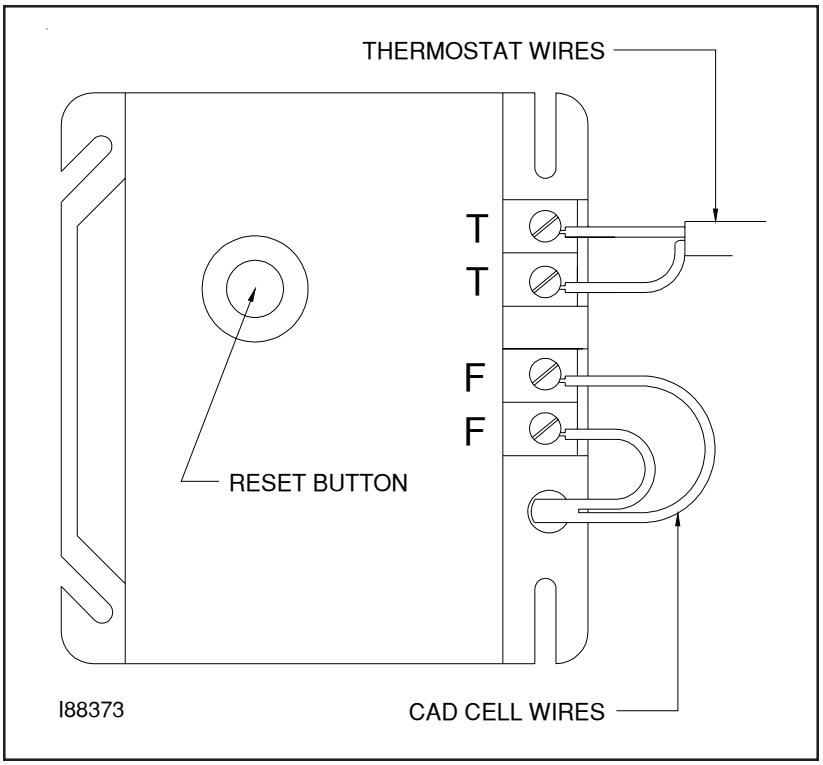


Figure 7B - Honeywell Oil Primary Control CB-551-CE Burner (CB-350-CTB)

ATTENTION: It is very important that the "F" and "T" terminals of the Oil Primary Control are wired exactly as shown in Figure 7A. NEVER connect jumper wires to these terminals or severe damage may occur to the Oil Primary Control.

SECTION 8: ADJUSTING THE DRAFT OVER FIRE

Understanding the Importance of Draft

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

Checking for Correct Draft Over Fire

NOTE: Your coil tube boiler is equipped with an observation/draft reading port to check draft over fire. *A qualified serviceman with proper equipment must adjust your CTB 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.
2. Adjust the barometric damper to achieve the *required draft over fire of -0.02 w.c.* (water column).
3. Record the reading in the Maintenance Record located in the Appendixes.
4. If correct draft over fire cannot be achieved, contact your Clean Burn dealer immediately.
   ATTENTION: Only operate your CTB with a draft over fire of -0.02 w.c. Poor draft results in back pressure and poor burner performance. DO NOT operate your CTB with a draft over fire greater than -0.04 w.c.; an abnormally high stack temperature may result from a draft over fire that is too high.

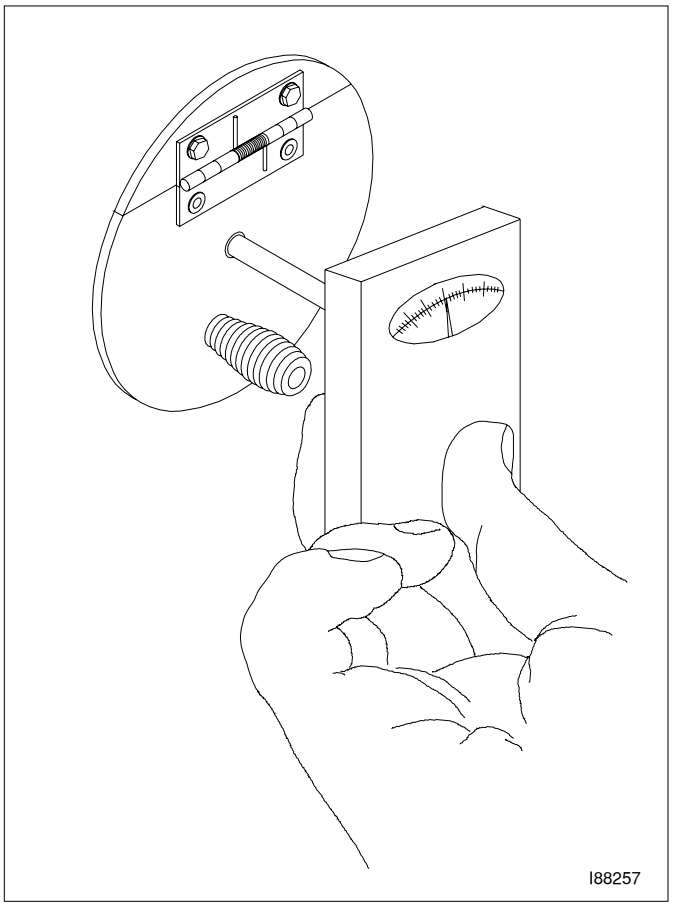


Figure 8A - Checking for Proper Draft Over Fire

ATTENTION: Backdraft must be resolved or your boiler 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.

Checking for Correct Draft Over Fire (continued)

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.
- Incorrect combustion air band setting on the burner. (See Section 6.)
- Boiler flues are plugged with ash. (See Section 9.)
- Improper seal on clean-out door on back panel. (See Section 9.)
- Exhaust fans in your building are sucking gases down the stack.

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.)

If there is insufficient make-up air, the exhaust fan will suck air and combustion gases down the coil tube boiler stack and create backdraft in the boiler. After the burner is shut down, the backdraft may suck the residual heat out of the combustion chamber and into the burner causing damage to the burner. Even if the exhaust fan is on another level of the building or in another room away from the boiler, the exhaust fan will still create backdraft at the boiler.

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.

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 coil tube boiler 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 boiler and burner will occur. 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.

Correcting Backdraft

The CTB system designer/installer must ensure that there is the proper amount of combustion air in the boiler/mechanical room.

Combustion Air is the required amount of air that the equipment needs to permit the satisfactory combustion of oil, the proper venting of combustion gases, and to maintain a safe ambient temperature within the space at safe limits under normal conditions of use.

The following requirements should be followed for proper supply of combustion air:

Units located in confined spaces (units in a boiler room/mechanical room) must have two (2) permanent openings, one near the top of the enclosure and one near the bottom of the enclosure - as follows:

1. If all of the air is taken directly from the outside of the building by use of vertical ducts - must have a total free area of not less than 225 cm^2 (35 in^2) per gallon of oil of the total appliance(s) input rating
2. If all of the air is taken directly from the outside of the building by use of horizontal ducts - must have a total free area of not less than 450 cm^2 (70 in^2) per gallon of oil of the total appliance(s) input rating
3. If all of the air is taken directly from inside of the building - must have a total free area of not less than 900 cm^2 (140 in^2) per gallon of oil of the total appliances(s) input rating

NOTE: An optional draft inducer (according to local codes only) may be added to help correct backdraft.

CAUTION: Under no circumstances should the equipment room ever be under a negative pressure. Look for exhaust fans, compressors, air handling units, or anything else that may take air away from the boiler. Also look for chemical fumes, solvents, refrigerants, etc. that may be in use around the boiler and cause damage to it.

SECTION 9: MAINTENANCE

Understanding Maintenance

Maintaining your Clean Burn CTB is an important activity which includes several periodic maintenance activities and an annual burner tune-up...all are necessary to keep your boiler running in peak condition.

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

The following chart summarizes all the maintenance activities which should be performed on the CTB at the intervals indicated. Instructions/procedures for these activities are included in this chapter.

Maintenance Activity	Interval
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 oil tank	At least once a year
Cleaning out ash CB-200-CTB*	Approx. every 750 hrs. per burner hour meter
Cleaning out ash CB-350-CTB*	Approx. every 1000 hrs. per burner hour meter
Checking boiler water condition	Periodically by qualified water treatment company
Annual burner tune-up	At least once a year

*It is very important to clean the ash from the CTB on schedule. Normal use of the boiler requires clean-out at least twice during the heating season. Heavy, around-the-clock usage requires more frequent clean-out (e.g. one month of continual running of the boiler is 720 hours).

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

Annual Preventative Maintenance and Burner Tune-up

The Clean Burn CTB requires annual preventative maintenance. The burner also requires an annual 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 maintenance for your boiler. Various levels of service are provided to fit your particular need. This work is usually performed during the warm-weather months to prepare the boiler for the next heating season.

Cleaning the Canister Filter

ATTENTION: Never operate the oil pump with more than 10" HG of vacuum on the vacuum gauge. High vacuum on the suction side of the pump separates air from the oil (cavitation) and will cause the burner to shut down.

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, remove the canister bowl, and filter element. Now pour the oil into the container.
4. Clean the filter element and the bowl in a parts washer.
5. Referring to Figure 9A, check the condition of the O-rings. Replace any that are cracked or worn.
6. Ensure that the canister filter is 100% airtight by firmly tightening the four bolts.
7. Open the ball valve. Refer to Sections 5 and 6 for instructions on priming the pump and starting the burner.

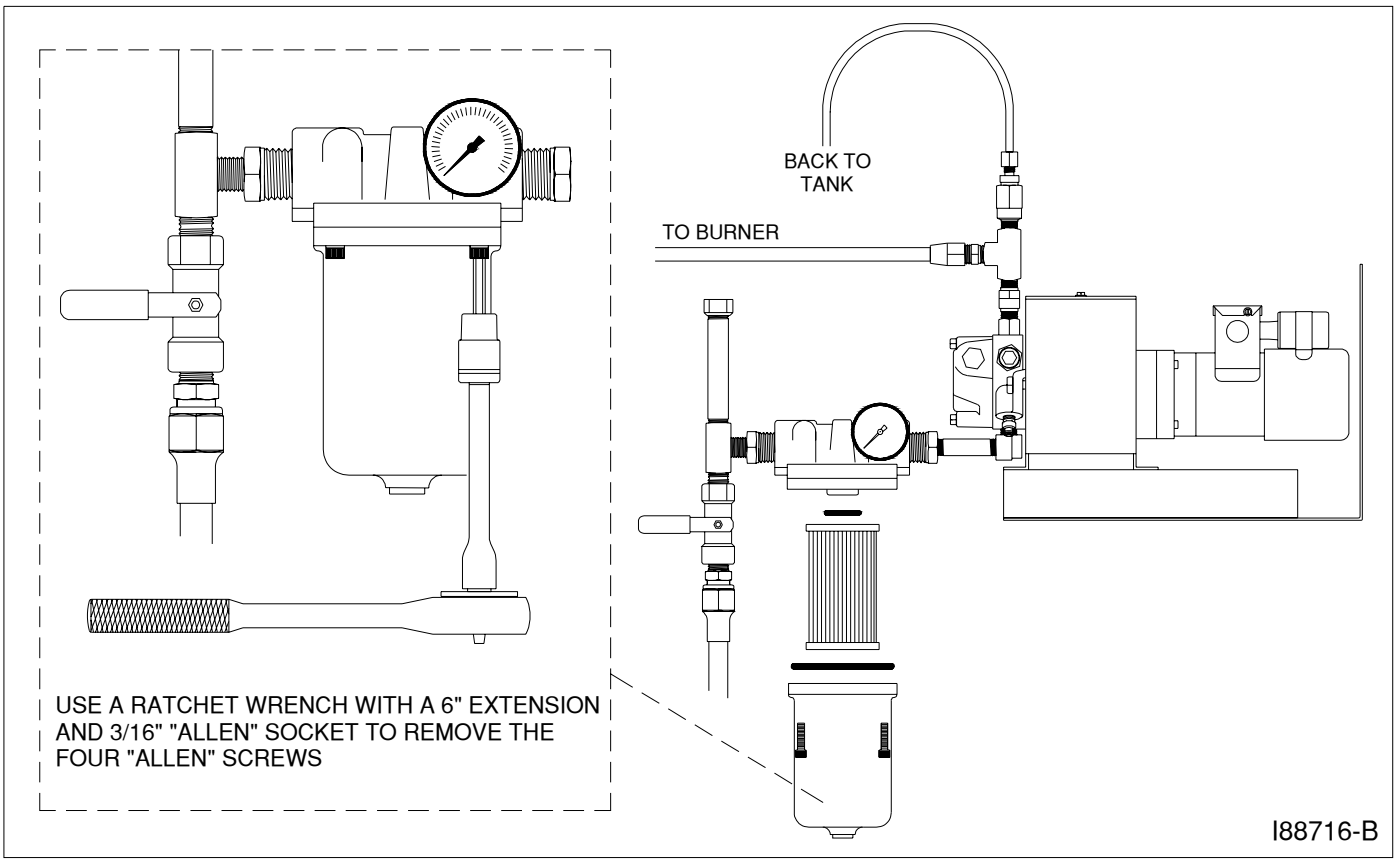


Figure 9A - Canister Filter Component Detail

Servicing the Metering Pump

1. Refer to Figure 9B.
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.

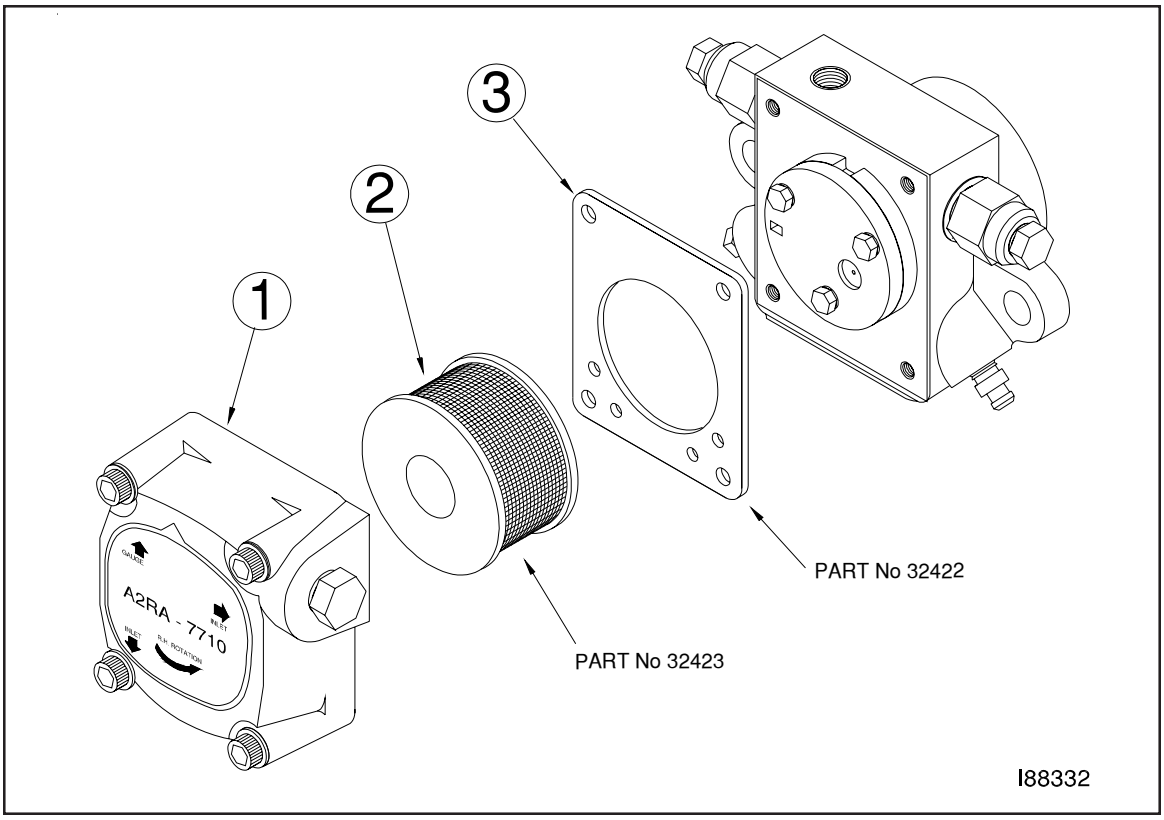


Figure 9B - Servicing the Metering Pump

Cleaning the Check Valve / Screen

This procedure applies to coil tube boiler 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 9C. 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.

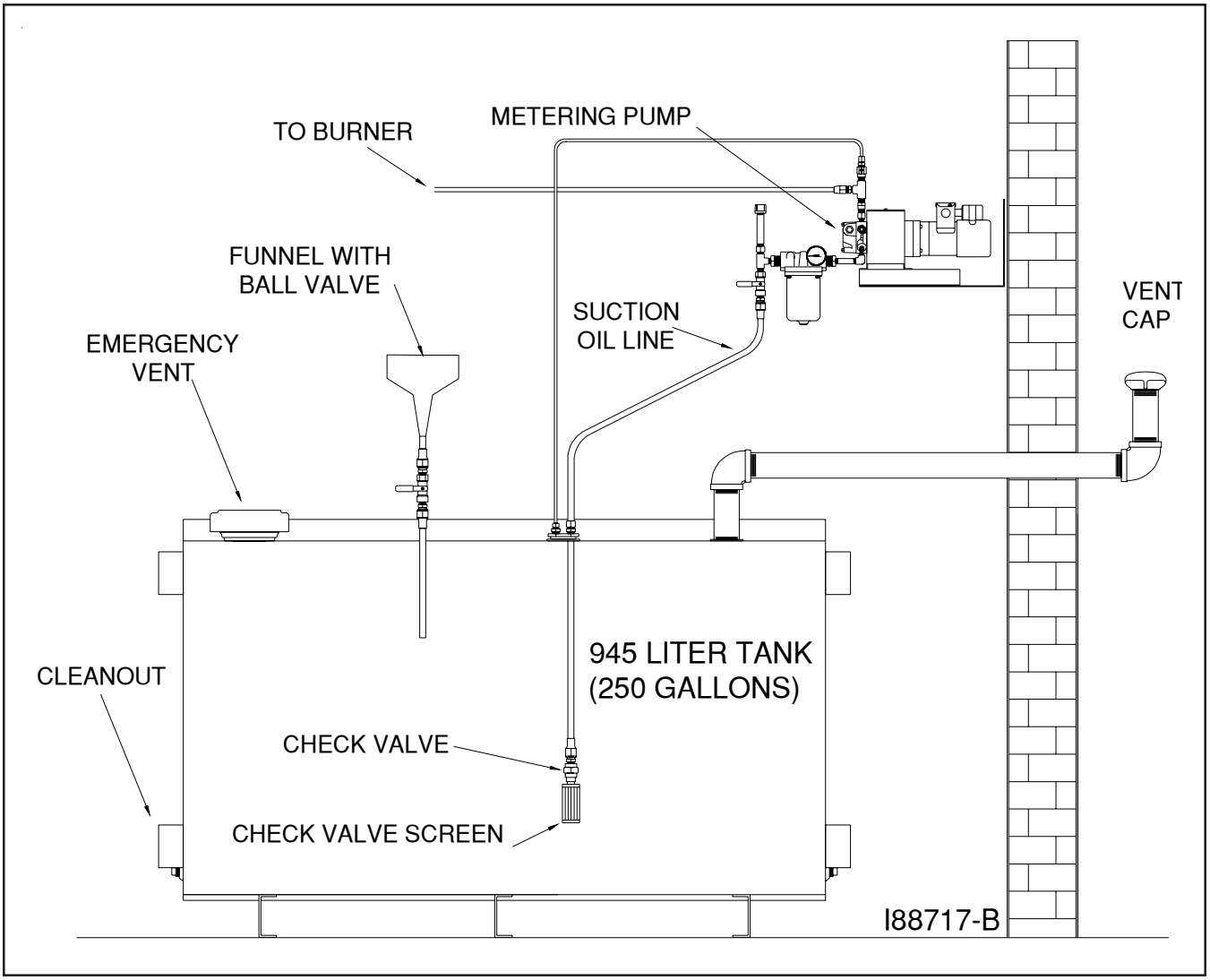


Figure 9C - Check Valve Detail

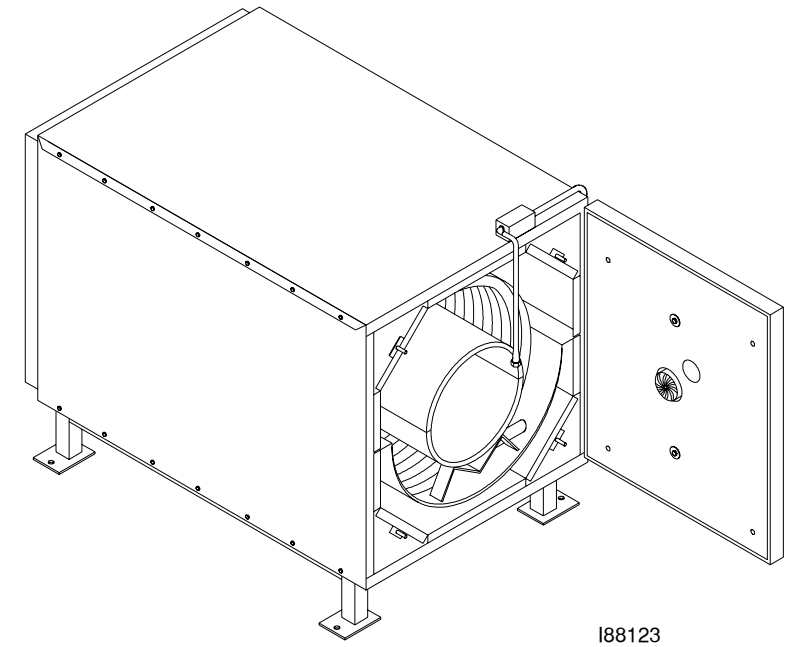
Cleaning the Ash from the Coil Tube Boiler

ATTENTION: Your CTB may require frequent clean out of the ash due to contaminants in the oil or heavy use. As ash accumulates, CTB heat output declines, and the stack temperature rises. 3 mm (1/8") of ash has the insulating capacity of 2.5 cm (1") of fiberglass insulation and reduces heat transfer significantly. Never allow more than 6 mm (1/4") of ash to accumulate in the combustion chamber heat exchanger flues or stack.

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

- Respirator for fine particles
- Rubber gloves
- Safety goggles
- Protective clothing

1. Ensure that power has been turned OFF, and all "hot" components have been allowed to cool sufficiently. Shop air should be turned OFF and disconnected. Allow at least one hour for the ceramics to cool.
2. Clean the ash from the combustion chamber (see Figure 9D):
   a. Bleed-down pressure on the air and oil lines by slightly loosening the fittings at the bottom of the connector block.
   b. With air and oil pressure completely bled off, disconnect the air and oil pressure lines from the bottom of the connector block. **NOTE:** Cover these lines to keep dirt from entering the air/oil supply.
   c. Remove the lock nuts on the clean-out door.
   d. Carefully swing open the clean-out door to expose the coiled heat exchanger, flue passages, and the combustion chamber.
   e. Remove the two ceramic sleeve half-pieces from the combustion chamber, and remove the supporting ceramic stand pieces.
   f. Use a wire or bristle brush to thoroughly clean out the ash from the combustion chamber and flue passages.
   g. While cleaning out the combustion chamber, also check the burner retention head and throat. Carefully clean these elements.



ATTENTION: When cleaning the combustion chamber, ensure that you do not gouge or damage the refractory material on the inside of the clean-out door and target wall. DO NOT bump or bend burner components while cleaning the combustion chamber.

Figure 9D - Accessing the Combustion Chamber for Cleaning

Cleaning the Ash (continued)

(2.) h. Thoroughly vacuum any remaining ash residue from the flue passages. A long wand on the hose of your shop vac is helpful in reaching all the way back.

i. Inspect the combustion chamber and its components to ensure that it is in good condition. Inspect the inside of the clean-out door and target wall. Make sure the refractory material on the inside of the door is in good condition, and the door seals tightly when closed. If the door does not seal tightly, replace any damaged components.

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, then vacuum out.
   d. Disconnect the stack from the CTB breach.
   e. Thoroughly vacuum out the back of the boiler, including the boiler breach (through the breach). If desired, the back panel can be removed for cleaning.

   ATTENTION: When handling the front door and rear panel, be careful that you do not damage the insulation seal surfaces. Two technicians may be required to remove and install the rear panel safely. The panel weighs approximately 39 Kg (85 lbs).
4. Reassemble the boiler components (ceramic stand, ceramic sleeve half-pieces, back panel, etc.) If necessary, refer to Section 3 for additional Assembly information.
5. Close the clean-out door, install and tighten the washer and nuts. Make sure that the clean-out door and rear panel close and seal properly. Reconnect all disconnected lines (oil and air) on the bottom of the connector block.

   NOTE: You may need to bleed air from the oil line before starting the burner. See Section 5 for pertinent instructions.

Cleaning the Oil 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.

End of Season Maintenance

Turn main power to your coil tube boiler OFF at the end of the heating season. Environmental regulations allow your used oil to be burned only for "heat recovery." DO NOT operate your boiler during warm weather just to burn oil. ***Contact your local Clean Burn dealer to schedule your annual burner tune-up. Allow only trained, authorized service personnel to service your burner.***

In the "off" season after the boiler has been cleaned, spray the combustion chamber with a light coat of oil to reduce corrosion caused by moisture in the air.

NOTE: If the CTB is not used during the cold-weather months, it must be protected to prevent damage from freezing temperatures.

SECTION 10: THE CTB HYDRONIC SYSTEM

Understanding the CTB Hydronic System

The Clean Burn Coil Tube Boiler (CTB) is designed to function as a low-mass boiler (i.e. it will not maintain boiler water temperature when there is no call for heat). ***Low-mass boilers require that a sufficient, constant flow of water be maintained through the coil*** in order to: (a) remove the heat from the boiler when the burner is firing AND (b) prevent the flow switch from shutting off the burner.

IMPORTANT NOTE: When designing the system layout and application for your CTB, keep in mind that it is NOT suitable for open systems. The Clean Burn CTB has been designed to operate as a closed loop boiler system. Potable water heating (i.e. for domestic or washing purposes) can be accomplished by incorporating a heat exchanger into the system.

Special Safety Guidelines for the Design and Installation of Hydronic Systems

Adhere to the following ***Safety Guidelines*** when designing and setting up the CTB hydronics system:

- The CTB must be installed on non-combustible flooring.
- The CTB must be installed in accordance with national, state, and local plumbing, heating, and electrical codes and the regulations of the serving utilities which may differ from this manual. Authorities having jurisdiction should be consulted before installations are made. In all cases, reference should be made to all aplicable standards.
- The heating system must be designed by a competent hydronics contractor, and only persons knowledgeable in the layout and installation of hydronic heating systems should install this boiler.
- The boiler must be connected to an approved chimney in good condition. Serious property damage could result if the boiler is connected to a dirty or inadequate chimney. The interior of the chimney flue must be inspected periodically through the heating season for any obstructions. A clean and unobstructed chimney flue is necessary to allow noxious fumes that could cause serious injury to vent safely and will contribute toward maintaining the boiler's efficiency.
- It is the responsibility of the installing contractor to see that all controls are correctly installed and are operating properly when the installation is completed.
- To ensure optimum performance, qualified personnel must perform proper and timely maintenance on the CTB according to the procedures provided in Section 9 of this manual.

CTB System Function and Configuration

Water Flow and Temperature

The Clean Burn Coil Tube Boiler design requires continuous water flow through the boiler heat exchanger to ensure proper system operation. The boiler circulator must be capable of developing sufficient (head) pressure to overcome the resistance of the boiler plus the circulating system at the required flow rate. If the water flow through the boiler is too low, the flow switch will not allow the burner to operate. (Refer to Appendix A, as needed, for CTB system specifications.)

Heating systems using zone valves, zone pumps, or three-way valves may experience reduced water flow through the boiler. This condition can cause excessive water temperature rise and unstable boiler operation. The normal temperature rise across the boiler is 11 °C(20 °F). **Minimum operating temperature for the CTB is 71 °C (160 °F).** To avoid condensation, the return water temperature should not fall below 60 °C (140 °F).

System Pressure

The Clean Burn CTB is designed to operate in closed, pressurized hydronic systems. Certain levels of pressure are required for proper system operation--**a minimum of 0.8 bar (12 PSI) should be maintained on the system where the boiler supply water temperature is 93 °C (200 °F) or less.** If a higher working pressure is required, contact the Clean Burn Service Department for proper pressure requirements.

Sample System Configuration: Primary/Secondary Pumping System

A sample hydronic system setup using Clean Burn Coil Tube Boilers is shown in Figure 10A. This system, a ***Primary/Secondary Pumping System,*** allows for many special hydronic requirements (e.g. water return temperatures below the normal 60 °C (140 °F), variable flow zones, multiple zones, multi-temperature systems, and/or multiple boilers) and provides maximum flexibility while maintaining optimal system functioning. **A critical advantage of this type of system is that it dramatically reduces the danger of thermal shock to the boiler.**

In a Primary/Secondary Pumping System (as shown in Figure 10A), the primary loop circulator runs when any of the zones call for heat. In some system setups, the circulator may run continuously during the heating season. The circulator pushes hot water past the zone tees; any of the secondary zone pumps can draw hot water out of the first tee (as though the tee were a boiler). Each zone then returns cooler water through the second tee where it mixes with the hot water being pushed through by the primary loop circulator. **The close positioning of the two zone tees is crucial to the operation of the system; the tees must be at least 15 cm (6") but not more than 31 cm (12") apart.** This allows for circulators of different flow rates to be used in the same system while maintaining proper flow and functioning.

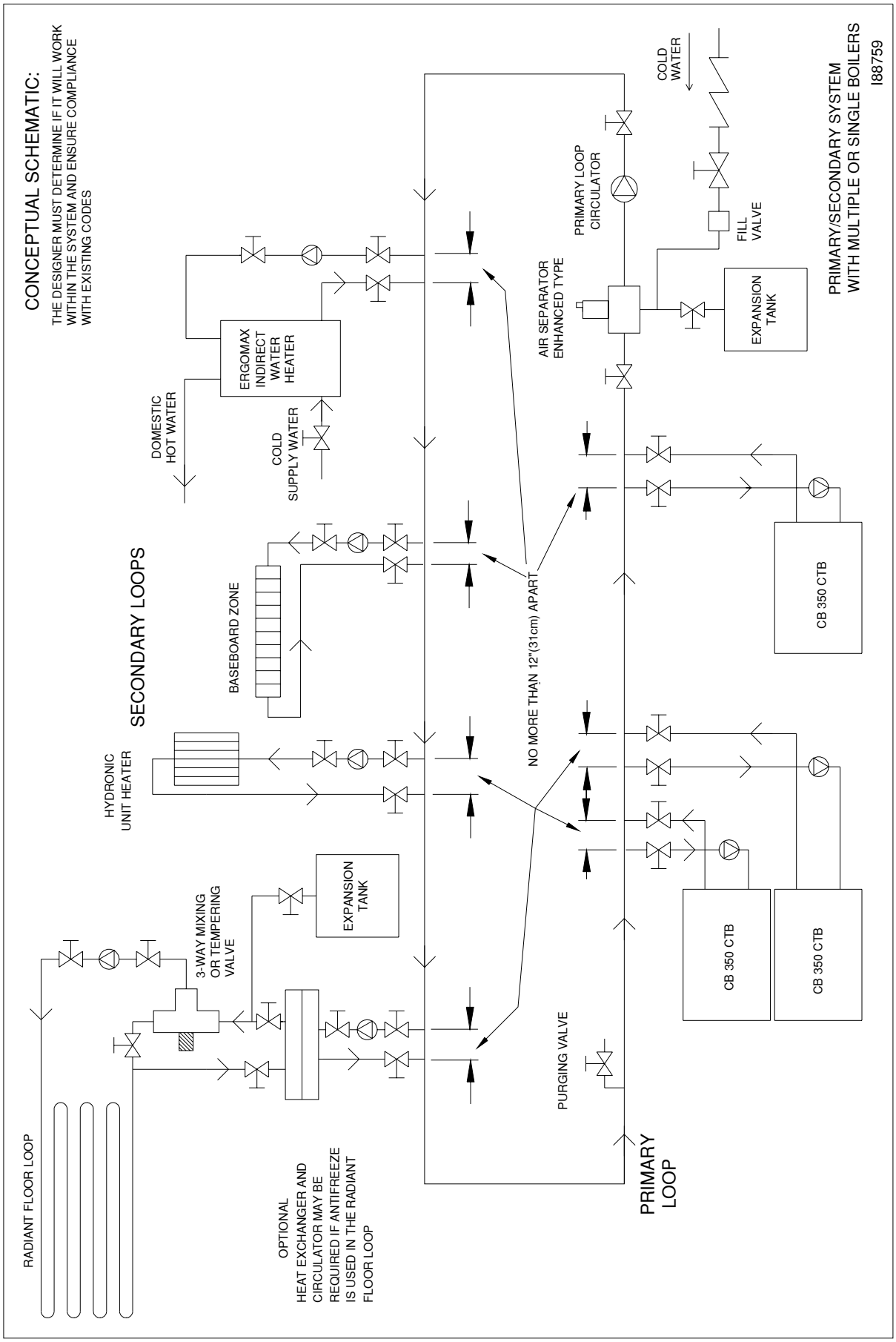


Figure 10A - Sample Primary/Secondary Hydronic System Diagram

CTB Setup Options

When designing and setting up the CTB Hydronic System, please be aware of the following options and special setup requirements:

(1) ***The optional circulator (which you may have ordered from Clean Burn for your CTB system) is sized to ensure a flow of water through the coil tube ONLY;*** it is NOT sized to be used as a system circulator. An additional circulator must be installed to flow water through the system and to the boiler.

(2) ***In low load conditions,*** Clean Burn recommends the installation of a larger storage tank next to the CTB to extend the run time and to reduce the occurrence of short cycling. Position the tank close to the boiler to reduce the required connective piping as shown in sample configuration, Figure 10B.

(3) ***If hot water is required in the system installation for washing or other related activities,*** Clean Burn offers **Ergomax Heat Exchangers/Storage Tanks in 182, 273, and 450 liter sizes (48, 72, and 119 gallon sizes)**. Contact your local Clean Burn representative for additional details on these CTB system components. Refer to Figure 10C for a sample system configuration using an Ergomax Heat Exchanger. This configuration is ideal for installations requiring pressure washing, car/truck washing, etc. The Ergomax unit works well with a CTB because it stores boiler water in the tank and acts as a buffer (tempering) tank while enabling reduction of short cycling.

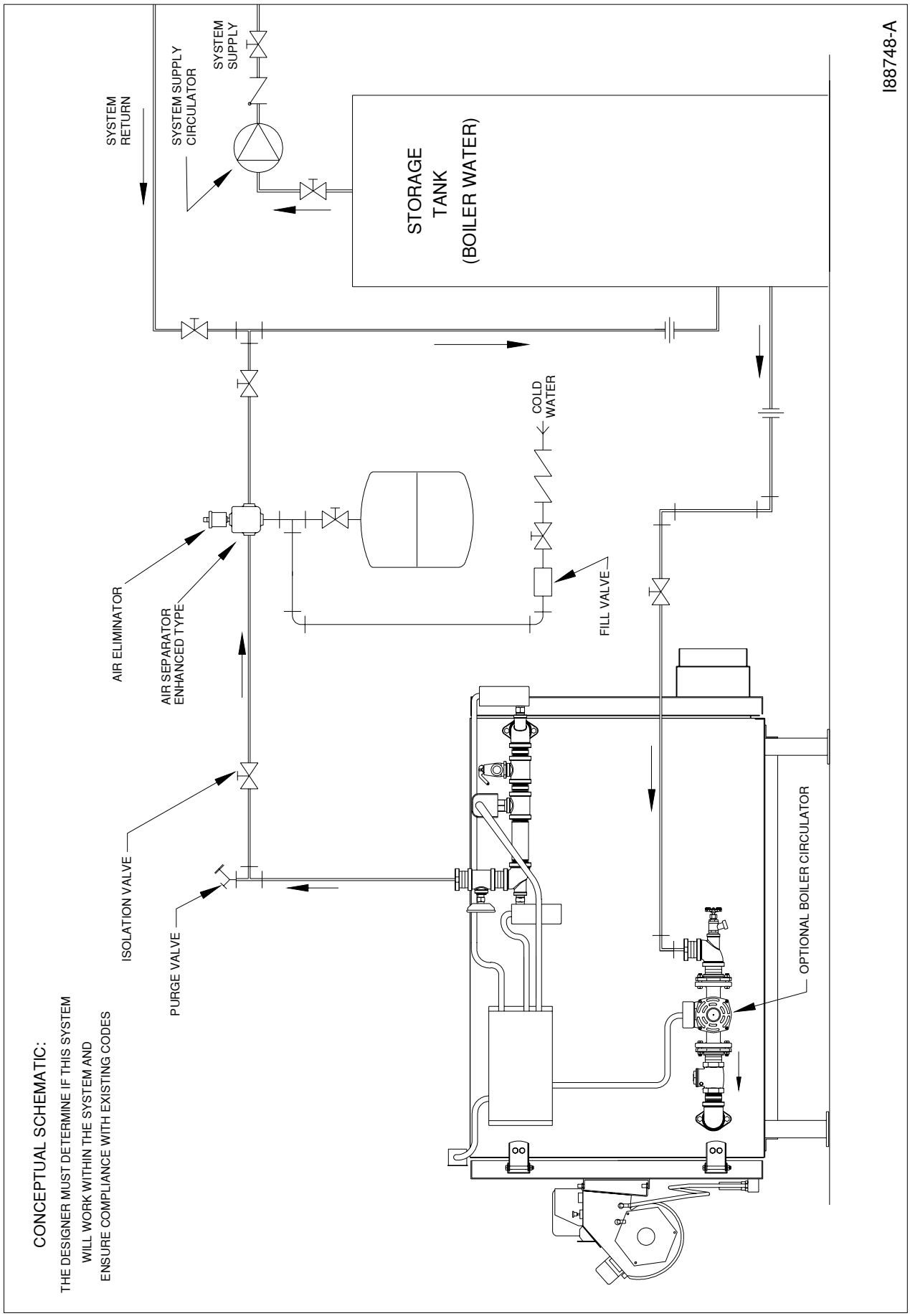


Figure 10B - Model CB-350-CTB with Additional Larger Storage Tank

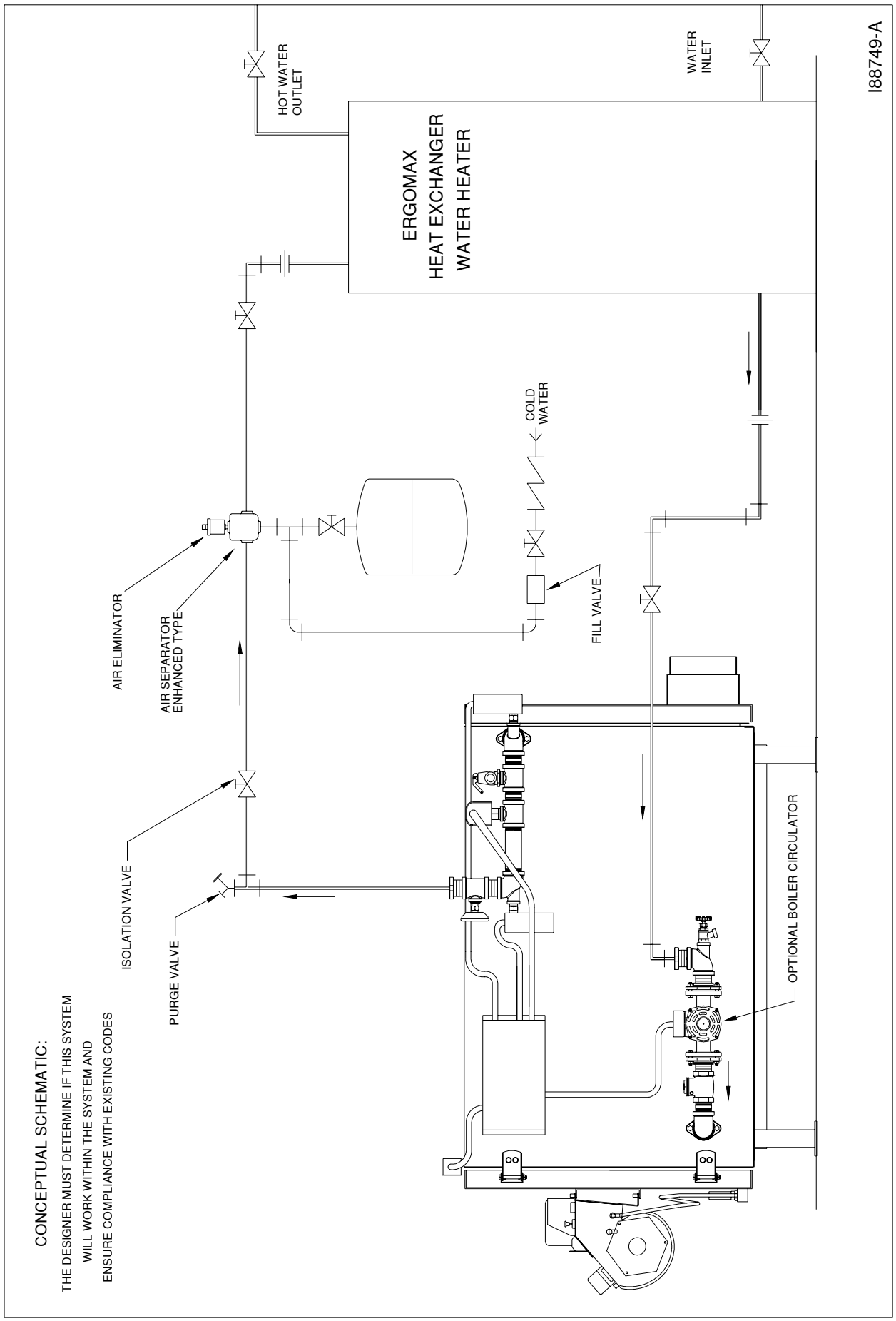


Figure 10C - CB-350-CTB with Ergomax Indirect Water Heater

Guidelines for CTB Setup and Operation

1. Refer to the appropriate illustration in this section for your CTB system configuration, as well as Figures 4A/4B in the Installation chapter.
2. Connect the supply and return piping to the heating system. (Additional information in Section 4).

CAUTION: Hot water pipes shall have clearances of at least 13 mm (1/2") from all combustible surfaces. For additional technical reference material, see I=B=R Installation and Piping Guide No. 200.

3. The relief valve must be installed with the spindle in the vertical position. The relief valve discharge pipe must be extended to within four inches of the floor or to a drain.
4. To reduce the amount of cold water returned to the boiler (and to protect the boiler from thermal shock), a return blend loop should be utilized.
5. Fill the entire heating system with water and vent air from the system according to the following instructions:
   (a) Close the isolation valve in the boiler supply piping.
   (b) Isolate all circuits by closing the zone valves or balancing valves.
   (c) Attach a hose to the purge valve located just below the isolation valve in the boiler supply piping.
   NOTE: Ensure that the end of the hose drains into a bucket located in a drain area or outside.
   (d) Starting with one circuit, open the first zone valve ONLY.
   (e) Open the purge valve.
   (f) Open the fill valve (the make-up water line should be located on the system side of the isolation valve in the boiler supply piping.)
   (g) Allow water to overflow from the bucket until discharge from the hose is bubble-free.
   ATTENTION: Air in the hose may cause the hose to "jump" and water to spray out; ensure that the area (and equipment nearby) is protected from any possible water damage.
   (h) Open the zone valve to the second zone to be purged, then close the first. Repeat this step until all zones have been purged, but always have one zone open. At completion, open all zone valves.
   (i) Close the purge valve, continue filling the system until the pressure gauge reads 0.8 bar (12 psi). Close the fill valve.
   NOTE: If the make-up water line is equipped with a pressure reducing valve, the system will automatically fill to 0.8 bar (12 psi).
   (j) Open the isolation valve in the boiler supply piping.
   (k) Remove the hose from the purge valve.
   (l) As soon as the boiler is filled, heat the water in the boiler to 82 °C (180 °F) to de-aerate the water.

Guidelines for Preventing Oxygen Contamination

ATTENTION: Oxygen contamination of boiler water will cause corrosion of iron and steel boiler components, and can lead to boiler failure (and void warranty). Causes of oxygen contamination include:

- Addition of excessive make-up water as a result of system leaks
- Absorption through open tanks and fittings
- Oxygen permeable material in the distribution system

To ensure optimal CTB maintenance and operation, follow these recommendations to eliminate damaging oxygen contamination:

- Repair system leaks to eliminate the need for the addition of make-up water
- Eliminate open tanks from the system
- Eliminate and/or repair leaky fittings
- Use non-permeable materials in the distribution system
- Isolate the boiler from the water heater system (i.e. wash and potable waters) by installing a heat exchanger.

Guidelines for Initial Cleaning of the Hydronics System and Maintaining Water Quality

- Clean the boiler with an alkaline cleaner (e.g. soda ash or detergent) as recommended by a qualified water treatment company.
  NOTE: This is necessary to remove oil or other coatings from the tube surfaces. These protective coatings are commonly applied to new tubes to prevent rusting during storage/ transit and will cause corrosion if left on the tubes during operation of the boiler.
- After cleaning the boiler, drain the system in a manner and to a location that hot water can be discharged safely.
- Remove plugs from all available locations, and wash the water side of the boiler as thoroughly as possible using a high-pressure water stream.
- Refill the system with fresh water.
- Test the pH of the water in the system. The pH should be higher than 8.5 but lower than 9.5. Add appropriate boiler water treatment compounds as recommended by your qualified water treatment company (if necessary) to bring the pH within the specified range.
- Heat the water in the boiler to 82 °C (180 °F) to de-aerate the water.

Guidelines for CTB Operation

After proper and safe CTB boiler setup and installation has been accomplished, CTB operation proceeds as follows:

(a) Refer to Section 6 for instructions on starting the CTB.
(b) Following burner startup, set the operating control dial at 82 - 93 °C (180 - 200 °F).

ATTENTION: If, during normal operation, it is necessary to add water to your system more than once a year, consult a qualified service technician to check your system for leaks. A leaky system will increase the volume of make-up water supplied to the boiler which can significantly shorten the life of the boiler and cause damage to the boiler.

APPENDIX A

Detailed Coil Tube Boiler Specifications

CTB Technical Specifications

Model	CB-200-CTB	CB-350-CTB
Maximum Input	59 KW (200,000 BTUH)*	103 KW (350,000 BTUH)
Listed Fuels	#2, #4, #5 fuel oils Used crankcase oil Used ATF Used hydraulic oil	#2, #4, #5 fuel oils Used crankcase oil Used ATF Used hydraulic oil
Water Volume	19 Liters (5 Gallons)	45 Liters (12 Gallons)
Cabinet Dimensions	L X W X H 102cm X 74cm X 75cm (40” X 29” X 29 ½”)	L X W X H 142cm X 86cm X 160cm (56” X 34” X 63”)
Overall Length (With Burner / Breach)	150 cm (59”)	188 cm (74”)
Approximate Weight	307 Kg (677 lbs) – dry	562 Kg (1240 lbs) - dry
Mounting	non-combustible floor	non-combustible floor
Electrical Requirements	230 Volts / 50 Hz	230 Volts / 50 Hz
Maximum Fuse Size	20 Amps**	20 Amps**
Approximate Amp Draw	9 Amps	10 Amps
Maximum Oil Consumption	5.3 LPH (1.4 GPH)	9.5 LPH (2.5 GPH)
Oil Pump	Suntec A2RA-7710	Suntec A2RA-7710
Oil Pump Motor	Bison Gear Motor 1/20 HP	Bison Gear Motor 1/20 HP
Pump Motor Rotation	CCW shaft end	CCW shaft end
Canister Filter	Lenz DH-750-100	Lenz DH-750-100
Stack Size	20 cm (8”)	20 cm (8”)
Approximate Air Compressor Requirements	0.06 CMM @1.7 bar 2.0 CFM @ 25 PSI	0.07 CMM @ 1.7 bar 2.5 CFM @ 25 PSI

* Nominal values; actual values will vary depending on installation.
** With optional accessories, 30 amps may be required.

Burner Technical Specifications

Model	CB-200-CTB	CB-350-CTB
Burner	CB-500-CE 5W	CB-551-CE
Ignition Transformer	Danfoss 14,000 Volts	Franceformer 14,000 Volts
Nozzle	Delavan 9-5	Delavan 9-5
Burner Motor	1/10 HP 2800 RPM With Centrifugal Switch	1/10 HP 2800 RPM With Centrifugal Switch
Burner Motor Rotation	CCW Shaft End	CCW Shaft End
Compressed Air Requirements	0.06 CMM @ 1.7 bar 2.0 CFM @ 25 PSI	0.07 CMM @ 1.7 bar 2.5 CFM at 25 PSI
Oil Primary Control	Danfoss	Honeywell
Heater Element in Preheater Block	450 Watts	450 Watts
Air Pressure Switch	MPL 808	MPL 808
Heater Thermostat	60 ^{o}C (140 ^{o}F)	60 ^{o}C (140 ^{o}F)

CB-200-CTB Hydronic Specifications

NOTE: These specifications apply for each CTB unit or coil.

- Water flow through the boiler: 57 LPM (15 GPM) at 6.0-6.7 m (20-22 ft.) of head (pressure)
- 11 ^{o}C (20 ^{o}F) temperature rise (ΔT)
- Coil length: 34 m (112 ft) long, 2.5 cm (1") diameter steel tubing made to Sch. 40 piping specs
- System operating pressure: 0.8 to 1.5 bar (12 to 22 psi)
- Standard relief valve setting: 2 bar (30 psi)
- Relief valve capacity: 550 MBH
- Heating surface: 3.6 m^2 (38.7 ft^2)

CB-350-CTB Hydronic Specifications

NOTE: These specifications apply for each CTB unit or coil.

- Water flow through the boiler: 95 LPM (25 GPM) at 5.5 m (18 ft.) of head (pressure)
- 11 ^{o}C (20 ^{o}F) temperature rise (ΔT)
- Coil length: 48 m (158 ft.) long, 3 cm (1-1/4") diameter steel tubing made to Sch. 40 piping specs
- System operating pressure: 0.8 to 1.5 bar (12 to 22 psi)
- Standard relief valve setting: 2 bar (30 psi)
- Relief valve capacity: 550 MBH
- Heating surface: 6.3 m^2 (68 ft^2)

CTB Accessories and Parts Reference

C.B. Part # 350-CTB	C.B. Part # 200-CTB	Description	
90187	90199	Boiler Stacking Adapter Kit	
90188	90200	Boiler Stand (base)	
35080		Circulator Flange Gasket O-Ring	
	35116	Flange, 1" NPT (set)	
35061		Flange, 1-1/2 NPT (set)	
35079		Flange, 1-1/4 NPT (set)	
35053		Flange Gasket, 3-hole	
28150		Operating Aquastat, L4006A	
35110		Electronic Low Water Cut-Off with Probe, 750P-MT-120	
35111		Probe (only) for Low Water Cut-Off	
28149		High Temperature Cut-off, L4006H	
33332		Flow Switch (without paddle)	
35106		1-1/2" Stainless Steel Paddle for Flow Switch (sized to fit)	
	35117	1-5/16" Stainless Steel Paddle for Flow Switch (sized to fit)	
33330		Temp-Pressure Boiler Gauge	
35048		Relief Valve, 2 bar (30 psi)	
35049		Well Immersion, 3/4" NPT	

Ergomax Indirect Water Heater (Heat Exchangers)

35096	E24, 98 liters (26 gallons)	
35097	E44, 182 liters (48 gallons)	
35098	E45, 182 liters (48 gallons)	
35099	E65, 273 liters (72 gallons)	
35100	E109, 450 liters (119 gallons)	
35107	Air Separator, EAS - 1-1/2	(1-1/2" piping with air vent)
35108	Air Separator, EAS -2	(2" piping with air vent)

Remote Temperature Controls

	33532	Wall Thermostat (CB-200-CTB)
33506		Wall Thermostat (CB-350-CTB)
33412		Two-Stage Remote Temperature Control (For Dual-Stacked Boilers)

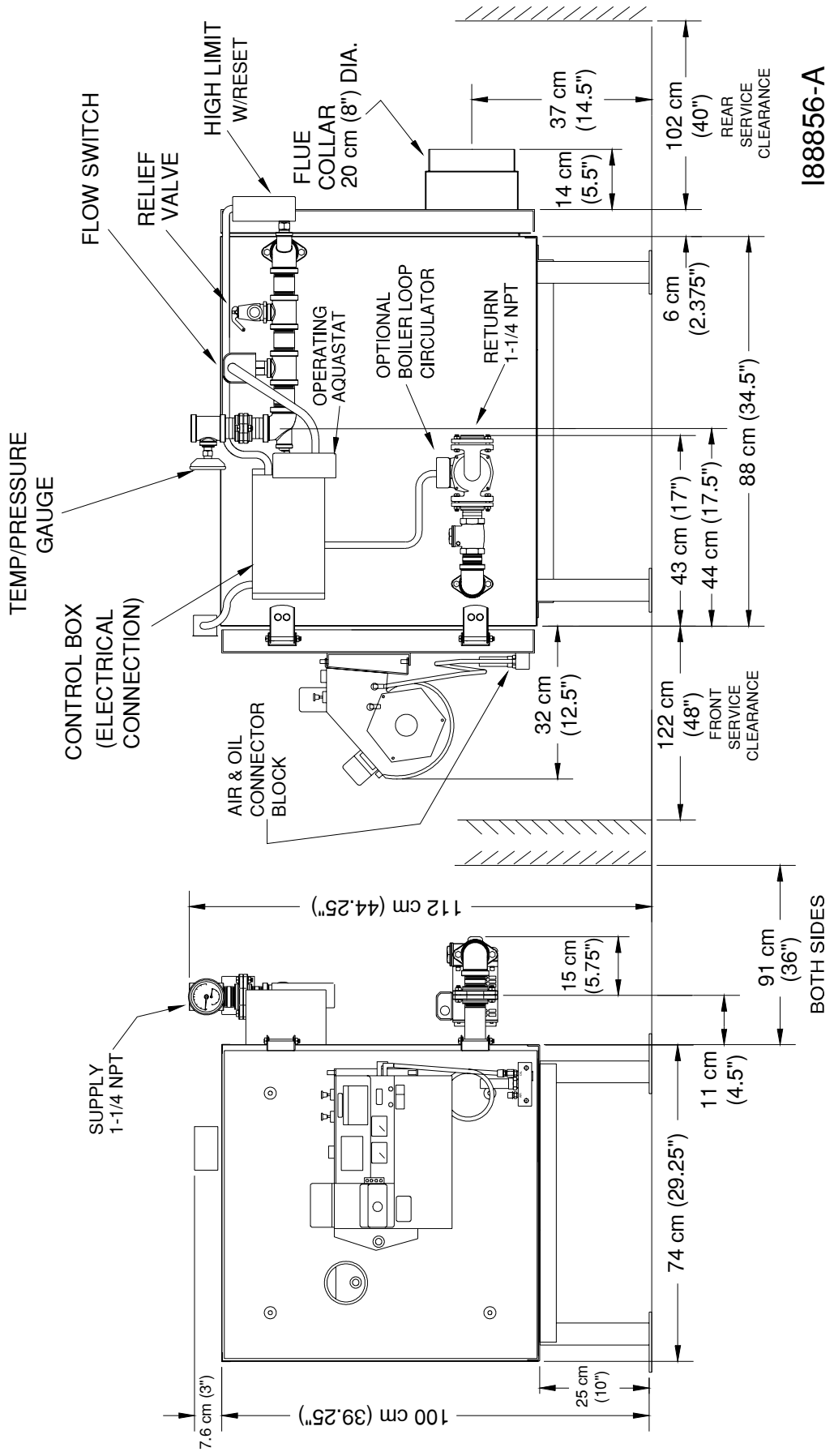


Figure A1 - Model CB-200-CTB Dimensions (Single Boiler)

CTB Dimensi

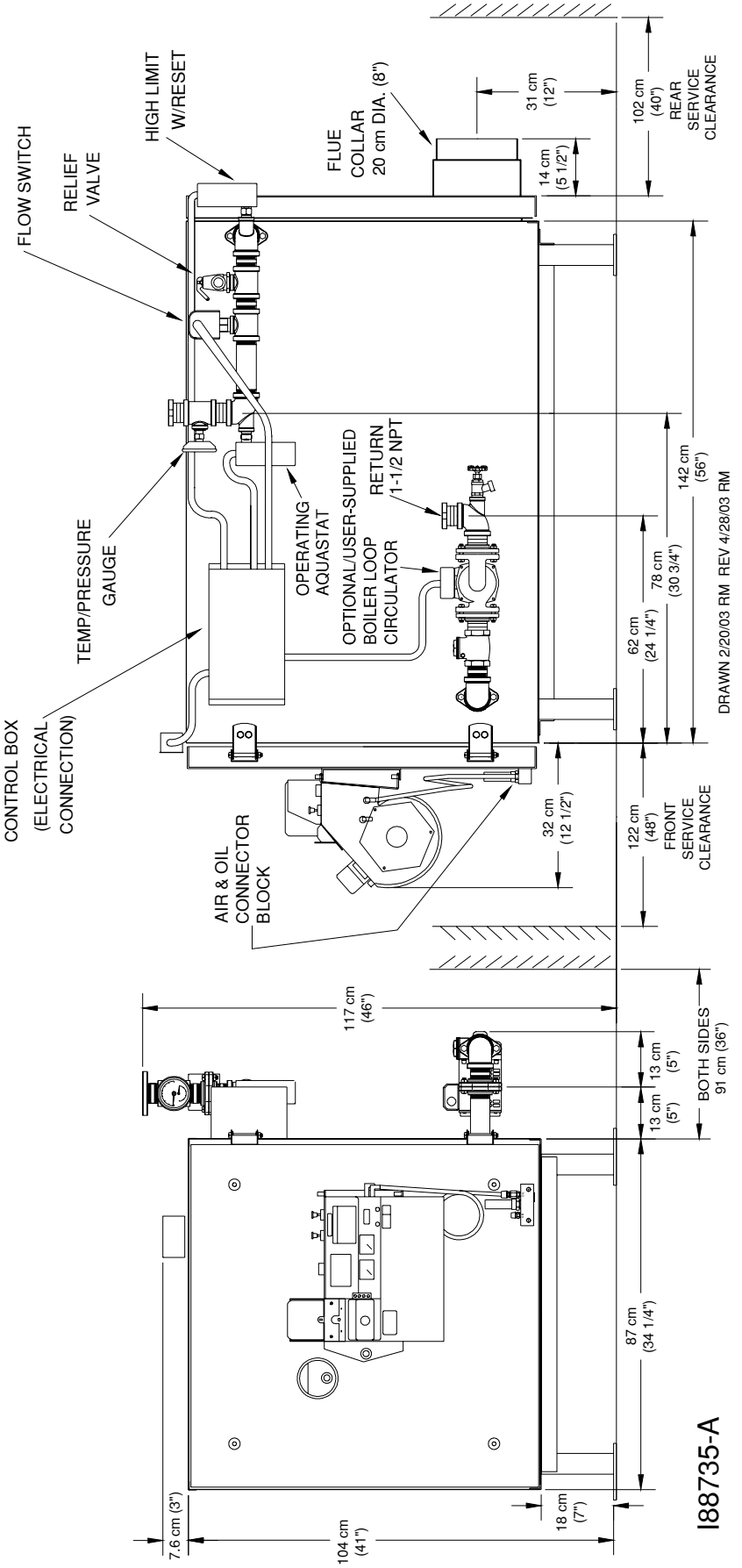


Figure A3 - Model CB-350-CTB Dimensions (Single Boiler)

CTB Dimensions

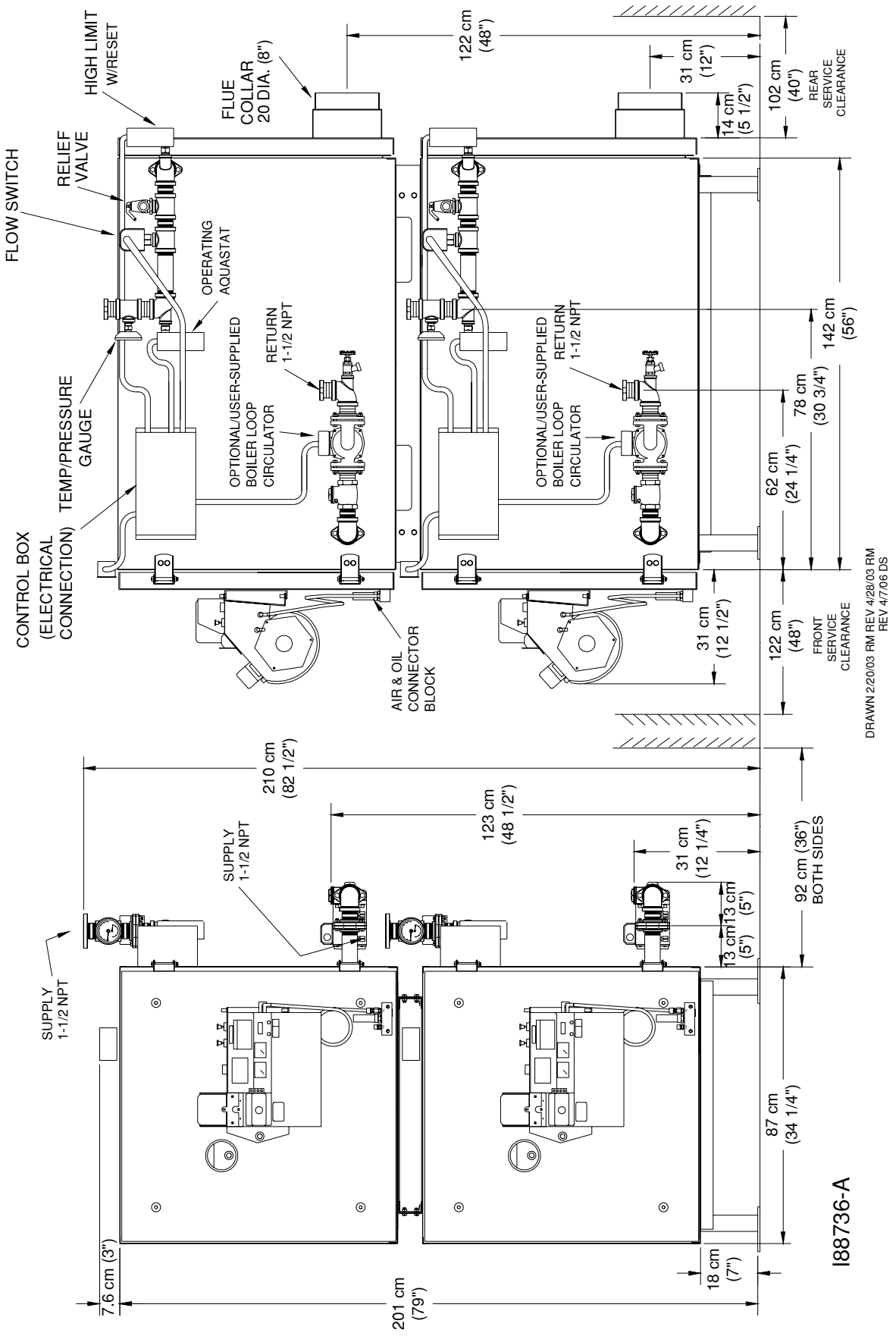


Figure A4 - Dual-Stacked Boiler Dimensions (Two CB-350-CTB Boilers)

Burner Components CB-200-CTB

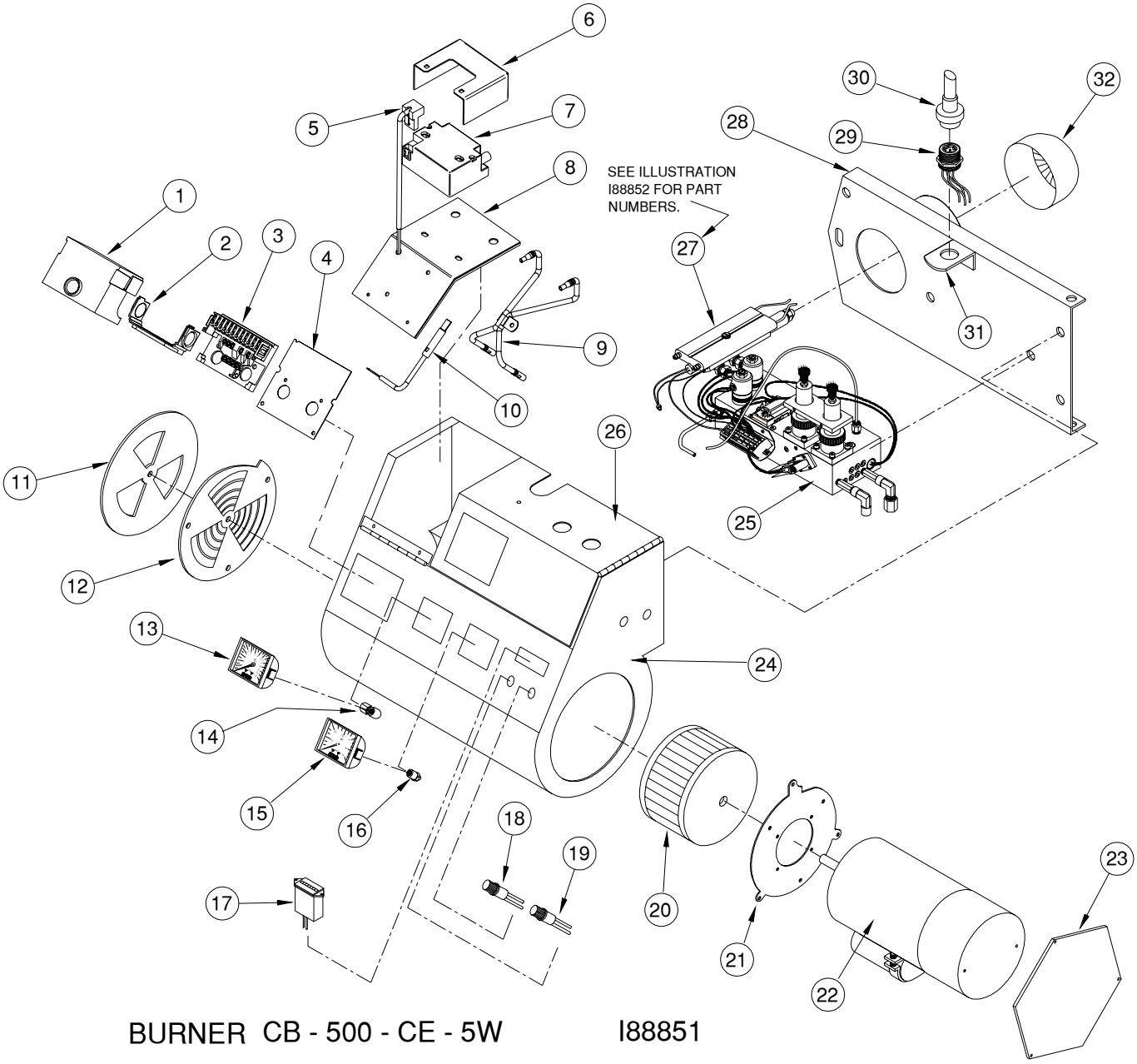


Figure A5 - CB-500-CE 5W Burner Component Detail (CB-200-CTB)

Burner Components CB-200-CTB (continued)

Item#	C. B. Part#	Component Description
1	33521	BURNER CONTROL, BHO 64
2	33523	FRONT PLATE FOR BHO 64
3	33522	BASE FOR BHO 64
4	26122	PLATE, DANFOSS PRIMARY
5	33526	PRIMARY CABLE WITH PLUG
6	26121	COVER, DANFOSS IGNITER
7	33524	DANFOSS IGNITER, TYPE EBI 230V
8	26120	PLATE, DANFOSS IGNITER
9	33528	SPARK-PLUG CABLE
10	33525	PHOTO UNIT LD
11	26103	AIR INTAKE OUTER PLATE
12	11359	AIR INTAKE INNER PLATE
13	32178	OIL GAUGE 0-15 PSI
14	32235	FEMALE ELBOW (3/16 T x 1/8 NPT)
15	32179	AIR GAUGE 0-60 PSI
16	32253	FEMALE ELBOW (1/8 TP x 1/8 NPT)
17	33161	HOUR METER (50 Hz)
18	33166	GREEN LIGHT (POWER) 230V
19	33338	AMBER LIGHT (PUMP) 230 V
20	31113	FAN SQUIRREL CAGE
21	26044	MOTOR MOUNT PLATE
22	33337	BLOWER MOTOR (230 V)
23	26053	RIGHT SIDE COVER
24	11335	HOUSING (INCLUDES ITEM 26)
25	13156	HEATER BLOCK ASSEMBLY
26	11265	COVER-HINGED
27	SEE NOTE	NOZZLE ADAPTER ASSEMBLY
28	11334	HINGE MOUNTING PLATE
29	11285	CONNECTOR RECEPTACLE
30	33534	CONNECTOR PLUG
31	26052	LATCH BRACKET
32	11308	RETENTION HEAD

Burner Components CB-200-CTB (continued)

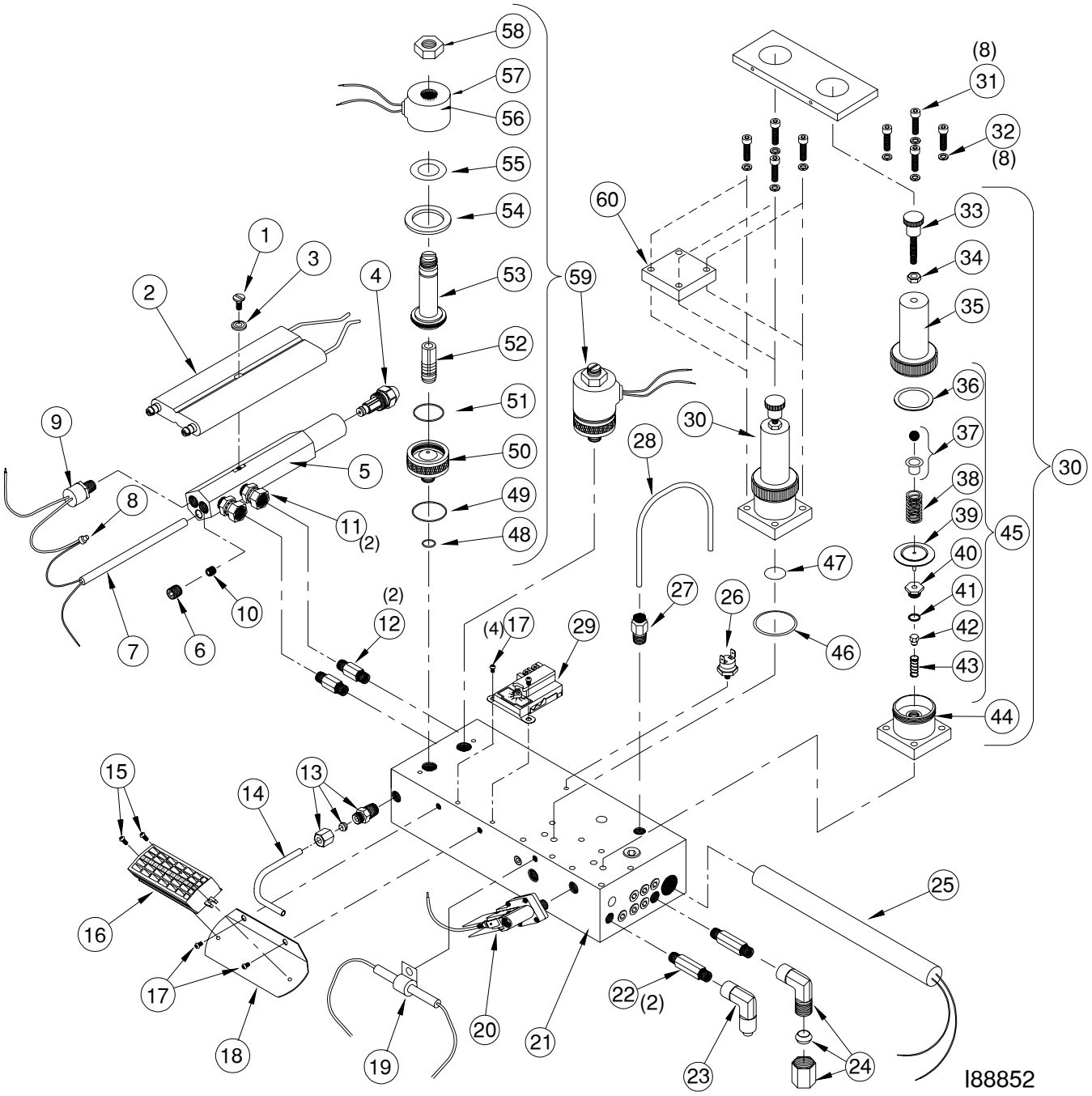


Figure A6 - CB-500-CE 5W Preheater Block and Electrode Assembly Component Detail (CB-200-CTB)

Burner Components CB-200-CTB (continued)

Item#	C.B. Part#	Qty.	Component Description
1	34169	1	ELECTRODE SCREW - 10-32 x 3/4
2	33527	1	PLUG IN ELECTRODE
3	34165	1	WASHER
4	32000	1	9 - 5 NOZZLE
5	13150	1	NOZZLE ADAPTOR
6	32007	1	PLUG - 1/8 NPT
7	33375	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	33278	1	THERMAL CUT-OFF
20	33057	1	AIR PRESSURE SWITCH
21	26090	1	HEATER BLOCK
22	32190	2	HEX NIPPLE - 1/8 NPT x 2
23	32202	1	FEMALE ELBOW (FOR 1/4" AIR LINE)
24	32201	1	FEMALE ELBOW (FOR 3/8" OIL LINE)
25	33289	1	PRE-HEATER ELEMENT (450 WATTS)
26	33378	1	PROVING SWITCH (NORMALLY OPEN)
27	32325	1	MALE ELBOW 1/8 x 1/8 NPT (FOR AIR GAUGE LINE)
28	54020	1	3/16 COPPER TUBING(OIL GAUGE LINE)
29	33011	1	HEATER BLOCK THERMOSTAT(NORMALLY CLOSED)
30	32359	2	REGULATOR SURFACE MOUNT
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	33384	2	COIL (230 V)
57	33320	2	COIL HOUSING
58	33321	2	NUT
59	33371	2	AIR/OIL SOLENOID ASSEMBLY (230 V)
60	26107	1	REG. SQUARE CAP

Burner Components CB-350-CTB

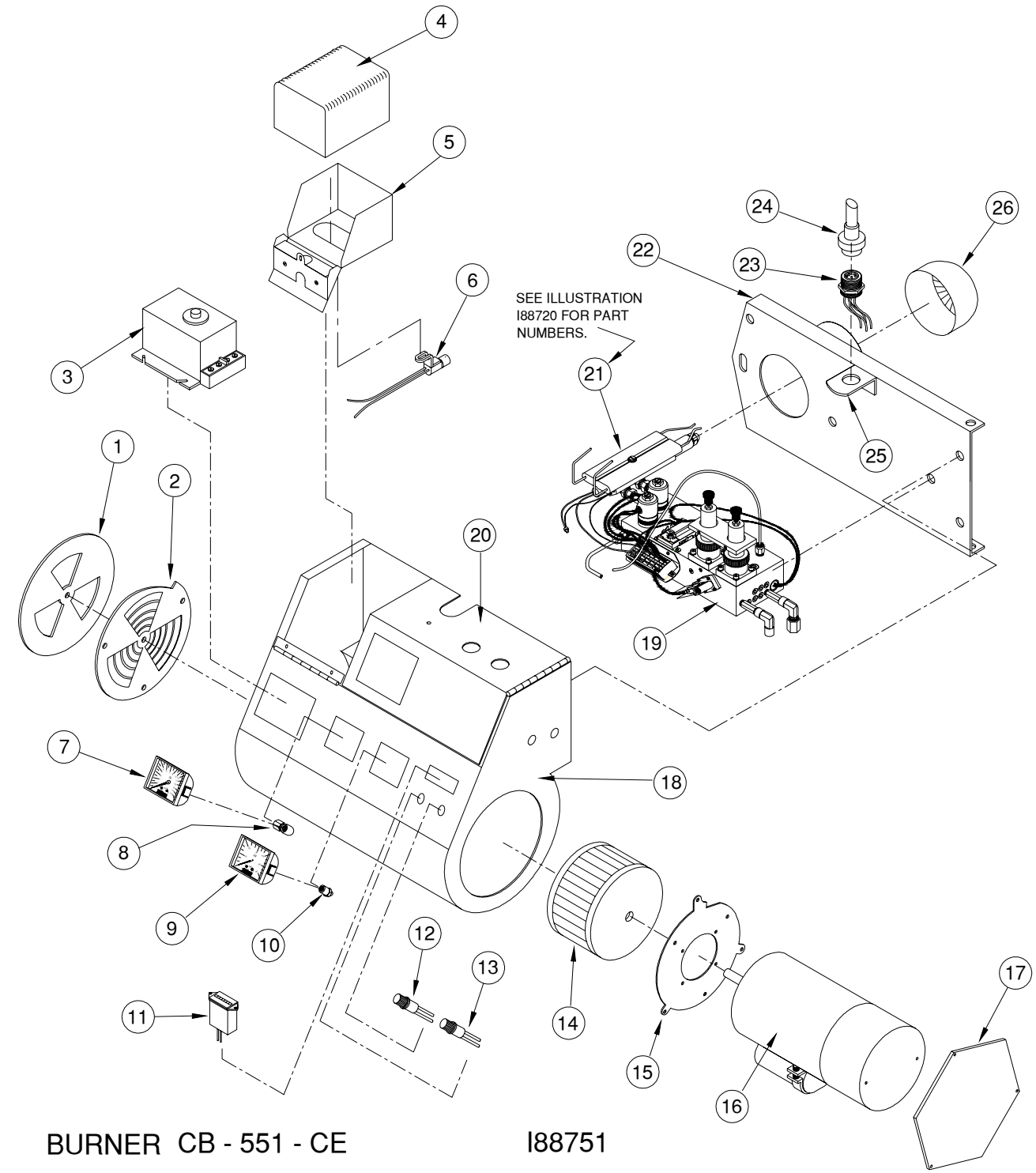


Figure A7 - CB-551-CE Burner Component Detail (CB-350-CTB)

Burner Components CB-350-CTB (continued)

Item#	C. B. Part#	Component Description
1	26103	AIR INTAKE OUTER PLATE
2	11359	AIR INTAKE INNER PLATE
3	33158	HONEYWELL PRIMARY CONTROL
4	33341	FRANCEFORMER
5	11529	TRANSFORMER PLATE
6	33116	CAD CELL
7	32178	OIL GAUGE 0-15 PSI
8	32235	FEMALE ELBOW (3/16 T x 1/8 NPT)
9	32179	AIR GAUGE 0-60 PSI
10	32253	FEMALE ELBOW (1/8 TP x 1/8 NPT)
11	33161	HOUR METER (50 Hz)
12	33166	GREEN LIGHT (POWER) 230 V
13	33338	AMBER LIGHT (PUMP) 230 V
14	31113	FAN SQUIRREL CAGE
15	26044	MOTOR MOUNT PLATE
16	33337	BLOWER MOTOR (230 V)
17	26053	RIGHT SIDE COVER
18	11335	HOUSING (INCLUDES ITEM 20)
19	13156	HEATER BLOCK ASSEMBLY
20	11265	COVER-HINGED
21	SEE NOTE	NOZZLE ADAPTER ASSEMBLY
22	11334	HINGE MOUNTING PLATE
23	33480	CONNECTOR RECEPTACLE
24	33479	CONNECTOR PLUG
25	26052	LATCH BRACKET
26	11376	RETENTION HEAD

Burner Components CB-350-CTB (continued)

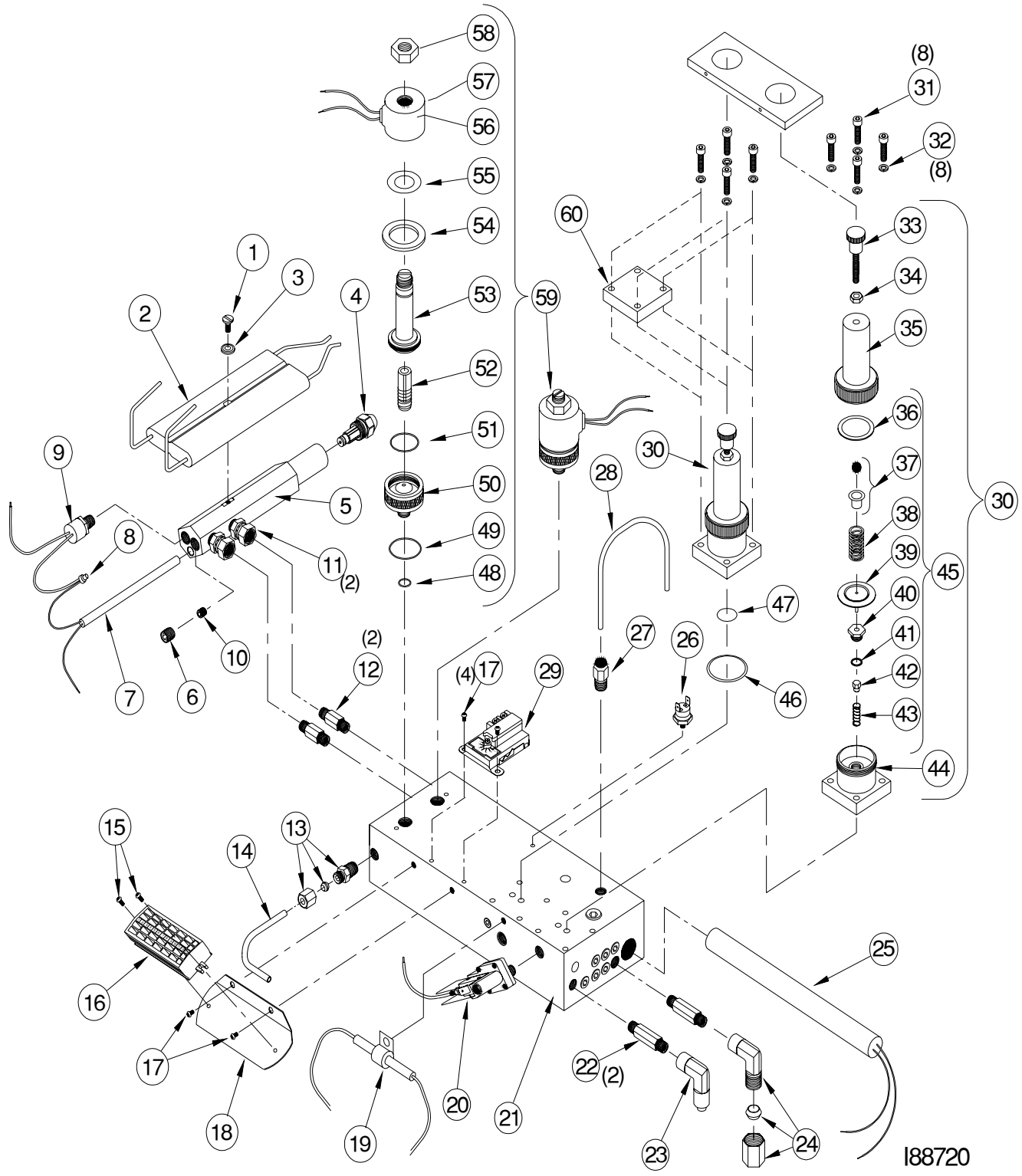
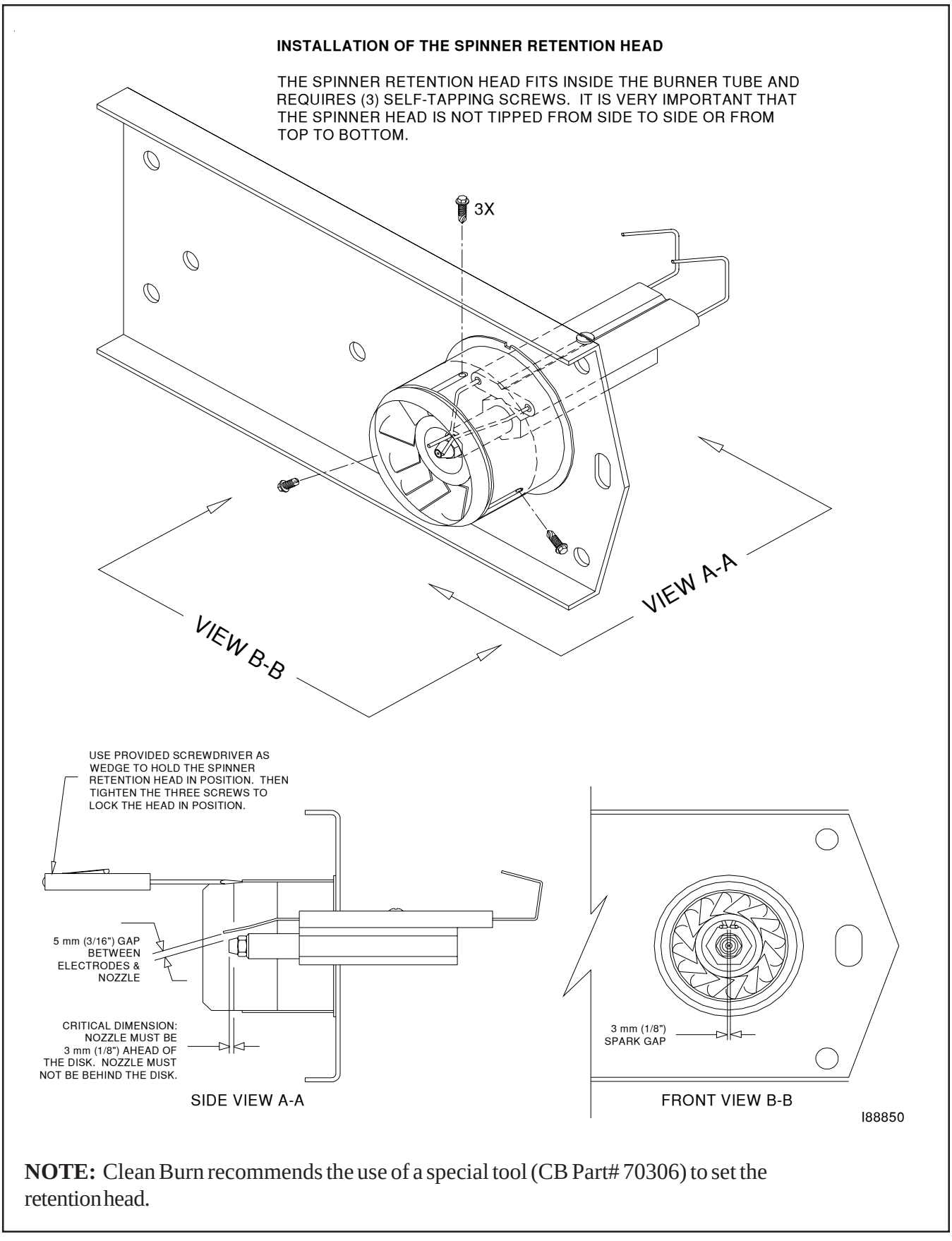


Figure A8 - CB-551-CE Preheater Block and Electrode Assembly Component Detail (CB-350-CTB)

Burner Components CB-350-CTB (continued)

Item#	C.B. Part#	Qty.	Component Description
1	34169	1	ELECTRODE SCREW - 10-32 x 3/4
2	33342	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	33375	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	33278	1	THERMAL CUT-OFF
20	33057	1	AIR PRESSURE SWITCH
21	26090	1	HEATER BLOCK
22	32190	2	HEX NIPPLE - 1/8 NPT x 2
23	32202	1	FEMALE ELBOW (FOR 1/4" AIR LINE)
24	32201	1	FEMALE ELBOW (FOR 3/8" OIL LINE)
25	33289	1	PRE-HEATER ELEMENT (450 WATTS)
26	33378	1	PROVING SWITCH (NORMALLY OPEN)
27	32325	1	MALE ELBOW 1/8 x 1/8 NPT (FOR AIR GAUGE LINE)
28	54020	1	3/16 COPPER TUBING(OIL GAUGE LINE)
29	33011	1	HEATER BLOCK THERMOSTAT(NORMALLY CLOSED)
30	32359	2	REGULATOR SURFACE MOUNT
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	33384	2	COIL (230 V)
57	33320	2	COIL HOUSING
58	33321	2	NUT
59	33371	2	AIR/OIL SOLENOID ASSEMBLY (230 V)
60	26107	1	REG. SQUARE CAP

Burner Components (continued)

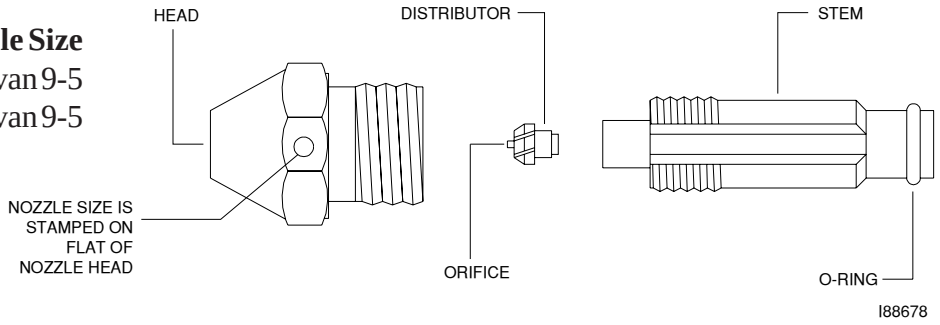


NOTE: Clean Burn recommends the use of a special tool (CB Part# 70306) to set the retention head.

Figure A9 - Burner Electrode Specifications

Burner Components (continued)

Model	Nozzle Size
CB-200-CTB	Delavan 9-5
CB-350-CTB	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.
8. Re-install the burner and adjust for optimal performance as necessary.

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

Figure A10 - Cleaning the Nozzle

APPENDIX B

Wiring Diagrams

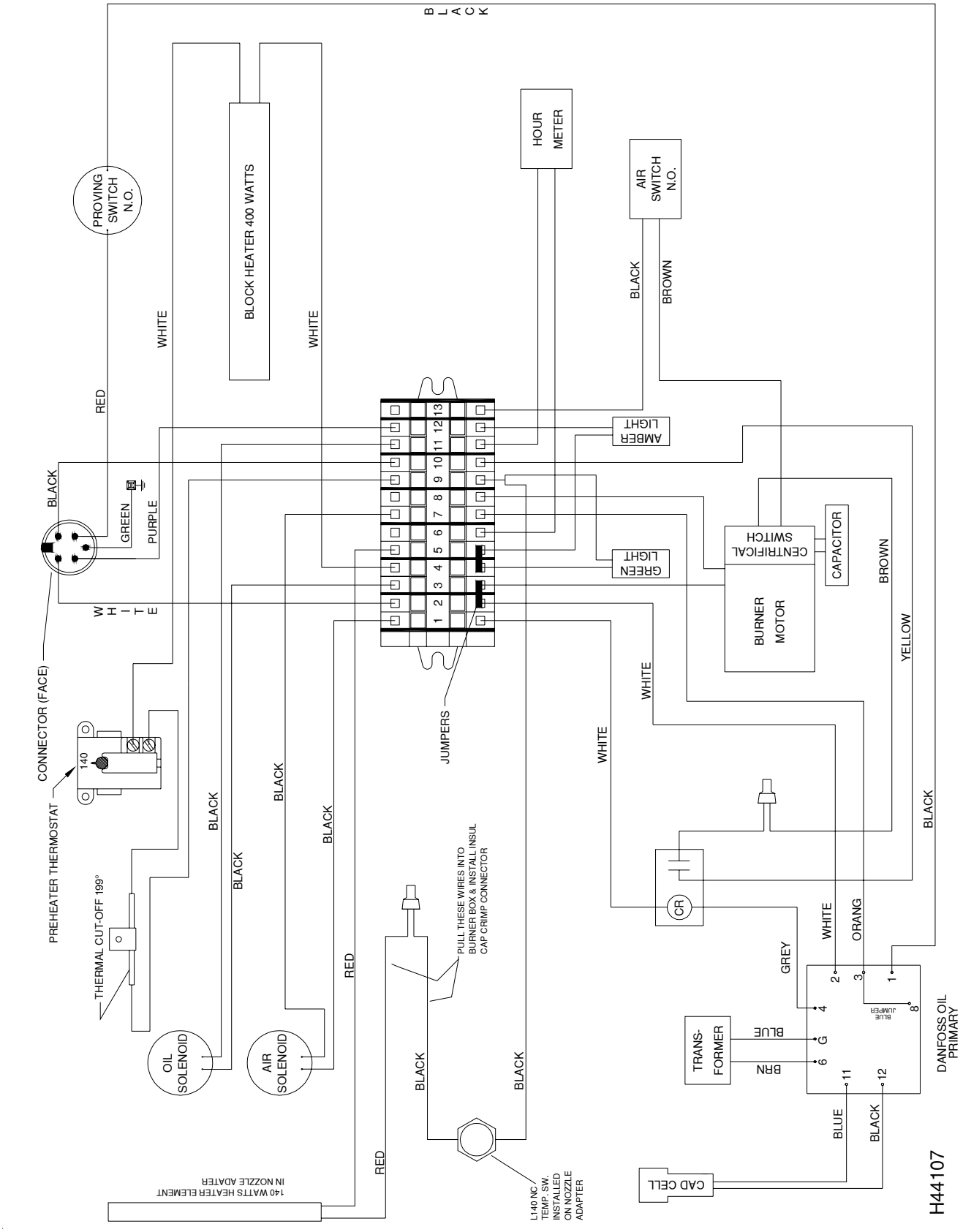


Figure B1 - CB-500-CE 5W Burner Wiring Diagram (CB-200-CTB)

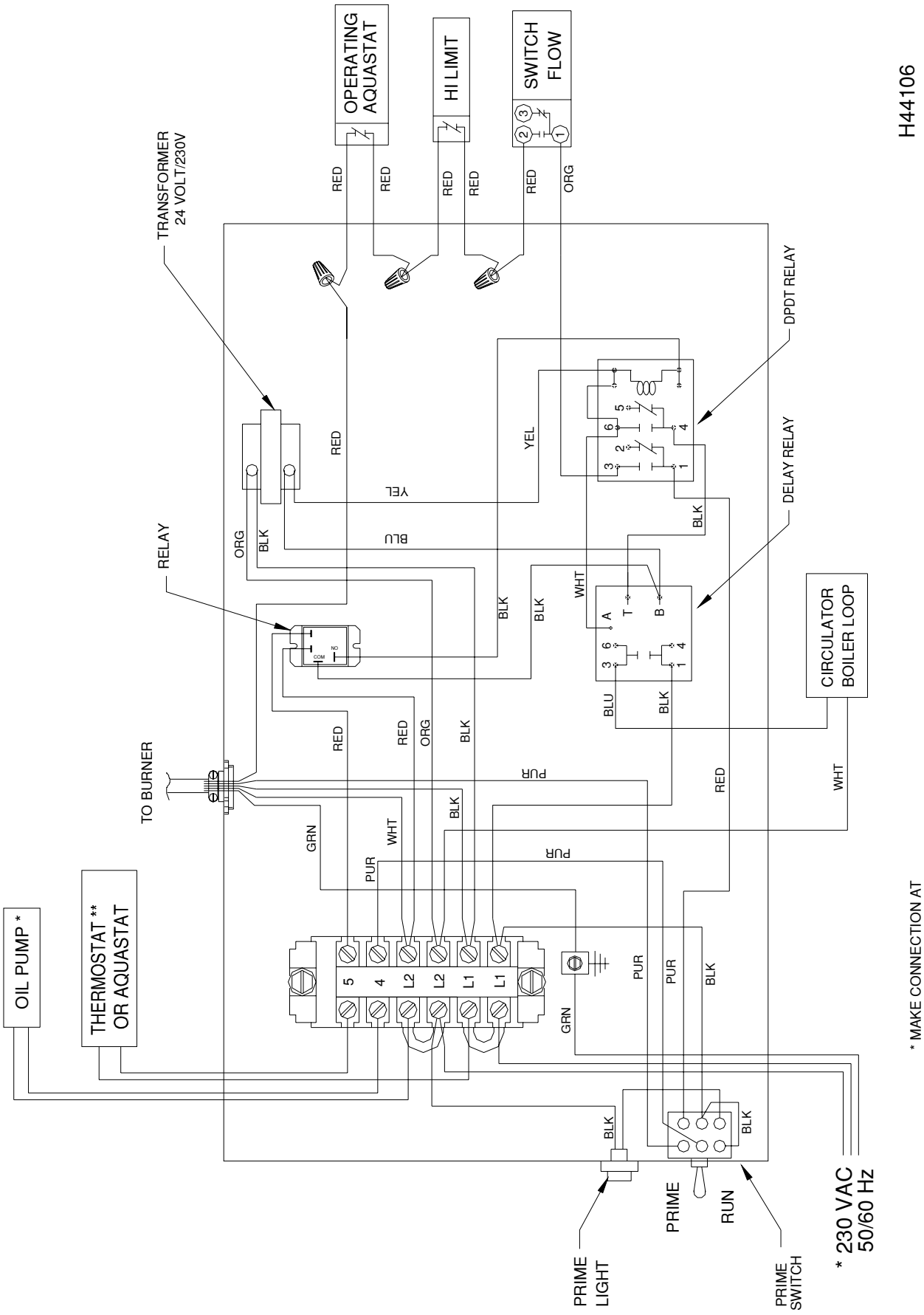


Figure B2 - CB-200-CTB Wiring Diagram (Control Box)

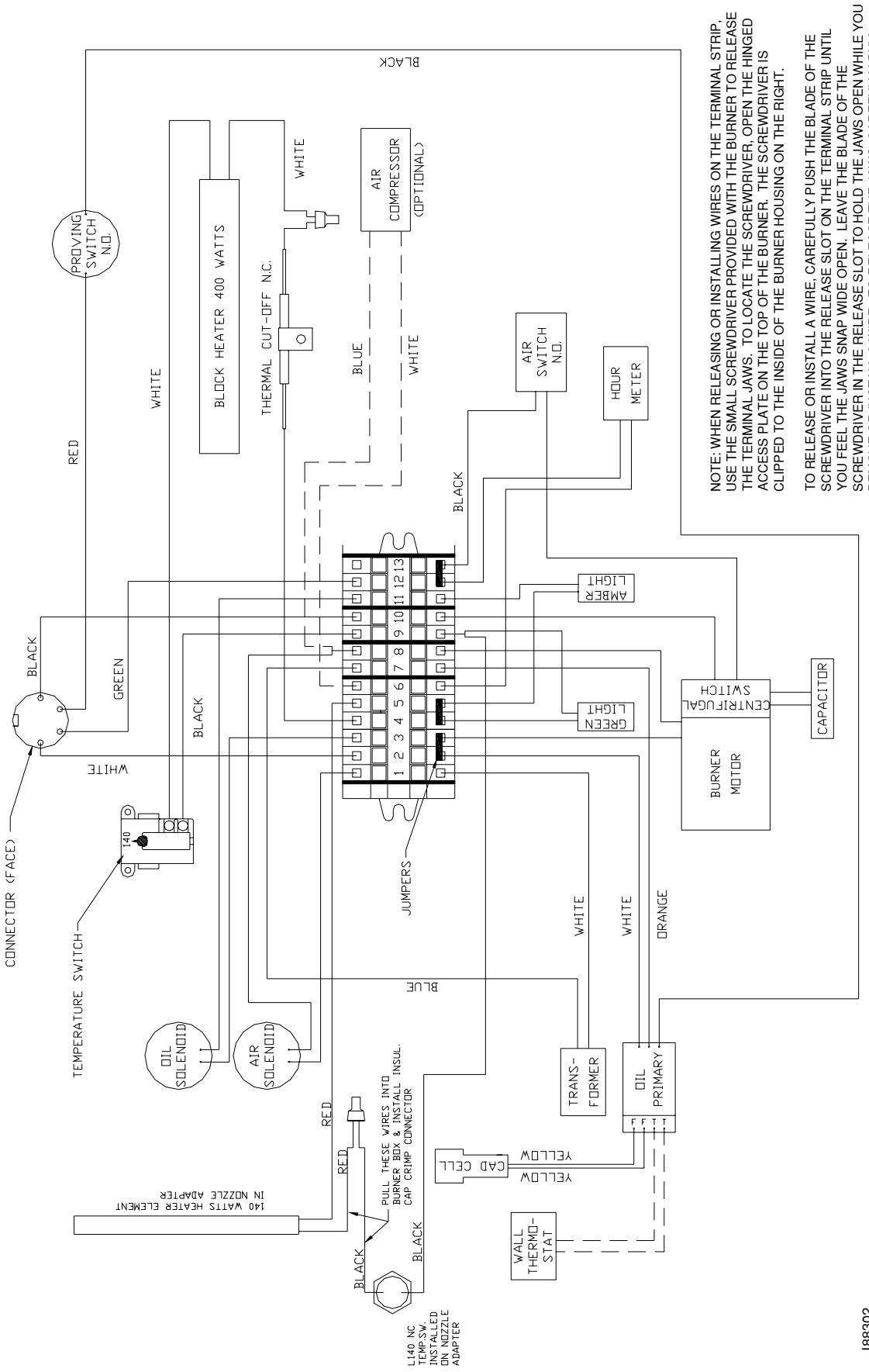


Figure B3 - CB-551-CE Burner Wiring Diagram (CB-350-CTB)

Wiring Diagrams (continued)

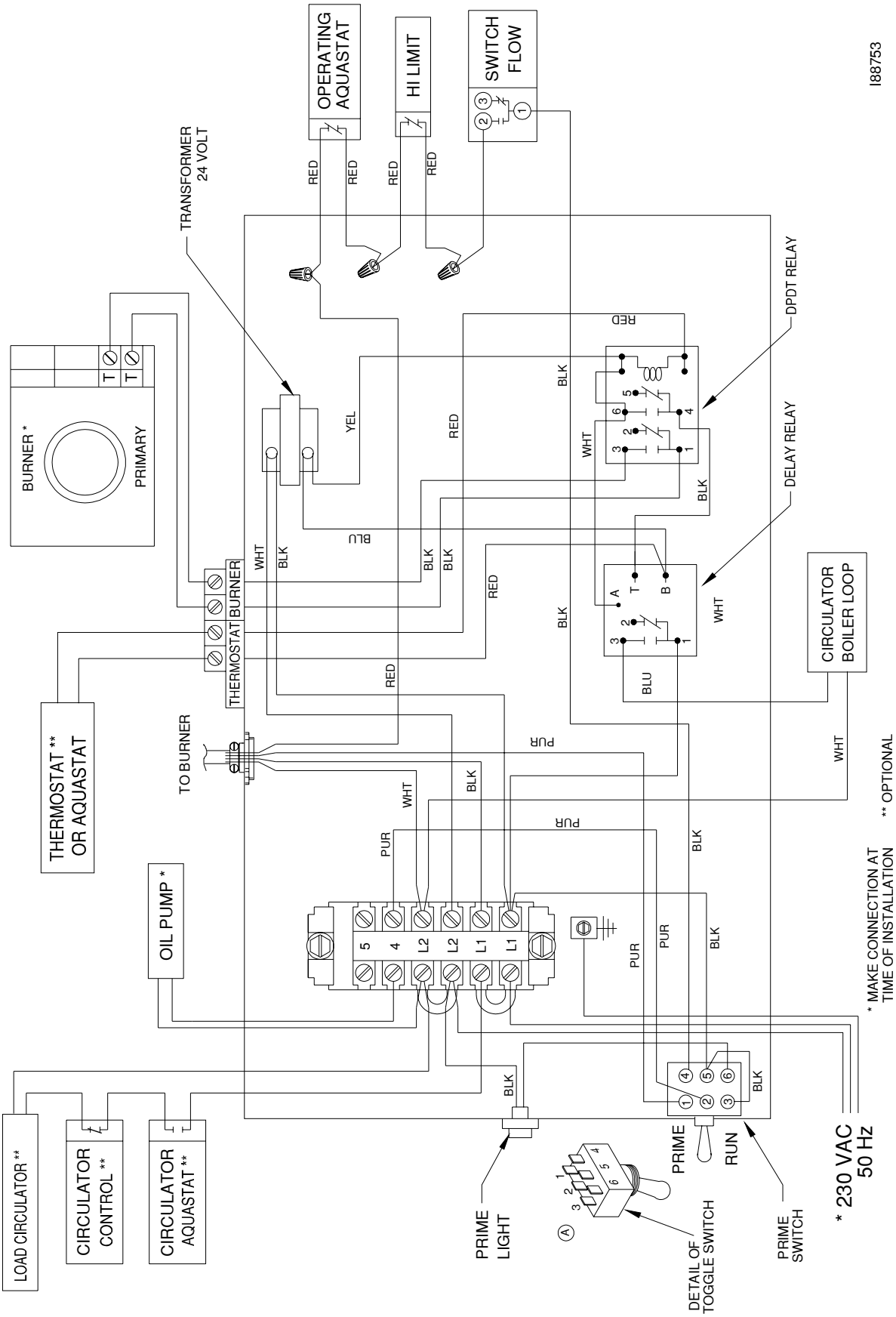


Figure B4 - CB -350-CTB Wiring Diagram (Control Box)

The CTB sequence of operation is summarized as follows:

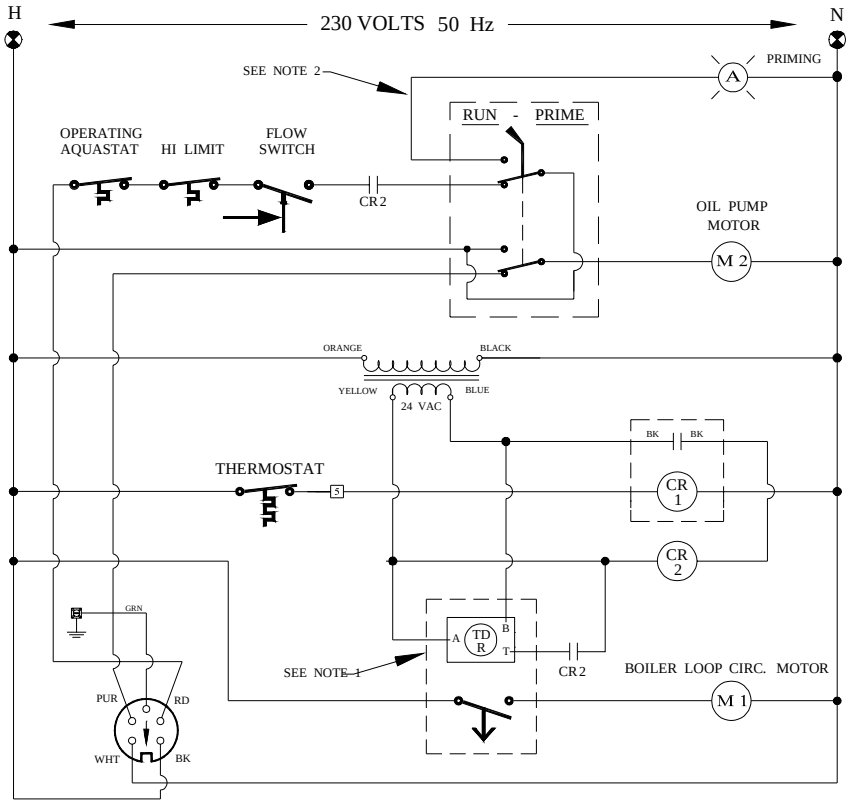
(1) A call for heat by the thermostat energizes the DPDT relay which in turn energizes the circulator delay relay and the boiler loop circulator to establish a flow of water through the coil.
(2) The flow switch closes. The power then continues from the flow switch through the high limit aquastat, through the operating aquastat, and then to the burner.
(3) If the burner ignites within approximately 15 seconds and the cad cell sees flame, the burner will continue to operate until the call for heat is satisfied or the setting of the operating aquastat is reached.
(4) If the thermostat is not satisfied, but the temperature setting of the operating aquastat is reached, the burner will stop until the return water drops the water temperature in the boiler (re-closing the operating aquastat and turning the burner back on).
(5) The boiler loop circulator will operate as long as the thermostat is calling for heat.
(6) The boiler loop circulator circuit includes a delay relay that keeps the circulator operating approximately ten minutes after the call for heat is satisfied.

NOTE 1:

TDR TIMER CONTACT CLOSES INSTANTANEOUSLY WHEN RELAY IS ENERGIZED (TRIGGERED BY CR2) AND OPENS 10 MINUTES AFTER CR2 IS DE-ENERGIZED

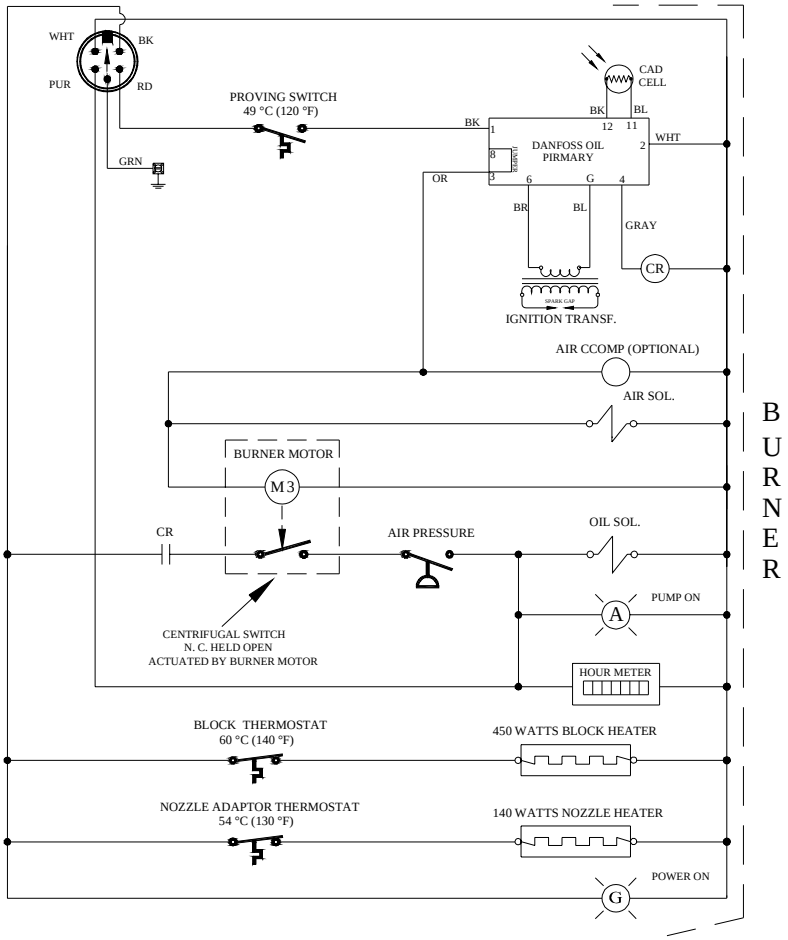
NOTE 2:

D P D T TOGGLE SWITCH ON FURNACE CABINET TOGLE DOWN: BURNER TOGGLE UP : PRIME



- CONNECTION TO CUSTOMER POWER

□ - CONNECTION AT TERMINAL BLOCK INSIDE BOILER CONTROL BOX



DWG. No.	44111	
DRAWN BY:	RM	
DATE:	9/28/05	
REVISION		
No.	DATE	BY

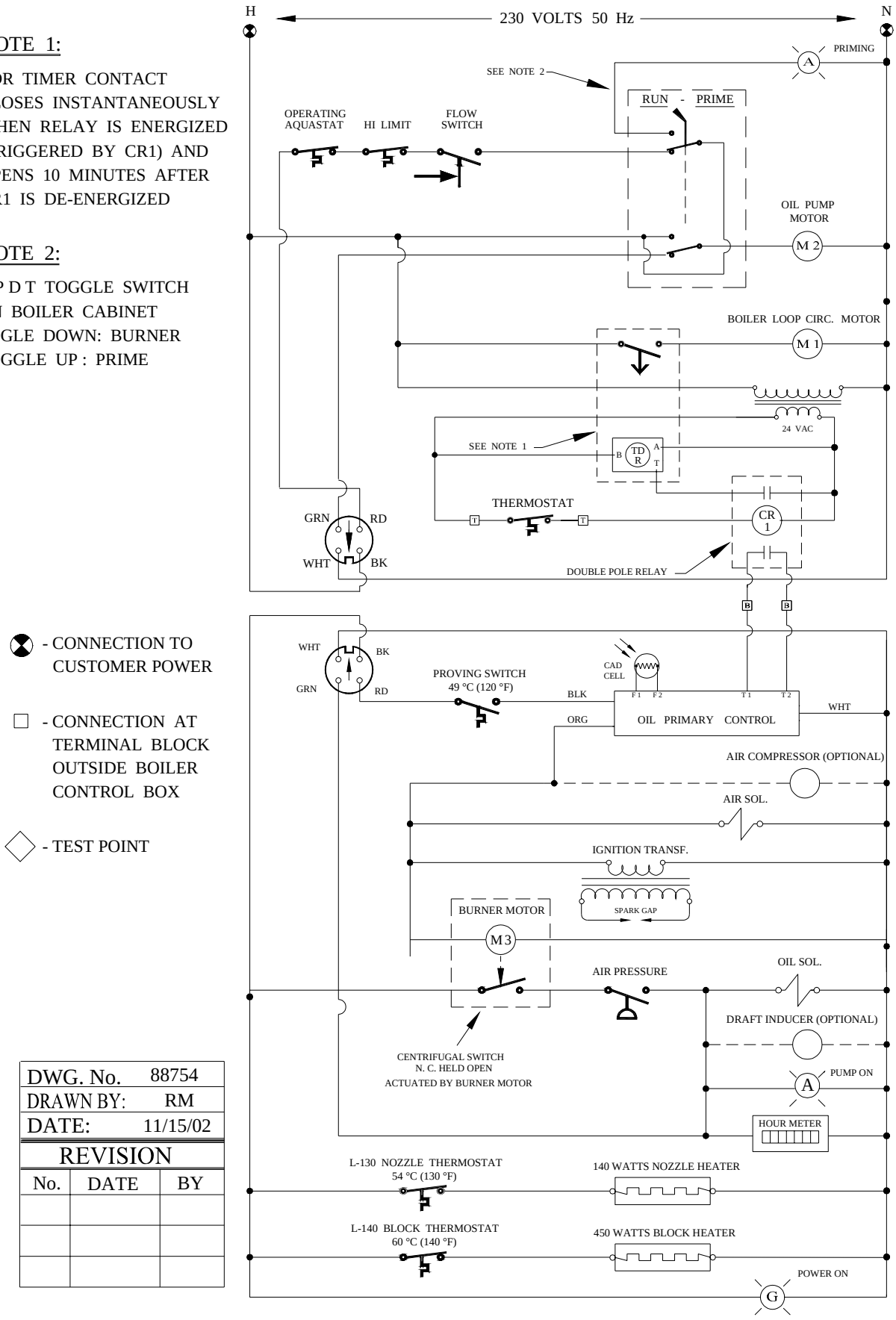
Figure B5 - CB-200-CTB Ladder Schematic

NOTE 1:

TDR TIMER CONTACT CLOSES INSTANTANEOUSLY WHEN RELAY IS ENERGIZED (TRIGGERED BY CR1) AND OPENS 10 MINUTES AFTER CR1 IS DE-ENERGIZED

NOTE 2:

D P D T TOGGLE SWITCH ON BOILER CABINET
TOGLE DOWN: BURNER
TOGGLE UP : PRIME



⊗ - CONNECTION TO CUSTOMER POWER

□ - CONNECTION AT TERMINAL BLOCK OUTSIDE BOILER CONTROL BOX

◇ - TEST POINT

DWG. No.	88754
DRAWN BY:	RM
DATE:	11/15/02

REVISION		
No.	DATE	BY

Figure B6- CB-350-CTB Ladder Schematic

APPENDIX C

Additional Installation and Maintenance Requirements

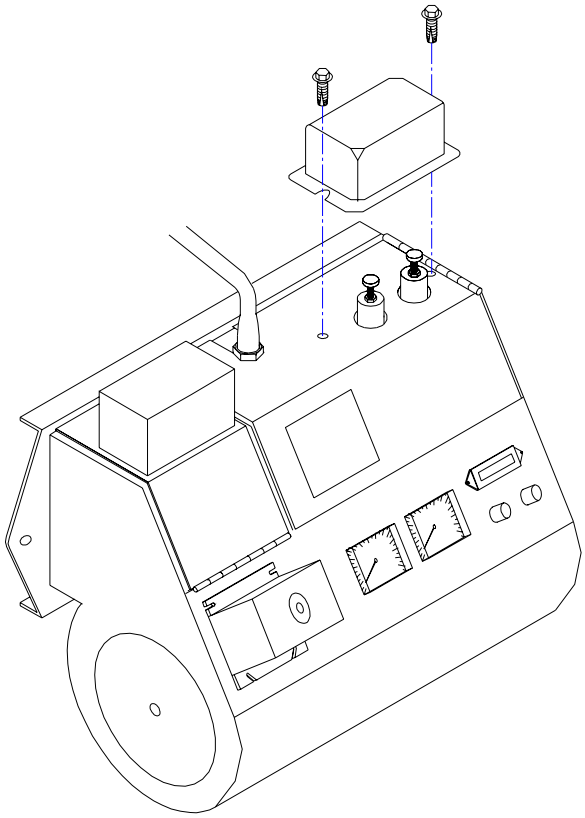
The following activities must also be accomplished for boiler installations in the United Kingdom:

- Installing a cover over the oil/air regulators on the burner
- Installing a fire valve above the burner

Instructions and/or drawings for these activities are provided in this Appendix.

Installing a Cover over the Oil/Air Regulators

A cover (C.B. #31185) must be placed over the oil and air regulator to prevent unauthorized adjustment after the equipment has been commissioned by a qualified person (Figure 1).



Oil/Air Regulator Cover Installation

I88330

Figure C1 - Installing a Cover over the Oil/Air Regulators on the Burner

Installing a Fire Valve

Install a fire valve element in a position above the burner as shown in Figure C2 to provide adequate protection in accordance with BS 5410 Parts 1 and 2.

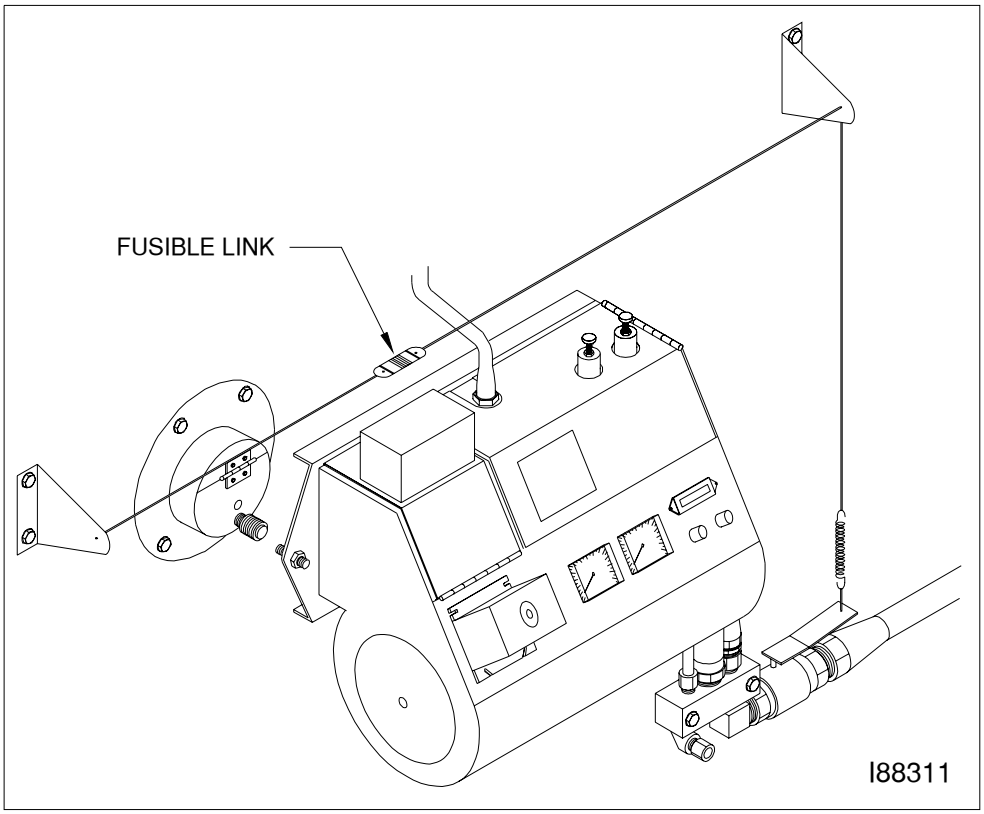


Figure C2 - Installation of a Fire Valve

APPENDIX D

Coil Tube Boiler Service Record

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

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

CTB 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