

ASSEMBLY, INSTALLATION, MAINTENANCE AND OPERATING INSTRUCTIONS

INOV8 Multi-fueled Boiler



Control No. 3120734

Save These Instructions!

This manual must be kept near the boiler!

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Notations Used in this Manual



RISK OF INJURY OR SYSTEM DAMAGE – Identifies a possible dangerous situation that can lead to personal injury or physical damage.



NOTICE – This is a tip or notice for optimum use of equipment and adjustment as well as useful information.

SECTION 1 – GENERAL GUIDELINES

Congratulations on your purchase of this INOV8 Multi-fueled Boiler. You have selected the highest quality, precision-engineered piece of equipment available, designed specifically to allow you to fully benefit from the used oils generated in your business. INOV8 has not compromised in engineering this product for high efficiency, safety, longevity, operating economy, and to allow you a maximum of fuel choices; all while providing the highest standards of environmental considerations. This manual was written for the novice technician with detailed instructions for the installation, start-up, routine operation and maintenance of this boiler. If these instructions and pertinent local regulations are followed closely you will be assured full satisfaction. This manual covers installation, maintenance and service of the INOV8 models V135, V170, V220 and V300 boilers utilizing the R200 INOV8 burner and the appropriately sized Viessmann boiler.

CODES & REGULATIONS

All work shall be performed in strict accordance with the requirements of state, provincial and local regulating agencies and codes pertaining to oil-burning equipment installations. After start-up the owner or its representative should be instructed about the boiler operation and be given this manual. This equipment must be installed according to these national standards.

For burner equipment:	ANSI/NFPA # 31 – <i>Standard for the Installation of Oil-Burning Equipment</i> – 2006 Edition, and in Canada to CSA Standard B139.
For chimney installation:	ANSI/NFPA # 211 – <i>Standard for Chimneys, Fireplaces, Vents, and Solid Fuel Burning Appliance</i> , 2006 Edition
For oil storage installation:	NFPA # 31 – <i>Standard for the Installation of Oil-Burning Equipment</i> – 2006 Edition
For electrical installation:	NFPA # 70 – <i>National Electrical Code</i> – 2005

Cleaning and routine maintenance must be carried out at least quarterly during operation. This shall include an overall check of the heating system. There should be periodic inspection of the combustion chamber for possible deterioration. Any discrepancies must be corrected immediately.

NOTE: This manual is for reference only. The manual does NOT purport to address all design, installation and safety considerations. It is the responsibility of the user of this manual to determine the applicability and safety of each individual application and ensure its compliance with local building codes.



U.S. EPA REGULATIONS & USED OIL BURNING

On August 12, 1992 the U.S. Environmental Protection Agency (EPA) announced that it would not list nor classify as hazardous waste, used oil destined for recycling. They also affirmed the long-standing regulatory exemption, which allows the operation of used oil-fired boilers. Under this exemption, used oil-fired boilers may operate without a regulation so long as the owner burns "**on-specification used oil**". Used oil exceeding EPA designated levels of contaminants is classified as "**off-specification used oil**" which means the owner must comply with three requirements: the heater does not exceed 500,000 BTU per hour, it is vented to the outside, and burns oil generated on-site or collected from do-it-yourself oil changers. After years of careful study the EPA concluded that used oils that are recycled in this manner do not pose a substantial present or potential hazard to human health or the environment so long as they are managed properly. To this end, EPA's regulations are designed to provide safe and environmentally sound used oil management practices.

LISTING AGENCIES

The INOV8 burner is tested and listed by **Intertek ETL Semko (ETL)** - an internationally recognized third party test agency to UL 296 – Standard for Safety for Oil Burners, Tenth Edition, Dated September 11, 2003. When combined with a hot air appliance the burner was also tested to UL 296A - Standard for Safety for Waste Oil Burning Air-Heating Appliances, Edition 2, Revision 2006/03/08 (the U.S. used oil standard), and to CSA B140.0 General Requirements for Oil Burning Equipment General Instruction No 2-4 (R1991) Rev: 1991/01/01 and is listed with the European Economic Community with a CE registration number 3884/97. The INOV8 tanks are also tested and listed by ETL to UL 80 *Standard for Steel Tanks for Oil-Burned Fuel*.

FUELS- GENERAL INFORMATION

This product is approved to burn the following oils: crankcase oil, crankcase oil with up to 20% gasoline, fuel oils up to #6 heating oil, jet fuel, mineral spirits and transmission oil. The following unlisted oils have been tested and passed combustion analysis requirements but are not approved as fuels due to a lack of standards to define them: used and crude vegetable oil, and biodiesel. DO NOT attempt to burn other liquids without written authorization from INOV8 International, Inc. Only used oil generated on the premises of the owner may be used in this equipment, unless written authorization is obtained from the regulatory authority.

Caution – used oils may contain gasoline, heavy metallic compounds and foreign materials. When burned, these compounds are emitted from or deposited within this boiler and therefore care should be taken when storing these oils or when using, cleaning and maintaining this equipment.



SPECIAL PRECAUTIONS!

1. When burning waste oils this burner is listed for commercial or industrial use only. It may not be used for residential or any other unauthorized purpose.
2. All boilers must be wired strictly in accordance with wiring diagram and instructions in this manual.
3. Disconnect the power supply before making wiring connections to prevent electrical shock and equipment damage.
4. Disconnect the power supply before cleaning the boiler.
5. Do not install chimney connector closer than 18 inches to combustible materials in any direction.
6. DO NOT add fluids with the classification of a hazardous waste, or fuels with flash points below 100°F (such as gasoline) to your used oils. (Check your local codes for restrictions.)
7. For your protection - DO NOT store or use gasoline or other flammable vapors and liquids in the vicinity of this or any other appliance.
8. Canadian standards allow only used oil generated on the premises of the owner to be used as fuel, unless permitted by the regulatory authority.
9. Separate manuals are provided from equipment supplied by Viessmann and other manufacturers of components for this boiler equipment. These manuals provide important information on the installation and operation of their respective products. **However, installation references to the installation of the chimney and the return water temperature found in the INOV8 instructions supersede anything found elsewhere.**
10. The INOV8 products are not designed for use in hazardous atmospheres containing flammable vapors or combustible dust, or atmospheres containing chlorinated or halogenated hydrocarbons.

WARRANTY IS VOID IF ...

1. The appliance is not installed in accordance with these instructions and applicable codes and ordinances.
2. The wiring is not in accordance with drawings in this manual.
3. The boiler or burner is not maintained in accordance with maintenance requirements – particularly failure to clean the combustion chamber and heat exchanger on a regular basis.
4. Other than specified fuel is burned.
5. Fuel input capacity is over the rated condition of maximum flow rate shown in the table for boiler / burner settings.

Note: Information on the Limited Warranty was sent along with the sales order.

VENTING

Failure to provide proper venting could result in death, serious injury, and/or property damage. Units must be installed with a flue connection, draft regulator and proper vent to the outside of the building. Safe operation of any gravity vented heating equipment requires a properly operating vent system, correct provision for combustion air, and regular maintenance and inspection.

DISPOSAL

Dispose of packaging in an environmentally responsible manner. Dispose of all heating system components that have to be replaced at an authorized disposal site. Dispose of ash in a responsible manner.

UNPACKING & INSPECTING

Immediately upon receipt, check the boiler, accessories and burner for any damage that may have occurred in shipment. If damage is found, INOV8 or the sales representative must be notified within two days in order to process shipping damage claims. Be careful when handling the module, as the electrodes and the flame retention head are factory set and if either are bumped or moved, the operation of the burner could be affected. Refer to page 24 for proper electrode configuration.

SHIPPING & PARTS INFORMATION

The INOV8 Waste Oil Boiler is shipped on a pallet consisting of several boxes depending on the various accessories purchased from INOV8. The various assemblies that make up a boiler system are listed below. Check for the items that they are received:

1. **Boiler Assembly** – In most cases, the boiler steel will be shipped strapped to a pallet. The additional items are packaged separately. A boiler instruction manual will also accompany the boiler that must be referenced for detailed boiler installation and operating instructions.
2. **INOV8 Burner** – The burner is separately packaged along with the items listed in items # 3, 4, and 5.
3. **Air regulator Assembly**, (see photo below) includes:
 - a. Air regulator
 - b. Air gauge, 0 – 160 psig
 - c. Plastic nut
 - d. Bracket and screws
 - e. ¼" air tube
4. **Stainless Steel Tube Assembly**. This is mounted in the center of the boiler combustion chamber.
5. **Draft Inducer** – Tjernlund model D-3 (optional)
6. **Junction Box** – includes on/off switch, light and relay.
7. **Oil Pickup Assembly**, includes these parts from the top down:
 - a. 3/4 " x 2" black nipple
 - b. One 90° street elbow
 - c. Filter mount and one primary strainer, model General Filter model #2A-17A. It is a cleanable strainer with a replacement part number GFI 2029 (see photo at right).
 - d. One 90° street elbow
 - e. One ¾" x 12" pipe nipple
 - f. Double tap bushing, 2" with ¾" x ½" reducing bushing
 - g. 45° elbow and bushing
8. **Other items include:**
 - a. Instruction Manual
 - b. Spare vapor eliminator filter
 - c. Spare 10 amp (brown) & 4 amp (orange) fuses
 - d. Burner gasket
9. **Bench Tank - (optional)**, which includes:
 - a. 300 gallon bench-type tank
 - b. Tank gauge, oil supply and lines with fittings
10. **Boost Pump (optional)**

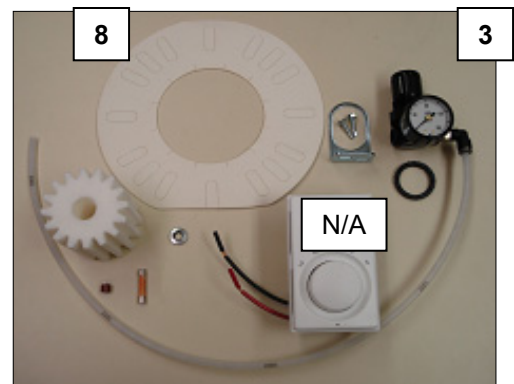


Chart 1 - Burner Specifications Chart When Used with a Viessmann Boiler

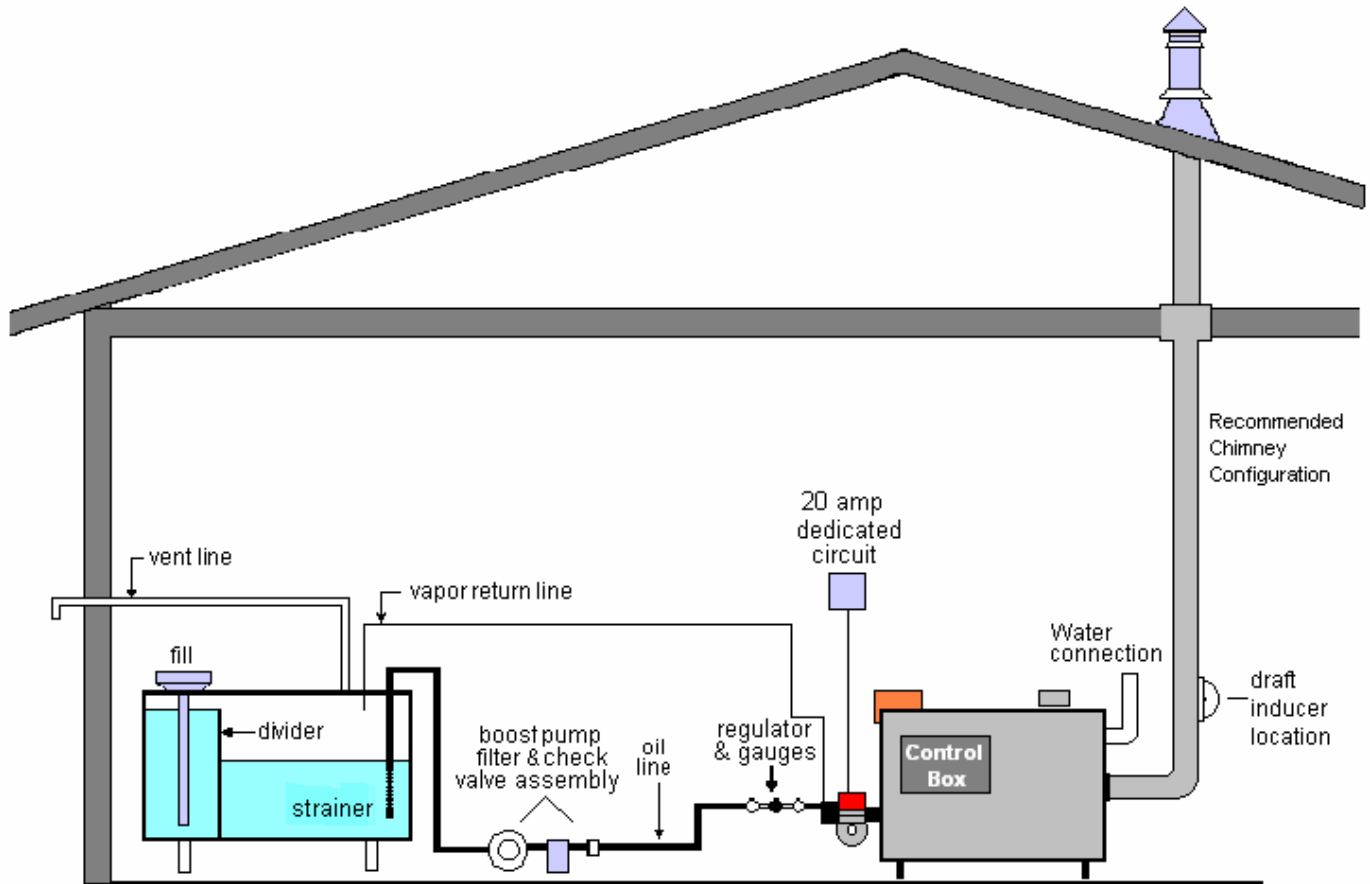
Boiler Model #	V135	V170	V220	V300
Burner model #	R200	R200	R200	R200
Input BTU (in 1000s)	135	170	219	300
Nozzle size #30609 -	3.1	3.1	3.1	3.1
Oil pressure setting *	6	8	10	14
GPH	1.08	1.36	1.75	2.40
Burner height, inches	14	14	14	14
Burner width, inches	18	18	18	18
Burner length, inches	16	16	16	16
Compressed air in CFM	2	2	2	3
Compressed air in PSI	30	30	30	30
Secondary air band settings	2	2	2 to 3	5
Air connection to regulator, npt	0.25	0.25	0.25	0.25
Electrical requirements (in amps)	20	20	20	20
Volts	120	120	120	120
Hertz	60	60	60	60
Burner Motor - hp	1/5	1/5	1/5	1/5
Fuel Pump connection (3/4" or larger) in NPT	1/4	1/4	1/4	1/4
Weight - in pounds	52	52	52	52
Items Shipped with Burner & Boiler				
Spare fuses - one 4 amp & one 10 amp				
Instruction Manual for burner				
Stainless inserts for boiler				
Spare filter for vapor eliminator				
Oil Regulator Assembly or Kit				
Electrical Box (includes relay & on/off switch)				
Floating Oil Pickup / Filter Assembly, includes filter mount with strainer, floating oil pickup, 2" fitting for tank & check valve				
Shipping weight of INOV8 items	100	100	100	100
Tjernlund Draft Inducer, if needed:				
Model #	D-3	D-3	D-3	D-3
Tjernlund connection size (inches)	8	8	8	8
Chimney size (inches)	8	8	8	10

On-site items required for burner (not supplied by INOV8)

Oil line from tank, Return line to tank, Compressed air supply line, Chimney, Oil storage tank, Electrical Supply
 Low-water cut-off (recommend Hydro level Company Safeguard - PN#45-175 with probe #EL1214-SV)
 Circulators, mixing valves, zone controls & tubing/piping for water side



Figure 1 - Boiler Installation Overview



Notes:

1. The door can hinge right or left, be sure to direct supplies to hinge side.
2. This drawing is only pertinent to the fuel and venting requirements.
3. All water connections and related installation issues are the responsibility of the installer.
4. This drawing is not intended to be complete. The entire installation & operation manual must be referred to prior to startup.

SECTION 2 – BOILER INSTALLATION

PRE-INSTALLATION INFORMATION

The proper burning of waste oil in a boiler requires special considerations identified by INOV8 that must be adhered to. These are listed here and described in detail later in the text.

1. Recirculation of boiler water is required such that the return water temperature to the boiler is at a minimum of 180°F before a heating load is applied to the boiler.
2. Reliable, consistent combustion air is essential for burning waste oils. INOV8 assures this by recommending a high quality draft inducer with the boiler system when applicable.
3. Fresh air must be supplied to the boiler room.
4. Prevent short firing cycles. If only one boiler is used, short cycling can be prevented by spreading the ON - OFF temperature settings of the Aqua stat. For a multiple boiler operation, a control system that includes a FIRST ON - FIRST OFF firing sequence is preferred.
5. Care should be taken to allow flexibility of the oil supply line, the vapor vent line and the electrical conduit to the burner so that the door can swing freely from whichever side the hinge pivot is placed. Please note that the door may be mounted with the pivot point on either side.
6. This product is approved to burn the following fuels: crankcase oils, gear box oils (85 - 140 wt), up to 175 wt heat transfer oils, transmission & hydraulic oils, and oils with up to 10% gasoline. Special permission must be obtained to burn other fuels, such as vegetable oils and biodiesel. DO NOT attempt to burn other liquids.
7. The assembly, installation, adjustment and maintenance of this equipment must be in accordance with the instructions in this manual, accepted hydronic boiler standards, and in compliance with all federal, state and local regulations regarding environmental control, fuel storage, fire and electrical standards. There may be additional local standards and permits required. If an unauthorized individual works on this equipment, the warranty may be voided.
8. The INOV8 equipment must be operated according to the settings established in this manual, the boiler manual, and displayed on the boiler system.
9. Using waste oil as a fuel may introduce uncontrollable instances of flameout. It is strongly recommended to use anti-freeze in the boiler to prevent damage for this and these other reasons:
 - If the heated water is used for underground snow melting or in a make-up air system (both are subject to damage from freezing).
 - To prevent rust scaling or corrosion of the cast iron, which can reduce boiler output as much as 30% in a short time.
 - If there is a chance that the boiler room might be exposed to freezing temperatures such as from cold air from the chimney or open door.

VENTING CONSIDERATIONS

It may be necessary to install an exhaust blower in the stack to offset the pressure drop of the boiler, the loss of natural draft resulting from the relative cool stack temperature, and the increasing flue side pressure drop resulting from the accumulation of ash in the boiler. Draft must be maintained at no less than -0.02 during firing conditions. **If the chimney does not provide adequate draft the following problems will occur: 1) there will be dirty combustion yielding black smoke, 2) soot will build up quickly inside the boiler, 3) unburned oil will build up on the flame retention head, 4) back pressure from the exhaust will carry ash and soot backwards into the burner housing causing nozzle blockages, and 5) unburned oil will accumulate inside the burning chamber. Any warranties provided by INOV8 will be voided.**

FRESH AIR FOR BOILER ROOM

Generally a boiler will be located in an independent room with inadequate air to supply both combustion air and ventilation air necessary to maintain a nominal 70° F temperature. As a result, the room will be under a vacuum causing operating problems on the burner, and high temperatures causing burner component failure. It is, thus, necessary to provide outside air to prevent the negative pressure and to keep the room relatively cool. This is extremely important because the burner motor and the motor on the draft boost blower (when used) cannot operate in high temperatures. If this is not accomplished, the motors will 'shut-down' on excessive internal temperature leading to early motor failure and unsatisfactory combustion.

BOILER SYSTEM LOCATION

The boiler location is important to the efficient operation of the system. Sites must be selected which take into consideration the national standards for oil burning equipment found in ANSI and NFPA-31. These abbreviated guidelines will insure the most beneficial location.

1. Select a location as close as possible to the oil storage tank.
2. The boiler should be situated to provide accessibility to any clean-out panels that may be on the back of the boiler and ample space for the door to swing out for cleaning and service. The oil supply, the oil vent, the electrical, and the compressed air conduits must be installed so that the boiler door can freely swing open. Note that the hinges can be located on either side of the boiler to best suit the installation.
3. To prevent premature heat exchanger failure, DO NOT locate in areas where chlorinated, halogenated or acid vapors are present in the atmosphere.
4. DO NOT install unit outdoors.
5. Minimum clearances must be adhered to – see the specification sheet.
6. Care should be taken to allow flexibility of the oil supply line, the vapor vent line and the electrical conduit to the burner so that the door can swing freely from whichever side the pivot is placed.
7. INOV8 relies on the installer for the piping and connections to the boiler. A manual from the boiler manufacturer is provided for information in this regard.

MULTIPLE BOILER INSTALLATIONS

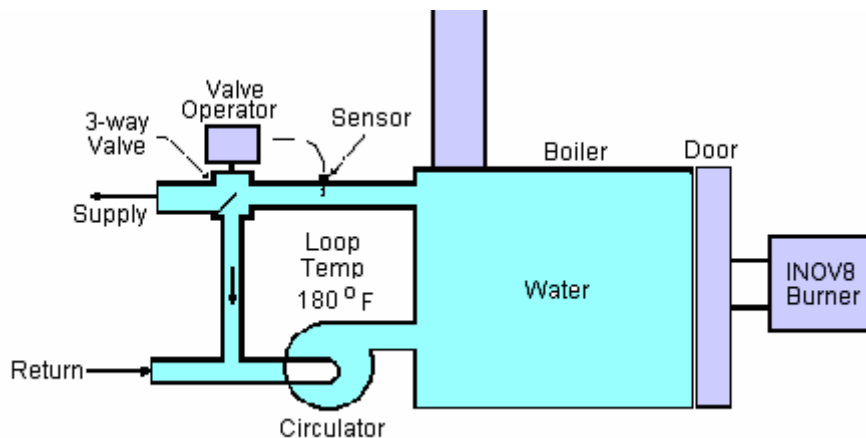
In multiple unit installations, arrange boilers so that space is provided on all sides of the boiler and the manifold piping does not obstruct access. Provide appropriate valving on each boiler so isolation can be obtained and still maintain system heating of working units. The INOV8 dealer can provide recommendations for the most efficient installation of multiple units. The installations will vary depending upon the unique layout of the facilities.

BOILER OPERATING TEMPERATURE

A boiler has a nominal wall temperature of 180°F wherein the corresponding temperature in a furnace may be over 800°F. Neither of these is of concern while burning #2 fuel oil but inherent stray oil in waste oil burning will accumulate as a tar-like substance on the low temperature wall of the boiler. The INOV8 boiler uses a stainless steel sleeve around the flame initiation zone along with the requirement that the boiler temperature be maintained at a nominal 180°F to prevent a build-up of oil on the walls.

Hydronic circulators and control systems are commercially available that will retain all heat generated within the boiler until the boiler temperature reaches a pre-set operating temperature of a nominal 180°F, similar to automotive engines. Starting with a cold boiler, all heat generated will re-circulate within the boiler until the set temperature is reached. As continued firing occurs, a thermostatically controlled valve will open to share this overage heat with an external load. It is essential that water is re-circulated within the boiler during all firing times. Such a system is necessary to complete combustion of stray oil droplets that will deposit on the boiler wall if the temperature of nominal 180°F is not maintained. See the following figure for an illustration of the preferred hydronic circuit and control valve that will maintain boiler water temperature at a high level as normally occurs in an automotive engine.

Figure 2 - Hydronic Circuit & Control Valve Illustration



INSTALLATION DETAILS

ATTACHING THE BURNER TO THE BOILER

Carefully remove the burner and components from the shipping box. Be careful when handling the burner, as the electrodes and the flame retention head are factory set and if either are bumped or moved, the operation of the burner could be affected. If the electrodes get out of adjustment, refer to page 24 for a diagram of the proper electrode settings. The burner has been pre-fired in the factory prior to shipping and will have oil in it. A plug has been installed in the pump for shipping and should be removed carefully to avoid spilling oil.

INSTALLING THE BURNER:

1. Place the burner gasket onto the air tube.
2. Remove the three 3/8"-16 nuts from the burner mounting plate studs.
3. Place burner on mounting plate studs.
4. Now tighten the 3/8" nuts that hold the burner to the mounting plate.

INSTALLING THE ELECTRICAL PLUG

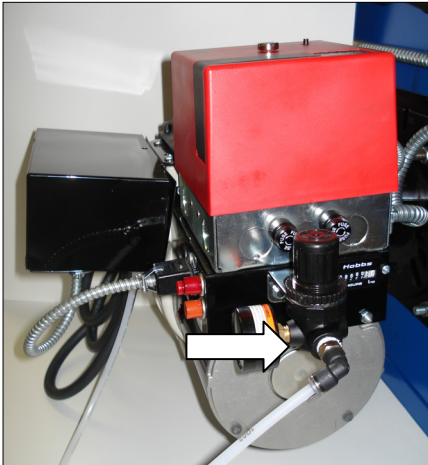
Insert the round burner power plug into the socket provided on the bottom of the electrical junction box that houses the on/off switch with a corresponding light and relays.

ELECTRICAL HOOKUP OF THE BOILER

1. Remove a convenient knock-out from the electrical junction box to allow connection of your electrical supply conduit.
2. Attach the hot wire (typically black) to the 6" black pigtail.
3. Attach the Neutral wire (typically white) to the 6" white pigtail.
4. Attach the earth ground wire to the 6" green pigtail that comes off of the junction box.

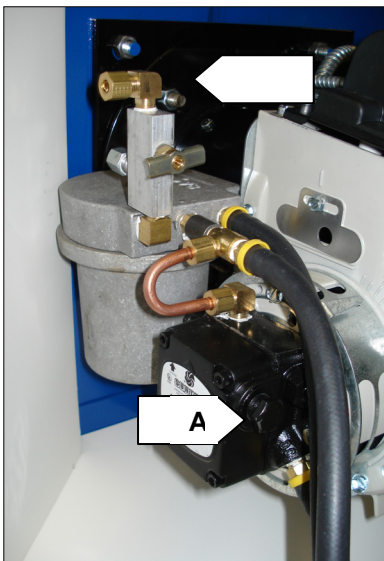
ATTACHING THE AIR CONNECTION

The air regulator assembly is in a plastic bag in the burner box.



1. Remove the screws and all necessary parts from the plastic bag.
2. Mount the 'L' shaped bracket to the right side of the burner just above the end of the motor (as shown in the photo at right).
3. Secure with the two screws that are provided.
4. Then mount the air regulator into the bracket, securing it with the black plastic ring nut.
5. Connect the 1/4" air line into the right-most fitting in the bottom of the module block. It just slides in and locks. It can be removed by pushing up on the ring on the fitting and then pulling the line back out.
6. There is a 1/4" NPT hole in the regulator into which you can install a quick-disconnect type of fitting. To this connect the air supply line coming from the compressor. The regulator will be set during the section on "Operating the Boiler".

ATTACHING THE OIL DELIVERY LINE ('A' IN PHOTO)



Specifics on the oil storage and plumbing are covered in the section titled "Tank & Piping Considerations" starting on page 16. The items in that section must have been completed in order to have an oil supply line run to the burner at this time. Assuming the line is in place: the oil supply line will connect to the inlet port of the pump on the burner. There are two inlet ports: one on the bottom of the pump and one on the side. Connect to the one on the side. Attach the line to the pump via a 1/2" x 1/4" NPT flare fitting and use the corresponding female portion with a barb fitting to attach to a flexible oil line. DO NOT do the following:

- plumb the line directly into the pump,
- use any compression fittings,
- use rigid line that will be difficult to remove for servicing the burner.

Be sure to seal the 1/4" NPT threads of the flare fitting at the pump inlet. ONLY Use pipe sealant suitable for waste oil, such as Loctite #565.

ATTACHING THE RETURN LINE ('B' IN PHOTO)

As noted in the section "Installation of Vent Line from Vapor Eliminator Back to the Tank" on page 17, a 1/4" O.D. (minimum) copper or plastic line must be installed from the burner back to the tank. This line will connect to the brass elbow on top of the oil pressure release mechanism via the compression nut and ferrule supplied on that elbow. There will be no pressure in this line as long as the line is open all the way back to the tank. It is ABSOLUTELY IMPERATIVE that no valves or other constrictions be placed or allowed to exist (like crimps) in this line.

BLOCKED VENT SWITCH—SUPPLIED WITH CANADIAN BOILERS (OR OPTIONAL)



The Blocked Vent Switch responds to hot flue gases backing up through its heat transfer tube during a blockage and shuts off the burner. The Backflow Sensor Switch is supplied with boilers shipped to Canada (or as an optional purchase) and must be installed in accordance with these instructions and those that accompany the switch, that are abbreviated here.

1. Drill or pierce a clean hole (about 3/4" diameter) in the vent pipe near the heater outlet.
2. The heat transfer tube must have the fiber gasket installed against the mounting plate before attaching the unit to the vent pipe.

3. Insert the heat transfer tube with gasket into the 3/4" diameter hole placed in the vent pipe during step 1.
4. Secure the assembly to the vent pipe with a minimum of 4 sheet metal screws. The channel must be mounted horizontally.
5. Refer to the electrical diagram in the Addendum for wiring connections – DO NOT refer to the diagrams that accompany the switch.

This switch requires annual inspection and maintenance to remove any ash buildup on the thermal switch surface.

AIR SUPPLY INSTALLATION

There are two air supplies used in the combustion process. Combustion air entering the chamber through openings in the burner housing, located next to the oil pump, is referred to as "secondary or combustion air". Air is also supplied to the nozzle under pressure in order to atomize the oil into small particles for burning. A shop air compressor supplies this air. This compressor air is referred to as either primary air or atomizing air. Installation of the primary air is described below:

1. A continuous supply of compressed air (2.0 CFM at 30 psig) is required to operate the boiler. The boiler includes a factory provided pressure regulator rated at 300 PSIG with a gauge rated to 160 PSIG inlet for shop air. The connection requires 1/4 " NPTM. The pressure regulator is located on the right side of the burner housing (see photo on page 11) and controls air for use in atomization.
2. The shop air must be free of dirt and water. A filter should be installed in the line before attaching to the INOV8 burner. Do not attach the shop air directly to the burner module as damage will occur from the high pressure.
3. Air may be piped directly from the air compressor supply tank by using 1/4-inch (or larger) pipe, seamless copper tubing, or air hose. If piping or rigid tubing is used it is recommended that a short piece of hose be used to connect to the air regulator (on the burner) in order to swing the burner away for cleaning the combustion chamber. If air hose is used, it should have a minimum burst pressure rating of 300 psig.
4. Water routinely condenses in the air lines of a shop compressor and must be removed periodically. Water must be kept to a minimum to prevent component failure and operating problems.

Note – If there are concerns for leaving the air compressor on during nights and weekends, INOV8 has a compressor protection device available.



NOTE

CHIMNEY INSTALLATION

To dispose of flue gases, venting must be installed per NFPA #31 "Installation of Oil Burning Equipment" and all local codes. National and state codes concerning the chimney are sometimes confusing. It is important that you consult your local or state Fire Prevention Officer prior to installing your chimney. Most codes recommend that a "Class A" stainless steel lined insulated chimney be used from a point 18 inches below the ceiling to the top of the rain cap. The purpose of the insulated chimney is primarily to protect combustible building materials from high temperature, but it also supports the chimney draft and prevents harmful condensation within the chimney. For each gallon of oil burned, there is a gallon of water vapor generated as a product of the combustion process. This water vapor can condense inside the chimney in cold weather. Some waste oils contain various ingredients that will form acids when combined with the condensation. These acids will prematurely corrode non-insulated, non-stainless steel piping.

The purpose for the chimney is to provide a safe removal of the products of combustion and protection of structural members of the building from excessive temperature. The stack must be installed the proper distance above the roofline to avoid down drafts. Also, make sure the flue pipe connected to the boiler can be easily removed and swung out of the way for ease in cleaning. These additional guidelines should be followed:

1. See Chart #1 - Boiler Specifications for the proper size of chimney to install with your boiler system. It is extremely important to install the proper size to ensure adequate combustion air to your burner. If the proper size is not installed, INOV8 voids any performance warranties on the boiler system.
2. When installing multiple boilers, each boiler must have a dedicated draft inducer. It is not recommended, but if there is no other option the separate chimneys can then be connected to a common chimney large enough to handle the combined gas flow. If necessary, additional draft support must be installed to insure a negative draft over the fire of -0.02 to .07. That could require more chimney sections, another draft inducer and/or installing a sealed combustion kit onto the burner.
3. DO NOT reduce stack sizes, or lengths, or use improper components.
4. Use single-wall stack for INTERIOR CHIMNEY ONLY! Stack temperatures are 300° to 600°F and must be installed with proper clearances from combustible surfaces.
5. A metal ventilated, approved thimble must be used when passing through a combustible wall. Once through the wall, DO NOT use a single-wall component.
6. Never locate a joint inside walls or in a joist spacer.
7. The last stack section must extend at least 3 feet above the highest point at which it comes in contact with the roof, and at least 2 feet higher than any ridge, parapet wall or roof structure within 10 feet of the chimney.
8. Install a non-restrictive stack cap (rain cap). In extremely windy locations, a Breidert type vent cap is recommended.
9. DO NOT over fire the boiler system! You should never see smoke coming from the stack.

INSTALLING THE OPTIONAL DRAFT INDUCER

A draft inducer is a motor driven fan that attaches to the chimney for the purpose of augmenting the natural draw of that chimney. It may be necessary to install a draft inducer on chimneys that fall short of providing sufficient draft for some reason or other, but a draft inducer is not a cure-all: It provides no relief for resonation problems that can occur in horizontal runs, for instance, and it cannot overcome the effects of an exhaust system operating within the building. If your installation requires the assistance of a draft inducer, install it according to the following guidelines:

Install it just above the barometric draft control (if used) in a vertical section, on the opposite side of the chimney from where the boiler flue pipe enters. Avoid mounting in horizontal sections for these reasons: a) ash will accumulate on the blades, b) it will be exposed to excessive heat, and c) it will need to be supported in some manner. A red wire is provided in the boiler's electrical junction box which functions to control a relay that turns the draft inducer on at the proper time. Wire the draft inducer and relay in accordance with the electrical wiring diagram. Draft inducers are adjustable and may need to be adjusted to obtain proper draft.

INSTALLING THE BAROMETRIC DRAFT CONTROL

When a **draft inducer** is used in a boiler chimney it is generally **not** necessary to also use a barometric draft control. However if there is an excessively high chimney or high draft created by a chimney, then this should be used. The best location for the barometric draft control is in the first vertical section within one to three feet of the boiler, and before the draft inducer. The flapper on the barometric draft control should be installed so it is facing away from the fan on the boiler. The flapper must be vertical when closed. Use a spirit level to make sure the barometric draft control is plumb in all directions, regardless of whether the flue is horizontal, vertical or sloping. Do not attach the barometric draft control in a horizontal section of flue pipe or in a room separate from the boiler. See the photo on page 5. Additional installation instructions are included with each damper.

INSTALLING AN OPTIONAL SEALED COMBUSTION SYSTEM

Refer to the burner diagram on page 20 for identification and location of parts.

1. Remove the oil supply line (item #4 on drawing) from the burner pump.
2. Remove the copper 'U' shaped tube just above the pump.
3. Disconnect the pump outlet hose from port 'C' under the module. Remove the other end of the hose from the oil pump.

4. Remove the two bolts that secure the oil pump to the burner casing.
5. Remove the oil pump. (The plastic pump shaft drive coupling is made of three parts: some, all or none of which might remain on the pump shaft during removal. Put it back together if necessary and slide it all onto the motor shaft.)
6. Remove the two screws that secure the disk shaped secondary combustion air bands to the burner casing. The screws are just above and below the pump.
7. Remove the disk shaped air band. (It will not be re-installed.)
8. Loosen the cinching screw that binds the disk shaped secondary combustion air band to the burner casing and remove the bands. (It will not be re-installed.)
9. Install the provided 45° 'street' elbow into the hole in the pump from where the hose was earlier removed. Use thread sealant and turn it to a position such that the outlet of the elbow will be horizontal when the pump is remounted.
10. Install the provided sheet metal air boot onto the extended casing of the burner. The provided sponge rubber gasket will seal the boot to the burner casing. The two slots in the gasket will line up with the two oil pump bolt holes. (Rotate the air boot until the left side is essentially vertical.)
11. Using bolts saved in step 4 above, re-install oil pump with coupling connecting both shafts. Be aware that the flat on the pump shaft must align with the flat side in the coupling. Don't tighten the bolts yet
12. Re-attach the copper 'U' bend removed earlier.
13. Wiggle the boot to make sure it's properly seated. Then tighten the pump bolts.
14. Attach the pump hose to the 45° 'street' elbow. Use thread sealant.
15. Re-attach the other end of the hose to port 'C' under the module block.
16. Re-install the oil delivery line to the pump inlet with 1/8-27 NPT 45° street elbow.
17. Cut a 4" round hole through the wall near the chimney. The termination of the vent must be on the same plane as the termination of the chimney.
18. Install the provided air intake mechanism and secure it to the wall.
19. The termination of the vent pipe must be at the same plane as the chimney pipe.
20. Connect the f" port on the intake mechanism to the 4" port on the sealed combustion boot with solid vent hose (Not provided)
21. Secure the hose at both ends with hose clamps. (Not provided)
22. Set the combustion air adjustment knob in the boot to around 60.
23. Assure that the barometric draft control flapper is sealed shut and can no longer function.
24. Start the boiler and allow time for the chimney to get hot.
25. Make further adjustment to the combustion air as necessary to produce a good flame. You want as little combustion air as possible to produce a clean flame. Check the draft to be sure the setting is proper.

NOTE: *It is important that the air brought into the burner through the sealed combustion adapter boot is allowed to warm up. Cold outside air will cool the preheated oil and cause combustion problems. Longer lengths of vent pipe and/or running it along side the boiler are two options for pre-warming. Call the factory for other suggestions.*



NOTE

DRAFT MEASUREMENTS & ADJUSTMENTS

The draft should be measured only after the installation is complete and the burner is operating long enough for the boiler to get up to temperature. The draft inducer should be adjusted so the draft reading is between 0.02 to 0.07 inches of water in the combustion chamber. As the ash of burning waste oil accumulates in the boiler, the draft over fire will decrease leading to dirty combustion if the boiler is not cleaned. There are pressure switches available that can be used to sound an alarm if the draft over-the-fire becomes too small indicating a dirty boiler. The cleaning frequency depends on the amount of ash in the fuel being burned, i.e. lubricating oils have the most ash, solvents and #2 fuel oil have none. Vegetable oils may leave some debris depending upon the preheat temperature and the type of oil. Burning lubricating (or crankcase oil) generally requires cleaning every three to four weeks but each boiler setup will differ depending upon the type of oil, filtering of the oil, the temperature of the Aquastat setting on the boiler and the preheat temperature of the waste oil.

INOV8 recommends using a Dwyer Pressure Gauge, Draft Right or Bacharach Draft Gauge. Draft measurements must be re-done any time there is a change in the air band setting located on the burner housing (secondary air). Follow these instructions for measuring the draft over the fire and the flue draft:

1. Check the draft while the burner and draft inducer are running. Insert the draft gauge into the port located above the burner by the sight glass. Remove the brass fitting to allow draft measurement. The measurement must indicate a draft of between 0.02 to 0.07 inches of water for new installed or newly cleaned boiler systems. The boiler system will not operate properly with a positive draft. The ash must be removed to restore the draft to the recommended level.
2. Insufficient Draft or Back Draft. Building infiltration will generally provide enough air for combustion. However, several conditions may result in positive air pressure within the boiler system and cause a back draft of flue gases. These include the operation of building exhaust fans without adequate air make-up equipment, high winds, and excessive ash buildup. Positive pressure can be detected if combustion fumes are smelled in the building or the burner begins pulsing. If either situation occurs the boiler system must be manually shut off by either turning down the thermostat or by shutting off the power.

ELECTRICAL SUPPLY & AQUASTAT INSTALLATION

National codes require that a licensed electrician install the electrical portions of this boiler system, and that the installation be in accordance with ANSI and NAPA 70-1990 National Electric Codes. The proper storage and handling of oil is monitored by the federal EPA and most state environmental agencies, such as the Department of Natural Resources (DNA). Guidance for the storage and the disposition of used oil can be found in NAPA section 31 - the Flammable & Combustible Liquids Code. Some states have adopted more stringent regulations and must be identified and adhered to. Your installer is responsible for knowing these regulations and of any pertinent application and/or approval requirements for your oil storage system. See page 44 for the electrical diagram.

WIRING GUIDELINES

The boiler system typically requires a 20-amp ground fault protected circuit breaker in the distribution panel but may vary due to loading by customer installed devices whose current draw is unknown to INOV8. The following devices must be considered:

1. The INOV8 burner – approximately 10 amps.
2. The boost pump motor – 3.5 amps (if supplied by INOV8).
3. The draft inducer motor (if supplied by INOV8): Tjernlund model D-3 has .96 amps.
4. The circulating pump motor – not provided by INOV8. See motor for amp draw.

The INOV8 burner and control for the boost pump, draft inducer and circulating pump will all draw their power from the 20 amp wall breaker; however, the boost pump and draft inducer are controlled by relays and so may receive their motor currents from sources other than the 20-amp breaker. The installer may also wish to control the circulating pump via a relay off the Aqua stat, in which case the circulating pump motor can be on another power source as well.

Two conductor 12 gauge wire with safety green ground is recommended. The power load specifications for the boiler are also found on the boiler system label. Do not operate the boiler system on less than 110 volts or more than 130 volts. Your boiler system must have a proper dedicated electrical circuit to avoid overloads and to comply with code. **Never use an extension cord or tie into existing circuits.** The combustion controller cannot carry the extra amperage necessary to operate a boost pump or a draft inducer directly. It is thus necessary that relays be used to protect the controller. The relays are supplied in the electrical control panel.

INSTALLING THE VISSMANN VITOTRONIC 100 CONTROL

1. Mount the control per Viessmann's instructions.
2. Two cables from the control will be brought into the electrical junction box supplied by INOV8. They are the cables that attach to connectors 40 and 41 on the Vitotronic circuit board. You will attach them to those connectors and then remove the connectors (or plugs) from the other ends of the cables. Route the cables between the boilers covers and insulation into the electrical junction box and connect them to the labeled wiring existing in the junction box as shown in the electrical diagram on page 44.

OIL STORAGE, FILTERS & PIPING CONSIDERATIONS

OIL STORAGE CONSIDERATIONS

The proper storage and handling of oil is monitored by the federal EPA and most state environmental agencies, such as the Department of Natural Resources (DNR), your local Fire Marshall and/or the Regional Environmental Protection Agency. Some states have adopted more stringent regulations which must be identified and adhered to. Your installer is responsible for knowing these regulations and of any pertinent application and/or approval requirements for your oil storage system.

Federal and some state and local regulations restrict the burning of gasoline, paint thinners and other volatile (low-flash point) solvents, PCBs, benzenes (carburetor solvent), and fluorinated hydrocarbons (refrigerants). DO NOT add anti-freeze, oil additives, or paint as these will not burn and cause operating problems.

The instructions found in this manual are general guidelines; exact local regulations must prevail. Installation of the oil storage and piping must be done by a licensed or qualified installer in accordance with the pertinent state and local codes and the nationally accepted standard, NFPA 31 – Standard for the Installation of Oil-Burning Equipment 2006 Edition.



ADDITIONAL OIL STORAGE CONSIDERATION

Many operational problems can be eliminated if proper care is taken in setting up an oil storage system. All waste oil contains substantial amounts of water and sludge, both of which settle to the bottom of a tank over a period of time. A storage system that allows sufficient settlement time will provide trouble free operation. A two-tank system is recommended allowing one tank to settle while drawing from the other.

Use a fill pipe when adding oil. This fill pipe should extend to within two inches of the bottom of the tank to minimize the disturbance of the upper oil that is supplied to the burner. At least once a year the water and sludge should be drained off the bottom of the tank. If not drained, the pump will draw the water and sludge into the filters and may cause a shutdown in operation. The tank should be located in close proximity to the boiler. Inside, outside or buried tanks must be used in accordance with state and local installation codes.

PIPING & CONNECTIONS RECOMMENDATIONS

Air leaks in the oil line will cause sporadic operation. The pipe or tubing size is important for the best operation of the pump. The following recommendations will produce airtight connections and trouble-free operations.

1. If the storage tank is inside the building, use 1/2" i.d. (Up to 30 feet to the boiler).
2. If the tank is more than 30 feet away then 1" i.d. or bigger is required (depending on the distance).



3. Copper piping or iron piping can be used if care is taken with each joint and the line has a continuous upward incline of at least 1-inch per 1 foot to vent air to the burner. Flexible copper tubing may be suitable. When using soft copper tubing or plastic tubing *flare fittings* are required. Proper sized copper tubing with proper flare fittings has the least potential for leaks. DO NOT use numerous short lengths of pipe as each fitting is a potential source of a leak.
4. **At no time should pipe unions or compression fittings be used. Sealant (such as Loctite #565, Swak, p/n MS-PTS-6, or Permatex #2 Non-hardening Gasket Sealer) must be used on all pipe threads.**

VAPOR ELIMINATOR FILTER / PRESSURE RELIEF ASSEMBLY

The filter element in the vapor eliminator canister can plug up over time due to the normal collection of debris. When the filter is plugged, an amber light on the burner will come on while the burner is firing to indicate that the filter should be changed. If the filter is not changed, the pressure relief assembly will vent the over pressured oil back to the tank through the 1/4" return line. The vapor eliminator/pressure relief assembly located on the burner (see items #2 and 26 on page 20) serves three functions:

1. It vents any vapors that accumulate in the burner's oil circulating system back to the oil supply tank.
2. It filters the oil as it is heated and re-circulated at the burner.
3. It shunts the full volume of the pump back to the tank in the event the vapor eliminator filter should become totally plugged.

INSTALLATION OF VENT LINE FROM VAPOR ELIMINATOR BACK TO THE TANK

A minimum of 1/4" copper line or plastic tubing must be run from the compression fitting on the pressure relief assembly (see item #13 on page 20) back to the oil supply tank. There must be no valves or constrictions in this line. See "Burner Ignition Start-up" for adjustment of the valve controlling flow through this line.

1. Insert one end of the return line into the nut and ferrule (provided) on the pressure relief valve on the vapor eliminator.
2. Run the line along the oil supply line back to the oil storage tank through an available opening. Make sure the return line nearly touches the bottom of the tank to prevent loss of prime in the oil supply line. If no opening is available, use a "T" fitting to share an opening with the either the oil supply (that feeds the burner) or fill opening.
3. While the burner is running there should be a steady rapid drip (not a stream) coming from the end of the return line. Adjust the valve accordingly. Excessive flow will take all the hot oil back to the tank, inadequate flow will cause vapor to build in the burner.

TANK FILTER

INOv8 provides an in-line filter assembly to be installed in the oil supply line. This filter will need to be changed every six months or as indicated on the filter restriction indicator; the frequency depends on the type of oil. This filter is a General Filter, model 11V-R2000K Gar-Ber Fuel/Water Separator. It has a machined aluminum head. The filter dimensions are: 9" H x 4-3/4" W. It comes with a 1/8" vacuum bleed port, a 3/8" NPT inlet and outlet, has 10 micron removal, filtering area of 500 square inches, working pressure of 15 psig and a flow rate of 90 gph, and is UL listed. Replacement elements require part number R2000 Epoxy-coated Disposable Spin-On Filter.

BENCH TANK INSTALLATION

Tanks are available in a variety of sizes and configurations. Our model T300 HB, a 300 gallon tank is specially designed to handle the settling requirements for waste oils. The bench tank comes fully supplied with all necessary fittings for a complete installation. Many states and cities have additional regulations regarding the storage of waste or other fuels that may require stricter measures. It is very important to check with your local fire inspector, or the proper authority, or a qualified tank installer regarding the requirements in your area. Refer to these steps for a basic installation.



Installation Instructions

1. It's generally a good idea to locate the bench tank on an outside wall for ease in venting the tank.
2. There are four openings on top of the tank, to be used for:
 - a. The fill – left front, 2"
 - b. The gauge – back middle
 - c. Venting – left back, 3"
 - d. Supply line to burner, right back, 2"

BOOST PUMP (OPTIONAL)

INOV8 supplies two different boost pumps: 1) an electric gear pump manufactured by Suntec Industries, and 2) a Husky diaphragm pump manufactured by Graco Industries. Both do a fine job moving waste oil from a storage tank to the burner. The installations are different in that the Suntec pump requires an electrical connection to power the pump, while the Graco pump requires air pressure to drive the pump. Both pumps require an oil regulator assembly to reduce the oil pressure to the burner.

- Suntec pump: The pump **MUST** be mounted so the motor / pump shaft line are horizontal and the pressure relief valve in the boost pump must be set to 20 PSI. The pump will not work if mounted upside down. See the electrical hookup for the boost pump on the electrical diagram on page 44.
- Graco Diaphragm pump: an air pressure regulator and gauge assembly must be installed in the airline prior to the pump. The air regulator controls the pumping pressure and is usually set at 30 - 40 PSIG. This may be varied to accommodate your installation. Instructions accompany the pump and must be followed for the installation.

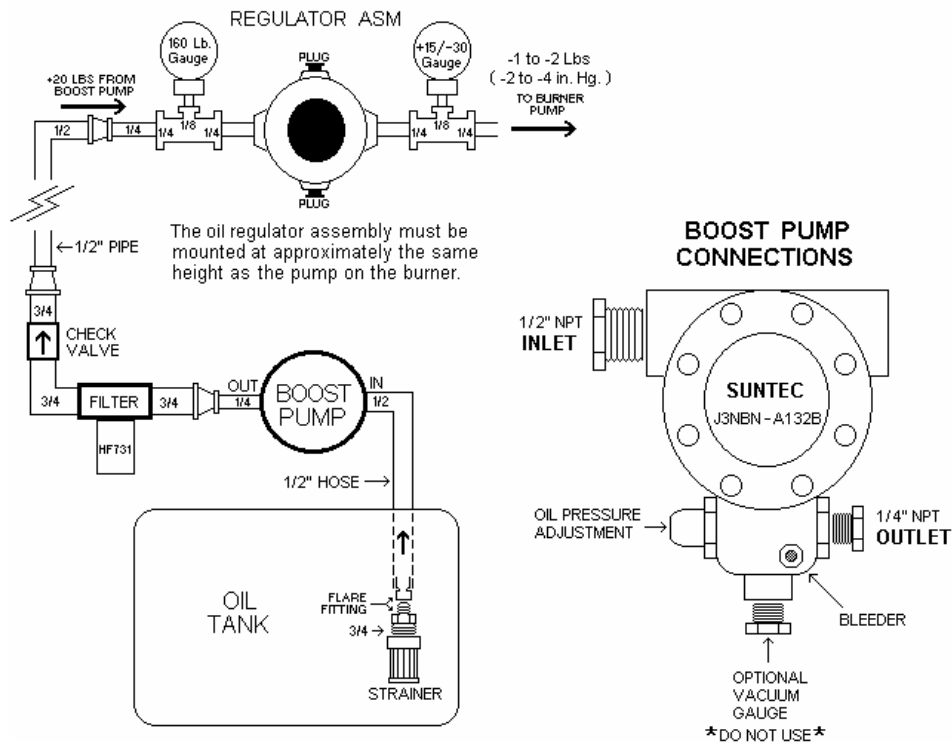
Follow these guidelines for either pump:

1. Install the boost pump as close to the oil tank as local code allows, but always inside the building. Keep the suction line and suction lift as short as possible. The maximum horizontal suction run is 30 feet and the maximum suction lift is 4 feet.
2. Make sure the boost pump can be easily primed and serviced and it is protected from water and combustible fumes. A strainer (not supplied by INOV8) should be installed at the end of the oil suction line within the tank to protect the boost pump from debris.
3. Locate the filter/check valve assembly at a convenient location between the boost pump and the oil pressure regulator assembly (supplied by INOV8 with boost pumps). Connect to the outlet side of the boost pump with 1/2 inch copper tubing.
4. After the proper piping/tubing has been installed the pump may be turned on for priming. For the Suntec Pump, leave the bleeder port of the boost pump fully open until all entrapped air is purged from the suction line (at least one-gallon of oil). When a steady stream of oil is flowing, close the bleeder port and snug it tight with a 3/8" wrench. If the oil stream fluctuates and sputters, check for air leaks in the suction line.

5. An oil pressure regulator and gauge assembly must be installed near and at the same height as the burner.
6. The oil line between the tank and the boost pump must be absolutely airtight so the pump does not suck air. It is very important that pipe compound be used on all fittings and that they are tight. Pressure test the line prior to use. Follow the recommendations in the following section for installing the piping.

If multiple boilers are installed, one boost pump will supply a maximum of three burners; however, a separate filter and regulator assembly is necessary for each boiler. See drawing for additional details.

Figure 3 - Diagram Showing Installation of Suntec Boost Pump, Filter, Check valve, Regulator & Gauges

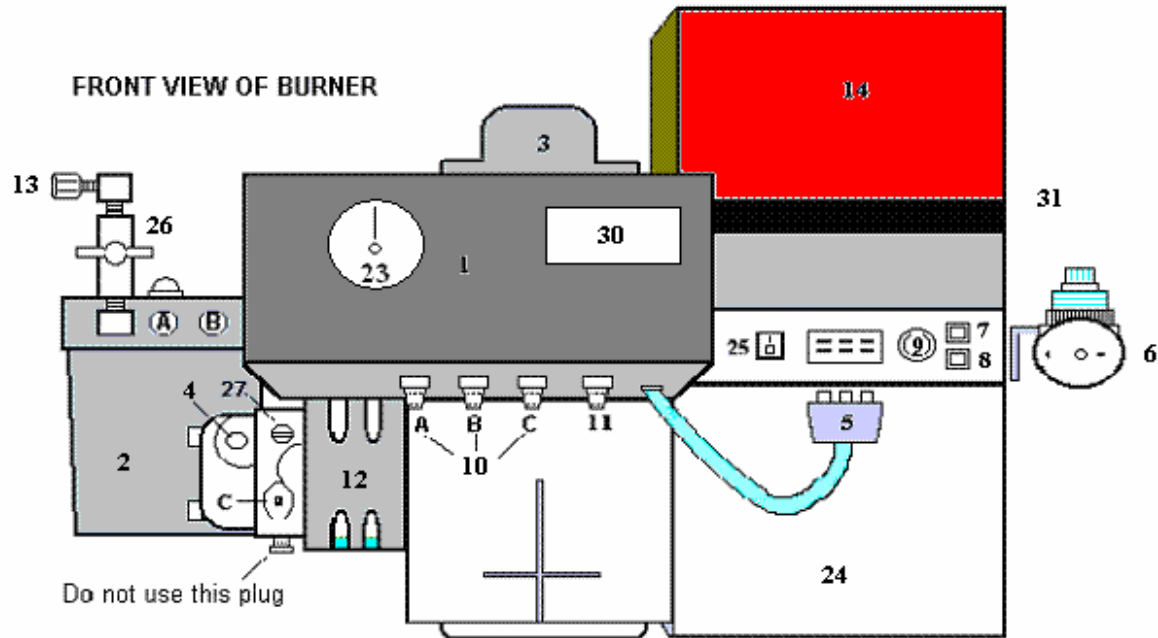


NOTE: The boost pump can be mounted at or below the level of the oil tank BUT MUST NOT be mounted more than four feet above.

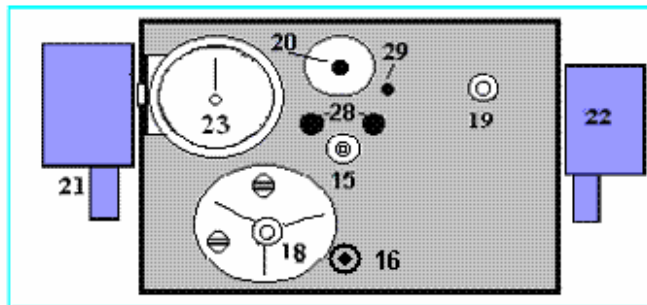


ALSO: The (+) (-) gauge on the outlet of the regulator shows positive (+) pressure in pounds per square inch (PSI) and negative pressure in inches of mercury (in. Hg). One PSI is equal to two inches of mercury and, with earth's air pressure being around 15 PSIG at sea level, a reading of -30 inches of mercury is equal to a complete vacuum. A setting of -4 on this gauge should be adequate. If the pressure falls below -10 there is an increased chance that you will start sucking air through the pump seal or fail to get adequate firing pressure due to normal pump wear. Positive pressure on this gauge means you are shoving oil into the burner pump. The internal regulator in this pump will regulate properly only when the pump is sucking on the inlet line – so don't run with a positive pressure on this gauge. A good rule of thumb for setting the pressure is to first set the regulating screw in the burner pump at mid range and then adjust the external regulator for a proper flame length. This allows you to make future flame length adjustments using the burner pump pressure regulator screw – which is the correct procedure.

Figure 4 – Burner Diagram



EXPANDED VIEW OF MODULE CONTROLS



KEY

1 - Module	16 - Temperature controller probe
2 - Oil filter & vapor eliminator	17 -
3 - Ignition transformer	18 - Dirty filter pressure switch
4 - Oil supply (port) connection on pump	19 - Air connection
5 - Module plug	20 - Bimba cylinder & needle
6 - Regulator for shop air supply	21 - Oil solenoid
7 - Safety shutdown light - red	22 - Air solenoid
8 - Dirty filter light - amber	23 - Oil pressure gauge (0-60)
9 - Ignition transformer test switch (red button)	24 - Burner motor
10 - Oil line connections	25 - Heater rocker switch (black)
11 - Air connection from regulator	26 - Pressure relief valve
12 - Secondary air adjustment	27 - Oil pressure adjusting screw
13 - Return vent line connection	28 - U-bend cleanout holes
14 - Combustion controller	29 - Air apportioning adjusting screw
15 - Heating element	30 - LED temperature controller (new in 8/07)
	31 - Fuse & circuit breaker location

FINAL INSTALLATION CHECKLIST

DO NOT operate your boiler until it is properly installed in all respects and your installation meets all applicable national and local codes! Correct any deficiencies prior to operation.

1. Were all items identified on the "Parts List" received in good order?
2. Was this boiler installed by a qualified HVAC installer?
3. Has the Installation Manual been reviewed thoroughly?
4. Have all oil, air and vent connections been checked ?
5. Have the oil lines been installed according to specifications?
6. Have you verified compressor air quality?
7. Have you met draft specifications?
8. Have you verified oil quality?

SECTION 3 – OPERATING THE BOILER

FIRST START-UP OF BOILER

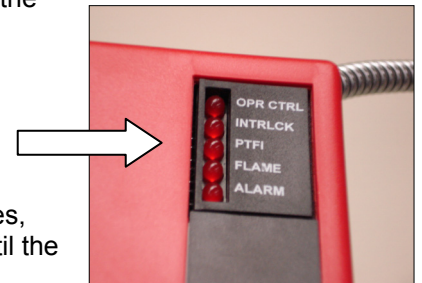
If this is the first time firing the boiler there will be no oil in the supply system and it will have to be primed. The following section tells how to do that. Once primed, the next step is to fire up the boiler.

PRIMING THE OIL SYSTEM

1. Push the heater switch into the ON ('1') position and disconnect the 6-prong module plug. This will allow the burner pump to run without the burner trying to fire during the priming.
2. Turn the system power on by turning up the wall thermostat and/or setting the Aquastat to the desired temperature.
3. (Power to the burner will start the burner motor that drives the oil pump.
4. If your oil delivery passes through an external oil pressure regulator assembly (typically installations with a boost pump installed), screw the knob of the regulator all the way in to set the regulator to the maximum open position.
5. Open the valve on the oil pressure relief mechanism to allow oil to flow back to the tank through the return line. If after a few minutes it seems that no oil is being drawn up to the burner, screw the oil pressure adjusting screw (item #27 on figure 5) all the way in and see if that helps.
6. When oil flow through the return line is steady, reduce it to fast drips.
7. If you screwed the knob of the external oil regulator assembly all the way in back in step 3, unscrew it until the larger gauge on the oil regulator assembly reads -2 in Hg. This gauge will be very slow to react so keep correcting the adjustment until -2 in Hg. Becomes the constant reading.
8. Turn the wall thermostat down until the burner motor stops.
9. Plug the 6-prong module plug back in. DO NOT try to force this plug back in as it will only go in one way.
10. If you screwed the oil pressure adjusting screw in back in step 4 then unscrew it back out now to where it's flush with the nut.
11. The burner is now primed and ready to be test fired, at which time the air and oil pressures will be set.

FIRING UP THE BOILER THE FIRST TIME

1. Set the Heater Switch ON if burning waste oil, OFF for diesel, etc.
2. Adjust the Air Regulator between 30 and 35 PSIG (unless installing the B650, then refer to Chart 1 for setting the dual air regulators).
3. Turn on the power to the system by turning up the wall thermostat and/or setting the Aquastat to the desired temperature.
4. The following sequence of events will then take place:
5. The burner power will come on (the Aquastat calls for heat).
6. The burner pump will start circulating the oil through the burner.
7. If the HEATER SWITCH is ON, the oil will begin to heat and, after about 5 minutes, will be hot enough to turn on the INTRLCK light. The INTRLCK light will blink until the oil reaches temperature.



8. If the heater switch is OFF, the INTRLCK light will come on immediately. Note: The INTRLCK light is ON when it quits blinking and comes on solid.
9. The INTRLCK light coming on starts the PRE PURGE cycle.
10. The draft inducer turns on.
11. At the end of the PRE PURGE cycle which is 90 seconds, the PTFI light comes on.
12. PTFI light ON means the burner is trying to fire.
13. During the period that the PTFI light is on (and thereafter if the burner fires) the air pressure can be corrected to 30 psig if necessary and the oil pressure can be set to produce a flame that falls just short of hitting the far end of the burning chamber. Look through the viewing port. See Chart 1 for the appropriate oil pressure setting. Be aware that oil pressure can be adjusted ONLY when PTFI is on or the burner is actually firing. Also be aware that the air pressure typically drops a number of pounds from where you had it preset as soon as the PTFI light comes on.
14. Adjust the return line oil flow to a very rapid drip.
15. If the oil is coming through an external regulator assembly, set the external regulator so that the +/- outlet gauge on the assembly reads in the minus 2 to minus 4 range with the oil pressure adjustment on the burner pump set to produce a flame of the correct length.
16. After its runs 10 minutes, check the draft and CO₂ reading. (See Maintenance Procedure: Checking the Draft.)
17. When obtaining the CO₂ readings use a combustion analyzer or equivalent measuring device. With a clean heat exchanger and proper oil and air settings the CO₂ should be within a range of 9 to 12%, and a Bacharach smoke reading not greater than No. 1.
18. If the CO₂, smoke reading and draft are OK then your installation is complete. If not, call INOV8 service and we'll take you through the possible causes.

*****DO NOT LET IT RUN WITH NO DRAFT*****

NORMAL OPERATION OF BOILER

After completion of the above steps, the operation of the INOV8 Boiler is automatic. For a more complete description of how the burner works, see Theory of Operation starting on page 40.



NOTE

If the flame is extinguished while in the "RUN" sequence the combustion control will terminate oil flow in 3 seconds and revert back to a 90 second purge. The burner will make one attempt to re-establish the flame for each time the burner has reached the "RUN" mode. If flame is not established during the first 10 second "PTFI" Pilot sequence, the Fireeye combustion control will terminate oil flow in 10 seconds and revert to a full safety shutdown that requires a manual reset. Safety shutdown will be indicated by the red light on the control panel. Depress the reset button (located on the top of the controller box) and hold it down for at least one second to reset the burner. If a safety shutdown occurs again, refer to the Trouble Shooting section of this manual.

Chart 2 – Factory Settings

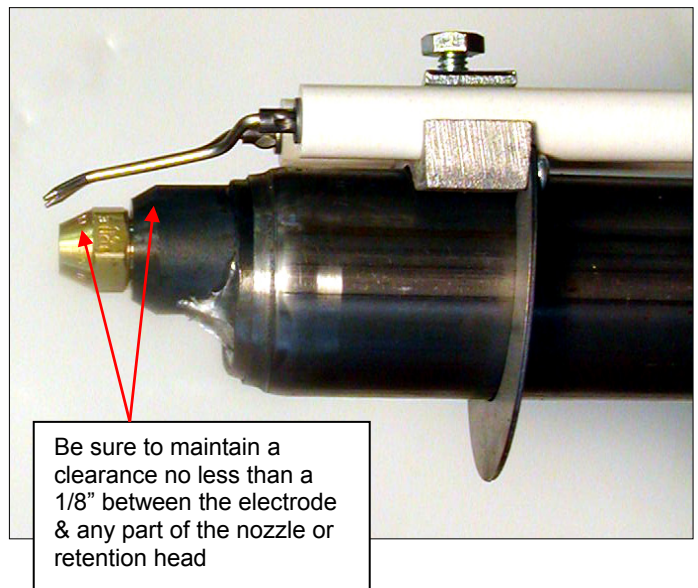
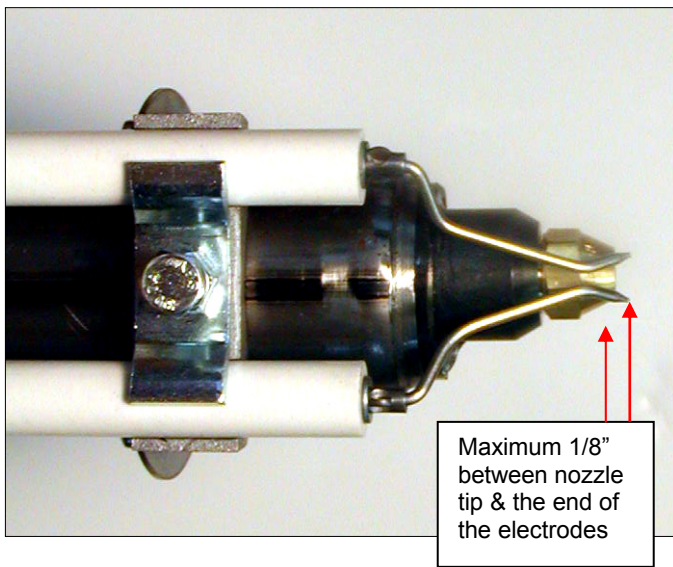
<u>DESCRIPTION</u>	<u>LOCATION</u>	<u>SETTING</u>
Primary Air Pressure*	Right side of burner	Refer to Chart #1 starting on page 3
Air Bands	Adjustable shutters next to oil pump	Refer to Chart #1 starting on page 3
Oil Pressure*	Adjustable screw, front of oil pump	Refer to Chart #1 starting on page 3
Block Temperature	Shown on the LOVE control display	135 to 150 degrees
Draft Measurement	Brass fitting on door by sight glass	0.02 to 0.07" H ₂ O
Boiler Temperature	Aquastat settings	200 with Return @ 180 degrees
Flue Temperature	At breach end of boiler	325 to 400° F
Ignition Transformer Switch	Button right of 6-prong module plug	Out - 10 second ignition (normal) Depressed - continuous ignition
Heater Switch	Rocker switch on front of burner	1 = heater on 0 = heater off
Nozzle Tightness	Brass nozzle tip	Torque =10 in-lb.
Boost Pump	Pressure relief valve in boost pump	20 lb. Output pressure
Oil Pressure Regulator	Outlet pressure, set to	-2 to -4 in. Hg
Electrodes	Mounted on module	See figure below

* The perfect setting depends on the chimney setup and must be determined on site. Adjustments can be made only when the burner is running. During warm-up the oil pressure gauge may reach 30 PSI or higher due to expansion. Disregard this.

Note: Adjustments to these settings are discussed in greater detail in the Trouble Shooting and Maintenance Procedures sections of this manual.

Figure 5 - Electrode Adjustment Diagram

Insure that the spacing between the electrodes and the module components or flame retention head is never less than the 1/8" gap between the electrodes.



FLAME ADJUSTMENTS

The appearance of the flame provides a good indication of proper oil and air settings. The secondary air adjustment is factory set to create the most efficient combustion; however, unique situations may require changing this setting in the field. A properly burning flame should burn just short of the back and never mushroom off the back or side walls. Damage to the boiler could result from over-firing and the warranty may be voided. The size and appearance of the flame are essentially determined by three things: the oil pressure adjustment, the atomizing air pressure adjustment and the combustion air adjustment.

Increasing either atomizing air or combustion air will shorten the flame. Decreasing either will, of course, lengthen the flame and also cause it to take on a softer, more orange and billowy appearance. If reduced sufficiently you will start to see smoke coming out the chimney indicating poor burning.

Set the atomizing air pressure at 30 psig, the combustion air adjustment should already be set at the factory to the #2 on the scale. Then adjust the oil pressure to provide a flame that stops just short of hitting the far end of the burning chamber. If you hear a rumbling or pulsation with the flame adjustment set properly then there's something wrong with the drafting. Call INOV8 service for help.

Procedure:

1. To adjust the oil pressure, turn the adjusting screw in the center of the nut on the pump clockwise to increase pressure (located to the right of the oil inlet on the pump). See photo at right or item #27 on the burner diagram on page 20. DO NOT loosen nut.
2. To reduce the length of the flame, turn the adjusting screw in the counterclockwise direction.
3. Smoke coming from the chimney always indicates there is too much fuel for the available air. Continue adjusting the combustion air or oil pressure until there is no smoke.
4. Combustion tests done by Bacharach equipment should result in smoke spot tests of either zero or #1 on the Bacharach scale. If the test yields higher presence of smoke, then adjustment should be made.

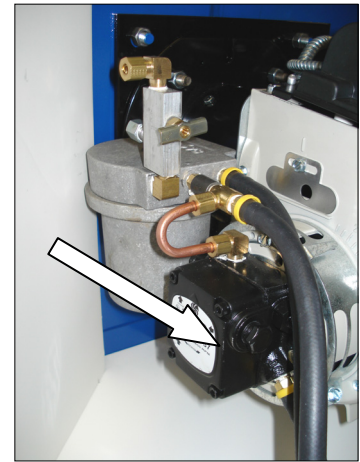
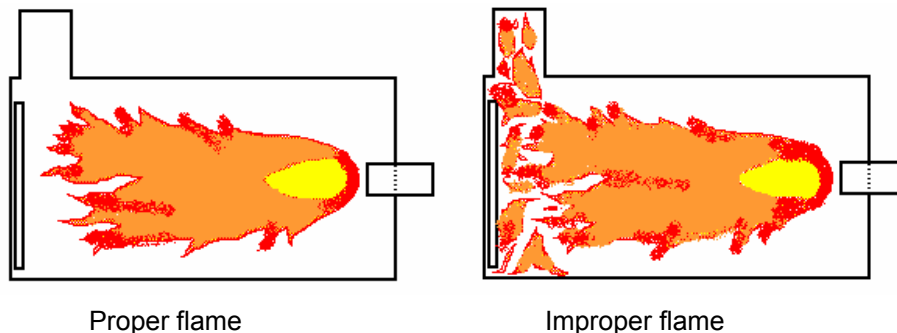


Figure 6 – Proper & Improper Flame appearances



MAINTENANCE

GENERAL INFORMATION

The INOV8 boiler was designed to eliminate much of the time associated with servicing waste oil burning equipment. The fact remains that the oils we are burning were not originally intended to be used for fuel and involve additional attention over conventional heating equipment. To obtain maximum benefit from your used oil-burning boiler, routine maintenance must be performed. This manual has detailed instructions for routine servicing, which if not performed will result in damage to your boiler and voiding of the warranty.

A powdery ash will slowly build up on the inside walls of the combustion chamber and heat exchanger as the oil is burned and, if not removed will cause the boiler to put less heat into the building and more heat up the chimney. The rate at which this ash builds up is relative to the type of oil being burned. Crankcase oil contains the highest quantity of ash. One-eighth of an inch of ash has the insulating capacity of one inch of fiberglass! Even less desirable is the deterioration of the burner and frequent boiler outages that result from loss of draft due to this ash build-up. Inspect your boiler after the first month of operation to determine how much ash is accumulating, and adjust your service schedule accordingly. If you are using transmission fluid, fuel oil, diesel or other clean fuel, your cleaning requirements will be much less often.

Many operational problems can be eliminated if proper care is taken in setting up an oil storage system. All waste oil contains substantial amounts of water and sludge, both of which settle to the bottom of a tank over a period of time. A storage system that allows sufficient settlement time will provide trouble free operation. A complete description of a factory recommended oil storage system can be found starting on page 16.

CHANGING FILTERS

The amber indicator light, located on the front of the burner, will light when the oil flow through the filter in the vapor eliminator is restricted. To prevent operating problems INOV8 recommends changing the filter every time the boiler is vacuumed or at least every 500 hours of usage. Clean fuels don't require that changing frequency.

Reduced oil pressure at the burner is an indication that the tank filter is getting dirty and needs to be replaced. **Always check the flame length after changing the tank filter.** Reset oil pressure if necessary.

DRAFT INDUCER CLEANING

The blades of the draft inducer fan will accumulate ash and become unbalanced. They must be cleaned at least annually.

VACUUMING THE BOILER

Wait until the boiler has cooled to room temperature before cleaning. The powdery ash that accumulates in the combustion chamber should be removed periodically. Be sure to turn the power off to the burner. Remove the bolts securing the boiler door and swing it open. Vacuum and brush the walls of chamber as necessary. Close door and return bolts. By removing the ash before excessive accumulation you will obtain higher efficiency from the boiler and reduce the chance of burner failure.

ANNUAL MAINTENANCE

Under average conditions, it is recommended that the following routine be performed at least once a year along with a spot inspection prior to the heating season. In excessively dirty environments, service should be performed more often. At the end of the heating season do these things:

1. Run the burner on fuel oil or diesel fuel before finally shutting it off. That will help keep the inside of the burner clean.
2. Keep the fuel valve nearest to the supply tank shut off when the burner is shut off for extended periods.
3. Vacuum all interior parts of the boiler.
4. Remove water from the bottom of the oil tank.
5. Check the chimney.
6. Inspect and clean Blocked Vent Switch (only on Canadian units but optional on US units) – see instructions that accompanied the switch.

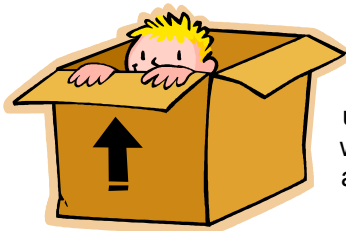
CHIMNEY INSPECTION

At the end of each heating season check the entire chimney, inside and outside. Unfasten the clean out cap at the bottom of the chimney Tee and empty the residue. At the same time check the chimney and the flue to see if there is enough residue build-up to require cleaning the chimney. The summer humidity mixes with the ash producing acids that will corrode the chimney pipe. Replace broken or rusted sections. Make sure any guy wires and wall supports are secure, and re-caulk roof flashing. Check the chimney top to insure it has not been damaged in a storm. Insure that the barometric draft control operates freely.

SUMMER BURNER REFURBISHING PROGRAM

During the early summer months, INOV8 provides a burner-reconditioning program. This involves returning the burner to the factory. It will be completely disassembled, thoroughly cleaned, reassembled, inspected, tested and all settings returned to factory specs. Defective, worn and unreliable components will be replaced. If desired, optional equipment updates will be installed. Upon request samples of waste oil will be tested and measured for flash point and a report provided for your files.

When sending the burner in for this service be sure to notate your company name, contact information, phone number and any performance details that would be helpful to the technician. These burners are returned in order of their receipt. The best time to send a burner in is during the months of May, June and July during INOV8's slower time. The work is discounted 20% to encourage participation ONLY during these three months. Burners sent in for service after July risk receiving them back in time for the heating season.



When packaging the burner for shipping remember to plug the oil lines as the oil will leak out damaging the packaging material and shipping damage can occur. Also protect the Fireye control from damage. Replacing the Fireye will be hundreds of dollars. Do not use Styrofoam peanuts as packing materials – preferably use several layers of bubble wrap. Newspaper and rags are ok ONLY if packed tightly. INOV8 sells burner boxes with all necessary packing materials already included for \$10 per box. It can be shipped to you.

SECTION 4 - TROUBLESHOOTING

GENERAL FAILURE CATEGORIES & POTENTIAL CAUSES

- 1. The burner motor isn't running.**
 - a. The controller has shut the burner down on alarm
 - b. The Aquastat is not "ON" calling for heat
 - c. The 120v power to the boiler is lost
 - d. The burner motor has failed
 - e. The burner controller has failed.

- 2. The burner motor runs & runs but nothing else happens.**
 - a. The heating element isn't heating
 - b. The oil temperature controller set points have been programmed incorrectly or the controller is not working correctly.

- 3. The burner motor runs for a while and then the burner shuts off on alarm. It did not try to fire.** (the "PTFI" light never came on.)
 - a. The UV sensor thinks it is seeing a constant flame

- 4. The unit tried to fire (PTFI light came on) but no flame was established.**

Section A – If there is no oil spray and no pressure on the oil gauge during PTFI, then:

 - a. You're out of oil or the oil is not being drawn up to the pump
 - b. The oil solenoid isn't opening

Section B – If there is no oil spray but good pressure on the oil gauge during PTFI, then:

 - a. The Bimba cylinder didn't pull back
 - b. The final delivery tube is coked shut
 - c. The nozzle is blocked
 - d. There is no atomizing air getting to the nozzle
 - e. The oil gauge is misleading

Section C – If there is oil spray and oil gauge pressure looks OK during PTFI, then:

 - a. The oil has not been heated enough to burn
 - b. There is no ignition arc
 - c. The oil is bad
 - d. There is too much secondary (combustion) air
 - e. There is too much primary (atomizing) air
 - f. The flame retention head is misplaced, missing or dirty
 - g. The heater switch is "OFF"

- 5. The unit fires but runs badly. May lose the flame and have to restart.**
 - a. Air is getting in the oil stream and is being vented out the nozzle
 - b. The oil pressure is too high causing over-firing
 - c. The oil is not hot enough to burn well
 - d. The oil is bad and may have water in it
 - e. The draft is inadequate or inconsistent
 - f. Particles are getting to the nozzle and blocking the spinner

- 6. The unit fires fine but shuts off on alarm about 10 seconds later.**
 - a. The UV sensor is not seeing the flame

7. The unit fires but runs badly at first, after a few minutes it has straightened out and will run fine until the next time it is fired.
 - a. The OUT2 set point (Interlock) of the oil temperature controller has been programmed too low.
 - b. Draft is insufficient until the chimney warms up

8. The unit fires and runs well for a short time. Then abruptly shuts off, re-fires, runs, shuts off, etc.
 - a. The oil temperature is falling below the OUT2 (Interlock) set point in the oil temperature controller. The OUT1 and OUT2 set points may have been programmed too close together – they require at least 20 degrees separation.

9. The unit fires and (probably) continues burning but it will burn OK for a few minutes and then poorly for a few minutes in a repeating cycle.
 - a. The OUT1 set point in the oil temperature controller has either been set too low (cool oil burns poorly) or too high (oil at too high temperature will boil)

10. The unit fires (possibly only after multiple tries), may or may not run smoothly for a while, shuts off (retries) periodically through the day and is most likely down on alarm when you come in the following morning.
 - a. Air is getting in the oil stream and being vented out the nozzle
 - b. The oil pressure is too high
 - c. The oil is not hot enough to burn well
 - d. The oil is bad (perhaps has water in it)
 - e. The draft is inadequate or inconsistent
 - f. Particles are getting to the nozzle and blocking the spinner.

USING LIGHTS ON THE CONTROLLER TO DIAGNOSE SYMPTOMS

There are 5 lights on top of the controller. They are (and their function is):

“OPR CTRL” – This light will come on when power is applied to the burner i.e. when the Aquastat or wall thermostat calls for heat. It means there’s 120v on controller terminal 7.

“INTRLCK” – This light comes on (quits blinking) when the oil temperature has reached the OUT2 set point in the oil temperature controller. OUT2 active sends 120V to Fireye controller terminal 6.

“PTFI” – ‘Pilot Trial For Ignition’ – comes on for 10 seconds when the burner fires. When it is on, the ignition transformer is on and there is 120v on controller terminal 3 – which provides power to the air and oil solenoid valves.

“FLAME” – Comes on when the U.V. sensor sees a flame (or the ignition arc). It goes off 3 seconds after the U.V. sensor stops seeing a flame.

“ALARM” – Comes on when the controller has shut the burner down abnormally. It signals the same thing as the red alarm light by the 6-prong plug. When on, there is 120v on controller terminal “A”.

Their value comes into play primarily for failures that occur after the burner has been running for a while and then shuts off. This, along with a failure to fire at all, comprises the bulk of the problems reported. Other than a loss of power, there are really only three things that cause the burner to shut off. The controller initiates the first two. The third is due to some condition that the controller doesn’t become aware of until three seconds after the flame has gone out. They are:

1. The U.V. sensor can't see a flame, even though there might be one.
2. The oil temperature has fallen below the OUT2 (Interlock) set point in the oil temperature controller.
3. Anything else – including a blocked nozzle, loss of air pressure, loss of oil, and the flow from the tank turned from oil to water, etc.

Of the five lights on the controller, we need only the flame light and the OUT2 light on the oil temperature controller to tell us if the failure is due to item 1, 2 or 3 above. Both lights will be on when the burner is firing. What they do when the flame goes out will aim us at item 1, 2 or 3. Observe the lights when the flame goes out:

- If the flame light stays on for 3 seconds after the flame goes out, the problem is item 3. Call INOV8 for help identifying the failure.
- If flame light goes off at the same time the flame goes out, then the problem is either item 1 or 2. To tell which, you must continue watching the controllers until the 5 second Fireye initiation and the 5 second oil temperature controller initiation sequences complete. At that time, see if the OUT2 light is on the oil temperature controller.
 - If it is ON, the burner shut off because the UV sensor couldn't see the flame.
 - If it is OFF, the burner shut off because the oil temperature fell below the OUT2 set point in the oil temperature controller.

SECTION 5 – DETAILED SERVICING PROCEDURES

In the course of servicing your burner, you may be required to perform or be knowledgeable of the following procedures. Refer to the glossary.

REMOVING THE MODULE FROM THE BURNER

1. Shut the burner off.
2. Pull the 6-prong plug.
3. Remove screws from front lip of transformer. Tip the ignition transformer back on its hinge.
4. Move the UV sensor out of the way. Take note of its position as it must be returned to exactly the same position.
5. Grasp the module cover box, lift and pull straight back to carefully withdraw the module from the burner. The hoses are long enough to allow removal without having to disconnect them.

REPLACING THE MODULE INTO THE BURNER

1. Shut the burner off.
2. Slide the module back into the burner, being careful not to hit the electrodes. Be aware that the head of the electrode bolt must slide into a bracket that is attached to the top of the inside of the air tube that the module fits into. This mating of the bolt and bracket positions the nozzle in the center of the flame retention head. The head of the bolt can be seen through an inspection hole on top of the air tube.
3. Return the UV sensor to its location securing it in place. It must be aimed at the nozzle.
4. Lower the ignition transformer. Make sure the transformer springs are resting on the electrode rods. Reinstall screws.
5. Plug in the 6-prong plug.

FLUSHING THE FINAL DELIVERY

1. Perform steps 1 through 4 in "Removing the Module from the Burner".
2. Disconnect the leftmost (final delivery) oil line from the module.
3. Angle it downward into a bucket, turn on the burner motor and squirt oil into a bucket for about 10 seconds to flush it out. Then reconnect it.
4. Turn the air regulator up to 90 PSI.
5. Pull the module out of the burner (see above instructions).
6. Remove the nozzle (which includes the spinner). Take care with the spinner as it will be impossible to run your boiler if it gets lost.
7. Plug in the 6-prong plug.
8. Aim the module downward into a bucket and run the burner through PTFI. When PTFI comes on, the needle should pull back and oil should squirt out the end of the module where the nozzle was. If no oil squirts out, it could be because the needle stuck and failed to pull back. Use the plastic handle of a screwdriver to push in on the tip of the needle that protrudes from the nozzle. Then let it back out gently and try the procedure again. You should get a stream of oil for 10 seconds. Repeat the procedure three or four times (popping the needle loose each time, if necessary) to insure complete flushing.

9. Perform the Maintenance Procedure: Cleaning the Nozzle.
10. With the spinner replaced and the nozzle back on, put the module back into the burner, turn the air pressure back down to where it was originally and see if the burner fires.
11. **Note:** This procedure will fail if you have a long, small diameter airline running from your compressor to the burner. The pressure will drop so much in the airline that there's not enough left to pull the Bimba back.

CHECKING THE OIL SPRAY

Unplug the 6-prong plug, pull the module out of the burner, plug the 6-prong plug back in, hold the module horizontal and run the burner through PTFI. When PTFI comes on, you should see an elongated gray cloud of atomized oil come out the nozzle. It should extend seven feet or more. A cloud less than seven feet indicates a partial nozzle blockage. An erratic cloud (fluctuating length) means the same thing. To know exactly what it should look like, do this check at a time when the burner is running well.

Note: Don't worry about the fuel cloud igniting – You've got the electrodes in your hand and the ignition transformer's still on the burner. However, it will make a mess on your floor so you will want to cover the floor with a tarp.



CHECKING THE OIL SYSTEM

Note: It's not uncommon for the pump seal to wear a groove in the pump shaft. When badly grooved, oil may leak out and get thrown around inside the burner housing by the fan. It's also possible that the groove is letting air get sucked into the oil system which may cause rough burning or, if the air leak is large, prevent the pump from drawing oil from the tank. Keep this in mind as you go through the following checks. If you find the bottom of the ignition transformer all covered with oil it's a sure sign that the shaft is grooved; however that does not necessarily mean that it's letting in air and lack of oil on the transformer doesn't necessarily mean that there is no groove. Refer to maintenance procedure: "Rebuilding the pump" if you need to replace the shaft and seal before going on.



1. Remove the final delivery hose (leftmost hose) from the module and aim it into a bucket. Turn the burner on and inspect the flow from the hose. Let it squirt for at least 30 seconds. It should be a steady stream strong enough to reach across the bucket. It should not be spurting at all, as that would indicate air in the oil. To check for air that may not be sufficient to cause spurting, submerge the hose in the oil and look for small bubbles to accumulate on the surface. There should be none. Also notice the color of the oil – it should be black. A gray or milky appearance indicates water in the oil. If you're not sure, but you suspect bad oil could be causing problems with the burner, get a bucket of known good oil and suck out of it. Be sure the 'bad' oil has been replaced by the 'good' before concluding anything. i.e. Open the vent line and run a stream of oil back to the tank for a few minutes. This will clear all but the final delivery hose and passage. Four or five firing attempts should then clear that.
2. If you got little or no flow from the hose, you should suspect the tank filter right away. Screw on a fresh one and see if that fixes it. If not, it could be the vapor eliminator filter. There are specific indicators to tell you when that filter is plugged (Dirty filter light on @ PTFI or a full and uncontrollable full flow through the return line) but you could try a fresh one anyway to be on the safe side.
3. Assuming you've ruled out the filters, there is possibly an air leak or blockage in the oil supply line. Install a test hose to the pump inlet and suck from a bucket of oil on the floor. Then see if you can get good oil flow. If you do, there is an air leak or obstruction in the line coming from the oil tank. (Or you're out of oil.)

4. If you still get no flow, squirt some oil into the oil inlet in the pump and try again – the pump may have just needed priming. Try screwing the oil pressure adjusting screw all the way in if priming didn't help.
5. If you still get no flow, look through the secondary air holes and make sure the pump coupling looks OK. Remove the pump to inspect it if you're not sure that the motor is actually turning the pump.
6. Assuming the pump was turning, remove the copper "U" bend from the top of the pump. Then remove the pump hose from the right-most module oil fitting and aim it into a can. Then, with your finger blocking the brass fitting on top of the pump that the "U" bend was on, start the motor and see if you get any flow from the pump hose. If you still get no flow, either there is an air leak right at the pump (fittings, shaft seal or cork gasket) or the pump is misbehaving. (See Maintenance Procedure: "Rebuilding the pump"). Call INOV8 service for assistance.

CHECKING THE IGNITION ARC



Danger: The ignition transformer produces a very high voltage. You are not in danger of electrocution from it because it cannot supply a lethal current, however it can give you a good enough shock to hurt. Be constantly aware of this.

1. Disconnect the 6-prong plug, cover the UV sensor, swing the burner out from the burning chamber, start the burner motor, depress the ignition test switch and inspect the arc (if any). You should see a rough horseshoe shaped spark fanning out beyond the nozzle. If the arcing does not match this description insure the electrodes are in position and properly shaped. Look for arcing between the electrodes and flame retention head, nozzle or module tube. Even if the arc looks good, make sure the electrode wires aren't bent down so far that they could be in contact with the fuel spray. That can prevent firing.
2. If you see no arc, flip up the ignition transformer, take a plastic handled screwdriver and, with the burner motor running and the ignition test switch on, slide the screwdriver shank from one transformer spring toward the other and see if you can draw an arc. It should arc over when the screwdriver blade is approximately ¼" from the second spring and be able to be drawn back to at least ¾" in length. If all you get is a tiny little blue spark, the transformer is bad. If you get no arc, either the transformer is bad or no voltage is getting to it. If you get a good arc, make sure the transformer springs are not slipping off the electrode rods when the transformer is put back down. Be aware that a plugged up (or absent) flame retention head will affect the spark dramatically. If you see nothing obvious, call INOV8 service.

CHECKING THE ATOMIZING AIR SYSTEM

When the Fireye controller attempts to fire the burner it does so by putting 120v on the orange wire coming to the module. (It also turns on the ignition transformer.) The 120v on the orange wire energizes the air solenoid coil causing it to open and let air flow into the module block. This air splits up and flows two places:

1. Through the small plastic line to the Bimba cylinder causing the cylinder to actuate, pulling the needle out of the nozzle.
2. Past the Air Apportioning Adjustment and then on to (and out) the nozzle where it atomizes the oil. A quick check to see if you're getting sufficient atomizing air is to place a small rod (nail, Allen wrench, coat hanger, etc.) into the threaded hole in the end of the Bimba cylinder until it bottoms out. Then see if you feel it kick back about ½" when PTFI comes on. It should.

Here are some things that could be wrong in the air supply system:

- Supply from building air compressor is absent. See if you have any pressure on the air regulator gauge.
- The air regulator pressure is not adjusted to 30 lbs @ PTFI. Check the air regulator gauge when the PTFI light is on.
- The 4-amp orange burner fuse or the 10-amp fuse in the controller (or both) is blown. If either is blown, you will not have 120v on the orange wire to open the air solenoid when the PTFI light comes on. Remove the fuses and check them with a meter.
- The air solenoid is defective. To check it, remove the plastic line from the Bimba cylinder elbow. (Push the ring in and pull the line out) Try to fire the burner and see if any air comes out the plastic line at PTFI time. If not, the solenoid isn't opening. Perform the Maintenance Procedure: Bypassing the Air Solenoid to see if it's bad.

CHECKING THE DRAFT & THINGS THAT CAN CAUSE IT TO BE WRONG

Draft can be checked with a draft gauge by holding it against the opening on the front of the boiler by the sight glass. A small screw must be removed from the port to have access to the combustion chamber pressure. In the absence of a draft gauge another way that seems to work well enough is to hold a cigarette lighter flame by the draft port to see if the flame gets sucked into the hole. If it does, your draft is probably OK. If there is too much air blowing around the hole to get a good check, hold a tube like a ¼" brake line to the hole and place the flame at the other end of the tube. If the flame is not sucked into the hole, you have a draft problem. The burner must be firing and time should be given for the chimney to heat up before making this check. Should you have a draft gauge, use it to measure the draft at the same place: .02" wc is bare minimum. A reading of around .04" wc is typical. If your reading is much higher than this, too much heat is being lost up the chimney. Here are things that typically cause insufficient draft:

- The boiler is dirty.
- The barometric damper flap is open too far (if installed).
- The burner is over firing.
- The combustion air adjustment is open too far.
- The chimney is ineffective – too short, too many elbows, too much horizontal.
- There is an exhaust fan running somewhere in your building. These things don't tend to require explanation of how to detect and correct. Bear in mind that draft improves when the chimney is hot, so, if you have problems getting the burner to start but then find it running well later, the problem could be draft. If you can't correct your poor draft, contact INOV8.

BY-PASSING THE BIMBA CYLINDER

CRITICAL WARNING: DO NOT bypass the Bimba cylinder if the oil solenoid is not functioning properly.

A Bimba cylinder that is leaking air internally causes the burner to run roughly or go out. This is due to the air getting into the oil stream and venting out the nozzle. When an air bubble vents out the nozzle, the flame extinguishes – maybe very briefly. Air venting out the nozzle is always indicated by a bouncing of the oil gauge needle and there are things other than the Bimba cylinder that can cause it but, if you've been directed here from the Trouble-Shooting section because symptoms pointed at the Bimba, here's how to bypass it:

1. Remove the little 1/8" plastic airline completely by disconnecting both ends from the quick-disconnects. (Push in the ring, pull out the line.) Put the plastic line somewhere that you won't lose it.
2. We need to keep the air from coming out the quick-disconnect that's screwed into the block. You can either remove it and replace it with a 1/16" pipe plug or you can stick something like an 8-penny (8D) nail into it. Don't use anything that's likely to damage it.

3. Remove the 90° elbow from the Bimba cylinder. It will be damaged if not removed before attempting to remove the Bimba cylinder.
4. Remove the Bimba cylinder. (The needle comes out with it and don't lose the "O" ring that seals the Bimba to the module block. (Place a rag against the module block beneath the cylinder to catch any oil that runs out the vacated hole so it doesn't get down into the heating element.)
5. Unscrew the needle from the Bimba cylinder and put it with the plastic line.
6. Screw the Bimba cylinder back into the block just to plug the hole. Make sure the 'O' ring's there.
7. If the trouble that brought you here has been corrected by this bypassing procedure, you can run with it bypassed until you receive a new cylinder, but check to make sure no oil is squirting out the nozzle before PTFI. If oil is squirting out, the oil solenoid is not functioning and you cannot run with the Bimba bypassed.

REPLACING THE VAPOR ELIMINATOR FILTER

Place a small bucket under the vapor eliminator canister to catch any oil that may spill as you are doing this procedure.

1. Loosen the nut on top of the vapor eliminator canister.
2. Carefully lower the canister **as it will be full of oil**. Pour the oil into the bucket (this can then be returned to the oil storage tank).
3. Pull the vapor eliminator filter out of the canister and discard. It is rayon and will be soft.
4. Clean the canister before inserting the new filter. Canister debris can get shifted to the bolt area during removal of the old filter and that debris can then run up by the bolt, through the center of the new filter and on to the nozzle.
5. Replace the filter being sure to use care. Don't shove the new filter down into the canister so far that the top of the filter doesn't press against the vapor eliminator head when the canister is screwed back on. Otherwise the oil just flows over the top of the filter.
6. Don't be too rough with the new filter. The fibers can be rubbed loose and loose fibers in the passage running up through the middle of the filter can pass to the nozzle.
7. Return the o-ring and secure with the rubber-backed washer. Replace both items every other filter change.

CLEANING THE NOZZLE

The nozzle is made up of two parts plus an aluminum washer that we add to it. There is the nozzle cap (the brass part that unscrews) and the 'spinner' which you will see sitting in a small tube after removing the 'cap'. The aluminum washer seals the spinner into the tube that it sits in. We refer to it as the 'spinner washer'. The oil passes through the small passage in the center of the spinner and that's where nozzle blockages occur. For cleaning:

1. Pull the module out of the burner to get better access to the nozzle. Refer to the section on Removing the Module from the Burner on page 31.
2. Unscrew the nozzle cap with a 5/8" open-end wrench. Be careful when taking it off as the spinner could get knocked out of its tube and fall on the floor. The boiler will not operate without the spinner properly in place.
3. Remove the spinner. If stuck, grip it with a rag and pliers and give it a twist. Remember the spinner sits in the END of the tube. Don't try twisting the whole tube and be aware that the spinner doesn't actually spin. It 'spins' the air when it passes through mixing it with the oil.

4. The passage through the spinner is of two diameters and is best cleaned by using two drill bits: a #50 to clean the larger entryway passage and a #74 to clean the exit hole. You will turn the drill bits by hand and will likely need a pin vise to hold the #74 bit. If you don't have a #50 bit, a 1/16" bit will do.
5. After the drill bits, squirt some carburetor cleaner through it and put it back together. Make sure the aluminum washer is still on the spinner and don't torque the cap back on too tight. We say 10 inch-pounds which means "snug". (You're tightening it down onto the spinner washer; you're not seating the brass cap into the threaded steel module tip.) If the nozzle plugs up again shortly after this cleaning, perform the Maintenance Procedure: Flushing the Final Delivery System.

REBUILDING THE PUMP

A pump "rebuild" may be necessary for either of two conditions:

- The pump shaft has a groove worn into it by the seal.
- The pump internal pressure regulator is sticking.

As long as you have the pump apart to correct one condition, you should also check the other. A pump "rebuild kit" is available from INOV8. They contain the shaft, seal and cork cover gasket.

Replacing pump the shaft and seal:

1. Remove the pump from the burner in the following way:
2. Disconnect the oil supply line from the pump and plug the inlet hole.
3. Disconnect the pump hose from the module fitting.
4. Remove the copper "U" bend from the top of the pump.
5. Remove the 2 bolts that hold the pump in. (3/8" socket)
6. Slide the pump out of the burner housing.
7. **Note:** the pump coupling may or may not come out with the pump. If it didn't reach in and pull it out; you'll need it later. Insure the shaft is properly aligned with the coupling when reassembling.
8. Drain the oil out of the pump as best you can.
9. Remove the 4 cover bolts, cover and screen.
10. Remove the 3 gear set bolts and the gear set pieces notating the position of the pieces. Don't lose the moon-shaped piece.
11. Remove the shaft (with gear).
12. Remove the seal-retaining clip. (C-clip)
13. Stick something like a large Phillips screwdriver into the seal and pry it out. Don't stick the tool in any further than necessary to catch the seal, as it will nick the area where the seal seats if you do.
14. Clean all the pump parts with solvent. (Carb cleaner will melt the paint.)
15. Inspect the pump base to see if the shaft gear has worn into it significantly. If you can catch the groove readily with your fingernail, the pump is near the end of its life. It's hard to say how much wear is too much; if you're drawing oil from far away or up quite a few feet, or if you're burning something thin like diesel fuel then a small amount of wear might be too much. Call if you want to run your situation by us.
16. Lubricate the new seal and press it in.
17. Replace the fiber washer (if there was one) and retaining clip.

18. Oil the new shaft and place it in the pump.
19. Oil the 3 pieces of the gear set, put them back together, and bolt them back on the pump base.

Note: You can't put these together wrong – if you try, the bolt holes won't line up. Tighten the bolts a little at a time, all the while turning the shaft with the pump coupling. The shaft should turn freely when the bolts are tight. If it binds (or “clicks”), loosen the bolts, wiggle the gear set and try again.

- Using the new cork gasket, reinstall the strainer and cover.
- Replace the pump on the burner.

CLEANING THE PUMP INTERNAL PRESSURE REGULATOR

1. Perform the 1st 2 steps of “Replacing the pump shaft and seal” above.
2. Remove the 11/16-inch “nut” from the back of the pump.
3. Remove the 11/16-inch “nut” from the front of the pump. (The pressure adjusting screw will come out with the nut.)
4. Remove the spring centering device – noting its orientation.
5. Remove the spring.
6. Remove the piston. It can be removed out the front or back – whichever is easier. You'll probably have to push it out with something (dull)
7. Clean all the parts. If the piston was stuck you'll need to scrub out the passage with something. A gun cleaning brush on an air drill works well. ***Don't use anything that could mar the walls of the passage.
8. Oil the parts and put them back together. Be aware that there was an aluminum washer under each “nut” – as they may have fallen off during cleaning.
9. Replace the pump on the burner.

OIL TEMPERATURE CONTROLLER: OPERATION & SETTINGS



This device is installed in the module cover box and controls the temperature to which the oil will be heated and the temperature that must be reached before the Fireye controller will be allowed to fire the burner. The control can be easily changed to accommodate different oils that require higher or lower preheat temperatures, for example vegetable oil, heavy oil and synthetic lubricants or lightweight oils like solvents. The readout as shown at left can be easily adjusted by depressing up and down arrow buttons. Refer to the recommended settings.

The INOV8 burner has been approved to burn fuel oils up to #6, and a variety of used petroleum based shop and vehicle oils. Although testing was done, the following vegetable oils are not included in approved fuels under the UL 296A standard for waste oil burning: corn, soybean, and canola oils – both used and new. All of these oils make potential fuels but have different BTU values and flashpoints that require adjustments to the burner pressure and preheat temperature. It's also important to be aware that the preheat temperature showing on the LED readout is the temperature of the steel block in the module and not the direct temperature of the oil – which can be 30° to 50°F higher than the steel block temperature. If the oil being burned is not standard waste crankcase oil, oil analysis will determine the flashpoint and BTU value for proper setting of the oil temperature and pressure settings. The settings in Chart 3 are typical but may need to be adjusted based on test results of your oil.

Chart 3 – Oil Temperature & Temperature Control Settings

Type of Oil	*BTU/Gal	* Flashpoint in degrees F	SP1 Setting	SP2 Setting
<i>Petroleum based oils</i>				
Used crankcase - regular	147,000	240 - 350	150	130
Fuel oil - #2 & diesel	140,000	126	Off	Off
<i>Non-petroleum based oils</i>				
B100	130,000	130	Off	Off
Crude soy	140,000	650	170	140
Glycerin (sample 1)	102,000	320	170	140
Glycerin (sample 2)	111,000	70	Off	Off
Used cooking oil	133,000	400 - 650	170	140

* Flashpoints and BTU values have been obtained from US Oil Chek analysis, data available from NFPA, and various MSDS publications and may not accurately represent all samples.

** When adjusting oil pressure refer to instructions found on page 25.

Adjusting the Temperature Controller

Two temperature settings control the preheat function; OUT1 maintains the temperature within 5 degrees of the set point, and OUT2 prevents the burner from firing with oil that is not yet at the set point temperature (also know as interlock). There are two basic factory set points based on the type of oil specified to be used as fuel.

	SP1	SP2
Petroleum based oils	150°F	130°F
Vegetable based oils	170°F	140°F

When making adjustments follow this procedure:

1. Press and release the SET button. The current value of OUT1 is displayed and the SP1 and the LED for the OUT1 lights blink. Press UP or DOWN to increase or decrease the value. The range of OUT1 temperature is 120°F to 180°F. Press SET to confirm the new value. This will then cause SP2 and the LED for OUT2 lights to blink.
2. Press UP or DOWN to increase or decrease the value of SP2 and press SET to confirm the new value and exit. The range of temperature for this setting is 100°F to 140° F.

Note: At least 20° F span must be between the OUT1 and OUT2 settings for this to function properly. Also be aware that when the preheater switch (see item #24 on the burner diagram for location) is in the OFF or “0” position, the lights on the temperature control will be off.



Message Display

Under normal operation, the temperature of the probe will be displayed. Call INOV8 if any of the following messages appear:

- Err Memory reading error
- AH1 Maximum temperature alarm
- AL1 Minimum temperature alarm
- ooo Open probe
- --- Shorted probe

REMOVING EXCESS OIL FROM COMBUSTION CHAMBER

While this should never happen with the Fireye combustion control that is specifically designed to prevent excess oil, follow this procedure if necessary. **If unburned oil accumulates, DO NOT attempt to fire the heater and burn off the oil.** Perform steps on page 26 for shutting down power and removing the burner for cleaning the combustion chamber. Scoop out any excess oil. It can be returned to the tank if properly filtered. Put in "Oil Dry" to absorb any wet oil, and scrape out and discard. If oil is present in the heat exchanger tubes, perform the same cleaning routine in them.

PROCEDURE FOR PARTS REPLACEMENT

If it is determined that part of the boiler is faulty, a replacement part will be sent via UPS regular delivery. If overnight delivery is desired, the service will be billed to you. The billing will depend upon the warranty provisions. These additional conditions apply to the replacement policy:

1. For the first twelve months of owning the boiler, all shipping of warranted parts from the factory is paid for by INOV8. The customer is responsible for returning the faulty part to INOV8 or the INOV8 dealer. After the first year the owner shall pay the costs of shipping.
2. During the first year an invoice will be issued for the replacement part. When the faulty part is received at the factory, full credit will be issued.
3. INOV8 reserves the right to send a representative for an on-site inspection.
4. INOV8 is not responsible for any labor cost for the servicing, removal or replacement of parts.
5. Repaired or exchanged equipment will carry the unexpired portion of the original equipment warranty or six months, whichever is greater.
6. If inspection by INOV8 discloses a defect not covered by this warranty, the equipment will be returned as is, repaired, or replaced at the discretion of the owner. If repaired in the factory, INOV8's regular labor charges will apply.
7. This provision expires one (1) calendar year from the date of delivery.

THEORY OF OPERATION

Overview:

When the Aquastat or the wall thermostat calls for heat, it does so by sending power to the Fireye controller, which then turns on the burner motor and oil heater. The burner motor drives the oil pump which circulates the oil through the module, vapor eliminator and back to the pump to be circulated again. On each pass through the module, the oil gets a little hotter by passing close by the oil heater. Each pass through the vapor eliminator filters it and vents off any vapor that may have been released by heating and the churning action of the pump. This heating and circulating continues until the oil reaches firing temperature. At that time a signal is sent to the controller, causing it to start the 90-second pre-purge timeout and then fire the burner.

The ultraviolet sensor (U.V. sensor) will be watching the flame while the burner is running and a loss of flame will cause it to shut off for 90 seconds and then try to fire again (retry). Should the burner fail to ignite (whether on the initial attempt or on a retry), the U.V. sensor will notice the absence of flame and signal the controller to shut off the burner on alarm.

Assuming the burner started and is running O.K., it will continue circulating and heating the oil (under control of the oil temperature controller that maintains it at firing temperature) until the Aquastat or wall thermostat decides the water is hot enough and turns it off.

In Depth

Sequence of Events:

1. The Aquastat or wall thermostat sends 120v through the burner relay to controller terminals 1 and 7. The voltage on terminal 7 causes the controller to turn on the OPR CTRL light and close a relay, which puts 120v onto controller terminal 8.
2. Voltage on terminal 8 is fed to:
 - a. The burner motor that will now start circulating the oil through the burner.
 - b. The heater switch which, if ON, will start heating the circulating oil.
 - c. The Ignition test switch which, if depressed, will turn on the electrodes.
 - d. The orange boost pump control wire which, if you have an electrically controlled boost pump, will cause it to start running.
3. At this time the controller also starts looking for flame in the burning chamber. There should be none, if a continuous flame signal is detected for some reason, the controller will shut off the burner on alarm without trying to fire.
4. When the module block (oil) reaches the SP2 set point in the oil temperature controller, that controller will place 120V on its OUT2 terminal (9) which is tied back to the Fireye interlock terminal (6). Note: If the heater switch had been OFF, the 120v signal would have been sent back as soon as the burner motor started.
5. The controller, seeing voltage on terminal #6, turns the blinking INTRLCK light on solid and starts the 90-second pre-purge.
6. At the end of the 90 seconds the controller puts 120v on terminal 4 to turn on the ignition transformer and terminal 3 to 'turn on' the orange wire firing circuit. The next 10-second period is called "Pilot Trial For Ignition" and is represented by the PTFI light on the controller being on.
7. The 120v on the orange wire energizes (opens) the air and oil solenoids.
8. The air now coming into the module will cause:

- a. The Bimba cylinder to withdraw the needle from the nozzle.
 - b. Air to flow out the nozzle (To atomize the oil stream when it arrives.)
9. The 120v on the orange wire also energizes (opens) the oil solenoid causing it to allow oil to flow to the oil gauge and out the nozzle.
 10. The hot atomized oil sprays through the ignition arc, causing it to ignite. This state continues throughout the 10 second PTFI interval – whether a flame was established or not.
 11. At the end of the PTFI period the controller will:
 - If a flame was established:
 - a. Turn off the PTFI light.
 - b. Remove voltage from terminal 4, which turns off the ignition transformer.
 - c. Apply voltage to terminal 5 (Main valve which is unused in an F200).
 - d. Leave the voltage on pilot valve terminal 3 (Orange wire firing circuit).
 - e. Enter “RUN” mode – Meaning only that, should the burner now lose the flame, it will go into another 90 second pre-purge and then retry.
 - If no flame was established, shut down the burner by:
 - a. Removing voltage from terminal 4. (Ignition transformer circuit)
 - b. Removing voltage from terminal 3. (Orange wire firing circuit)
 - c. Removing voltage from terminal 8. (Burner motor and heater circuit)
 - d. Turning on the ALARM light on the controller.
 - e. Applying voltage to terminal “A” which turns on the red alarm light.
 - f. Tripping the controller’s reset button, which must be depressed for one second to get the burner going again.

MAIN COMPONENTS & THEIR FUNCTIONS

THE FIREYE CONTROLLER

The Fireye combustion controller provides these functions:

1. It turns on the burner motor and heating element when the Aquastat or wall thermostat supplies power to it.
2. It delays firing for 90 seconds after being told the oil is hot, in order to purge out any fumes that may still be in the burning chamber.
3. It turns on the ignition transformer for the 10 seconds that PTFI is on.
4. It puts 120 volts on the orange wire circuit that causes the burner to fire.
5. It monitors the flame via the U.V. sensor and shuts the burner down or causes it to go through a 90 second purge and retry if it loses sight of the flame. (If flame is not detected in the 1st 10 seconds of any firing attempt, the burner will be shut down with the ALARM light on the controller and the red light on the front of the burner ON. If the U.V. sensor saw a flame for the first ten seconds that went away later, the controller will do a 90 second purge and retry.)
6. It monitors the signal coming from the module that tells it that the oil is hot enough to fire. If at anytime that signal goes away, it will shut off the burner until the signal reappears. Then the 90 second purge and re-firing will occur. The signal comes from the OUT2 in the oil temperature controller.

7. It monitors (via the U.V. sensor) any flame in the burning chamber that is present when there should be none – such as residual oil. It will wait for the flame to go out and then do the 90 second purge and fire. If, however, the flame does not go out in ~ 15 seconds, it will shut the burner down on alarm.

The Burner Motor has two functions: It blows air for combustion into the combustion chamber and it drives the oil pump via a slip-on coupling that connects their shafts together. Prior to the burner firing, the air being blown in is for purging residual fumes from the burning chamber rather than combustion. The amount of air being blown in is controlled by the Combustion Air adjustment that is a band and plate on the left side of the burner casing (unless the sealed combustion adaptor is installed), in which case it's a knob adjustment. Adjustment is made to provide sufficient air to cause complete burning (no smoke) but not so much as to cause the flame to be blown away from the nozzle or to overpower the chimney's draft that would produce unacceptable operation.

The Heating Element is an 800-watt, 9" long by 3/8" diameter rod that runs from the center of the module block to within a couple of inches of the nozzle. It heats the oil that flows through the module under control of the SP1 set point and OUT1 relay in the oil temperature controller.

The Ignition Test Switch allows the ignition transformer to be turned on for inspection of the arc or for debugging an ignition problem. The switch is active anytime the burner motor is running.

The Heater Switch allows the burner to be run with or without heating the fuel; Waste oil requires the heater to be in the '1' position (ON). Fuel oil, diesel fuel, etc. can be burned without heating by setting the switch to the '0' (OFF) position.

The orange wire connects to the coil of a boost pump control relay (supplied with the boost pump) if you have an electric boost pump installed. The boost pump will run when the burner pump runs.

THE OIL SYSTEM

As the pump turns, it will draw oil to the burner from the tank to replace any air that may have accumulated in the supply line or burner. This air is vented out through the 1/4" line that runs from the vapor eliminator back to the tank. For this air venting to take place, a constant drip rate of a few drops per second must be maintained through the tube. This is done with the valve at the vapor eliminator - which also may be opened up wide to speed purging if your line or burner has been drained of oil or if you got water in the oil supply that you need to purge out. The pump sends the oil over to the right-most module oil fitting where it enters the module and flows through an internal "U" bend where the oil heating takes place. It then flows out the "U" bend through the middle module oil fitting and over to the vapor eliminator. At the point of exit from the module, its pressure is monitored by the Dirty Filter pressure switch. Should pressure at this point exceed 35 lbs., the amber light on the burner will turn on letting you know that the vapor eliminator filter is plugging up - causing the 35-lb. backpressure. Normal pressure in the circulating system should only be 2 or 3 pounds higher than the firing pressure showing on the oil gauge.

The oil entering the vapor eliminator from the module will flow through the filter and out the center fitting on the vapor eliminator where it is returned to the pump through the copper "U" bend to be circulated again. A small part of the oil entering the vapor eliminator from the module is vented back to the tank through the copper or plastic drip tube. The oil that is sent to the nozzle is also taken from the center fitting on the vapor eliminator - through the hose that goes to the left- most oil fitting on the module. We generally term this hose the "final delivery hose" since it supplies oil to the "final delivery passage" that runs to the nozzle. Flow through this hose is prevented by the oil solenoid until the burner fires. At that time, the opening of the solenoid allows the oil to flow to the oil gauge and out to the nozzle. Be aware that any pressure showing on the oil gauge prior to firing is due to heat expansion of the oil in the final delivery passage and has nothing to do with true circulating system pressure.

THE PRIMARY (ATOMIZING) AIR SYSTEM

This is the air that is supplied by your air compressor and its function comes into play when the burner fires.

When the controller attempts to fire the burner, three things happen:

1. The PTFI light on the controller comes on.
2. 120v is applied to controller terminal 3 to which the orange wire going to the module is connected.
3. 120v is applied to controller terminal 4 to which the ignition transformer is connected.

On the module, the orange wire connects to the air and oil solenoids at the left-most screw of the Dirty Filter Switch. Energizing the Air Solenoid allows the compressed air to flow into the module block where it can then pressurize the 1/8" plastic line to the Bimba cylinder causing it to retract the needle from the nozzle. It also flows past an air apportioning screw in the module block on its way to the nozzle for atomizing the oil stream. Energizing the Oil Solenoid allows oil to flow into the module block, past the Oil Gauge where its pressure is monitored and on to the nozzle to be mixed with the Atomizing air. At this point, you have hot atomized oil spraying out the nozzle through the ignition arc that was turned on at the same time the orange wire was energized. At this point you will have a flame.

ELECTRICAL DIAGRAMS

Figure 7– Basic Wiring Diagram for Boiler with a Tjernlund Draft Inducer

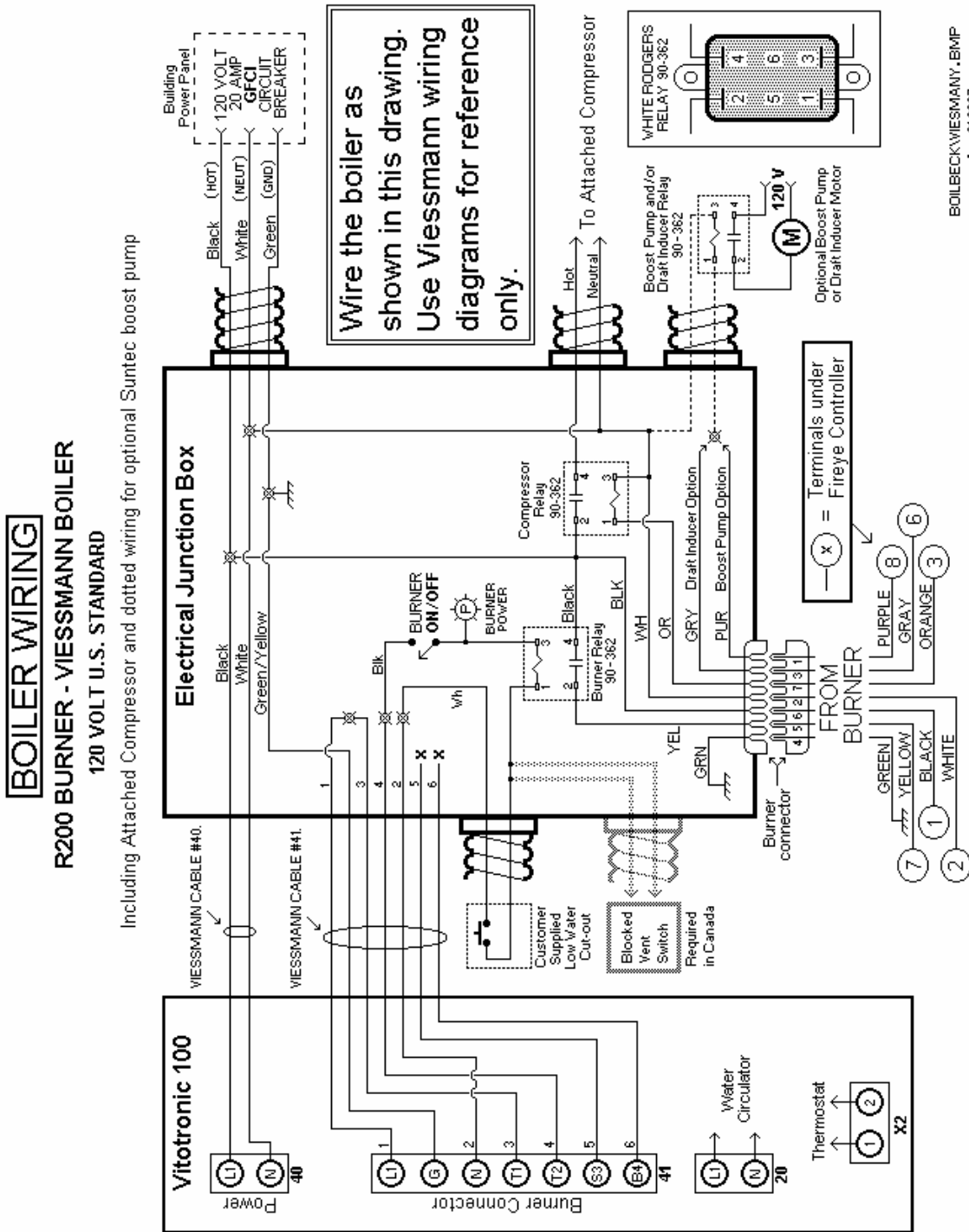


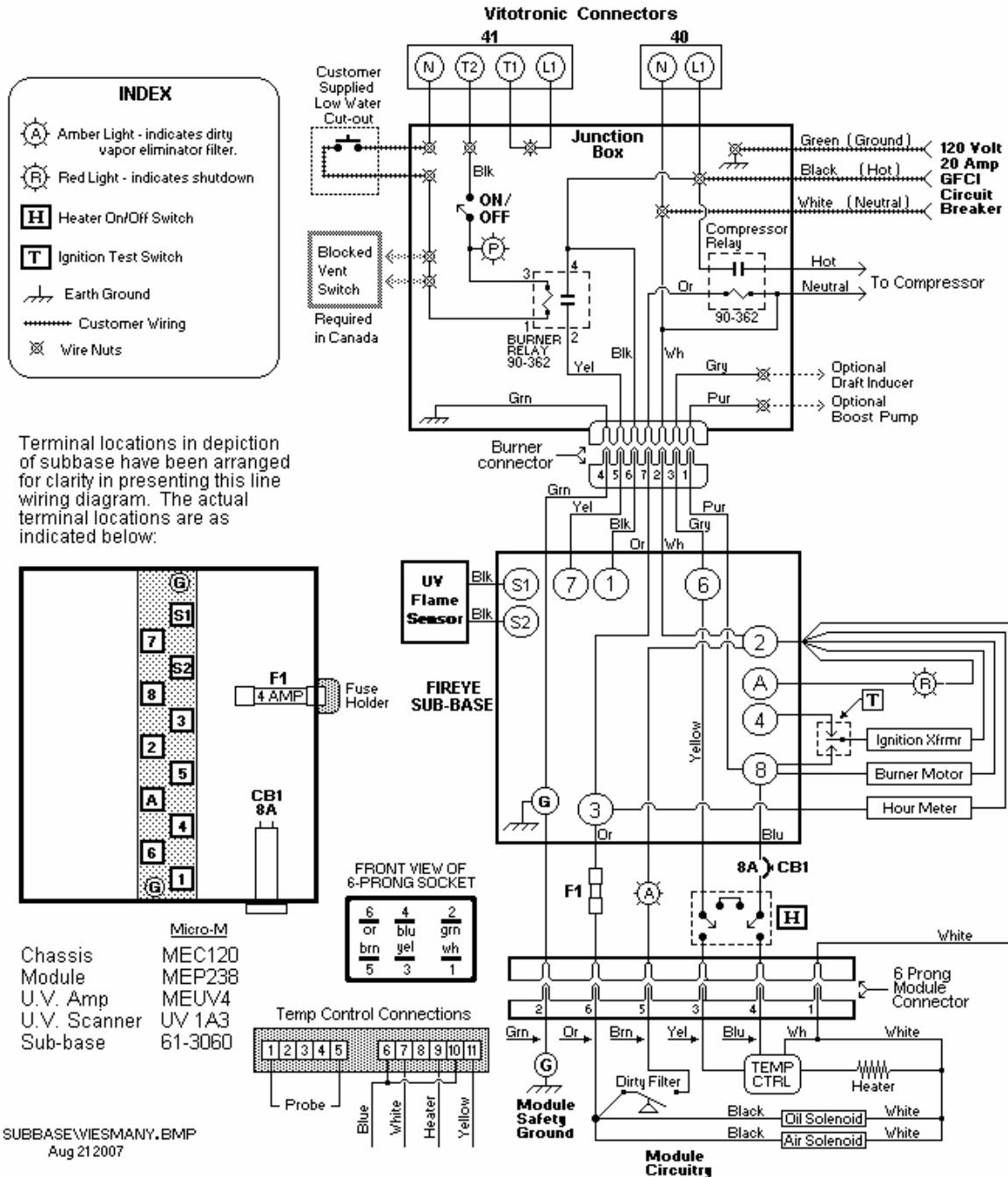
Figure 8 – Electrical Subbase Diagram for Burner

R200 BURNER WIRING

ON VIESSMANN BOILERS

With Attached Compressor and Post Purge

120 VOLT U.S. STANDARD



Terminal locations in depiction of subbase have been arranged for clarity in presenting this line wiring diagram. The actual terminal locations are as indicated below:

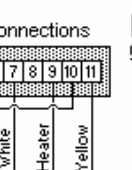
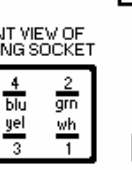
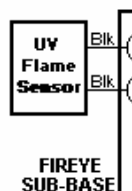
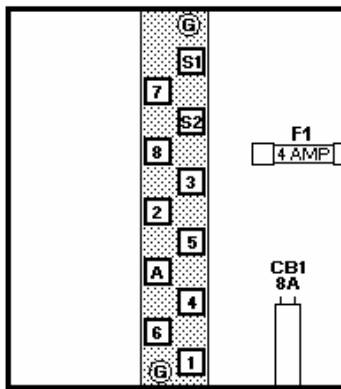


CHART 4 – PARTS & TOOLS LIST

Installation and maintenance of the INOV8 boiler requires the standard tools used in heating oil installations. For your convenience they are listed here. Also listed are small replacement parts that are good to stock and a few unique trouble shooting tools available only from INOV8. Advanced servicing tools are also listed.

Item Description	Part #	Source
Tools for Installing & Servicing:		
Combination Wrenches, a set or: 7/16, 1/2, 9/16, 5/8, 11/32, 5/16 & 3/8		Sears
Needle nose pliers		Sears
Allen wrench with 'T' handle - 1/8"		Sears
Screwdrivers, phillips		Sears
Screwdrivers, flathead		Sears
Multi-meter, Craftsman		Sears
Temperature measure gun, Craftsman		Sears
Small replacement parts:		
VE replacement filter with rubber backed washer - set of six	30406	INOV8
Nozzles: one # 3.1	20240	INOV8
Flame Retention Head	30250	INOV8
Aluminum gaskets	20060	INOV8
O-ring set: for vapor eliminator & bimba	20272	INOV8
Replacement o-rings & parts with Viton	20273	INOV8
Fuse set: 2 each of 4, 8 & 10 amp fuses	30236	INOV8
Troubleshooting Tools:		
Test hose - 1/2" id reinforced hose with a fittings to attach to the pump and a +/- pressure gauge, long enough to reach from burner to floor	TA105	INOV8
Drill bits: #74 & #50	TA110	INOV8
Pin vise to hold the small drill bits	TA115	INOV8
2' long piece of 22 gauge single-strand insulated wire		INOV8
1 1/2' long piece of 1/4" o.d. tubing (copper or brake line)		INOV8
Combustion Analysis & Advanced Tools		
Amprobe clip-on current measuring device		Sears
Craftsman Electrician Kit - above three items		Sears
Bacharach Draft Gauge		Bacharach
Bacharach Hand-held Combustion Analyzer, model		Bacharach

SECTION 6 - GLOSSARY

Air Apportioning Adjustment	A setscrew adjustment in the module block which reduces the 30-psi atomizing air coming in to the correct pressure at the nozzle. It is factory set and held with Loctite.
Air Regulator	The air hose connects to this. It regulates the primary air for combustion. It is located on the right side of the burner. Used to reduce the high air pressure from your compressor to the 30 psi atomizing air pressure required by the burner.
Air Tube	The 4" diameter black metal tube with the flange on it by which you attach the burner to the boiler.
Alarm Light (Red)	A warning light which indicates that the combustion controller has shut the burner down because it failed to fire (or the controller couldn't 'see' that it fired) during the 10 second pilot (PTFI) ignition period. There are actually 2 alarm lights, one on top of the combustion controller and one on the front panel of the burner. The one on the panel is just a more visible duplicate of the other.
Amber Light	This is lit when there is a pressure increase within the oil circulating system signaling a dirty vapor eliminator filter. This bulb will light to signal that the vapor eliminator filter is dirty. It will not signal until the burner is firing (or trying to fire). It has NOTHING TO DO WITH the condition of the tank filter. It only signals...i.e. It doesn't cause the burner to shut off or anything. Location: (aka: Yellow light, Orange light and Dirty Filter light)
Atomizing Air	The term given to the compressed air fed to the burner. It's primary role is to mix in the nozzle with the oil to produce a combustible fuel cloud which would then be said to have been ATOMIZED – much like a perfume atomizer. Secondly, it supplies the air pressure to pull back the Bimba cylinder.
Ash	Each 55 gallon barrel of oil contains 1-1/2 quarts of non-burnable solids that collect in the combustion chamber. This ash consists of the additive package within new lubricating oil plus trace amounts of wear metals.
Barometric Draft Control	When installed into the chimney, this device helps to control the draft. This device is intended to smooth out draft variations caused by wind gusts and chimney performance. The more the flapper is open the less draft you have in the burning chamber. Normal chimneys require it be closed; only opening slightly during wind gusts.
Bimba Cylinder	A pneumatically operated plunger attached to the needle that actuates at PTFI time and de-actuates when the controller shuts off the burner. (Also see Needle)
Boost Pump	A stand-alone oil pump required at installations where the burner is quite distant from, or too highly elevated above the oil supply tank. Specifics of boost pump installation are covered elsewhere in this manual.
Burner	The flame producing mechanism that mounts onto the boiler cabinet. Rather self-explanatory but we use the term to distinguish it from the boiler as a whole.
Burning Chamber	See combustion chamber.
Burner Flange	See Air Tube

Calling for Heat	A term that you will see used in this manual. It means that the Aquastat or the wall thermostat is set at a temperature higher than the water or room temperature.
Check Valve	It is part of the floating pickup and filter assembly that is included your boiler order. The check valve holds the oil in the lines to prevent having to prime the pump each time a filter is changed. Located downstream from the tank filter, this valve will attempt to prevent the fuel from running from the burner back to the tank.
Clinker	A build-up of unburned oil inside the combustion chamber. Clinkers are caused by too much water in the air or oil supply and will cause problems.
Coking	Burned, hardened oil inside the oil circulation passages in the module that is created from an excessive preheat setting of the OUT1 set point in the temperature controller.
Combustion Air	Atomizing air injects through the nozzle to create a fuel cloud but there isn't enough of it to supply all the oxygen needed for combustion. Combustion air is drawn through the adjustable shutters into the burner's fan and then blown down the air tube, through the flame retention head and then into the combustion chamber. If you have installed a Sealed Combustion Adaptor, a knob controls the shutters.
Combustion Chamber	Also called burning chamber and fire box. The large barrel shaped chamber that the flame is contained in. Unburned ash collects in this chamber.
Combustion Control	Also called controller, red box, Fireye, brain box. This device monitors and controls the combustion and provides numerous safety features. This device controls all the burner sequences and shuts the burner off if it finds things not running properly.
Compression Fitting	A nut and ferrule type gland fitting used for sealing to steel tubing. This compression fitting does not seal on copper or plastic suction lines. Don't use such a fitting anywhere in your fuel supply line.
Dirty Filter Switch	A switch, which monitors the pressure in the oil circulating system of the burner. Pressure exceeding 35 psi – indicating the vapor eliminator filter is dirty – will cause this switch to close which turns on the amber light.
Delivery Line	Copper piping, oil-approved hose or steel pipe that connects the oil tanks with the boiler.
Draft	The vacuum pressure inside the burning chamber that moves the air up the chimney. The boiler requires this pressure to be negative and, unless you have a draft inducer installed, the only thing producing this vacuum is the chimney itself by the action of the hot air rising up. Draft is measured in hundredths of an inch of water column and our boilers run fine with a draft of negative 3 to 5 hundredths. See the Maintenance Procedures section of the manual for checking draft.
Draft Inducers	A fan mounted in the chimney that increases draft by helping the chimney pull the flue gasses out of the boiler.
External Oil Regulator Assembly	An assembly comprised of an inlet pressure gauge, an oil regulator and an outlet pressure gauge. It is used in boost pump applications and boiler installations to provide a correct inlet pressure to the pump on the burner. Additional information exists in the Boost Pump section of this manual.
Flame Retention Head	Located in the end of the air tube of the burner, the flame retention head mixes the atomized oil with combustion air.

Flared Fittings	The only fitting to be used with soft copper tubing at disconnection points in the fuel delivery line. Disconnection is easy and flare fittings form a good seal.
Heat exchanger	The passages through which the hot flue gasses pass on their way to the chimney after leaving the burning chamber. Although the burning chamber itself contributes to the heat exchange process it is considered to be separate from the 'heat exchanger'.
Heating element	An electrical device residing in and removable from the module. This device provides the heat necessary to raise the oil to a temperature at which it will burn.
Heater switch	A rocker switch labeled "1" and "0" to indicate the universal positions of 1=ON and 0=OFF. The switch must be in the 1 (ON) position when burning fuels such as waste oil. If fuel oil, diesel fuel, kerosene, etc. is being burned, the switch should be turned off.
Hour Meter	Located in the panel that attaches to the burner motor, this meter will accumulate time whenever the burner is firing.
Ignition Test Switch	A momentary push-button switch that is active whenever the burner motor is running. Depressing it will turn on the ignition transformer allowing you to check the appearance of the electrode arc.
Ignition Transformer	Supplies voltage for the ignition arc. Voltage is transferred to the electrodes via the springs, which rest on the electrode rods.
INTRLCK Light	A light on the Fireye combustion controller indicating that the fuel is at a temperature at which it will burn.
Module	The "firing gun" part of the burner that can be slid out of the air tube for servicing. The portion of the burner that houses the components required to accomplish firing including the nozzle, electrodes, dirty filter switch, air and oil solenoids, heating element, etc.
Module Block	A 1" x 3" x4" steel block upon which are mounted the components as described above. It is visible when the module cover box is flipped open.
Module Connector	Also called the 6-prong plug. This plug allows the module to be electrically disconnected from the burner proper.
Module Cover Box	A sheet-metal box that is hinged to allow access to the components mounted on the module block. The shipping screws in the front lip of the ignition transformer must be removed and the transformer flipped up to allow it to be opened.
Module Hanging Bracket	A notched plate mounted inside the air tube. A bolt on the module slides into a slot in this bracket for the purpose of centering the nozzle in the flame retention head.
Needle	A device that seats into the nozzle when the burner is not firing. It prevents oil from seeping out the nozzle between firings and also aids in clearing nozzle obstructions.
Nozzle	The mechanism responsible for mixing the oil with the atomizing air and producing the atomized fuel cloud for combustion. It is comprised of two parts: The outer brass cap that screws into the module tube and the 'spinner' which sits in the end of the oil delivery tube accessible once the outer brass cap is removed. A nozzle blockage is the blockage of the small passage through the spinner. The spinner doesn't 'spin'. It's fixed in place; it only causes the air passing through the slots around its perimeter to 'spin' as it mixes with the oil.

Oil Delivery Line	In general terms this includes all the plumbing and components involved in transferring oil from the tank to the burner. The name is also used to describe just that final portion of plastic line that connects to the pump on the burner.
Oil Pressure Gauge	A gauge, which reflects the oil pressure on the nozzle. It is visible through a hole in the module cover box.
Oil Pressure Relief Mechanism	A combination oil pressure relief and oil flow adjustment device. It houses the valve by which you set the return oil flow to the tank and also a pressure relief valve which will open up, bypassing the adjustable valve, if pressure in the system gets very high due to a blocked vapor eliminator filter. When relieving, it dumps the pump flow back to the tank.
OPR CTRL Light	A light on the combustion controller indicating that power is ON.
Oil Hoses	These three hoses connect the burner to the module. They are rated for high temperature, high pressure and are fire resistant.
Oil Temperature Controller	A device installed in the module cover box which controls the temperature to which the oil will be heated and the temperature that must be reached before the Fireye controller will be allowed to fire the burner.
Pre Purge	A function provided by the combustion controller that causes the burner's blower fan to run for 90 seconds before the burner will fire. It does this to insure no combustible vapors remain in the combustion chamber at the time of firing.
PTFI Light	A light on the combustion controller that will come on for the first 10 seconds of firing. It stands for Pilot Trial For Ignition and indicates that voltage is being applied to the solenoid valves and ignition transformer.
Red Light	When lit, this signals a safety shutdown situation. See 'Alarm Light'.
Reinforced Hose	A clear, braided, oil-approved hose, recommended for supply oil line.
Reset Button	A push-button type switch located on the top of the combustion controller. This switch must be pressed for one second to restart the burner if the red alarm light is ON.
Residual Flame	A flame that continues after the burner shuts off. This is not normal. The combustion controller will not allow the burner to fire if residual flame is present.
Return Line	A 1/4" (minimum) copper or plastic line that runs from the oil pressure relief mechanism on the vapor eliminator back to the fuel tank. Flow through it is normally set to a rapid drip by the valve on the pressure relief mechanism. Should the vapor eliminator filter plug up, the pressure relief mechanism will shunt the full 18 GPH flow from the pump back to the tank.
Sealed Combustion Adaptor	A device that can be attached to the burner to allow it to draw its combustion air from outside the building. It would be an essential item in a building that has negative internal pressure due to exhausting equipment.
Six-Prong Plug	This connector completes the circuit between the module and the burner. See 'Module Connector'
Solenoid	Two essentially identical solenoid valves provide control for atomizing air and oil delivery to the nozzle. They energize (open) when the controller fires the burner.
Spinner	See Nozzle.

Sub-base	The metal electrical box that the controller sits on. It contains all the wiring attachments for the controller plus a 4 amp fuse and an 8 amp circuit breaker. It is accessed by removing the Fireye controller.
Tank	Storage for waste oil.
Tank Filter	A spin-on filter, generally in the 75-micron range, that filters the oil coming out of the tank.
Test Hose	A good tool to have if you've got trouble drawing oil from the tank due to suspected obstruction or air leak. It's also useful if you think the quality of your oil might be causing burning problems. You can make it yourself out of ½" reinforced plastic hose. Make it long enough to reach from the burner to the floor and attach a fitting to one end that allows attachment to your pump. You can then use it to suck from a bucket of known good oil sitting on the floor, which should tell you if there's a problem with the normal delivery system.
Ultra Violet (UV) Sensor	The part of the Fireye combustion control that detects the flame. It is a blue device installed under the transformer.
Vapor Eliminator	This cast aluminum canister houses a replaceable filter element and provides a settling chamber which provides for the venting off of vapor that can accumulate during the oil heating process.
Vapor Eliminator Filter	A replaceable 10-micron filter element intended to remove fine particles that have passed through the tank filter.
Wall Thermostat	May not be used but if it is – then it's function is to instruct the Aquastat that controls the burner on the boiler to operate, as any other thermostat, to control the room temperature. INOV8 does not provide this thermostat with the boiler.