ASSEMBLY, INSTALLATION, MAINTENANCE AND OPERATING INSTRUCTIONS

INOV8 Multi-fueled Boiler with G750 & G900 Burners

Save These Instructions!  This manual must be kept near the boiler!
# TABLE of CONTENTS

## GENERAL GUIDELINES

- Codes & Regulations ........................................................................................................... 6
- U.S. EPA Regulations & Used Oil Burning ........................................................................... 7
- Listing Agencies .................................................................................................................. 7
- Fuels - general information ............................................................................................... 7
- Special Precautions! .............................................................................................................. 7
- Warranty is void if ............................................................................................................... 8
- Unpacking & Inspecting .................................................................................................... 8
- Disposal of Packaging ....................................................................................................... 9
- Shipping & parts information ............................................................................................ 9
  - Boiler Specifications Chart .......................................................................................... 10
    - Note: the Gas-Oil burner settings for air, oil and gas pressures are in the chart on page 32. 11
  - Boiler Installation Overview ......................................................................................... 12

## BOILER PRE-INSTALLATION

- Venting Considerations ..................................................................................................... 14
- Fresh Air for Boiler Room ................................................................................................. 14
- Boiler System Location ...................................................................................................... 14
- Multiple Boiler Installations ............................................................................................. 14
- Boiler Operating Temperature .......................................................................................... 15
  - Hydronic Circuit & Control Valve Illustration ............................................................. 15

## BURNER & CONTROLS

### SECTION 1 - DEFINITION OF CONTROLS & THEIR FUNCTION

- Control panel ..................................................................................................................... 16

### SECTION 2 - BOILER INSTALLATION

- Burner Installed onto Boiler ............................................................................................. 20
  - Mounting Flange Dimensions ..................................................................................... 21
  - Electrode and Flame Retention Head Setting ............................................................. 22
  - Installation of Sediment Trap and Gas Supply ........................................................... 23
  - Attaching the Vapor Eliminator Return Line ............................................................... 25
- Chimney Installation ......................................................................................................... 25
  - Installing the Draft Inducer .......................................................................................... 27
  - Installing the Barometric Draft Control ....................................................................... 27
  - Draft Measurements & Adjustments ............................................................................ 27
- Electrical Supply & Wiring Safety Controls ..................................................................... 28
  - Wiring Guidelines ........................................................................................................ 28
  - Wiring Aquastat .......................................................................................................... 28
- Oil Storage, Filters & Piping Considerations .................................................................... 29
  - Piping & Connections Recommendations ............................................................... 29
  - Vapor Eliminator Filter / Pressure Relief Assembly ..................................................... 29
  - Installation of Vent Line from Vapor Eliminator back to the Tank ............................. 29
  - In-line Filter .................................................................................................................. 30
  - Boost Pump (optional) ................................................................................................. 30
  - Bench Tank Installation ............................................................................................... 31
  - Diaphragm Pump Installation ...................................................................................... 31
- **Diagram Showing Installation of Suntec Boost Pump, Filter, Check Valve, Regulator & Gauges** ......................................................................................................................... 32

### SECTION 3 - ASSEMBLING & INSTALLING OF ALL COMPONENTS

- Burner Settings Chart ..................................................................................................... 33
- High Altitude Settings .................................................................................................... 33
- Step-by-Step Procedure for Starting Burner .................................................................... 34
- Burner Operation based on Fuel Selection .................................................................... 35
- Timing Sequence of Burner Controls ............................................................................ 37
- Oil Flame Adjustments ................................................................................................... 37
- Proper & Improper Flame appearances ........................................................................ 38
PLC OPERATION OVERVIEW ................................................................................................................................. 39

Power switch off ..................................................................................................................................................... 39
Power Off Configuration Displays – Category #1 ................................................................................................... 39
Running modes – Category #2 ............................................................................................................................. 40
Operational errors and conditions – Category #3 .................................................................................................. 41
Error Displays that Correct Automatically when Trouble Clears – Category #4 ..................................................... 42
Forced-to-Gas (FTG) reasons – Category #5 ......................................................................................................... 42

SERVICE & MAINTENANCE ................................................................................................................................. 44

Boiler Maintenance ......................................................................................................................................................... 44
Changing fuse ........................................................................................................................................................ 45
Replacing the Vapor Eliminator Filter (or Cleaning the strainer) ............................................................................ 46
Cleaning the Nozzle ............................................................................................................................................... 46
Rebuilding the Pump .............................................................................................................................................. 47
Cleaning the Pump Internal Pressure Regulator .................................................................................................... 48
Ultraviolet sensor cleaning ..................................................................................................................................... 48

ANNUAL MAINTENANCE ................................................................................................................................. 50

Chimney Inspection ........................................................................................................................................................ 50
Summer Burner Refurbishing Program ........................................................................................................................... 50
BASIC WIRING DIAGRAM FOR BOILER WITH EITHER G750 OR G900 BURNER ............................................................ 52
SUBBASE WIRING DIAGRAM FOR BOILER ................................................................................................................ 53
ELECTRICAL DRAWING FOR PLC CONTROL PANEL .................................................................................................. 54
GLOSSARY ............................................................................................................................................................ 55

<table>
<thead>
<tr>
<th>Notations Used in this Manual</th>
</tr>
</thead>
<tbody>
<tr>
<td>![CAUTION]</td>
</tr>
<tr>
<td>![NOTE]</td>
</tr>
</tbody>
</table>
IMPORTANT BURNER INFORMATION

These instructions must be kept with the burner.

CAUTION: All gas burners MUST be installed by trained and licensed technicians. WARNING: Installation of this burner must conform with local codes or, in the absence of local codes, with the Standard for the Installation of Domestic Gas Conversion Burners, ANSI Z21.8-1984, and Addendum, Z21.8a-1989, and the National Fuel Gas code, ANSI Z223.1-1984, and CAN/CGA B149.1 & .2. If an external electrical source is utilized, the conversion burner, when installed, must be electrically grounded in accordance with local codes or, in the absence of local codes, with the national Electrical Code, ANSI/NFPA No. 70-1990 and CSA Electrical Code.

<table>
<thead>
<tr>
<th>Technical Specifications</th>
<th>Natural</th>
<th>Propane</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gas Supply Pressures</strong></td>
<td>Min. 5&quot; w.c.</td>
<td>Min. 8&quot; w.c.</td>
</tr>
<tr>
<td></td>
<td>Max. 7&quot; w.c.</td>
<td>Max. 14&quot; w.c.</td>
</tr>
<tr>
<td><strong>Manifold Pressures</strong></td>
<td>See chart on page</td>
<td>See chart on page</td>
</tr>
<tr>
<td><strong>Power Supply Required</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Burner Motor</strong></td>
<td>120 Volts 60 Hz 1 Phase</td>
<td></td>
</tr>
<tr>
<td></td>
<td>232T 2.2 Amps 3250 RPM</td>
<td></td>
</tr>
</tbody>
</table>

WARNING: If the information in these instructions is not followed exactly, a fire or explosion may result causing property damage, personal injury or death. Do not store or use gasoline or any other flammable vapors or liquid in the vicinity of this or any other appliance.

WHAT TO DO IF YOU SMELL GAS:
1. Do not try to light any appliance.
2. Do not touch electrical switches; Do not use any phone in your building.
3. Immediately call your gas supplier from a neighbor’s phone. Follow the gas supplier’s instructions.
4. If you cannot reach you gas supplier, call the fire department.

Installation and service must be performed by a qualified installer, service agency or the gas supplier.
AVERTISSEMENT

Cette trousse de conversion ne doit être installée que par le représentant d’un organisme qualifié et conformément aux instructions du fabricant et aux codes et exigences pertinentes de l’autorité compétente. (Au Canada, il s’agit des codes d’installation CAN/CGA-B149.) Quiconque ne respecte pas à la lettre les instructions du présent guide risque de déclencher un incendie, une explosion ou la production de monoxyde de carbone entraînant des dommages matériels, des blessures ou la mort. L’organisme qualifié qui effectue les travaux est responsable de l’installation de cette trousse. L’installation n’est pas terminée tant que le fonctionnement de l’appareil converti n’a pas été vérifié selon la notice du fabricant qui accompagne la trousse.

AVERTISSEMENT. Assurez-vous de bien suivre les instructions données dans cette notice pour réduire au minimum le risqué d’incendie ou d’explosion pouvant entraîner des dommages matériels, des blessures ou la mort.

- Ne pas entreposer ni utiliser d’essence ni d’autres vapeurs ou liquides inflammables a proximité de cet appareil ou de tout autre appareil.

AUE FAIRE SI VOUS SENTEZ UNE ODEUR DE GAS :

- Ne pas tenter d’allumer d’appareil.
- Ne touchez a aucun interrupteur. Ne pas vous servir des téléphones se trouvant dans le bâtiment ou vous étés.
- Appelez immédiatement votre fournisseur de gaz depuis un voisin. Suivez les instructions du fournisseur.
- Si vous ne pouvez rejoindre le fournisseur de gaz, appelez le service des incendies.

L’installation et l’entretien doivent être assurés par un installateur ou un service d’entretien qualifié ou par le fournisseur de gaz.

Contact Information:

INOV8 International, Inc.
67 Kraft Street
La Crosse, WI  54603
USA
www.inov8-intl.com
sales@inov8-intl.com
Ph: 877-684-6688
Ph: 608-785-2879
Fx: 608-785-2868
**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 includes 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 B175 through B850 boilers utilizing the Gas-Oil burner and the appropriately sized Buderus boiler.

**CODES & REGULATIONS**

All work shall be performed by a qualified contractor 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. INOV8 equipment is listed to the following standards which must be adhered to during installation:


- **For oil storage installation:** NFPA # 31 – Standard for the Installation of Oil-Burning Equipment – 2006 Edition

- **For electrical installation:** NFPA # 70 – National Electrical Code – 2005


- **For oil storage tank:** The INOV8 tanks are listed by ETL to UL 80 Standard for Steel Tanks for Oil-Burned Fuel and CAN/ULC-S602-03.

- **For Buderus Boiler** The boiler has these ratings for installations in the United States: ASME – Cast Iron Boiler and Pressure Vessel Code, MEA# 358-91-E, and some sizes have an Energy Star Rating. In Canada the boilers have the following registration: CRN# 1495.9c, 620.T. – see website for details: [www.buderus.us](http://www.buderus.us).
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 listed by Intertek ETL Semko (ETL) - an internationally recognized third party test agency to US and Canadian safety standards for gas and oil burners – see above standards. All INOV8 certifications can be viewed on their website: www.intertek-etlsemko.com.

Fuels- General Information

This product is approved to burn natural gas or propane. Note – the default setup is for natural gas, so the gas valve train must be adapted to burn propane. The burner can also burn the following oils: crankcase oil, crankcase oil with up to 20% gasoline, #2 fuel oil, mineral spirits, hydraulic and transmission oil. The following additional oils have been tested and passed combustion analysis but are not “listed” fuels due to a lack of standards to define them: used and crude vegetable oil, glycerin, jet fuel and 100% 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 – When burning crankcase oil that leaves an ash deposit, this burning MUST be installed on an approved waste oil burning device. Used oils may contain gasoline, heavy metallic compounds and foreign materials. When burned, these compounds are emitted from or deposited within your heating appliance and therefore care should be taken when storing these oils or when using, cleaning and maintaining this equipment.

Special Precautions!

1. The burner must be wired strictly in accordance with national electrical standards, the wiring diagram and instructions in this manual and above federal codes and local prevailing codes.
2. Disconnect the power supply before making wiring connections to prevent electrical shock and equipment damage. Disconnect the power supply before cleaning the burner.

3. Should over-heating occur: (a) shut off the manual gas control to the burner, (b) do not shut off the control switch to the pump or blower.

En cas de surchauffe : (a) fermez la commande manuelle de gaz à l’appareil, (b) ne pas fermer la commande de la pompe ou de la soufflerie.

4. Verify proper operation after servicing.

S’assurer que l’appareil fonctionne adéquatement une fois l’entretien terminé.

5. It cannot be used for any other unauthorized purposes.

6. This burner can be used with natural gas or propane. A conversion kit, as supplied by the manufacturer, shall be used to convert to the alternate fuel.

Convient au gaz naturel et au propane. Utilisez la trousse de conversion, fournie par le fabricant, pour la conversion à un autre combustible.

7. This product is not designed for use in hazardous atmospheres containing flammable vapors or combustible dust, or atmospheres containing chlorinated or halogenated hydrocarbons.

8. Separate manuals are provided for accessory or optional items to operate with this burner. These manuals provide important information on the installation and operation of their respective products. However, installation references to the chimney, anything relating to the operation, electrical, maintenance or repair of the burner, the oil storage, filtering and pumping, if found in the INOV8 instructions supersedes anything found elsewhere.

9. If the burner requires servicing, contact your INOV8 authorized service technician. DO NOT allow untrained, unauthorized personnel to service your burner or the warranty may be voided.

WARRANTY IS VOID IF …

1. The boiler and burner are 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.

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 electrode 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 22 for proper electrode configuration. The boiler is shipped from Buderus with baffle plates inside the flue passageways. These
plates are intended for clean fuel only and must be removed prior to operating the boiler with waste oils.

**DISPOSAL OF PACKAGING**

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.

**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** – The boiler consists of a multi-section cast iron boiler. In most cases, the boiler steel will be shipped pre-assembled, meaning the individual sections will be together. The sheet metal skins, relief valve and pressure/thermometer are separately packaged for assembly after the piping connections are completed. A boiler installation manual will also accompany the boiler.

2. **INOV8 Burner** – The burner is separately packaged.

3. **Control Panel** – contains the PLC control, Fireye combustion control, on/off switch, fuel selection switch, operating lights, fuses and circuit breaker.

4. **Vapor Eliminator**

5. **Oil Filter Assembly** includes these parts from the top down:
   a. One ¾” check valve, ¾” x 2” black nipple, one 90º street elbow
   b. Filter mount and one primary strainer, model General Filter model #2A-17A-3/4-200-NU. It is a cleanable strainer with a replacement part number GFI 2029.
   c. One 90º street elbow, one ¾” x 12” pipe nipple, double tap bushing, 2” with ¾” x ½” reducing bushing, 45º elbow and bushing
   d. Hose & float

6. **Gas valve train**, includes:
   a. Asco Solenoid Valve and Honeywell Two-Stage Gas Valve Actuator
   b. Piping & fittings

7. **Miscellaneous items**: Instruction Manual, spare fuses (one 8 amp, one 1 amp and one ½ amp), spare nozzle.

8. **Flange & Stainless Steel Sleeve Assembly**. This is mounted to the center of the door and provides the flange for the burner.

9. **Draft Inducer (optional)** – Tjernlund (model specific to boiler size)

10. **Bench Tank** - (optional), which includes:
    a. 300 gallon bench-type tank
    b. Tank gauge, oil supply and lines with fittings

11. **Boost Pump (optional)**
## Boiler Specifications Chart

The following chart provides the specification details for the five sizes of Buderus Boilers when used with an INOV8 burner. Complete information on Buderus boilers can be found on our website: [www.inov8-intl.com](http://www.inov8-intl.com) or the Buderus website [www.buderus.net](http://www.buderus.net).

### Buderus Boiler Specifications for INOV8 System:

<table>
<thead>
<tr>
<th>Buderus Model #:</th>
<th>B500</th>
<th>B650</th>
<th>B750</th>
<th>B850</th>
<th>B1050</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil Input - GPH (based on 140,000 BTU per gallon)</td>
<td>3.46</td>
<td>4.23</td>
<td>5.04</td>
<td>5.76</td>
<td>7.50</td>
</tr>
<tr>
<td>Gross Output (de-rated 10% from Buderus ratings)</td>
<td>408,600</td>
<td>503,100</td>
<td>596,700</td>
<td>691,200</td>
<td>908,100</td>
</tr>
<tr>
<td>Net IBR (de-rated 10% from Buderus ratings)</td>
<td>355,500</td>
<td>437,400</td>
<td>519,300</td>
<td>601,200</td>
<td>789,300</td>
</tr>
<tr>
<td>Overall Boiler Length</td>
<td>55 1/2</td>
<td>56 3/4</td>
<td>63 1/4&quot;</td>
<td>69 1/2&quot;</td>
<td>69</td>
</tr>
<tr>
<td>Minimum Boiler Width</td>
<td>20</td>
<td>20</td>
<td>33 1/2&quot;</td>
<td>33 1/2&quot;</td>
<td>33&quot;</td>
</tr>
</tbody>
</table>
| Boiler Width with Jacket & insulation | 34 3/4" | 34 3/4" | 34 3/4" | 34 3/4" | 38 1/2"
| Fire Box Depth | 37 1/2 | 43 3/4" | 50" | 56 1/4" | 52 1/2" |
| Fire Box Volume (cu. Ft.) | 6.39 | 7.59 | 8.79 | 9.99 | 17.16 |
| Dry Weight (lbs) | 1,391 | 1,585 | 1,779 | 1,973 | 3,059 |
| Water Content (gal) | 45.2 | 52.6 | 60 | 67.4 | 77.7 |
| Operating Weight (lbs) | 1,768 | 2,024 | 2,280 | 2,545 | 3,707 |
| Foundation Length | 42 1/2" | 48 1/2" | 54 1/4" | 61" | 60 1/4" |

### Water side connections:

| Water connection - inches | 3 | 3 | 3 | 3 | 4 |
| Return water connection (NPT) | 3 | 3 | 3 | 3 | 4 |
| Vent connection - inches | 7 | 7 | 7 | 7 | 10 |
| Chimney size - inches (minimum) | 10 | 10 | 12 | 12 | 12 |
| Chimney height - feet (minimum) | 15 | 15 | 15 | 15 | 15 |

### Clearances (in inches)

| Side wall | 15 3/4" | 15 3/4" | 12 | 12 | 32 |
| Side wall - burner door swing | 43 | 43 | 43 | 43 | 43 |
| Front of boiler (boiler length plus 40") | 85 | 91 | 95 | 104 | 101 |
| Behind (1/2 boiler length plus 20") | 43 | 46 | 49 | 52 | 51 |
| Top | 12 | 12 | 12 | 12 | 24 |
| Chimney connector | 18 | 18 | 18 | 18 | 18 |
### Boiler operating requirements

<table>
<thead>
<tr>
<th></th>
<th>240</th>
<th>240</th>
<th>240</th>
<th>240</th>
<th>240</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max operating temperature - F</td>
<td>240</td>
<td>240</td>
<td>240</td>
<td>240</td>
<td>240</td>
</tr>
<tr>
<td>Max operating pressure - PSIG</td>
<td>58</td>
<td>58</td>
<td>58</td>
<td>58</td>
<td>87</td>
</tr>
<tr>
<td>Max supply temperature - F</td>
<td>248</td>
<td>248</td>
<td>248</td>
<td>248</td>
<td>248</td>
</tr>
<tr>
<td>Min supply temperature - F</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>Min required draft - inches of WC</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.02</td>
<td>-0.02</td>
</tr>
<tr>
<td>Firebox Pressure (In. W.C.)</td>
<td>.54</td>
<td>.71</td>
<td>.71</td>
<td>.75</td>
<td>.57</td>
</tr>
</tbody>
</table>

### Draft Inducer Sizing:

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>I</th>
<th>I</th>
<th>I</th>
<th>I</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tjernlund Draft Inducer, model</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
<td>I</td>
</tr>
<tr>
<td>Tjernlund connection size (inches)</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>10</td>
</tr>
</tbody>
</table>

### Standard features of Buderus Boilers & supplied equipment:

- Factory assembled cast iron sections (can be ordered knocked-down)
- Full-size burner door hinged left or right (field adjustable)
- Supply & return connections at rear of boiler
- Blue enamel jacket with 3 1/2" wrap-around thermal insulation (packaged separate from cast iron)
- Flexible GL-180M cast iron with silicon "barrier skin", precision casting eliminates need for manual grinding
- Precision casting eliminates need for manual grinding
- 50 psig ASME relief valve
- 3-1/4" pressure and temperature gauge (tridicator)
- No refractory or target cup needed due to chamber geometry
- Aquastat – Honeywell model L7248C1006
- Tongue and groove flue side sealing for pressurized operation
- Burner mounting plate with stainless sleeve
- Stainless steel liner for bottom of boiler combustion chamber
- Oil Regulator & Gauge Assembly or Kit
- Floating Oil Pickup Assembly with 2" tank fittings
- Inline Oil Filter (or optional Strainer)
- Check valve & fittings for oil line connection
- Boiler cleaning brushes & Instruction Manual

**Note:** boilers de-rated 10% by INOV8 from Buderus specifications to accommodate the longer waste oil flame and the loss of heat transfer from ash between cleanings. Ratings are at clean conditions.

### Items Needed for Boiler Installation which are not included with INOV8 System:

- Low-Water Cut-out, oil & airlines, air compressor, water circulators and mixing valves, manifolds, zone controls or other water side controls, dual-acting barometric damper (for gas-oil burner), chimney, oil storage tank, boost pump for oil, electrical supply.

*Note- the Gas-Oil burner settings for air, oil and gas pressures are in the chart on page 33.*
Boiler Installation Overview

Notes:
1. The door can hinge right or left. Direct supplies to hinge side & use flexible oil hose.
2. This drawing only pertains to the fuel and venting requirements.
3. It will ease cleaning of the boiler to elevate it one or two feet.
4. Do not use more than one elbow or the flue gases slow & collect soot which can lead to chimney fires.
5. Vapor return line must extend to bottom of tank.
6. This drawing is not intended to be complete. The entire installation & operation manual must be referred to prior to startup.

The panel at right was assembled to ease installation of these components. It must be mounted within a few feet of the burner. Mounting brackets have been provided to secure this panel to the top of the boiler. The electrical connectors must reach to the burner and gas-valve train.

See part identification on page 16.
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. See the drawing on page 15.

2. Reliable, consistent combustion air is essential for burning waste oils. INOV8 assures this by supplying a high quality draft inducer with the boiler system.

3. Fresh air must be supplied to the boiler room.

4. Install the boiler onto a platform which raises it at least one foot to ease the maintenance process. The lower passageways are difficult to reach with a cleaning brush when laying on the floor.

5. 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.

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 hinge pivot is placed. Please note that the door may be mounted with the pivot point on either side.

7. The INOV8 equipment must be operated according to the settings established in this manual, the boiler manual, and displayed on the boiler system.

8. Should over-heating occur: (a) shut off the manual gas control to the burner, (b) **do not** shut off the control switch to the pump or blower.

**En cas de surchauffe :** (a) fermez la commande manuelle de gaz a l’appareil, (b) ne pas fermer la commande de la pompe ou de la soufflerie.

9. Verify proper operation after servicing.

**S’assurer que l’appareil fonctionne adéquatement une fois l’entretien termine**'.

10. It cannot be used for any other unauthorized purposes.

11. **This burner can be used with natural gas or propane. A conversion kit, as supplied by the manufacturer, shall be used to convert to the alternate fuel.**

**Convient au gaz naturel et au propane. Utilisez la trousse de conversion, fournie par le fabricant, pour la conversion à un autre combustible.**

12. 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 sections, 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

In most cases it is necessary to install an exhaust blower in the stack to offset the inherent pressure drop of the Buderus boiler, the loss of natural draft resulting from the relative cool stack temperature (caused by the high efficiency of the boiler), and the increasing flue side pressure drop resulting from the accumulation of ash in the boiler. INOV8 recommends a Tjernlund fixed speed blower fan for this purpose. Draft must be maintained at no less than -0.02 during firing conditions. The draft inducer should overcome the pressure drop in the boiler in order to keep an adequate supply of combustion air for a waste oil flame (the requirement is greater than with clean fuels). **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 which often has an inadequate air to supply both combustion air and ventilation air. As a result, the room can become under a vacuum causing operating problems on the burner. It is necessary to provide outside air to prevent the vacuum and to keep the room relatively cool. This is extremely important because the burner motor and the motor on the draft boost blower cannot operate in high temperatures 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 specifications on page 10.
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 wall temperature that usually is less than the boiling temperature of water – or 212°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 stray bits of waste oil will accumulate as a tar-like substance on the low temperature wall of the boiler. INOV8 requires the boiler temperature be maintained at 180 to 200 in addition to utilizing a stainless steel sleeve around the flame initiation zone 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 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. 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.

*Hydronic Circuit & Control Valve Illustration*
For correct operation of the dual – fuel burner, the customer must be familiar with the controls and indicators provided. They are located on the boiler control panel, the oil heater and regulator assembly, and the gas valve train. Setting burner operational controls such as an Aquastat, low water cutout and etc. is the responsibility of the installer but the customer should be aware of their operation as well. This chapter is divided into three sections: 1) Definition of controls and their function, 2) the Buderus Boiler & Controls, 3) Assembly or installation of all components, and 3) Start-up and operation of the burner, controls and boiler.

SECTION 1 - DEFINITION OF CONTROLS & THEIR FUNCTION

There are three unique control assemblies utilized on this multi-fueled boiler system that are described here. The Control Panel, the Burner, and the Gas Valve Train.

Control panel

The control panel will be mounted on the 2’ x 2’ steel panel. It contains the following list of items also identified in the drawing at right:

1. PLC Display/Keypad which incorporates:
   a. Information on the current state of operation
   b. Keypad input allowed for the current display
2. Fireye Combustion Controller which incorporates:
   a. Indicator lights showing the current state of the Fireye control
   b. The same lights showing error codes if the Fireye control goes to alarm.
   c. A pushbutton switch to reset a Fireye control alarm state.
3. Power ON/OFF switch with a power on light
4. Fuel Mode Selection switch
5. Fireye Alarm indicator & General Alarm indicator (Flashing light and audible alarm)
6. Gas and Oil firing rate indicators
7. Fuses
Burner Part Identification

The photos below show the gas/oil burner without the cover. You should be familiar with the parts that are identified as they may require occasional maintenance. The burner is a basic gas burner, but has been modified with the INOV8 patented "Drawer Assembly" that allows the burning of oil in addition to gas. It can burn as fuel natural gas or propane alone, any approved oil alone, or in combination with the gas.
Gas Train

Install the gas train in a convenient location and connect to the gas union in the bottom of the burner. Attach your gas supply line to the train according to the following diagram. Plug the gas train power conduit plug into the socket in the control panel. Note – the gas valve is set at approximately 3.5 in w.c. at the factory.

Note – High and low gas pressures can be measured at the manifold pressure access port on the burner (8). The Maxitrol regulator (5) and Honeywell two stage gas regulator (7) must be converted when using LP / propane.

Gas Train Legend
1. Gas supply & flow direction of gas
2. Gas supply main shutoff manual valve (field supplied)
3. Gas supply pressure test point (field supplied)
4. Gas train pipe
5. Gas appliance pressure regulator (field supplied)
6. Safety shutoff gas valve (24V)
7. Honeywell two-stage regulator
8. Gas burner manifold test point
Reducing Gas Regulator

Item 5 in the gas valve train is a field provided gas pressure reducing regulator. INOV8 recommends a Maxitrol Regulator which is suitable for natural or LP gas. It can be selected from the following guide. The selection depends on the incoming gas pressure and the BTU size of the burner.

**Straight-Thru-Flow Design — RV62, RV63, RV61, RV81, RV91, RV111 & RV131**

*main burner only*

<table>
<thead>
<tr>
<th>Model</th>
<th>Pipe Sizes</th>
<th>Capacities to (CFH)</th>
<th>Inlet Pressures to (psi)</th>
<th>Outlet Pressures (w.c.)</th>
<th>Venting</th>
</tr>
</thead>
<tbody>
<tr>
<td>RV52</td>
<td>1/2&quot; &amp; 3/4&quot;</td>
<td>900 CFH (25 m³/h)</td>
<td>1.5 (10.3 mbar)</td>
<td>0.4 to 12&quot; w.c.</td>
<td>1/8&quot; NPT</td>
</tr>
<tr>
<td>RV61</td>
<td>1&quot; &amp; 1-1/4&quot;</td>
<td>2500 CFH (70 m³/h)</td>
<td>1.0 (6.9 mbar)</td>
<td>0.4 to 22&quot; w.c.</td>
<td>1/8&quot; NPT</td>
</tr>
<tr>
<td>RV111</td>
<td>2-1/2&quot; &amp; 3&quot;</td>
<td>17000 CFH (481 m³/h)</td>
<td>1.0 (6.9 mbar)</td>
<td>0.4 to 22&quot; w.c.</td>
<td>3/4&quot; NPT</td>
</tr>
<tr>
<td>RV53</td>
<td>3/4&quot; &amp; 1&quot;</td>
<td>1300 CFH (36 m³/h)</td>
<td>0.75 (5.2 mbar)</td>
<td>0.4 to 12&quot; w.c.</td>
<td>1/8&quot; NPT</td>
</tr>
<tr>
<td>RV81 &amp; RV91*</td>
<td>1-1/4&quot;, 1-1/2&quot;, 2&quot; &amp; 2-1/2&quot;</td>
<td>4500 CFH (127 m³/h)</td>
<td>0.75 (5.2 mbar)</td>
<td>0.4 to 22&quot; w.c.</td>
<td>3/4&quot; NPT</td>
</tr>
<tr>
<td>RV131</td>
<td>4&quot; Flanged</td>
<td>30000 CFH (850 m³/h)</td>
<td>2.0 (14.1 mbar)</td>
<td>1.0&quot; to 22&quot; w.c.</td>
<td>3/4&quot; NPT</td>
</tr>
</tbody>
</table>

* See specific Sales Bulletin for pipe sizes available for each regulator shown.

**Photo of the Honeywell Gas Valve**

The photo below shows the Honeywell model V8944B1019 two-stage 24 VAC gas valve and regulator. When installing the gas supply a "main shutoff manual valve (item 2) and pressure test point" (item 3) should be installed at a convenient location upstream from the INOV8 supplied pressure regulator. See the Honeywell literature for complete installation instructions.

**Photo of Asco Solenoid**

The Asco Valve should be installed after a pressure reducing regulator.
SECTION 2 - BOILER INSTALLATION

The INOV8 waste oil burning boiler is comprised of an INOV8 burner, paired to appropriately sized Buderus cast iron assembled boilers, draft inducers, Honeywell Aquastats model L7248C1006, and various smaller fittings and components to enhance the operation of the system from the oil burning side. See the complete list of components in the Boiler & Burner Specifications. Please note that the boiler has been de-rated to accommodate an average efficiency of 80% taking into account at clean condition the boiler efficiency is 85% and prior to removing the ash the efficiency may drop to 75%.

The Buderus boiler manual must be referred to for details of installing the boiler regarding many issues – especially any water side applications. An important installation issue that is not addressed in their manual is that the boiler should be elevated about one to two feet to ease the cleaning process.

The boiler includes the assembled boiler castings and a separate box containing the insulation and jacket, fittings, boiler brushes and various fittings & other parts. The Tjernlund draft inducer has been selected based on INOV8’s 20 years of experience with waste oil boiler systems and their chimney setups. The overall objective is to provide a negative pressure over-fire of -0.04 in clean condition. A range is acceptable between -0.02 and -0.08. Draft exceeding that reading may allow the flame to lift off causing instability. A draft below -0.00 will not allow for sufficient time before cleaning of ash is required. If the provided draft inducer is not sufficient, larger sizes are available. If the draft inducer provides excessive draft, correct that by either adjusting the depth of the fan into the chimney, removing the inducer or adding a barometric damper. The draft measurement should be read in the port located near the sight glass (remove the small brass screw to access opening).

The boiler has these ratings for installations in the United States: ASME – Cast Iron Boiler and Pressure Vessel Code, MEA# 358-91-E, and some sizes have an Energy Star Rating. In Canada the boilers have the following registration: CRN# 1495.9c, 620.T.

SECTION 3 - ASSEMBLING & INSTALLING OF ALL COMPONENTS

BURNER INSTALLED ONTO BOILER

Carefully remove the burner and components from the shipping box taking care not to lose any of the supplied accessories. Check for signs of physical damage. Be careful when handling the burner, as the factory settings can be affected if moved and the operation of the burner could be affected. The burner has been pre-fired in the factory prior to shipping and will have oil in it.

The INOV8 gas/oil burner comes completely assembled and factory wired, ready for installation. The burner has a universal flange mount as illustrated below which when bolted to the boiler allows the burner to be adjusted for exact positioning in the combustion zone.

Step-by-Step Procedure

1. Remove the burner from the carton, taking care not to lose any of the supplied accessories. Check for signs of physical damage.
2. Compare the electrode placement that it is according to this manual’s drawing to be sure it wasn’t moved during shipping. An electrode out of proper position can cause dangerous back-fire.

3. Bolt the burner to the appliance. Be sure to install the supplied mounting gasket. Ensure that the burner is level and is centered in the appliance port.

4. Connect the line from the oil preheating box to the corresponding fitting at the upper-left rear of the burner.

5. Connect the ¾” plastic line from the air regulator to the slip fitting beside the oil hose fittings you just dealt with.

6. Plug the 7-pin burner connector and 2-pin UV connector into the corresponding sockets in the bottom right side of the boiler control panel.

7. Check that all gas train connections are tight and make your connections to the incoming gas supply.
   a. A sediment trap must be provided.
   b. If not already installed, a manual shutoff valve must be installed. This valve must be upstream of the burner gas train supply connection.
   c. A 1/8” NPT plugged tapping must be installed immediately upstream of the burner gas train supply connection and must be accessible for a test gauge.
   d. If required by local codes, provide gas vent lines at the gas regulators and valve.
   e. Perform required gas pressure test on incoming gas supply lines.

8. For electrical connection, bring 120 volt, 20 amp service into the control panel through a convenient knockout. (Swing out the control panel cover and look inside to help find a knockout position that won’t interfere with components or wiring inside the panel.)
   a. To make electrical connections, refer to field wiring diagram on page 52.
   b. Attach the hot wire (typically black) to the 6” black pigtail.
   c. Attach the neutral wire (typically white) to the 6” black pigtail.
   d. Attach the earth ground wire to the 6” green pigtail that comes off of the junction box.
   e. Label all wires prior to disconnection when servicing controls as wiring errors can cause improper and dangerous operation.

9. Check the burner functions as follows:
   a. Make a final check on both the gas and electrical connections.
   b. Loosen the screw in the manifold gas test point and install an appropriate manometer.
   c. The start-up procedure and instructions on setting the high and low gas pressure begins on page 34.

**Mounting Flange Dimensions**

The gas/oil burner utilizes a universal mounting flange as illustrated. Exact placement within the combustion chamber opening can be achieved.

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inches</strong></td>
<td>1-1/4</td>
<td>¼</td>
<td>7/16</td>
<td>2-3/16</td>
</tr>
<tr>
<td><strong>Millimeters</strong></td>
<td>32</td>
<td>6</td>
<td>11</td>
<td>56</td>
</tr>
</tbody>
</table>
Electrode and Flame Retention Head Setting

DO NOT turn the ignition electrode or change it from the position shown in the drawing or received from the factory. If the electrode is not located properly a dangerous situation may arise.

The electrode tip should be no further than 1/8” away from the flame retention head and can be close to the gas jet or between the jet and the flame retention head. The spark should hit the retention head. There should be immediate ignition for the gas flame. It may be necessary to rotate the electrode until it is located in front of the gas jet.

The proper position of the electrode will be when the flattened side is mounted on top of the Drawer Assembly and held in place by the electrode clamp. This will prevent rotation or moving closer or further away from the desired location.

Flat area on electrode insulation MUST be on the Drawer Assembly and held in place with the electrode clamp, so that the electrode cannot rotate out of position.
Installation of Sediment Trap and Gas Supply

Gas piping to the burner must be ½” minimum. Install only a full-ported shutoff valve. The valve must be located outside the appliance jacket and the pressure gauge port must be accessible.

Pressure test over ½ psig. The appliance and its individual shutoff valve must be disconnected from the gas supply piping system during any pressure testing of the system at a test pressure in excess of ½ psig.

Pressure test ½ psig or less. The appliance must be isolated from the gas supply piping system by closing its individual manual shutoff valve during any testing of the gas supply piping system at test pressures equal to or less than ½ psig.
**AIR SUPPLY HOOKUP & PRESSURE SETTINGS**

There are two air supplies used in the combustion process. Combustion air entering the chamber through openings in the burner housing 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 45 psig or higher) is required to operate the burner on the water heater. The water heater includes a factory provided pressure regulator rated at 300 PSIG that has a water separator and a gauge rated to 160 PSIG inlet for shop air. The air regulator assembly will be located on the left side of the gas-oil burner. The connection requires 1/4 NPTM. The air pressure will be regulated down to 30 psig – which is used to withdraw the needle from the nozzle.

2. A second pressure regulator and gauge are located on the front side of the burner. This regulator controls the air pressure that atomizes the oil. The air setting should be 14 psig at this location. A ¼” plastic airline will connect into the slip fitting on the back of the burner.

3. The shop air must be free of dirt and water. A desiccant air filter should be installed in the line before attaching to the first air regulator. 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.

4. 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 air hose is used, it should have a minimum burst pressure rating of 300 psig.

**Note** – If there are concerns for leaving the air compressor on during nights and weekends, INOV8 has a compressor protection device available. It is a timer switch that can be preset for a designated time. When that time is exceeded, the switch will shut down the air compressor.

---

**Atomizing Air Pressure Setting(s)**

The atomizing air regulator and gauge are located in the lower left corner of the burner. Lift the regulator from its locked position to adjust to 14 psig is displayed on the gauge as shown in the photo.

**Air Gate Adjustment**

On the right side of the burner – under the red cover is the air gate that supplies combustion air. The burner has been factory set. If an adjustment is required follow these steps: adjust the manual air gate (3) by loosening the locking screws (4). Once the optimal adjustment is reached, tighten the locking screws.
**ATTACHING THE OIL DELIVERY LINE**

The oil supply line will connect to the back side of the burner. Attach flexible oil line with a $\frac{1}{2}$" x $\frac{1}{4}$" NPT flare fitting and use the corresponding female portion with a barb fitting to attach to a flexible oil line. Extend the oil line approximately three (3) feet. Plumb into the rigid piping. **DO NOT** do the following:

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

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

**Attaching the Vapor Eliminator Return Line**

As noted in the section “Installation of Vent Line from Vapor Eliminator Back to the Tank” on page 29, a $\frac{1}{4}$" 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 relief 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.

**CHIMNEY INSTALLATION**

To dispose of flue gases, proper venting must be installed. National and state codes concerning the chimney are sometimes confusing. Most codes recommend that insulated 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.

INOV8 has found it necessary to require a draft inducer to insure an adequate amount of combustion air. As mentioned previously, Buderus boilers have very high efficiency which comes from small heat exchanger passageways creating a high internal pressure drop along with low stack temperatures. Most often a draft inducer is required to overcome this.

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 the 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. Never install vertical chimney or more than one 90 degree elbow, as the flue gas from waste oil combustion is heavy and contains ash that will settle out in the chimney. If soot is present in the flue gas, this could contribute to chimney fires. Clean chimneys prevent chimney fires.

3. 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 fresh air inlet.

4. DO NOT reduce chimney pipe sizes, or lengths, or use improper components.

5. 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.

6. A metal ventilated, approved thimble must be used when passing through a combustible wall. Once through the wall, DO NOT use single-wall pipe.

7. Never locate a joint inside walls or in a joist spacer.

8. The top chimney 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.

9. Install a non-restrictive stack cap (rain cap). In extremely windy locations, a Breidert type vent cap is recommended.

10. DO NOT over fire the boiler system! You should never see smoke coming from the stack.
Installing the 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 resonance 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.

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

For gas chimneys a double acting barometric draft control must be used in the chimney. INOV8 recommends the Field Control, model MG-1 or M+MG-2 (depending upon chimney size). The purpose of the double acting draft control is to open inward to reduce excessive drafting or to open outward to release pressure in the event of a puff of gas caused by delayed ignition.

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. 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. Additional installation instructions are included with the damper.

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. 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, UEI Eagle Draft Gauge, 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 burner 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 & WIRING SAFETY CONTROLS**

National codes require that a licensed electrician install the electrical portions of this boiler system. See page 52 for the electrical diagrams. INOV8 provides a standard Aquastat, but does not provide a High Temperature Cut-out or Low-Water Cut-out (both with manual resets). All three are required to operate this boiler. Provisions for wiring these safety controls are in the electrical diagrams in the back of this manual.

**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 pump motor – 3.5 amps (if supplied by INOV8).
3. The draft inducer motor (if supplied by INOV8); Tjernlund model I is 5.4 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.**

**Wiring Aquastat**

A 120-volt Aqua stat is required. The Aqua stat should be located in the well provided on top of the boiler. Use 2 conductor, 12 gauge wire to connect the Aqua stat. The Honeywell L7224 / L7248 Aqua stat provides these functions that the installer/operator should understand:

1. If the boiler is cold the circulator pump will not be energized until the boiler heats-up. When the thermostat calls for heat the burner will be immediately energized.
2. A “high limit setting” protects the boiler from excessive temperature in the event the circulator pump failed or if the thermostat calls for more heat than the system can provide.

Note: If a minimum boiler temperature is desired a separate Aquastat will be needed that provides the low limit function.
**OIL STORAGE, FILTERS & PIPING CONSIDERATIONS**

The installer is responsible for knowing prevailing regulations and of any pertinent application and/or approval requirements for your oil storage system. 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.

Many operational problems can be eliminated if proper care is taken in setting up an oil storage system. 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 in and may cause a shutdown in operation. The tank should be located in close proximity to the boiler.

**Piping & Connections Recommendations**

The pipe or tubing size is important for the best operation of the pump. Air leaks in the oil line will cause sporadic operation. 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 on the oil supply line. Sealant (such as Locktite #565 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. If the filter is not changed regularly, the pressure relief assembly will vent the over pressured oil back to the tank through the ¼" return line. For vegetable oil applications a strainer is used. This should be removed for cleaning periodically.

The vapor eliminator/pressure relief assembly serves three functions:

1. It vents 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.
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 ¼" copper line or plastic tubing must be run from the compression fitting on the pressure relief assembly 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 either the oil supply that feeds the burner or the 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.

**In-line 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 GF2A-17A-3/4-200-NU. Use General Filter part number GF #2029 for a replacement element.

**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 52.

- **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 sump 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. 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.

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.

**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.

**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”

**Diaphragm Pump Installation**

Follow the instructions that accompany the diaphragm pump. When ordered from INOV8 we supply the air regulator assembly required for controlling the oil pressure. Also, an oil regulator and gauge assembly must be used to set the proper pressure to the oil pump on the burner. Contact INOV8 if you need instructions or assistance.
**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.
SECTION 4 – START-UP AND OPERATION OF THE BURNER & CONTROLS

Little interaction between the operator and control panel should be necessary once the boiler is set up and running. Assuming the PLC display indicates a normal operation mode, only the Power and Fuel Mode Select switches would come into play, i.e. You turn the power switch ON, select the desired mode of operation and the controller handles everything necessary to get to that mode of operation automatically. Be aware that either of these switches must remain in a position for two (2) seconds before the switch selection will activate. The switches can be changed at any time – whether firing or not.

If an operational error exists, the general alarm will alert the customer and the PLC will display the condition and allow keypad depression to reset it. Others cause the burner to shut down. Some require no resetting – they clear automatically when the error condition has been corrected.

When all gas, oil and air connections made, and the following settings have been confirmed, make sure the Aquastat or room thermostat is calling for heat.

**Burner Settings Chart**

<table>
<thead>
<tr>
<th>Model #</th>
<th>Recommended Settings per</th>
<th>Pressure Settings in Inches of W.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>B650</td>
</tr>
<tr>
<td>NG</td>
<td>Supply Natural Gas Pressure</td>
<td>5 to 10</td>
</tr>
<tr>
<td></td>
<td>HI Manifold Pressure for Natural Gas</td>
<td>1.8</td>
</tr>
<tr>
<td></td>
<td>LO Manifold Pressure for Natural Gas</td>
<td>.9</td>
</tr>
<tr>
<td>LP</td>
<td>Supply LP/Propane Pressure</td>
<td>8 to 13</td>
</tr>
<tr>
<td></td>
<td>HI Manifold Pressure for LP/Propane</td>
<td>2.6</td>
</tr>
<tr>
<td></td>
<td>LO Manifold Pressure for LP/Propane</td>
<td>1.3</td>
</tr>
<tr>
<td>Oil</td>
<td>Oil Nozzle</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>HI Oil Pressure</td>
<td>10 psig</td>
</tr>
<tr>
<td></td>
<td>LO Oil Pressure</td>
<td>5 psig</td>
</tr>
<tr>
<td>Air</td>
<td>Air Gate Adjustment for N/G</td>
<td>2.8</td>
</tr>
<tr>
<td></td>
<td>Air Gate Adjustment for Propane</td>
<td>3.7</td>
</tr>
<tr>
<td></td>
<td>Air Pressure (gage on oil heater assy)</td>
<td>38 psig</td>
</tr>
<tr>
<td></td>
<td>Atomizing Air Pressure (gage on burner)</td>
<td>19 psig</td>
</tr>
<tr>
<td></td>
<td>Draft</td>
<td>-0.02 to -0.04</td>
</tr>
<tr>
<td>CO</td>
<td>Less than 100 ppm</td>
<td>Less than 100 ppm</td>
</tr>
<tr>
<td>CO2 as a %</td>
<td>5 to 10</td>
<td>5 to 10</td>
</tr>
<tr>
<td>Flue Gas</td>
<td>Flue gas temperature - F</td>
<td>350° to 500°</td>
</tr>
<tr>
<td>Smoke Patch Test</td>
<td>#0 to #2</td>
<td>#0 to #2</td>
</tr>
</tbody>
</table>

Please record the settings upon initial installation for future reference in this chart. It will be important to periodically check the heating appliance settings to assure consistency.

**High Altitude Settings**
For high altitudes more air for combustion is required. All settings in this manual have been obtained at approximately sea level. Special attention should be paid to air for combustion for elevations above sea level. If an increase in combustion air is insufficient, the burner must then be de-rated by approximately 4% for every 1000 feet above sea level.

**STEP-BY-STEP PROCEDURE FOR STARTING BURNER**

1. **Turn the power switch** on the control panel to the “ON” position (the green light will turn on). Be aware that this controller has a 10 second initialization period when first turned on.

2. **Set the mode switch** to the type of burner operation desired:
   a. GAS only (for initial firing this must be selected)
   b. OIL only
   c. GAS & OIL

3. **To prepare for setting the high and low gas pressures** follow this procedure:
   a. With the manometer in place (from page 20) check the manifold pressure by first determining existing manifold pressure.
   b. The fuel selection switch must be in the “gas only” position.
   c. At the end of the 90 second pre-purge cycle the gas valve is energized and the burner will be firing on gas.
   d. During the 10 second trial-for-ignition, note the manifold pressure on the manometer gauge.
   e. Compare the observed manifold pressure to the required value from the chart on the previous page.
   f. Once flame has been established, you’re now ready to adjust the gas pressure.

4. **To set the gas pressure for HI and LO settings** (refer to full instructions for Honeywell model V8944 Regulating Diaphragm Gas Valve):
   a. Valve outlet pressure measurements are made at a point approximately five pipe diameters downstream from the valve outlet. Consider pressure measurements made at the outlet pressure tap as reference measurements only, because turbulence and dynamic gas flow effects may result in erratic pressure readings.
   b. Shut off gas supply to valve and make sure valve is closed when setting up pressure measuring equipment.
   c. Set up pressure measuring equipment.
   d. Make sure the valve is closed. Turn on the supply gas to the valve.
   e. Set the thermostat or controller to energize the valve and check the final outlet pressure. See step 1. Allow enough time for the system pressure to stabilize.
   f. For regulator setpoint and spring range, please refer to Table 3 in instructions from Honeywell.
   g. The low pressure regulator and high pressure regulator adjustment screws are located under the slotted aluminum screw cap(s) of the adjustment housings (see photo). To adjust the pressure setting:
      i. Temporarily remove the slotted aluminum screw cap and gasket from the housing that contains the regulator adjustment setscrew.
      ii. Turn the adjustment setscrew clockwise to increase the pressure setting or counterclockwise to decrease the pressure setting. Allow adequate time (30 to 60 seconds) for the pressure to reach equilibrium between pressure adjustments. A mechanical range stop in the low pressure
regulator adjustment of the model controls the minimum setting to which the low pressure regulator can be adjusted. Do not turn the adjusting setscrew counterclockwise beyond the point at which it is stopped by the mechanical range limit.

iii. After the regulators have been properly adjusted, replace the gasket and slotted aluminum screw cap on the adjustment screw housing.

h. Start the system and observe its operation through at least one complete cycle to make sure the valve functions properly.

5. Check combustion gases using proper combustion analysis equipment to ensure safe levels of CO2 and CO during appliance start up. The gas valve should be used to make any necessary adjustments to ensure safe combustion. At this point do not adjust the air or head settings unless absolutely necessary.

6. Allow the burner to run until normal operating temperatures and conditions have been achieved.

7. Clock the gas meter to determine actual burner output. Make sure the burner cover is in place and air gate locking screws are secure for all combustion analysis. Adjust air gate if necessary. This test must be done by a qualified technician.

8. After completing the adjustments, remove the manometer and tighten the screw inside the manifold test point. Replace the regulator cap on the gas valve.

9. During burner operation the following will occur during all modes of operation:
   a. The OPR CTRL light on the burner’s Fireye control will come on and the burner motor will start.
   b. The INTERLCK light on the Fireye will come on solid (not blinking).
   c. 90 seconds later the PTFI light on the Fireye will come on, the burner flame igniter will come on.
   d. The gas train will supply ‘high pressure’ gas to the nozzle after a brief delay. “High Pressure” means maximum firing rate.)
   e. After 10 seconds, the PTFI light will go out, the igniter will turn off. Continue below for the selected mode of operation.

IMMEDIATELY AFTER FIRING

1. Continue to monitor initial operations and adjust the burner as required for correct operation. Note the combustion products readings for future performance monitoring and ensure operations are correct.
2. Continue with a normal shutdown. Observe the burner for correct response and physically inspect the burner and firebox sight glass to ensure that the flame has been completely cut off.
3. Closely monitor several complete cycles to confirm proper operation.
5. Balance the system to the design engineer’s specifications by adjusting flow, control, and temperature settings.

Burner Operation based on Fuel Selection

In GAS only mode: The burner will continue to fire on HI Gas (HI and LO Gas lights are on) until it is shut off by the operator.
In GAS with OIL INJECTION mode: operates exactly like “OIL” mode except that the burner will continue to fire on LO gas plus LO Oil after the transition period expires.

In OIL only mode: The operation will depend on whether the oil is hot enough to burn. If the oil temperature is at or above the INTERLOCK set point:

a) The fuel valves will switch from HI Gas to LO Gas plus LO Oil for a period of time determined by the TRANSITION setting. The atomizing air is also turned on at this time, as is the ignition – for five seconds.

b) At the end of the TRANSITION period, the LO Gas valve shuts off and the HI Oil valve opens (HI and LO Oil lights are on). Atomizing air remains on. If the oil temperature is below the INTERLOCK set point, the unit will continue to fire on HI Gas until the oil temperature reaches the INTERLOCK set point.

The burner will then be transitioned to Oil only mode as described above.

The operator can change modes while the burner is firing. If the mode is switched from “GAS” to one of the oil modes, the burner will either continue on ‘gas only’ if the oil temperature is below the interlock setpoint or it will transition to the selected oil mode as described above. Any transition to one of the gas modes will cause the ignition to come on for five seconds.

If the Fireye controller detects a flame failure while in any mode, it will drop voltage from its pilot (firing) terminal, run the burner motor for about 20 seconds (Post-Purge) and then go to an alarm state. The PLC will see the voltage drop from the pilot terminal and will shut off the burner fuel and air valves. PLC action at the time it sees the Fireye alarm terminal come on is determined by the mode selected and the state of the FORCEGAS program flag bit:

- If we’re in gas only mode or if the FORCEGAS flag is on, the burner will remain off, the Fireye alarm light will be on, the PLC will display an error message and cause the panel alarm light to flash and the audible alarm to beep.
- If we’re in either oil mode and the FORCEGAS flag bit is off, the PLC will switch its internal controls to ‘Gas only’ mode, turn on the FORCEGAS flag, reset the Fireye controller, display a message indicating the burner reset the Fireye controller, display a message indicating that the burner has been Forced-to-Gas (FTG) mode and activate the audible and visual panel alarm indicators. The operator can return to the mode selected on the mode switch by pressing <return> on the error message screen being displayed.
Timing Sequence of Burner Controls

Oil 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 #4 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 regulator(s) on the front of the burner clockwise to increase pressure. See photo

2. The low oil pressure regulator is in the middle and should be set to one-half of the high pressure regulator.

3. To reduce the length of the flame, turn the adjusting regulator in the counterclockwise direction.

4. 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.

5. 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 adjust as needed.

*Proper & Improper Flame appearances*

![Proper flame](image1.png) ![Improper flame](image2.png)
PLC Operation Overview

A PLC is a computer with a number and types of inputs and outputs which can be interrogated and controlled by the user program running in the PLC. A cycle or “scan” begins with the PLC taking a “snapshot” of the inputs and recording their states in an input table. The user program is then run to allow it to inspect the input conditions in the input table and set outputs on or off in an output table as desired. When the program has completed, the output conditions set in the output table are then transferred to the actual output terminals. This process of recording inputs, running the program and setting outputs is continually repeated many times per second. There are five categories of displays. The particular category being displayed determines the type of operator keypad entries allowed or required.

There are three main buttons to push on the PLC control. They look like the symbols below.

<table>
<thead>
<tr>
<th>Button</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enter</td>
<td>←</td>
</tr>
<tr>
<td>Down Arrow</td>
<td>↓</td>
</tr>
<tr>
<td>Up Arrow</td>
<td>↑</td>
</tr>
</tbody>
</table>

Power switch off

While category 1 is displayed, the operator can display “hardware” configuration parameters by depressing the <down arrow> button. Successive depressions will step through all configurable parameters, allowing alteration at any step by depressing the <enter> button. Depressing the <up arrow> will move back to the previous option. Pushing the <down arrow> after the last option will cause the display to return to the “Power Switch Off” screen.

The Y/N options are flipped by the left and right arrow buttons. The others require a numeric entry followed by the <enter> button. Depressing the <enter> button without entering a numeric value leaves the value unchanged. With the Power Switch set to “OFF” Press Down arrow to set “Config”.

Power Off Configuration Displays – Category #1

<table>
<thead>
<tr>
<th>Display</th>
<th>Options</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auto start after Power Failure</td>
<td>Y/N</td>
<td>Do you want burner operation to resume automatically after a power failure?</td>
</tr>
<tr>
<td>Oil Temperature Probe Present</td>
<td>Y/N</td>
<td>This will be Yes unless your unit burns only fuel that requires no heating.</td>
</tr>
<tr>
<td>Oil Heating Required</td>
<td>Y/N</td>
<td>Does your current fuel require heating before being allowed to fire?</td>
</tr>
<tr>
<td>Proc Temp Probe Present?</td>
<td>Y/N</td>
<td>Yes, if your unit is an evaporator. Otherwise, No.</td>
</tr>
<tr>
<td>Stop at Process Temperature?</td>
<td>Y/N</td>
<td>This will be Yes if you have an evaporator and you wish it to shut off when the Process (i.e. heat exchanger) reaches a particular temperature.</td>
</tr>
<tr>
<td>Differen = xx°</td>
<td></td>
<td>This is number of degrees that the oil</td>
</tr>
</tbody>
</table>
temperature can fall below the oil temperature setpoint before the oil heater turns back on.

**Init = xxx Seconds**
This “Initial” period determines how long to run on Gas before allowing a transition to an Oil mode. It allows draft to build by heating the chimney.

**Tran = xxx Seconds**
This is the number of seconds that the unit will fire on Gas-and-Oil before switching to Oil only mode. It gives time for hot oil to reach the nozzle.

**Htr Vfy = xxx Seconds**
This sets a time limit on how long we wait for the oil temperature to rise 3° before concluding the heater isn’t heating for some reason.

**Service**
Permits fuel and air valves, oil pump and ignition to be tested by depressing display buttons.

**Release Level**
Designates the release level of the INOV8 program controlling the PLC.

---

**Running modes – Category #2.**

While in category 2 the current state of operation is displayed at the top and the Oil and Process temperatures at the bottom. (Process temperature only relates to evaporators. Display will show *** if not.) Depressing the <down arrow> button steps you through displays from which you can reset oil heating temperatures and display “usage meters” that show the total number of hours the unit has fired in each of the three modes. The unit continues to operate while you’re changing or observing these items.

Depressing the <down arrow> while on any of these screens will display: OP = xxx° IP=xxx° LP=xxx° PP=xxx°. Where OP is the Oil Temperature setpoint, IP is the Oil Temperature Interlock setpoint, LP is the High Temperature Limit and PP is the Process temperature setpoint. If you wish to change any of these setpoints, depress the <down arrow> again until that setpoint is displayed and hit <enter>. Then enter the new value. Depressing the <down arrow> until you’ve advanced past the setpoints will display “Hour Meters” showing accumulated time firing on: Gas or Gas &Oil or Oil.

<table>
<thead>
<tr>
<th>Display</th>
<th>Settings</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Call for Heat</td>
<td>OT=xxx°</td>
<td>The boiler water is at the Aquastat setpoint so the burner is not being asked to fire.</td>
</tr>
<tr>
<td></td>
<td>PT=xxx°</td>
<td></td>
</tr>
<tr>
<td>Waiting for PTFI</td>
<td>OT=xxx°</td>
<td>Assuming the burner’s airflow interlock switch is closed, we’re in the 90 second pre-purge period.</td>
</tr>
<tr>
<td></td>
<td>PT=xxx°</td>
<td></td>
</tr>
<tr>
<td>On Gas: Oil Cold</td>
<td>OT=xxx°</td>
<td>An Oil mode is selected but the oil is not yet hot enough to be fired. We’re firing on Gas while waiting.</td>
</tr>
<tr>
<td></td>
<td>PT=xxx°</td>
<td></td>
</tr>
<tr>
<td>Mode Transition</td>
<td>OT=xxx°</td>
<td>We’re transitioning from Gas to an Oil mode and firing on a combination of both at LO pressures.</td>
</tr>
<tr>
<td></td>
<td>PT=xxx°</td>
<td></td>
</tr>
<tr>
<td>Firing on Gas</td>
<td>OT=xxx°</td>
<td>We’re firing on Gas at HI pressure.</td>
</tr>
<tr>
<td></td>
<td>PT=xxx°</td>
<td></td>
</tr>
<tr>
<td>Firing on Gas &amp; Oil</td>
<td>OT=xxx°</td>
<td>We’re firing on a combination of LO pressure gas and oil.</td>
</tr>
<tr>
<td></td>
<td>PT=xxx°</td>
<td></td>
</tr>
<tr>
<td>Initial firing</td>
<td>OT=xxx°</td>
<td>The Gas only firing that began at PTFI is continuing until the period in the “Init=xxx” parameter expires.</td>
</tr>
<tr>
<td></td>
<td>PT=xxx°</td>
<td></td>
</tr>
</tbody>
</table>
Running Mode Displays – Category #2

Operational errors and conditions – Category #3

While in category 3 the type of error or condition that has occurred is displayed and the visual and audible alarms are on. After appropriate action (based on the alarm type or condition) has been taken, the unit can be returned to an operational state by depressing the <enter> button. Depressing the left arrow button will turn off the audible alarm. Depressing the <enter> button on any of these screens will reset the error shutdown and attempt to fire again under the selected mode; however, the error condition that triggered this display may still exist.

Error Displays Requiring Manual Reset – Category #3

<table>
<thead>
<tr>
<th>Display</th>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power Restored</td>
<td>Reset</td>
<td>Power is back on after a power failure. This screen will not display if &quot;Restart after Power Failure&quot; is optioned.</td>
</tr>
<tr>
<td>Gas flame Failed</td>
<td>Reset</td>
<td>Burner failed while in a gas mode and has been left shut off with the Fireye control in an alarm state.</td>
</tr>
<tr>
<td>Water Temp @ SP</td>
<td>Reset</td>
<td>“Stop at Process Temperature” is optioned on and the heat exchanger has reached the desired temperature.</td>
</tr>
<tr>
<td>High Temp Limit</td>
<td>Reset</td>
<td>The evaporator heat exchanger temperature has exceeded the safety limit setting.</td>
</tr>
<tr>
<td>Fireye Resetting</td>
<td>Reset</td>
<td>Burner failed while in Oil-only mode and the Fireye control is in the process of being reset by the PLC.</td>
</tr>
<tr>
<td>Unk Fireye Alarm</td>
<td>Reset</td>
<td>Something caused the Fireye alarm to come on (or be on) at a time when the burner wasn’t even firing.</td>
</tr>
<tr>
<td>Waiting for PTFI</td>
<td>Reset</td>
<td>Same as in Category 2 but we’re in Forced-to-Gas mode.</td>
</tr>
<tr>
<td>Initial Firing</td>
<td>Reset</td>
<td>Same as in Category 2 but we’re in Forced-to-Gas mode.</td>
</tr>
<tr>
<td>Display</td>
<td>Action</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>HI Gas Rly Fail</td>
<td>Reset</td>
<td>The state of the relay that drives the HI Gas solenoid fuel valve was ON when it should be OFF or vice-versa.</td>
</tr>
<tr>
<td>LO Gas Rly Fail</td>
<td>Reset</td>
<td>The state of the relay that drives the LO Gas solenoid fuel valve was ON when it should be OFF or vice-versa.</td>
</tr>
<tr>
<td>HI Oil Rly Fail</td>
<td>Reset</td>
<td>The state of the relay that drives the HI Oil solenoid fuel valve was ON when it should be OFF or vice-versa.</td>
</tr>
<tr>
<td>LO Oil Rly Fail</td>
<td>Reset</td>
<td>The state of the relay that drives the LO Oil solenoid fuel valve was ON when it should be OFF or vice-versa.</td>
</tr>
<tr>
<td>FS Relay Failure</td>
<td>Reset</td>
<td>The state of the Failsafe relay was ON when it should be OFF or vice-versa.</td>
</tr>
<tr>
<td>Oil is over 200°</td>
<td>Reset</td>
<td>The oil temperature is too high. Either the oil temperature setpoint is over 200° or the heater relay is shorted.</td>
</tr>
</tbody>
</table>

**Hardware failures – category #4**

While in category 4 the component that failed is displayed. The unit recovers automatically when the hardware condition has been corrected. Depressing the left arrow button will turn off the audible alarm. Correcting the error will cause automatic reset and return to normal operation. It cannot be reset from the PLC display.

**Error Displays that Correct Automatically when Trouble Clears – Category #4**

<table>
<thead>
<tr>
<th>Display</th>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTD is Open</td>
<td>NoBeep</td>
<td>The oil temperature sensor is open.</td>
</tr>
<tr>
<td>TC is Open</td>
<td>NoBeep</td>
<td>The Process temperature sensor is open.</td>
</tr>
<tr>
<td>Mode Switch Fail</td>
<td>NoBeep</td>
<td>The mode selector switch has either no mode selected or more than one mode selected.</td>
</tr>
</tbody>
</table>

**Forced-to-Gas (FTG) reasons – Category #5.**

Category 5 displays error conditions that caused the burner to revert to gas from oil only mode. You will see: FTG: followed by the reason for the switch. Hitting <enter> will cause the burner to revert to the selected mode.
<table>
<thead>
<tr>
<th>Display</th>
<th>Action</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FTG: Fail on Oil</td>
<td><img src="image" alt="Reset" /> <img src="image" alt="NoBeep" /></td>
<td>Burner has failed while in Oil only mode. Operation has been switched to Gas only mode.</td>
</tr>
<tr>
<td>FTG: Heater Fail</td>
<td><img src="image" alt="Reset" /> <img src="image" alt="NoBeep" /></td>
<td>Oil temperature is failing to rise with the heater on. Operation has been switched to Gas only mode.</td>
</tr>
<tr>
<td>FTG: No Air PSIG</td>
<td><img src="image" alt="Reset" /> <img src="image" alt="NoBeep" /></td>
<td>Air pressure needed to atomize the oil is absent. Operation has been switched to Gas only mode.</td>
</tr>
<tr>
<td>FTG: No Oil PSIG</td>
<td><img src="image" alt="Reset" /> <img src="image" alt="NoBeep" /></td>
<td>Oil pump is putting out too little pressure to burn oil. Operation has been switched to Gas only mode.</td>
</tr>
</tbody>
</table>

There are also two information screens not related to categories that may appear. The following will display whenever the burner stops firing: “Burner shut-down <Post Purging>”.

The following will display after failing on Oil and before Fireye is reset. It allows time to see the code displayed in the five lights on the Fireye: “Fireye Alarm code displayed”.

This burner is equipped with multiple interlocking safety devices. In the event of a failure in the gas flame, the burner will “lock out” in a safety condition. In such an event, an illuminated red light will show on the Fireye control and on the top right corner of the PLC control panel. To restart the burner, press the “enter” button on the PLC. Should the burner return to the lock out condition, call a qualified service technician for assistance.
**SERVICE & MAINTENANCE**

**BOILER MAINTENANCE**

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 intended to be used for fuel and involve additional attention over conventional heating equipment. The additives in crankcase oil combined with contaminants generated by the normal operation of the engine, amount to about 1-½ quarts of solids for every 55 gallons (US gallon). 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 tubes 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. 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 week of operation to determine how much ash is accumulating, and adjust your service schedule accordingly. If you are using a blend of crankcase oil with other waste oil your experience should be a cleaning schedule of every three weeks. If you are using transmission fluid, fuel oil, diesel or other clean fuel, your cleaning requirements will be much less often.

*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.** Turn off power and remove 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.

*Draft Inducer Cleaning*

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

*Checking the Draft & things that can cause it to be wrong*

Draft can be checked with a draft gauge. 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. Reduce it to .04” wc by opening the barometric damper flap.** Here are things that typically cause insufficient draft:

- The heat exchanger tubes are dirty.
- The barometric damper flap is open too far.
- 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.

Vacuuming the Combustion Chamber & Heat Exchanger Tubes
Wait until the boiler has cooled to room temperature before cleaning. The powdery
ash that accumulates in the combustion chamber should be removed regularly. 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 the chamber as necessary. Close
door and return bolts. By removing the ash before excessive accumulation you will
maintain higher efficiency from the boiler and reduce the chance of burner failure.

Burner Maintenance
Like all precision equipment, this burner will require periodic maintenance. When first
installed the nozzle end should be inspected once a week for the first month. This is
to assure no oil is being collected on the flame retention head, nozzle and electrodes.
If oil is collecting an adjustment may be required. Debris collecting in this area is
caused by one of three things:

- Insufficient drafting – assure draft measure of -0.04 over-the-fire.
- Oil is not hot enough – assure 170°F degrees on temperature readout.
- Boiler temperature is not hot enough – Aquastat should be 180°F or higher.

The easiest way to remove any debris on the flame retention head, nozzle or
electrodes is with a small hand held torch. Hold torch so that flame can burn off the
debris within two minutes. If the debris amounts to so much that the air passages are
blocked, call INOV8. It may be necessary to run the burner on “gas-only” for a couple
hours a week.

Once it has been determined that debris is not collecting, then the same inspection
should occur monthly, then lengthen the time between inspections, but never less
than every three months of continuous operation. Add these additional functions:

1. Visually check the flame through the observation port. The flame should be
light orange in color when burning oil, and blue when burning gas. If the glass
is dirty clean it and re-check the flame color.
2. Check and clean the air intake louver on the burner to remove any buildup of
debris.
3. The motor is permanently lubricated and does not need oiling.

Caution: Label all wires prior to disconnection when servicing controls. Wiring
errors can cause improper and dangerous operation. Verify proper operation
after servicing.

Attention. Au moment de l'entretien des commandes, étiquetez tous les fils
avant de les débrancher. Des erreurs de câblage peuvent entraîner un
fonctionnement inadéquat et dangereux.

Changing fuse
Fuses can be accessed on the front of the Control Panel. Spare fuses should be kept on
hand.
Replacing the Vapor Eliminator Filter (or Cleaning the strainer)

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 screen or filter out of the canister. If it is rayon (it will be soft) discard and replace with a new one as shown in the photo. If it is a steel screen, clean with parts washer and replace. The parts of the vapor eliminator are shown. The white filter is for petroleum based oil and applications that don’t have water. The steel screen is for vegetable oil or watery oil.
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. Return the o-ring and secure with the rubber-backed washer. Replace both items as needed.
7. 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.

Needle Cleanout of Nozzle

Part of the patented features of the INOV8 burner includes a needle attached to a pneumatic actuator (Bimba cylinder) that penetrates the nozzle upon each shutdown. Air pressure retracts the needle and loss of air pressure allows a spring to force the needle into the nozzle. If the oil flame is not full sized, an obstruction may exist in the nozzle. Generally it will be automatically cleared by the action of the needle. If it does not work automatically, then a 1/8” or smaller rod (like a small screwdriver) can be inserted into the opening at the end of the Bimba cylinder. Use quick jabbing motions which forces the needle into the nozzle. If this does not clear an obstruction, then the nozzle will need to be removed and cleaned by hand.

Cleaning the Nozzle

Your oil side of your burner uses Delavan #30609–3.1. 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 small steel distributor (which is also called a ‘spinner’ though it does not turn or spin) 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. Access the nozzle by removing the burner from the water heater.
   a. Disconnect the power line and UV line at the burner.
   b. Disconnect the air and oil lines.
   c. Remove the nuts holding the burner onto the water heater.
   d. Carefully lift off the burner.
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 burner 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, flush the final delivery system.

6. Be sure to check the slots on the top of the spinner as that is the path of the air supply for the fuel. If the slots are blocked, sufficient air will not be provided to the burner and it will not function properly.

7. Also check inside the cap and remove any oil that is found.

**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 or 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 motor in the following way:
2. Disconnect the oil inlet line from the pump and plug the inlet hole.
3. Disconnect the pump hose and plug it.
4. Remove the 2 bolts that hold the pump in. (10 mm socket)
5. Slide the pump out of the housing.

**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.

6. Drain the oil out of the pump as best you can.
7. Remove the 4 cover bolts, cover and screen.
8. Remove the 3 gear set bolts and the gear set pieces noting the position of the plates. Don’t lose the moon-shaped piece.
9. Remove the shaft (with gear).
10. Remove the seal-retaining clip. (C-clip)
11. 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.
12. Clean all the pump parts with solvent. (Carb cleaner will melt the paint.)
13. 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.

14. Lubricate the new seal and press it in.

15. Replace the fiber washer (if there was one) and retaining clip.

16. Oil the new shaft and place it in the pump.

17. 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.

---

**Cleaning the Pump Internal Pressure Regulator**

Perform the 1st two steps of “Replacing the pump shaft and seal” above.

1. Remove the 11/16-inch “nut” from the back of the pump.

2. Remove the 11/16-inch “nut” from the front of the pump. (The pressure adjusting screw will come out with the nut.)

3. Remove the spring centering device – noting its orientation.

4. Remove the spring.

5. 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.

6. 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.

7. Oil the parts and put them back together. Be aware that there is an aluminum washer under each “nut” – as they may have fallen off during cleaning.

8. Replace the pump back on the motor.

---

**Ultraviolet sensor cleaning**

The ultraviolet sensor functions as the flame sensor for the Fireye combustion control. It is item E as shown in the photo, located under the red hood of the burner. You can unscrew the UV sensor from the burner and use carburetor cleaner and a rag to wipe clean the lens of the sensor. Non-abrasive hand cleaner may help if a brown film remains on the lens.
Burner Drawer Assembly Removal Procedure

The Drawer Assembly can be removed from the burner either from the front side leaving the burner installed on the boiler or furnace, or it can be removed from the nozzle end. To remove the drawer assembly from the burner follow these steps:

1. Remove the two screws to loosen the cover as shown in the first photo. Lift off the cover and set aside. Note – the air tube may need to be removed.
2. Remove the ¼” air line, the oil line and the ignition wire from the Drawer Assembly.
3. Loosen the bolt on the bottom of the air tube as shown in the second photo. There is a small lip on the inside of the air tube that the Drawer Assembly must be lifted over to remove.
   a. If removing from the front side, gentle turn the Assembly pulling towards yourself and clear the bolt on the bottom of the air tube. You may need to lower the bolt to provide sufficient clearance.
   b. If removing from the nozzle end, loosen the two nuts on top of the flange OR if the burner is on a door swing it open. Gently hold the burner by the flame retention head lifting and pulling it out of the burner.
4. Return the Drawer Assembly by reversing these steps, being very careful not to bump the electrode out of position.

NOTE – The holes in the flame retention head shown in above photo must be positioned in front of the UV Sensor to allow it to "see" the flame. The hole(s) is not for the electrode!
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:

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

This service should be performed by a qualified heating contractor.

1. Check ignition electrode. Clean, adjust or replace as necessary.
2. Check the flame ultraviolet sensor. Clean and adjust as necessary.
3. Check manifold gas pressure.
4. Check all burner adjustments.
5. Generally clean all exposed parts and components.
6. Do a complete combustion test with the burner cover in place and the air gate locking screws secure.
7. Check and clean the chimney.

Caution: Label all wires prior to disconnection when servicing controls. Wiring errors can cause improper and dangerous operation. Verify proper operation after servicing.

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 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 can be used ONLY if packed tightly. INOV8 sells burner boxes with all necessary packing materials already included for $15 per box. It can be shipped to you.

**ADDENDUM**

Contained in the addendum are wiring diagrams, a glossary, and what to do if technical assistance is required or for part replacement.

**TECHNICAL ASSISTANCE NEEDED**

Please contact INOV8 International, telephone support at 877-684-6688 (608-785-2879) or via email at service@inov8-intl.com.

**PROCEDURE FOR PART REPLACEMENT**

If it is determined that part of the equipment 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 burner, all shipping of warranted parts from the factory is paid for by INOV8. 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 the 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.
SUBBASE WIRING DIAGRAM FOR BOILER

120V G900 Burner with 24VAC Fuel Valves

BURNER WIRING

Control Panel

24VAC Common

Hi Fire

LO Fire

24VAC Common

Hi Gas

Lo Gas

Forg Burner with 24VAC Fuel Valves

Gas-Oil burner

ER & PLC Control

Edited 6/2013

Buderus Boiler with Gas-Oil burner & PLC Control – edited 6/2013

53
PLC Control Panel Wiring
24 VAC Gas Valves, 24 VDC Oil Valves.
## Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Air Regulator &amp; Gauge located in burner cover</strong></td>
<td>The shop airline connects to this. It regulates the atomizing air for combustion. Used to reduce the high air pressure from your compressor to the 30 psig operating air pressure required by the burner. It takes the full 30 psig to pull back the needle attached to the Bimba cylinder.</td>
</tr>
<tr>
<td><strong>Atomizing Air Regulator &amp; gauge</strong></td>
<td>This regulator fine tunes the air pressure at the burner. It should be set at 19 psig. The gauge is located in the lower left corner of the left side of the burner cover.</td>
</tr>
<tr>
<td><strong>Amber Light(s)</strong></td>
<td>Located on the Control Panel to indicate the burner is firing on either low of high oil. Note when firing on high oil pressure both lights will be on.</td>
</tr>
<tr>
<td><strong>Atomizing Air</strong></td>
<td>The term given to the compressed air fed to the burner. Its 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.</td>
</tr>
<tr>
<td><strong>Barometric Draft Control, double action type required with gas</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Bimba Cylinder</strong></td>
<td>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)</td>
</tr>
<tr>
<td><strong>Blue Light</strong></td>
<td>Located on the Control Panel to indicate the burner is firing on low or high gas. When firing on high pressure both lights will be on.</td>
</tr>
<tr>
<td><strong>Boost Pump</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Burner</strong></td>
<td>The flame producing mechanism that mounts onto the boiler. Rather self-explanatory but we use the term to distinguish it from the boiler as a whole.</td>
</tr>
<tr>
<td><strong>Check Valve</strong></td>
<td>It is part of the floating pickup and filter assembly that is included with your boiler system. 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.</td>
</tr>
<tr>
<td><strong>Coking</strong></td>
<td>Burned, hardened oil inside the oil circulation passages is created from an excessive preheat.</td>
</tr>
<tr>
<td><strong>Combustion Air</strong></td>
<td>Combustion air is drawn through the adjustable shutter into the burner’s fan and then blown down the air tube, through the flame retention head and then into the combustion chamber.</td>
</tr>
<tr>
<td>Comprehension Chamber</td>
<td>Also called burning chamber and fire box. The large barrel shaped chamber that the flame is contained in.</td>
</tr>
<tr>
<td>----------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Compression Fitting</td>
<td>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.</td>
</tr>
<tr>
<td>Delivery Line</td>
<td>Copper piping, oil-approved hose or steel pipe that connects the oil tanks with the oil pump.</td>
</tr>
<tr>
<td>Draft</td>
<td>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. Draft is measured in hundredths of an inch of water column and our boilers run fine with a draft of 0.02 to 0.04.</td>
</tr>
<tr>
<td>Draft Inducers</td>
<td>A fan mounted in the chimney that increases draft by helping the chimney pull the flue gasses out of the boiler.</td>
</tr>
<tr>
<td>Flame Retention Head</td>
<td>Located in the end of the air tube of the burner, the flame retention head mixes the atomized oil and gas with combustion air.</td>
</tr>
<tr>
<td>Flared Fittings</td>
<td>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.</td>
</tr>
<tr>
<td>Heating element</td>
<td>An electrical device residing in the oil heater assembly. This device provides the heat necessary to raise the oil to a temperature at which it will burn.</td>
</tr>
<tr>
<td>Ignition Transformer</td>
<td>Supplies voltage for the ignition arc. Voltage is transferred to the electrode. The electrode only ignites the gas flame – which later ignites the oil flame.</td>
</tr>
<tr>
<td>Needle</td>
<td>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.</td>
</tr>
<tr>
<td>Nozzle</td>
<td>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. 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.</td>
</tr>
<tr>
<td>OPR CTRL Light</td>
<td>A light on the combustion controller indicating there is a call for heat.</td>
</tr>
<tr>
<td>Pre Purge</td>
<td>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.</td>
</tr>
</tbody>
</table>
| 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 gas fuel valve and ignition.
<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transformer</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Reset Button</strong></td>
<td>Located on the PLC panel is a downward arrow that turns to the left as shown. It is the Reset Button for the burner system. Another push-button type switch is located on the combustion controller.</td>
</tr>
<tr>
<td><strong>Residual Flame</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Return Line</strong></td>
<td>A ¼&quot; (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.</td>
</tr>
<tr>
<td><strong>Solenoid</strong></td>
<td>Three essentially identical solenoid valves provide control for atomizing air and two stages of oil delivery to the nozzle. They are located in the burner on the back side of the heater block.</td>
</tr>
<tr>
<td><strong>Tank</strong></td>
<td>Storage for waste oil.</td>
</tr>
<tr>
<td><strong>Tank Filter</strong></td>
<td>A spin-on filter, generally in the 75-micron range, that filters the oil coming out of the tank.</td>
</tr>
<tr>
<td><strong>Ultra Violet (UV) Sensor</strong></td>
<td>The part of the Fireye combustion control that detects the flame.</td>
</tr>
<tr>
<td><strong>Vapor Eliminator (VE)</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>VE Filter</strong></td>
<td>A replaceable 10-micron filter element intended to remove coking debris.</td>
</tr>
<tr>
<td><strong>White Light</strong></td>
<td>Located on the Control Panel indicating that ignition is ON.</td>
</tr>
</tbody>
</table>