INTERNATIONAL INCORPORATED

ASSEMBLY, INSTALLATION, MAINTENANCE & OPERATING INSTRUCTIONS

INOV8 Evaporator, Model EV40 with Gas-Oil Burner

Control No. 3120734

Save These Instructions!

This manual must be kept near the evaporator!

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Notations Used in this Manual	
CAUTION	RISK OF INJURY OR SYSTEM DAMAGE – Identifies a possible dangerous situation that can lead to personal injury or physical damage.
NOTE	NOTICE – This is a tip or notice for optimum use of equipment and adjustment as well as useful information.

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.

Technical Specifications		
	Natural	Propane
Gas Supply Pressures	Min. 5" w.c. Max. 7" w.c.	Min. 8" w.c. Max. 14" w.c.
Manifold Pressures	See chart on page	See chart on page
Power Supply Required Burner Motor	120 Volts 60 Hz 1 Phase 232T 2.2 Amps 3250 RPM	

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.

Contact Information:

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GENERAL INFORMATION & GUIDELINES

Congratulations on your purchase of this INOV8 Multi-fueled burning Waste Water Evaporator. You have selected the highest quality, precision-engineered piece of equipment available, designed to allow use of the most economic fuel available to your business. INOV8 has designed this product for high efficiency, safety, longevity, and operating economy while providing the highest standards of environmental considerations. This manual covers installation, start-up, routine operation and maintenance. If these instructions and pertinent local regulations are followed you will be assured full satisfaction.

CODES & REGULATIONS

All work shall be performed in strict accordance with the requirements of state, provincial and local regulating agencies and codes pertaining to oil-burning equipment. After start-up the owner or its representative should be instructed about the equipment operation and be given this manual. This equipment has been designed to the following national standards. Installation must also be governed by these standards.

For burner:	ANSI Z21.17/CSA 2.7-M98 Domestic Gas Conversion Burners First Edition dated 1998, and CSA B140.2.1-M98 Oil Burners; Atomizing-type Dated July 1990. For waste oil applications: UL296A Waste Oil Burning Air Heating Appliances 2nd edition dated October 31, 1995 with revisions through and including March 8, 2006.
For chimney installation:	ANSI/NFPA # 211 – *Standard for Chimneys, Fireplaces, Vents, and Solid Fuel Burning* Appliance, 2006 Edition
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 gas valve train:	ANSI Z21.17*AEI, Issue 1998/01/01 Domestic Gas Conversion Burners, CSA C22.2#3*AEI – Issue: 1988/01/09 Rev: 1999/01/01 Electrical Features of Fuel-burning Equipment General Instruction No 1-2 (R1999)
For PLC control panel:	UL 873 – Standard for Safety for Temperature-Indicating and Regulating Equipment, Eleventh Edition, Dated December 22, 1994 / CSA C22.2 No. 24-93 Temperature-Indicating and regulating equipment.
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.

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.

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 the following fuel: natural gas or propane, fuel oil or waste crankcase oil, hydraulic fluids, transmission oil. DO NOT attempt to burn other liquids without written authorization from INOV8 International, Inc. **Caution** – used oils may contain gasoline, heavy metallic compounds and foreign materials. When burned, these compounds are emitted from or deposited within this evaporator 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. Also, 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 a 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 termine'.

5. It cannot be used for any other unauthorized purposes.
6. This burner can be used with natural gas or propane.

Convient au gaz naturel et au propane.

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 from 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 supersede anything found elsewhere**.
9. DO NOT add fluids with the classification of a hazardous waste, or fuels with flash points below 100^{o}F (such as gasoline) to your used oils. (Check your local codes for what is allowed to be evaporated.)
10. If the burner requires servicing, contact your INOV8 authorized service technician. DO NOT allow unauthorized personnel to service your burner or the warranty may be voided.

WARRANTY IS VOID IF …

1. The evaporator 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 evaporator 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 evaporator / burner settings.

UNPACKING & INSPECTING FOR SHIPPING DAMAGE

Immediately upon receipt, check all items for any damage that may have occurred in shipment. If damage is found, INOV8 or the sales representative must be notified immediately in order to process shipping damage claims. DO NOT ACCEPT the order if shipping damage is observed upon receipt. Note - prior to shipping, all components were inspected and the burner was test fired and operated normally.

PARTS LIST

The INOV8 Evaporator is shipped on a pallet in a crate with strapping, a styrofoam layer for additional protection and plastic wrap. The following items are packed separately:

1. **INOV8, model G750 Burner, which also includes:**
   a. Vapor Eliminator with two spare rayon filters and two stainless mesh screens, o-rings & washers
   b. Gas valve train,
   c. Spare nozzle (size 30609-5) and spare fuses (4 amp, 8 amp, 1.5 amp, 10 amp and 15 amp).
   d. Checkvalve – ½"
   e. Sump strainer – to install into Tank B (skimmed oil tank)
   f. Air regulator for burner
   g. Burner gaskets
   h. Silicon hose – 8' if needed for skimmer - rather than hard piping
   i. Solenoid solution fill valve
2. **Standpipe for Ultrasonic Sensor** includes mounting bracket and PVC pipe.
3. **Connection for Standpipe,** packed in separate box.
4. **Graco diaphragm boost pump with air regulator & gauge assembly**
5. **Tjernlund model D-3 draft inducer**
6. **T-piping for Oil Tanks with corresponding Solenoids & conduit connector**
7. **Float switch –** use as needed to signal a full or empty tank
8. **Operation & Maintenance Manual**

FEDERAL ENVIRONMENTAL PROTECTION AGENCY (EPA)

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 use of used oil as fuel. Under this exemption, used oil-fired burners may operate without 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 burner 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. Note – this evaporator uses an oil burning rate of 650,000 BTUs. 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.

EVAPORATOR PRE-INSTALLATION CONSIDERATIONS & SPECIFICATIONS

1. Use only approved insulated sections on the flue chimney of the evaporator. Do not install chimney connector closer than 18 inches to combustible materials in any direction. Allow at least three feet around the evaporator for ease in servicing.

2. The control panel provides connections for a secondary solenoid shutoff and alarms if desired.

3. The evaporator is equipped with a 1" fill solenoid in the ultra-sonic level set-stand base. If preferred the fill can be installed into the back end of the evaporator. Do this by installing a 2" 'T' with a 1" side port for supplying liquid to the tank. The 'T' is to be inside the 2" ball valve. Leave the straight access of the T for clean-out purposes.

4. The oil burner function requires at least 60 PSI of compressed air which the air regulator reduces to 30 PSI. The line size should be ¼" pipe and the connection into the air regulator is ¼ NPT. A quick disconnect fitting should be used at this connection.

5. A dedicated electrical circuit is required with a GFCI of 20 AMPS.

6. The evaporator is provided with 2" NPT-F ports at opposite ends. It is recommended that 2" ball valves be installed at each end to enable cleanout of the evaporator tank.

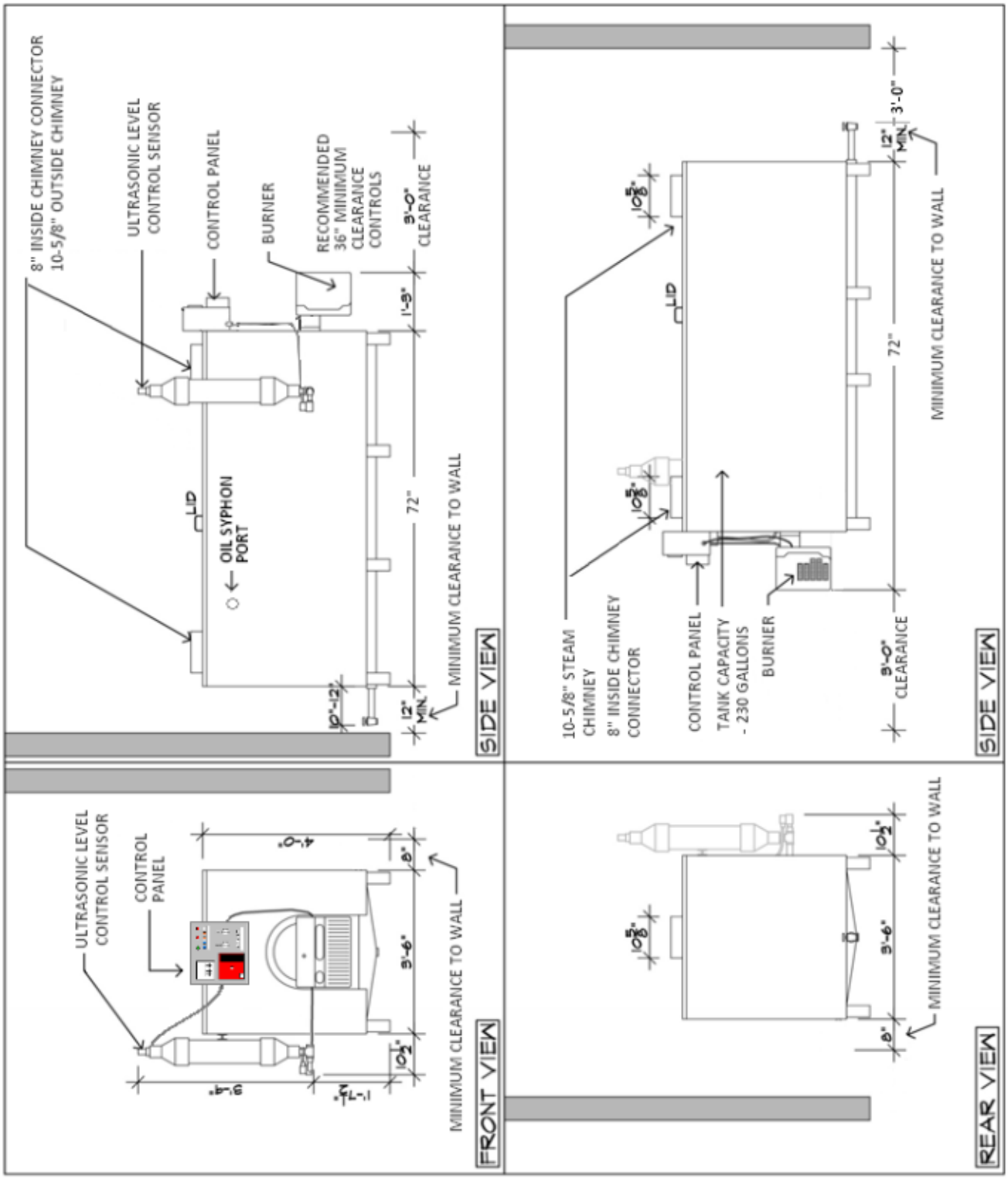
7. Select a location as close as possible to the oil storage tank. If the distance from the tank exceeds 40 feet a boost pump may be necessary.

8. The location should provide easy access to the evaporator for routine servicing and maintenance.

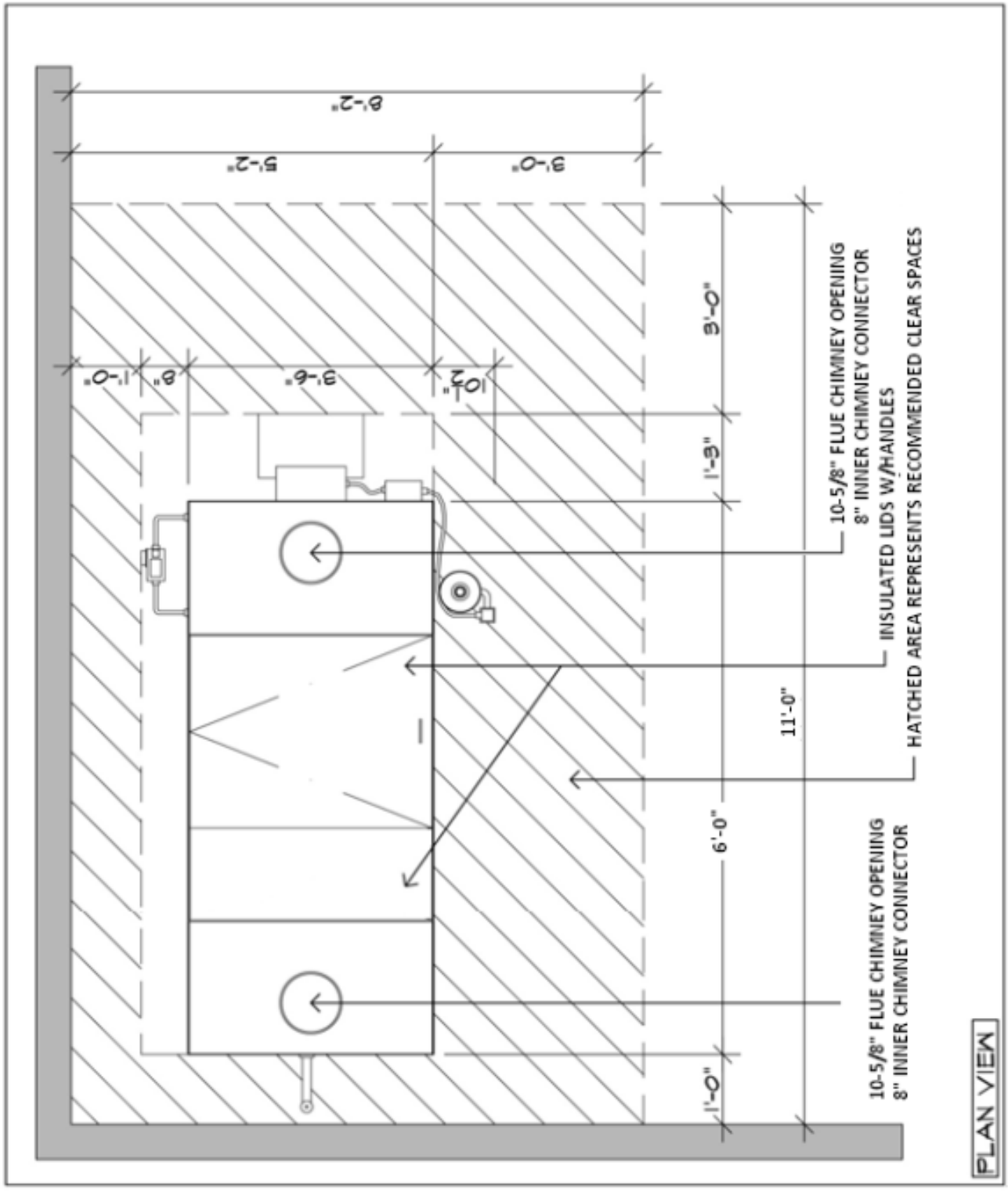
9. DO NOT install the evaporator outdoors unless in warm climates and then only if a rain shelter is provided.

10. For the skimming function, install a small holding container as close to the skimmer side – to allow easy access for drawing the oil to the burner. Use a high temperature hose or rigid piping to the skimmer to pass the hot oil and another one to pipe the oil to the burner.

EVAPORATOR DIMENSIONS & ELEVATIONS



EVAPORATOR OVERHEAD VIEW



Note – The gas valve can be located on the same side as the ultrasonic level sensor allowing the evaporator to be close to the back wall.

EVAPORATOR SPECIFICATIONS

EVAPORATOR SPECIFICATIONS FOR MODELS:	EV20	EV40	EV60
INPUT BTU	250,000	432,000	648,000
FUEL USAGE WHEN BURNING OIL, GPH*	1.78	3.08	4.62
DIMENSIONS, LENGTH/WIDTH/HEIGHT, INCHES **(WITH**	52.5 / 42 / 48	88.5 / 42 / 48	**127** / 42 / 48
EVAPORATION RATE WITH WATER	25	43	65
TANK CAPACITY, IN GALLONS	150	250	**350**
EFFICIENCY – THERMAL RATED IN %	86	87	87
EVAPORATOR CONSTRUCTION DETAILS			
TANK & COMBUSTION CHAMBER MATERIAL	10 Gauge 304 SS	10 Gauge 304 SS	10 Gauge 304 SS
OUTER SHELL MATERIAL	18 Gauge	18 Gauge	18 Gauge
OUTER SHELL FINISH	Powder-coat Blue	Powder-coat Blue	Powder-coat Blue
INLET & OUTLET PORTS FOR SOLUTION	¾"	¾"	¾"
WEIGHT, LBS.	850	1260	1575
TANK CLEANOUT PORTS – TWO ON BOTH ENDS	2"	2"	2"
FLUE CLEANOUT PORTS – TWO OR THREE	Two	Two	Three
THERMAL EXPANSION PROVISION OF TANK			
TANK BOTTOM DESIGN – V-SHAPED			
TANK INSULATION – 2" IN SIDE WALLS & 1" IN TOP			
CAN BE LIFTED BY FORKLIFT FROM BOTTOM OF TANK			
OPERATING CONTROLS ON EVAPORATOR			
ULTRASONIC LEVEL SENSOR FEATURES:	Yes	Yes	Yes
FOUR LEVEL CONTROL WITH SAFETY SHUTOFF			
AUTOMATIC KEEP FILL			
AUTOMATIC SOLUTION FILL SOLENOID – ¾" NPT			
DIGITAL ADJUSTABLE TEMP CONTROL FOR OVERHEAT	Yes	Yes	Yes

Notes:

- GPH is based on 140,000 BTU per gallon of waste oil. Samples vary and should be tested for BTU content prior to setting oil pressure.
- Tjernlund Draft Inducer, if needed EV20 = Model D-3 EV40 = Model D-3 EV60 = Model I

BURNER SPECIFICATIONS & SETTINGS	G200	G400	G750
INPUT BTU (X 1000)	250	432	648
FUEL USAGE, GPH	2.7	3.2	4.3
DIMENSIONS, LENGTH, INCHES	11-5/8	13-11/16	15-5/16
DIMENSIONS, WIDTH, INCHES	13-3/4	13-3/4	13-3/4
DIMENSIONS, HEIGHT, INCHES	10-11/16	10-11/16	10-11/16
WEIGHT OF BURNER, LBS	40	40	50
WEIGHT OF CONTROL PANEL, LBS	35	35	35
ELECTRICAL SUPPLY, VOLTS/HZ	120/60	120/60	120/60
ELECTRICAL DRAW (MAX), AMPS	20	20	20
240 VOLTS & 50 HZ AVAILABILITY	Yes	Yes	Yes
BURNER MOTOR, AMPS	2.2	2.2	4.3
BURNER, RPM	3,250	3,250	3,250
SEALED COMBUSTION KIT AVAILABLE	Yes	Yes	Yes
COMPRESSED AIR REQUIREMENTS, CFM	2	2	3
ATOMIZING AIR SETTING, PSIG	19	19	19
COMPRESSED AIR REQUIREMENTS, PSIG	30	30	35
NATURAL GAS SUPPLY PRESSURE, MIN/MAX " OF WC	4/10	4/10	7/14
N/G MANIFOLD PRESSURES, MIN/MAX-" OF WC	0.70/2.0	0.9/1.80	1.6/2.1
PROPANE SUPPLY PRESSURE, MIN/MAX " OF WC	8/13	8/13	8/13
PROPANE MANIFOLD PRESSURES, MIN/MAX-" OF WC	0.90/2.96	1.1/3.0	1.4/3.0
NOZZLE SIZE	3.1	5	7
HI OIL PRESSURE – PSIG	12	7	12
LO OIL PRESSURE – PSIG	6	4	6
FUEL PUMP CONNECTION – NPT	¼	¼	¼
AIR GATE ADJUSTMENT*	**2 to 4**	**2 to 4**	**2 to 4**

Burner Specifications continued:

SPECIFICATIONS	G200	G400	G750
SAFETY CONTROLS, STANDARD			
• **Fireye Industrial Control**	Yes	Yes	Yes
• **Ultraviolet flame detection**	Yes	Yes	Yes
• **90 second ignition pre-purge cycle**	Yes	Yes	Yes
• **Continual proof of atomizing air**	Yes	Yes	Yes
• **Continual proof of combustion air**	Yes	Yes	Yes
• **Safe start sequence**	Yes	Yes	Yes
• **Trial for ignition – 10 seconds**	Yes	Yes	Yes
• **Flame failure shutoff, in 3 seconds**	Yes	Yes	Yes
• **Safety shut-down indicator light**	Yes	Yes	Yes
• **Main flame trial-for-ignition, 6 seconds**	Yes	Yes	Yes
ADDITIONAL CONTROLS			
• **Fuel shut-off by solenoid valve(s) oil & gas**	Yes	Yes	Yes
• **Honeywell two-stage regulator model:**	VR8305Q	VR8305Q	V8944B
• **ASCO solenoid valve, model:**	K3A441U	K3A441U	K3A461U
• **Remote reset capable**	Yes	Yes	Yes
PLC BASED CONVENIENCE CONTROLS			
• **Automatic restart**	Yes	Yes	Yes
• **Ignition test switch**	Yes	Yes	Yes
• **Fuel Selection Switch**	Yes	Yes	Yes
• **Gas & Oil Usage**	Yes	Yes	Yes
• **Automatic switch to gas with loss of oil pressure**	Yes	Yes	Yes
• **Heater on/off switch & varying temperature**	Yes	Yes	Yes
• **Fuel Indicator Lights & Warning Lights**	**Yes**	**Yes**	**Yes**

- **Listed fuels:** Fuel oil, #2 up to #6, used crankcase oil, transmission & hydraulic, mineral spirits, vegetable oil, used crankcase oil with 10% gasoline. *Based on 140,000 BTU/gallon – oil must be analyzed for BTU content as oil pressure will vary.
- **Fuels capable of burning as fuel (& warranted with written approval from INOV8):** Used crankcase oils, Transmission & Hydraulic oils, 90 weight gear box oil, heat transfer oil, Mineral spirits solvents, Machine shop cutting oils, Vegetable oils – new & used (soybean, peanut, canola, corn, olive), Synthetic oils, and Commercial & Military jet fuels.

OVERVIEW OF EVAPORATION & OIL RECOVERY FOR FUEL

OVERVIEW OF OPERATION OF BURNER

The evaporator using the standard oil burner and the gas-oil burner operate very similarly. The standard burner can use as fuel, diesel, fuel oil and most waste shop oil or vehicle lubricants but it cannot tolerate more than 3% water in the oil. The gas-oil burner can also use as fuel the same oils. The difference is the ability of the gas-oil burner to evaporate water present in the oil, during the combustion. This overview mainly covers the unique manner in which the gas-oil burner operates.

The primary fuel of the gas-oil burner is propane (or natural gas); the secondary fuel is oil. The oil can be fuel oil, diesel, waste motor or shop oil, including the collected residual oily water mixture reduced by evaporation. The evaporator reduces water volume by continued boiling.

There are two main switches on the control panel. The one on the left shown by the yellow arrow controls three positions and corresponding functions: SKIM / OFF / RUN. To fill the evaporator with solution either the SKIM or RUN functions can be used. When the SKIM mode is selected, a solenoid (and optional pump) is activated and the solution is pumped into the tank until the solution reaches the preset level set on the ultrasonic level sensor. In this mode the fill solenoid and the ultrasonic level transmitter are activated, but no power is to the burner. The SKIM function is intended to allow manual control of the fill level to stop it when it reaches the optimal level for skimming the oil off of the water.

When the switch is set to RUN, in addition to power going to the fill solenoid and the ultrasonic level sensor, power also goes to the burner. When the water solution reaches the preset level on the ultrasonic level sensor, the burner initiates combustion. It takes about one hours to bring the solution to boiling temperature and evaporation to begin.

The second switch (on the right side) allows the selection of fuel model: Gas / Gas & Oil / Oil in that order from left to right. The burner always starts on gas even if the fuel selection is Gas & Oil or Oil-Only. If the fuel is diesel or fuel oil which do not require preheating, there is a switch in the PLC that turns the preheater OFF. In that setting the burner will initiate combustion immediately; if waste oil is used as fuel the oil preheater is ON and there is a delay of 5 minutes while the waste oil is being preheated. During the delay gas is being consumed but no oil, until the burner control senses the oil is at the preset temperature. At that point the burner initiates combustion of oil while the gas is reduced to half-firing rate. It stays at gas and oil for a few seconds then automatically transitions to oil only. The evaporator continues to operate on oil until either the fuel or water (to be evaporated) is depleted.

The combustion chamber and heat exchanger tubes are immersed under the water, which is now being heated. There are two chimneys; one for steam and the second for the flue gases. Once boiling and evaporation begins, the keep fill function automatically maintains the proper water level. If the water level drops below the set point the ultrasonic level sensor shuts off

the burner. There is a backup temperature sensor that if it reaches a preset 220 degrees the burner will shut off. If the ultrasonic level sensor measures the water level over the setpoint an (optional) secondary water solenoid is activated to close. The evaporator will function at this setting until it consumes available water, runs out of fuel, or a high temperature is reached. It can also be stopped by turning the left switch to the "OFF" position.

The gas-oil burner has adjustable air and fuel settings for both the gas side and for the oil side. The factory settings for the gas and oil solenoids are at 50% and 100% of the firing rate required for the evaporator size. This allows the burner to operate on 100% of either gas or oil, or at 50% firing rates when burning the combination of oil and gas. The oil pressure is reflected on a gauge shown on the face of the burner. The gauge is above two oil regulators that can be adjusted if necessary. The regulator below the gauge on the right side is for high oil pressure and the regulator to the immediate left is the low oil pressure. The regulator on the left side of the burner face is for controlling the air pressure at the nozzle. It is below the corresponding air pressure gauge.

OVERVIEW OF OIL SKIMMING FUNCTION

A 1-1/2" NPT port in the side of the evaporator connects to a stainless steel pipe that traverses the top of the water from one side to the other inside the evaporator tank. The top of the pipe is cut away to collect the oil that stratifies to the top of the tank. Remove the small cover on the evaporator to see the skimmer and water level. When there is about 10 gallons of oil available it will be about one inch thick and it should be removed by skimming. Our recommended procedure is to do this before the evaporator is turned on after being off for the night or weekend so that the oil has the best concentration. The solution inside the evaporator should be lower than the skimmer. If it is not remove some water by opening a valve on the far end until the water level is just below the opening on the skimmer pipe. Open the ball valve to the skimmer and turn the switch to "FILL" on the evaporator control panel. Be sure that the fill is slowed by closing down the ball valve that is located near the fill solenoid. This will prevent the oil from being stirred or flooding the 1-1/2" skimmer pipe. This will take a few minutes and must be manually monitored to determine when most of the oil has been skimmed.

The oil will be placed into a drum or small tank (for this purpose we've called it Tank B) for use as fuel in the burner when the FUEL SELECTION SWITCH is set to gas & oil. In that setting a solenoid will close to the good oil tank (Tank A) and a different one will open to Tank B. The gas-oil burner will operate on gas at half-firing rate and oil at half-firing rate – until the skimmed oil is depleted. An oil pressure switch on the burner will detect a loss of oil pressure forcing the burner to change the fuel to full gas turning on a light on the control panel and displaying a message on the PLC which says "FTG" – forced to gas. The FUEL SELECTION SWITCH should be changed to "OIL" to continue operation using waste oil as fuel. At that point an oil solenoid will open to Tank A and close to Tank B, allowing oil to the burner from the main tank. The evaporator will continue operation on waste oil.

DETAILED 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:

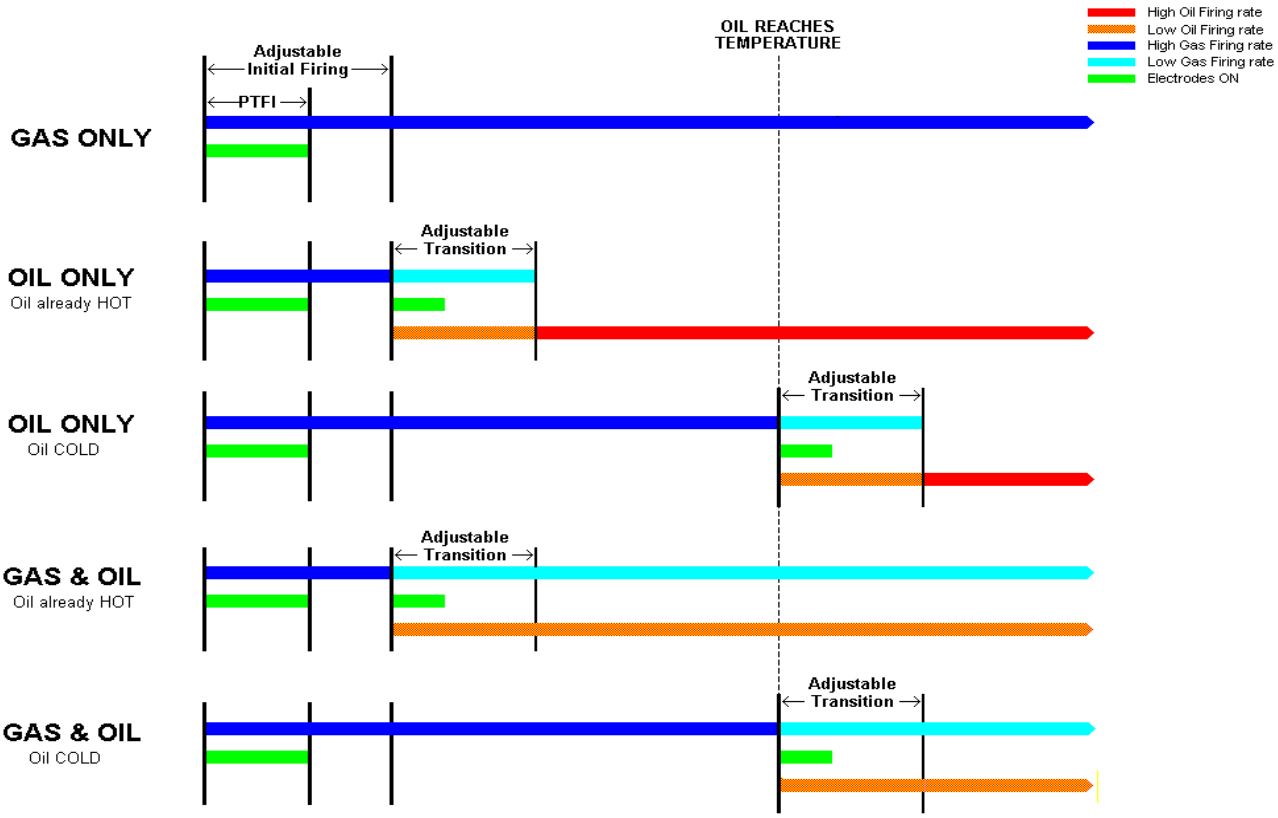
a) The fuel valves will switch from HI Gas to LO Gas plus LO Oil for a period of time determined by the TRANSITION setting. The atomizing air is also turned on at this time, as is the ignition – for five seconds.
b) At the end of the TRANSITION period, the LO Gas valve shuts off and the HI Oil valve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

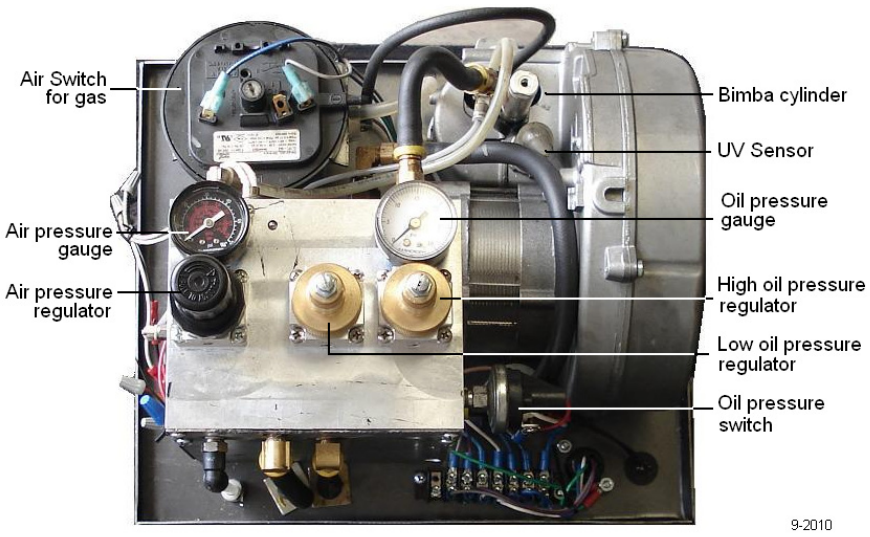


BURNER & CONTROLS

It is important to understand what the various controls do. They are described in greater detailed in the following sections:

- INOV8 Multi-Fuel Burner - Model G400,
- Control Panel,
- Fireye industrial-rated combustion control (the red box on the control panel),
- PLC Control – Its Operation & Settings,
- Ultrasonic Control – Its Operation & Settings,
- Dwyer High Limit Control
- Gas Valve Description & Components
- Tank A & Tank B - Piping & Corresponding Solenoids.

Gas-Oil Burner w/o Cover

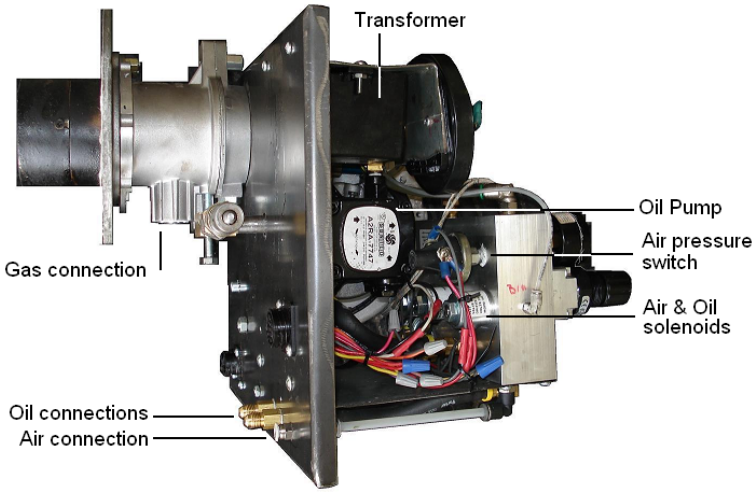


INOV8 MULTI-FUEL BURNER

The INOV8 gas-oil combination burner is capable of burning as fuel natural gas or propane, fuel oil, waste oil, or the combination of gas and oil. The burner cover has been removed to show the controls that control the oil preheating, the oil pressure at full and half rate, and the connection points.

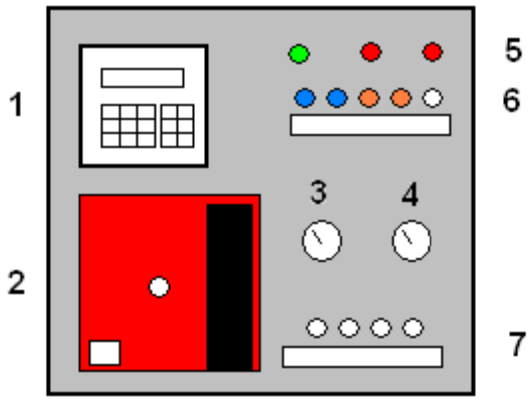
The operator should be familiar with the main components that are identified as they may require occasional maintenance. The burner is a basic gas burner that has been modified with INOV8's patented "Drawer Assembly".

Gas-Oil Burner - Side View Part ID



CONTROL PANEL

The control panel provides the following list of items:



1. PLC Display/Keypad provides:
   a. Information on the current state of operation
   b. Keypad input allowed for the current display
   c. Controls the fuel preheat temperature
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 SKIM / OFF / RUN switch with a power on light
4. Fuel Mode Selection switch: GAS / GAS-OIL / OIL
5. Fireye Alarm indicator & General Alarm indicator (Flashing light and audible alarm)
6. Gas and Oil firing light indicators
7. Fuses

FIREYE COMBUSTION CONTROL

The Fireye combustion controller provides the following functions:

1. It sends power to the burner motor when the evaporator power switch is set to “BURN ON”.
2. It delays firing for 90 seconds to purge any fuel vapor that may still be in the burning chamber.
3. It detects if there is flame in the burning chamber when there should be none and shuts the burner off on alarm if that unexpected flame does not go out in 30 seconds.
4. It fires the burner by sending voltage to the ignition transformer and fuel and air solenoids.
5. It monitors the flame and shuts off the burner on alarm should a flame failure occur.

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. See the Addendum for details on the categories and overall function of the PLC program. There are three main buttons to push on the PLC control. They look like the symbols below.

Enter = ↵

Down Arrow = ▼

Up Arrow = ▲

ULTRASONIC WATER-LEVEL CONTROL

The water level in the evaporator is monitored and controlled by an ultrasonic level-sensing device – shown in the photo at left. This device is a transducer which is mounted in the cap on top of the 4" PVC standpipe. Sharp audio pulses are transmitted down from the transducer to the surface of the water in the standpipe and the time that it takes these pulses to echo back up to the transducer allows the controller to determine the level of the water surface.

Four independent relays are provided in the control panel to provide outputs for water control solenoids, alarms, etc. Their condition (energized/de-energized) is constantly displayed on the controller panel with a corresponding light being ON, meaning the relay is energized. The relay connections are shown on the electrical diagram. We have programmed them as follows:

- **Relay #1 (High Water):** This relay will only energize if the normal fill valve fails to shut off for some reason. At normal levels this relay provides 120v to terminal 10 in the power panel to which you might, if so desired, have connected a secondary water solenoid valve in series to the normal fill solenoid. Should a high water situation occur, Relay #1 will energize, dropping power from this solenoid (terminal 10) and applying 120v to the high water alarm terminal 21 to which you might choose to connect an alarm of some sort.

- **Relay #2 (Water Level Control):** This relay will energize when the water level falls below a programmed 'low' point and de-energize when the tank has refilled to programmed 'full' point by controlling power on the fill solenoid attached to terminal #7.

- **Relay #3 (Low-Water):** This relay will energize if the water level should drop so far as to allow the top of the heat exchanger to overheat with continued burning. When energized it will remove voltage from the burner contactor coil which will in turn shut off the burner. 120v will also be placed on the Low Water Alarm terminal #20 should you wish to monitor it.

- **Relay #4 (Lock Out):** This relay is normally energized and will de-energize only if the water level controller senses that its transducer has lost the ability to either send or receive the sonic pulses. Should that happen, the relay will de-energize dropping power to the other level relays, causing the burner to shut off, the water solenoid valve(s) to shut off and 120V to be applied to the lock-out alarm terminal 18 in the power panel. To this terminal, you may wish to attach an alarm.

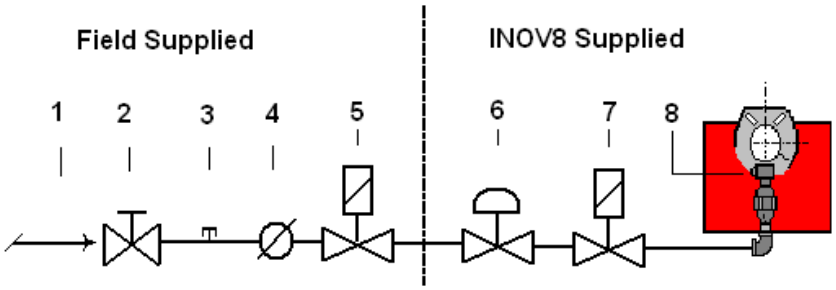
DWYER HIGH LIMIT CONTROL

This control receives temperature input from inside the waste water evaporator, at the hottest point of the heat exchanger. This control provides a backup in case the ultrasonic level control failed to sense a low level of water. It can also be used as an automatic shut down for batch operations. The factory presets this temperature at 220^{o} F. Should the temperature inside the evaporator reach the preset temperature this high limit control will shut down the burner, an alarm light on the control panel will be lit, and it will emit an audible alarm that requires a manual reset to stop the alarm and to re-start the evaporator.

GAS TRAIN INSTALLATION & COMPONENTS

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" w.c. at the factory and half of that for the low fire.

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 — RV52, RV53, RV61, RV81, RV91, RV111 & RV131

main burner only

Bulletin: MS2056

RV52

Pipe Sizes	1/2" & 3/4"
Capacities to	900 CFH (25 m³/h)
Inlet Pressures to	1/2 psi (35 mbar)
Outlet Pressures	1.0" to 12" w.c. (2.5 to 30 mbar)
Venting	1/8" NPT

RV53

Pipe Sizes	3/4" & 1"
Capacities to	1300 CFH (36 m³/h)
Inlet Pressures to	1/2 psi (35 mbar)
Outlet Pressures	1.0" to 12" w.c. (2.5 to 30 mbar)
Venting	1/8" NPT

RV61

Pipe Sizes	1" & 1-1/4"
Capacities to	2500 CFH (70 m³/h)
Inlet Pressures to	1 psi (70 mbar)
Outlet Pressures	1.0" to 22" w.c. (2.5 to 55 mbar)
Venting	1/8" NPT

RV81 & RV91*

Pipe Sizes	1-1/4", 1-1/2", 2" & 2-1/2"
Capacities to:	
(RV81)	4500 CFH (127 m³/h)
(RV91)	7500 CFH (212 m³/h)
Inlet Pressures to	1 psi (70 mbar)
Outlet Pressures	1.0" to 22" w.c. (2.5 to 55 mbar)

RV111

Pipe Sizes	2-1/2" & 3"
Capacities to	17000 CFH (481 m³/h)
Inlet Pressures to	1 psi (70 mbar)
Outlet Pressures	1.0" to 22" w.c. (2.5 to 55 mbar)
Venting	3/4" NPT

RV131

Pipe Sizes	4" Flanged
Capacities to	30000 CFH (850 m³/h)
Inlet Pressures to	2 psi (140 mbar)
Outlet Pressures	3.0" to 42" w.c. (7.5 to 105 mbar)
Venting	3/4" NPT

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

Honeywell Gas Valve Description

The photo below shows the Honeywell model VR8305Q, a two-stage 24 VAC gas valve and regulator. The regulator supplied by INOV8 has been converting to either natural gas or LP, based on the type of gas to be used. When installing the gas supply a "main shutoff manual valve (item 2 above) 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.
The Asco installation literature is also enclosed with this instruction manual.

SITE INSTALLATION INSTRUCTIONS

This section details installation of the individual components of the evaporator. They are:

- Compressed air supply & the required pressure settings
- Chimney & draft measurement
- Electrical supply
- Gas supply & installation
- Tanks A & B Piping & Solenoid Schematic
- Waste oil tank, supply lines & in-line filter

COMPRESSED AIR SUPPLY & PRESSURE SETTINGS

Air is 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 60 psig or higher) is required to operate the burner. The evaporator includes a factory provided pressure regulator rated at 300 PSIG that has 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 as shown in the photos on page 14.

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 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.

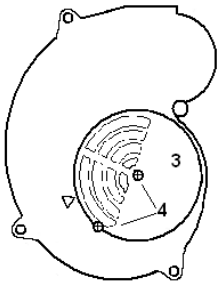
4. Air may be piped directly from the air compressor supply tank by using 1/4-inch (or larger) pipe, seamless copper tubing, or air hose. If air hose is used, it should have a minimum burst pressure rating of 300 psig.

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.

AIR PURPOSES & SETTING(S)

Compressed air is used to atomize the oil into tiny particles to allow for better combustion. It is supplied to the burner from an onsite air compressor. The onsite airline will connect into the air regulator and gauge and bracket assembly sent as a separate piece that can be installed at a convenient location close to the burner. A ¼" plastic airline then connects into the back of the burner with a slip fitting. There is a second air regulator on the front side of the burner shown by the yellow arrow in the photo to the right. The settings on these air regulators are different according to the following:

1. The incoming air pressure should be set at 30 psig. That pressure is used to withdraw the needle from the nozzle.
2. The atomizing air regulator and gauge are located in the lower left corner of the burner as seen in the photo at right. This setting should be 12-14 psig. If needed, lift the regulator from its locked position and adjust accordingly. This can be changed if it is determine more atomizing air is required due to elevation or other reasons. Once adjusted be sure to relock the regulator.



The combustion air setting is controlled by an air gate located under the red cover on the right side of the burner. It looks like the drawing at left. The combustion air gate has been factory set to the most common setting. If an adjustment is required: adjust the manual air gate (3) by loosening the locking screws (4). Once the optimal adjustment is reached, tighten the locking screws.

CHIMNEY INSTALLATION

The INOV8 evaporator requires two chimneys: one for the flue gases and the other for the steam. To dispose of flue gases, venting must be installed per NFPA #31 "Installation of Oil Burning Equipment" and all local codes. National and state codes concerning the chimney are sometimes confusing. It is important that you consult your local or state Fire Prevention Officer prior to installing your chimney. Most codes recommend that insulated chimney be used. 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 extreme cold weather. Some waste oils contain various ingredients that will form acids when combined with the condensation. These acids will prematurely corrode non-insulated, non-stainless steel piping.

The burner on the evaporator will not run with any degree of success when attached to an improperly installed chimney. The chimney MUST meet these requirements:

1. It must be tall enough and sufficiently clear of wind obstacles at the top to provide constant, adequate draft to the evaporator.

2. It must not have horizontal runs and elbows.

An ideal chimney would be one attached to the evaporator going straight up at least 12 feet through the roof and providing a negative draft of .03 to .04 as measured “over-the-fire”. Other items of important include:

1. Use at least eight (8”) inch round pipe for the full length of the chimney. If the chimney is taller than 15 feet you may need to increase the size to 10”. A mechanical draft inducer or additional sections may be required if 12’ does not yield sufficient draft.

2. Each evaporator must have two dedicated chimneys. DO NOT tie into old existing stacks!

3. DO NOT reduce stack sizes, or lengths, or use improper components. Install stack components with proper support.

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

5. Never locate a joint inside walls or in a joist space.

6. The last stack section must extend at least 3 feet above the highest point at which it comes in contact with the roof, and at least 2 feet higher than any ridge, parapet wall or roof structure within 10 feet of the chimney.

7. Install a non-restrictive stack cap (rain cap). In extremely windy locations, a Breidert type vent cap is recommended. A screen to restrict birds from access to the chimney is suggested.

8. You should never see smoke coming from the stack. Smoke always indicates an improper balance of fuel to air and usually means the evaporator is being over-fired – too much fuel.

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 resonation problems that can occur in horizontal runs, for instance, and it cannot overcome the effects of an exhaust system operating within the building. If your installation requires the assistance of a draft inducer, install it according to the following guidelines:

Install it just above the barometric draft control (if used) in a vertical section, on the opposite side of the chimney from where the boiler flue pipe enters. Avoid mounting in horizontal sections for these reasons: a) ash will accumulate on the blades, b) it will be exposed to excessive heat, and c) it will need to be supported in some manner. 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 is another reason a damper should be used. The best location for the barometric draft control is in the first vertical section within one to three feet of the evaporator, and before the draft inducer if used. 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 evaporator. 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 cover and use cardboard or something similar to block to opening to allow only the draft gauge into the opening. 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.

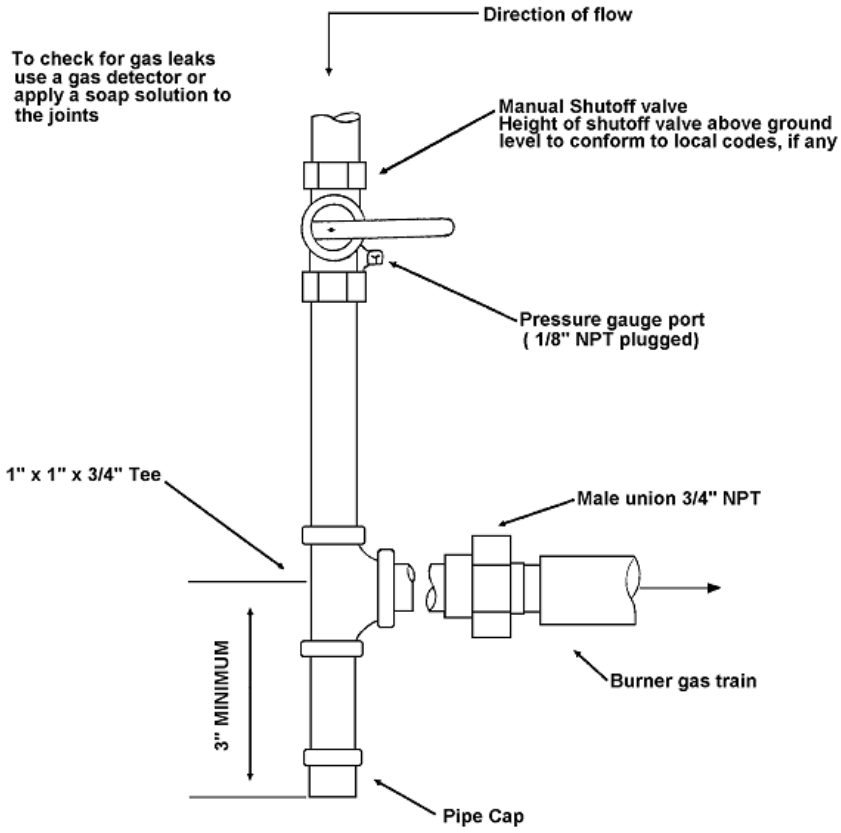
2. Insufficient Draft or Back Draft. Building infiltration will generally provide enough air for combustion. However, several conditions may result in positive air pressure within the boiler system and cause a back draft of flue gases. These include the operation of building exhaust fans without adequate 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 INSTALLATION

National codes require that a licensed electrician install the electrical supply to this evaporator, and that the installation be in accordance with ANSI and NFPA 70-1990 National Electric Codes. The evaporator power requirement is 120 volts. Do not operate the evaporator on less than 110 volts or more than 130 volts, or other than a 20 amp GFCI circuit breaker with a minimum of 12 gauge wire. Your evaporator 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! See diagrams on the following pages.

GAS SUPPLY INSTALLATION

Attach your gas supply line to the train according to prevailing national and local codes, and according to the diagram. Note – the gas valve is factory set at 3.0" w.c.. The high and low gas pressures can be measured at the manifold pressure access port on the burner (6). The gas valve can be used with either natural gas or propane and is adjusted to reflect the proper pressure required for the fuel being used. See the section on start-up of the burner to see how to measure the pressure and to make adjustments. 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. Refer to section entitled Gas Train Installation & Components on page 16.



INSTALLATION OF SEDIMENT TRAP AND GAS SUPPLY

Gas piping to the burner must be ¾" 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. The gas valve has a ¾" connection.

TANKS A & B PIPING & SOLENOID SCHEMATIC

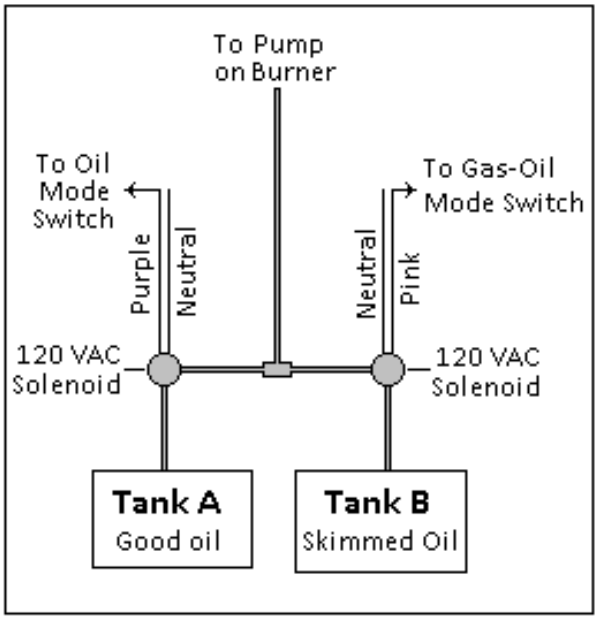
To utilize the skimmed oil from the evaporator, INOV8 provided a piping and solenoid assembly to connect two tanks that will hold "good" waste oil in **Tank A** and "skimmed" waste oil in **Tank B**. An assembly is provided that has a 'T' and pipe fittings and two 120 VAC solenoids, one in each side of the assembly.

Install the assembly so that it resembles the drawing. The solenoids are connected to a conduit fitting that will install into the control panel on the evaporator. Once connected and power is applied, the solenoids will open according to the fuel mode selection:

- **Gas & Oil** – the solenoid installed in the pipe to Tank A will close and the solenoid to Tank B will open – allowing the burner pump to draw oil from the skimmed oil tank. When the skimmed oil has been depleted a light on the control panel will be lit and the PLC will have the message on it "FTG" – forced to gas. At this point the operator should manually change the FUEL MODE SWITCH to OIL or GAS as desired.

- **Oil** – the solenoid installed in the pipe to Tank B will close and the solenoid to Tank A will open – allowing the burner pump to draw good oil.

Oil Line & Solenoid Connections for Good & Skimmed Oil Tanks



WASTE OIL STORAGE & OIL LINE RECOMMENDATIONS

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

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

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

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

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

Piping & Connections Recommendations

The piping installation is one of the most critical aspects of the installation of the evaporator, and the one that causes the most problems if done improperly. 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 evaporator).
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.

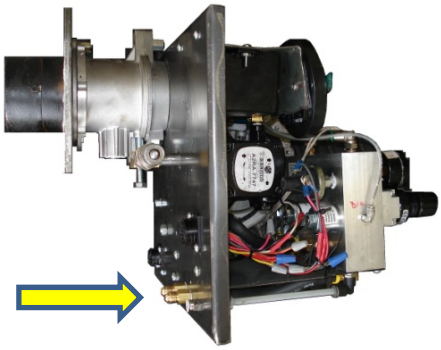
CAUTION

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.**

Tank Filter Recommendations

INOV8 provides an in-line filter or strainer assembly that connects directly to the waste oil supply line from the tank. This filter will need to be changed periodically; the frequency depends on the type of oil. It is helpful to fill new filters with waste oil before installing them. This reduces the amount of air that gets into the oil suction line. The replacement part from General Filter is #2615.

Attaching the Oil Supply Line



The oil supply line will connect to the back side of the burner. Attach flexible oil line with a ½" x ¼" 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 ¼" 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

The vapor eliminator/pressure relief assembly serves three functions:

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

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.

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.
4. Special note for applications burning skimmed oil – the return line should go to the Tank A – the main waste oil supply.

ATTACHING CONTROLS ONTO EVAPORATOR

This section assumes the above installation items have been completed so final connections are ready to be made. INOV8 supplies most electrical and oil connections as "quick disconnects" for ease in installation. It is advised that the connections made onsite also use quick disconnects where possible to ease maintenance later.

1. Burner Installation – Carefully remove the burner from the box. On the back side the mounting bracket will match up with the bolts on the evaporator. Secure with the nuts that are provided. Make the appropriate electrical connections. All use quick-connection fittings, but each plug is a different size so that they cannot be installed incorrectly.

2. Ultrasonic Level Control Tower – install following these steps:
   - Bolt the standpipe support bracket to the evaporator. Apply thread sealant to threads and screw into the port on the left side of the evaporator.
   - Apply thread sealant to the threads on the standpipe. Place the standpipe onto the elbow and screw into place.
   - Install the Ultrasonic Transducer cap onto the standpipe. It is important to not change the level of the cap as that will impact the proper sensing level.

3. Electrical Installation. Attach 120 volt building power into the control panel, see the electrical diagrams. Make the electrical supply connection into the control panel on terminals 7, 8 and 9 on the evaporator.

4. Steam Chimney - Install the chimney pipe on the steam connection on the far end from the burner on top of the evaporator lid. The chimney must be insulated stainless steel pipe of at least 12 feet of vertical length. A rain / wind cap must be installed on the top of each chimney. A Tjernlund draft inducer may need to be installed into this chimney.

5. Flue Chimney - Install the chimney pipe on the flue connection on the closet to the burner on top of the evaporator lid. The chimney must be insulated stainless steel pipe of at least 12 feet of vertical length. A rain / wind cap must be installed on the top of each chimney.

6. Compressed Air Connection - Install the air regulator onto the evaporator at a convenient location. Insert a compressed air line from the onsite air compressor into this air regulator. Insert the ¼" compressed air line from the regulator into the slip fitting on the back of the burner.

7. Waste Oil Line Connection – Install a 'T' fitting into the oil line that supplies the existing furnace - after the floating pickup assembly, oil filter and check valve. Then reconnect one side to the furnace and the other side to the evaporator.

8. Gas Valve - the gas valve can be installed at a convenient location on a wall or on the support legs of the evaporator. For wiring convenience it is helpful to be installed on the same side as the ultra-sonic level sensor, but not directly below it in case of water leaks.

9. Fill Solenoid – this is at the bottom of the ultrasonic level sensor. Connect the conduit into the control panel.

10. Oil Skimmer Connection – Install rigid piping or flexible tubing from the skimmer port into Tank B.

11. Oil line 'T' & Solenoid – Connect the conduit from the two solenoids into the control panel.

12. Electrical Connections – complete the connections to the optional equipment: High temperature alarm – terminal #17, Secondary fill solenoid – terminals 10, 11 & 12.

EVAPORATOR START-UP & BURNER SETTINGS

START-UP REMINDERS

Little interaction between the operator and control panel should be necessary once the evaporator is set up and running. Assuming the PLC display indicates a normal operation mode, only the Power and Fuel Mode Selection switches would come into play, i.e. You turn the power switch to SKIM or RUN and, select the desired fuel and the control panel 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.

With all gas, oil, air and water connections made, and the following settings have been confirmed, you are ready to start the burner.

BURNER SETTINGS CHART

Evaporator Model Number		EV20	EV40	EV60
NG	Supply Natural Gas Pressure	5 to 10	5 to 10	5 to 10
	HI Manifold Pressure for Natural Gas	2.0" w.c.	1.8" w.c.	2.1" w.c.
	LO Manifold Pressure for Natural Gas	0.7" w.c.	0.9" w.c.	1.6" w.c.
LP	Supply LP/ Propane Pressure	8" to 13" w.c.	8" to 13" w.c.	8" to 13" w.c.
	HI Manifold Pressure for LP/Propane	2.96" w.c.	3.0" w.c.	3.0" w.c.
	LO Manifold Pressure for LP/Propane	0.90" w.c.	1.1" w.c.	1.4" w.c.
OIL	Nozzle Size	3.1	5	5
	HI Oil Pressure	12 psig	7 psig	12 psig
	LO Oil Pressure	6 psig	3 psig	6 psig
	Maximum input of oil – gph or lph	1.68 / 6.0	2.85 / 10.70	5.35 / 20.25
	Nozzle tightness (snug), torque =	10 inch-lb.	10 inch-lb.	10 inch-lb.
AIR	Air Gate Adjustment	2 to 4	2 to 4	2 to 4
	Air pressure (gage on oil heater assy)	30 psig	30 psig	30 psig
	Atomizing Air Pressure (gage on burner	19 psig	19 psig	19 psig
FLUE GAS	Draft in w.c.	0.02 to 0.04"	0.02 to 0.04"	0.02 to 0.04"
	CO in ppm	Less than 100	Less than 100	Less than 100
	CO2	5% to 10%	5% to 10%	5% to 10%
	Flue gas temperature	350° to 500° F	350° to 500° F	350° to 500° F
	Smoke Patch Test – Results	#0 to #2	#0 to #2	#0 to #2

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.

Note - 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.

STARTING THE BURNER / EVAPORATOR

For the initial fill follow these steps:

1. Turn the **POWER SWITCH** to the "SKIM" or "RUN" position (the green light will turn on). This will activate the water level controller and send 120v to your fill valve solenoid and the evaporator tank will begin to fill. It will also supply power to the burner so be sure to have the FUEL MODE SWITCH set to Gas for the initial firing. Be aware that the controller has a 10 second initialization period when first turned on and during that time the LOCKOUT alarm light will be on.

2. Allow the evaporator tank to fill. Once the water reaches the preset level on the ultrasonic level sensor, the fill valve solenoid should de-energize and tank filling should cease.

3. The Honeywell gas valve has been set by the factory to the gas pressures shown in the table above but the pressures should be verified during start-up. You will need a gas manometer. To verify the pressures follow this procedure:
    a. The fuel selection switch must be in the "gas only" position. Start the burner by turning the power switch to RUN.
    b. With the manometer inserted into the gas pressure port on the burner, see the section on Gas Train Installation & Components on page 16 for location of the pressure port.
    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 can make the gas pressure adjustments.

4. 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.

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

6. 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. Note that this test must be done by a qualified gas technician.

7. After completing the adjustments, remove the manometer and tighten the screw inside the manifold test point. Replace the regulator cap on the gas valve if it had been removed.

8. 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. Make a note of 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.
4. Complete Operator training. Begin keeping a Maintenance Log and record all startup readings.
5. Balance the system to the design engineer's specifications by adjusting flow, control, and temperature settings.

The burner will be operating normally. It will take about 45 to 60 minutes for the water to boil and steam to begin coming out of the chimney. The burner / evaporator will continue operating, automatically filling the water as it is evaporated, unless one of the following occurs:

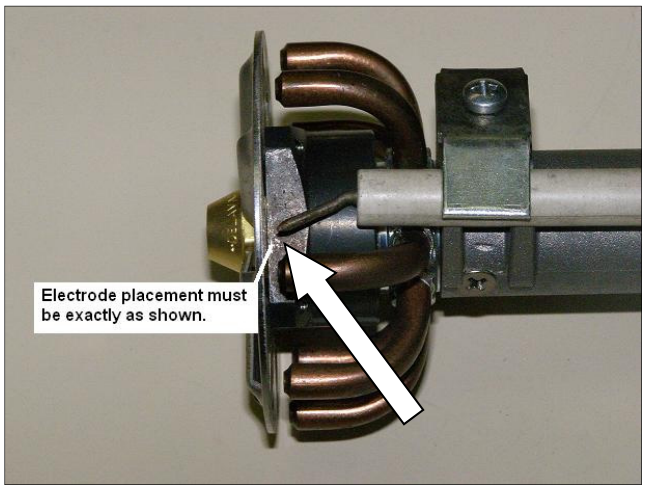
- The power is manually shut off,
- The water runs low,
- The temperature of 220^{o} F is reached,
- Other mechanical problem that requires operator attention. Call INOV8 service technician for assistance.

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 errors cause the burner to shut down. Some require no resetting – they clear automatically when the error condition has been corrected. See the Addendum for a complete list of PLC operation codes, errors and corrections.

MAINTENANCE & ADJUSTMENTS

To obtain maximum benefit from your used oil-burning evaporator, routine maintenance and occasional adjustments may be required. Follow these instructions for maintaining the evaporator in good operating condition.

Electrode Adjustments



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.

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 evaporator 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.

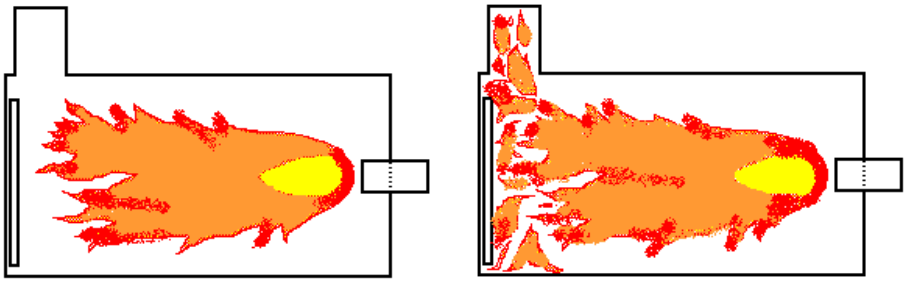
Increasing either atomizing air or combustion air will shorten the flame. Decreasing either will, of course, lengthen the flame and also cause it to take on a softer, more orange and billowy appearance. If reduced sufficiently you will start to see smoke coming out the chimney indicating poor burning.

Procedure:

1. To adjust the oil pressure, turn the adjusting regulator(s) on the front of the burner clockwise to increase pressure. The locking nut must first be loosened in order to adjust the pressure.

2. The low oil pressure regulator is in the middle and should be set to one-half of the high oil 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.
6. Be sure to re-tighten the locking nut on the regulators or the pressure will wander.

Proper & Improper Flame appearances



Proper flame Improper flame

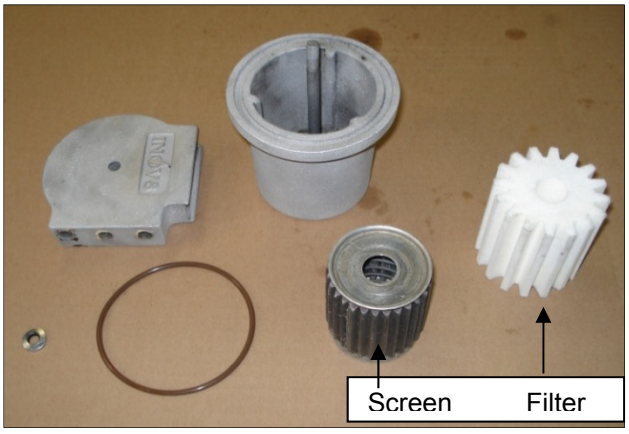
Changing fuses

Fuses and circuit breakers can be accessed on the control panel. Four amp fuses should be kept on hand.

Replacing the Vapor Eliminator Filter (or Cleaning the strainer)

When burning waste oil with little or no water use the rayon disposable filter elements. If burning skimmed oil with water present, then use the strainer as that will allow the water to pass to the nozzle. To clean the filter or strainer, follow these steps:

1. Place a small bucket under the vapor eliminator canister to catch any oil that may spill as you are doing this procedure.
2. Loosen the nut on top of the vapor eliminator canister.
3. 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.
4. 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 at right. If it is a steel screen, clean with parts washer and replace. The parts of the vapor eliminator are shown at right. The white filter is for applications that don't have water.



5. 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.

6. 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.
7. Return the o-ring and secure with the rubber-backed washer. Replace both items every other filter change.
8. 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.

Rebuilding the Pump

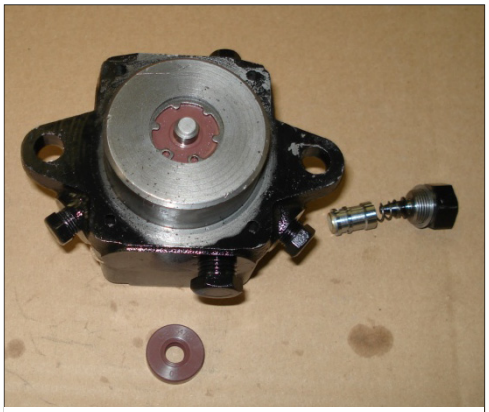
1. A pump "rebuild" may be necessary for either of two conditions:
   a. The pump shaft has a groove worn into it by the seal.
   b. The pump internal pressure regulator is sticking.

Pump – showing all internal parts

2. 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:

   a. Remove the pump from the motor in the following way:
      - Disconnect the oil inlet line form the pump and plug the inlet hole.
      - Disconnect the pump hose from the module fitting and plug it.
      - Remove the 2 bolts that hold the pump in. (3/8" socket)
      - 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.


Pump showing seal

   a. Drain the oil out of the pump as best you can.
   b. Remove the 4 cover bolts, cover and screen.
   c. Remove the 3 gear set bolts and the gear set pieces notating the position of the plates. Don't lose the moon-shaped piece.
   d. Remove the shaft (with gear).
   e. Remove the seal-retaining clip. (C-clip)
   f. 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.
   g. Clean all the pump parts with solvent. (Carb cleaner will melt the paint.)
   h. 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 of 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.
   i. Lubricate the new seal and press it in.
   j. Replace the fiber washer (if there was one) and retaining clip.

k. Oil the new shaft and place it in the pump.
l. 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

a. Perform the 1st two steps of "Replacing the pump shaft and seal" above.
b. Remove the 11/16-inch "nut" from the back of the pump.
c. Remove the 11/16-inch "nut" from the front of the pump. (The pressure adjusting screw will come out with the nut.)
d. Remove the spring centering device – noting its orientation.
e. Remove the spring.
f. 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)
g. 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.
h. Oil the parts and put them back together. Be aware that there was an aluminum washer under each "nut" – as they may have fallen off during cleaning.
i. Replace the pump back on the motor.

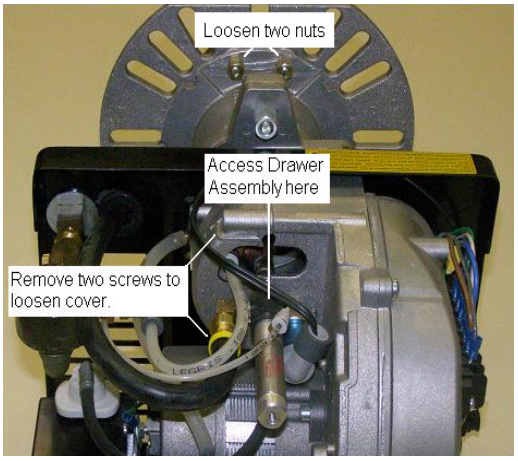
Ultraviolet sensor

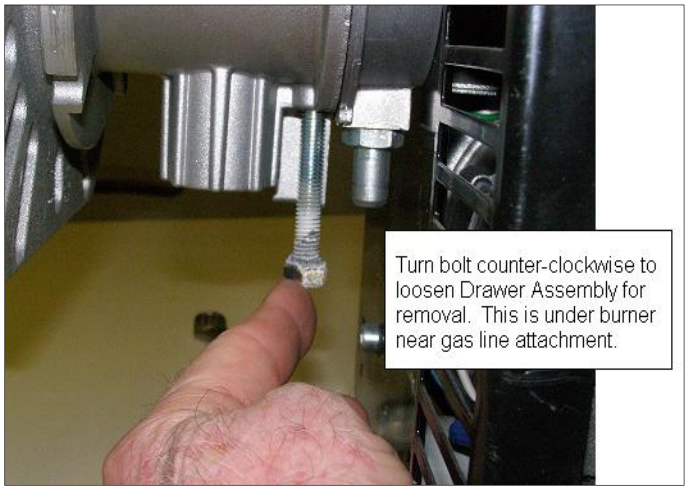
Use carburetor cleaner and rag to wipe clean the lens of the sensor. Non-abrasive hand cleaner may help if a brown film remains on the lens.

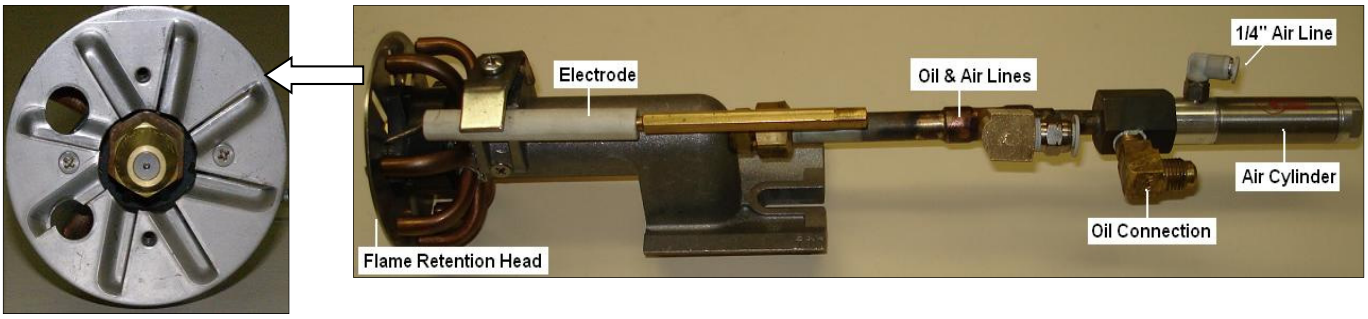
Burner Drawer Assembly Removal Procedure

The Drawer Assembly can be removed from the burner either from the front side leaving the burner installed on the evaporator, 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" airline, 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 front 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.

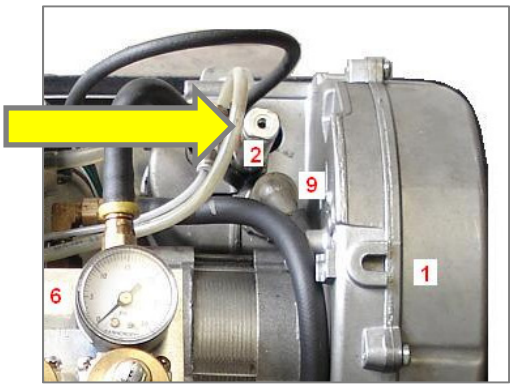






NOTE – The holes in the flame retention head shown in above photo must be positioned in front of the UV Sensor to allow it to "see" the flame. The hole(s) is not for the electrode!

Cleaning the Nozzle with the Needle



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 – shown by the yellow arrow. Use quick jabbing motions which will force the needle into the nozzle. If this does not clear an obstruction, then the nozzle will need to be removed and cleaned by manually.

Cleaning the Nozzle Manually

With the drawer assembly removed from the burner you can access the nozzle for manual cleaning. Your burner uses what we call a –5 nozzle. The nozzle is made up of two parts plus an aluminum washer that we add to it. There is the nozzle cap (the brass part that unscrews) and the 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:


Nozzle cap, washer.

1. 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.

2. 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 distributes the air when it passes through mixing it with the oil.

3. 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.

4. 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.

Vacuuming the Combustion Chamber / heat exchanger

The INOV8 evaporator was designed to accommodate the ash removal that is required when burning waste crankcase oil. The non-burnable additives in used oil combined with contaminants generated by the normal operation of an engine, amount to about 2-½ quarts of non-burnable solids in every 55 gallons. When using waste oil as fuel the inside of the combustion chamber and heat exchanger tubes will collect a light powdery ash and reduce the draft and the thermal efficiency of the evaporator if left uncleaned. It is important to remove the ash regularly. Clean your evaporator on schedule to help it perform efficiently and reliably. The frequency will have to be determined through experience but checked at least every 500 hours of operation.

The powdery ash that accumulates in the evaporator can be easily removed with a shop vac. The frequency of cleaning will vary on the type and quantity of oil burned. The quality of combustion can be determined by the color of the ash; the best color is a gray or tan. White ash indicates excessive airflow (secondary air needs adjusting), and black ash indicates too little air, too much oil, or a dirty nozzle. By removing the ash before excessive accumulation you will maintain high efficiency from the evaporator, have an easier job of cleaning, and reduce the chance of burner failure.

Procedure for cleaning the combustion chamber:

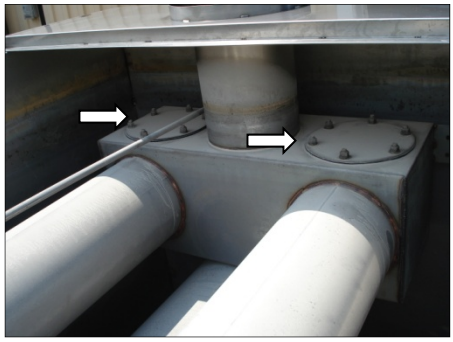
1. Turn the Main Power switch to "OFF". Wait for the evaporator to cool to room temperature.
2. Turn off the gas valve.
3. Disconnect the electrical connections.
4. Access the combustion chamber by removing the three nuts that hold the burner flange to the evaporator.
5. Gently lift the burner off of the bolts and lift it away from the opening.
6. Vacuum the combustion chamber.
7. Check to make sure no ash has accumulated in the ultra-violet sensor.
8. Remount the burner to the evaporator reversing all of the steps above.

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.** Shut down the power and remove the burner. Scoop out any excess oil. It can be returned to the tank if properly filtered. Put in "Oil Dry" to absorb any wet oil, and scrape out and discard. If oil is present in the heat exchanger tubes, perform the same cleaning routine in them.

Procedure for cleaning the heat exchanger tubes

1. This should be done each time the combustion chamber is cleaned, when the evaporator is cool.
2. Remove the chimney from the "burner end" of the evaporator.
3. Lift the lid with the chimney connector off the evaporator and set aside.
4. Remove the caps off of the two cleanout ports and reach inside with a shop vac hose and remove all ash. Be sure to reach the boxes at either end of the tubes. When replacing make sure of a tight seal.



Evaporator Tank Cleaning

When the above cleaning is done the tank should be emptied of water and any sludge or dirt should be removed from the bottom of the evaporator tank. The sludge MUST NEVER build up more than 6" in height from the bottom of the tank. If it builds up higher than 6" it may block the passageway leading to the Ultra-sonic sensor and prevent it from sensing the proper liquid level. That could cause a dangerous situation. There are two 2" openings on either end of the evaporator tank. By connecting a high pressure water line to either end of the evaporator it can be completely flushed of all debris.

Waste Oil Tank Cleaning

Waste oil also contains substantial amounts of water and sludge, both of which settle to the bottom of a tank over a period of time. A storage system that allows sufficient settlement time will provide trouble free operation. At least once a year check for water and sludge in the supply tank and discard if found.

Annual Maintenance

At least once a year the chimney should be checked for ash accumulation and to assure the following additional items:

1. Outside - The guy wires and wall support (if applicable) must be tight and secure. Check the roof flashing for caulking and the storm collar for proper position.
2. Check the chimney top to insure it has not been damaged in a storm. Check for bird nests in the top of the chimney.
3. Inside - Make sure no rusting has occurred, nor that any of the joint fasteners are loose.
4. Check the chimney and remove any ash build-up.

TECHNICAL ASSISTANCE NEEDED

Please contact INOV8 International telephone support at 608-785-2879.

WARRANTY

This product is warranted for one year from date of purchase to be free of mechanical and electrical defects in material and workmanship. The manufacturer's obligation hereunder is limited to repairing such products during the warranty period, provided the product is sent to INOV8 or to an Authorized Independent Dealer. This warranty does not cover (a) damage resulting from negligent use or misuse of the product, (b) use on improper voltage or current, (c) use contrary to operating instructions, or (d) disassembly, repair or alteration by any person not authorized to work on the product. The Telephone Servicing Procedure must have been followed within the warranty period, and according to these terms and conditions:

Terms & Conditions

1. The warranty sheet has been completed and is on file with INOV8.
2. The evaporator system has been installed, maintained and operated in accordance with this instruction manual and the other component manuals.
3. INOV8 is not responsible for any labor or related expense for the servicing, removal or replacement of parts.
4. INOV8 reserves the right to an on-site inspection by our factory representative.
5. Nothing contained herein shall serve to negate or modify the initial warranties extended by INOV8 to its customers or the limitations placed on warranties by the disclaimer appearing in the terms of the original sales contract.
6. These warranties are in lieu of all other warranties expressed or implied. INOV8 does not authorize any person(s) to make or assume for it any other obligation or liability that is not in accordance with these warranties.
7. These warranties give specific legal rights. There may also be other rights that are unique to the state of residence.

THE SELLER HAS MADE NO WARRANTY THAT THE GOODS COVERED BY THIS CONTRACT ARE MERCHANTABLE OR FIT FOR ANY PARTICULAR PURPOSE, AND THERE ARE NO WARRANTIES, EXPRESS OR IMPLIED, WHICH EXTEND BEYOND THE DESCRIPTION OF THE GOODS CONTAINED IN THIS CONTRACT. IN NO EVENT SHALL INOV8 BE LIABLE FOR CONSEQUENTIAL OR SPECIAL DAMAGES.

Part Replacement Procedure

If it is determined that part of the burner 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 evaporator, all shipping of warranted parts from the factory is paid for by INOV8. The customer is responsible for returning the faulty part to INOV8 or the INOV8 dealer. After the first year the owner shall pay all 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 in for an on-site inspection.

4. INOV8 is not responsible for any labor cost for the servicing, removal or replacement of parts.

5. Repaired or exchanged equipment will carry the unexpired portion of the original equipment warranty or six months, whichever is greater.

6. If inspection by INOV8 discloses a defect not covered by this warranty, the equipment will be returned as is, repaired, or replaced at the discretion of the owner. If repaired in the factory, INOV8's regular labor charges will apply.

7. This provision expires one (1) calendar year from the date of delivery.

ADDENDUM

PLC PROGRAM DETAILS

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

Display	Options	Explanation
Auto start after Power Failure	Y/N	Do you want burner operation to resume automatically after a power failure?
Oil Temperature Probe Present	Y/N	This will be Yes unless your unit burns only fuel that requires no heating.
Oil Heating Required	Y/N	Does your current fuel require heating before being allowed to fire?
Proc Temp Probe Present?	Y/N	Yes, if your unit is an evaporator. Otherwise, No.
Stop at Process Temperature?	Y/N	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.
Differen = xx^{o}		This is number of degrees that the oil 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^{o} 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^{o} IP=xxx^{o}, LP=xxx^{o} PP=xxx^{o}. 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.

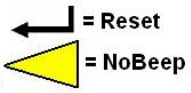
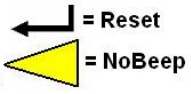
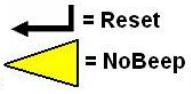
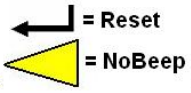
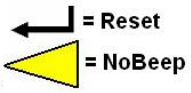
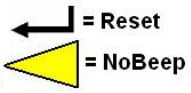
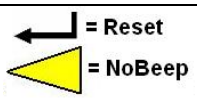
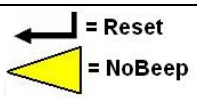
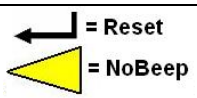
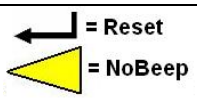
Running Mode Displays – Category #2

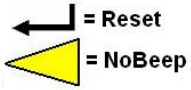
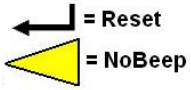
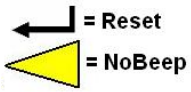
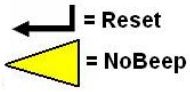
Display	Settings	Explanation
No Call for Heat	**OT=xxx^{o}** **PT=xxx^{o}**	The evaporatorwater is at the Aquastat setpoint so the burner is not being asked to fire.
Waiting for PTFI	**OT=xxx^{o}** **PT=xxx^{o}**	Assuming the burner's airflow interlock switch is closed, we're in the 90 second pre-purge period.
On Gas: Oil Cold	**OT=xxx^{o}** **PT=xxx^{o}**	An Oil mode is selected but the oil is not yet hot enough to be fired. We're firing on Gas while waiting.
Mode Transition	**OT=xxx^{o}** **PT=xxx^{o}**	We're transitioning from Gas to an Oil mode and firing on a combination of both at LO pressures.
Firing on Gas	**OT=xxx^{o}** **PT=xxx^{o}**	We're firing on Gas at HI pressure.
Firing on Gas & Oil	**OT=xxx^{o}** **PT=xxx^{o}**	We're firing on a combination of LO pressure gas and oil.
Initial firing	**OT=xxx^{o}** **PT=xxx^{o}**	The Gas only firing that began at PTFI is continuing until the period in the "Init=xxx" parameter expires.

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

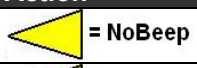
Display	Action	Description
Power Restored		Power is back on after a power failure. This screen will not display if "Restart after Power Failure" is optioned.
Gas flame Failed		Burner failed while in a gas mode and has been left shut off with the Fireye control in an alarm state.
Water Temp @ SP		"Stop at Process Temperature" is optioned on and the heat exchanger has reached the desired temperature.
High Temp Limit		The evaporator heat exchanger temperature has exceeded the safety limit setting.
Fireye Resetting		Burner failed while in Oil-only mode and the Fireye control is in the process of being reset by the PLC.
Unk Fireye Alarm		Something caused the Fireye alarm to come on (or be on) at a time when the burner wasn't even firing.
Waiting for PTFI		Same as in Category 2 but we're in Forced-to-Gas mode.
Initial Firing		Same as in Category 2 but we're in Forced-to-Gas mode.
HI Gas Rly Fail		The state of the relay that drives the HI Gas solenoid fuel valve was ON when it should be OFF or vice-versa.
LO Gas Rly Fail		The state of the relay that drives the LO Gas solenoid fuel valve was ON when it should be OFF or vice-versa.

HI Oil Rly Fail		The state of the relay that drives the HI Oil solenoid fuel valve was ON when it should be OFF or vice-versa.
LO Oil Rly Fail		The state of the relay that drives the LO Oil solenoid fuel valve was ON when it should be OFF or vice-versa.
FS Relay Failure		The state of the Failsafe relay was ON when it should be OFF or vice-versa.
Oil is over 200°		The oil temperature is too high. Either the oil temperature setpoint is over 200° or the heater relay is shorted.

Hardware failures – Category #4

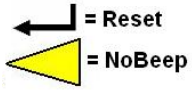
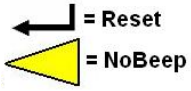
While in category 4 the component that failed is displayed. The unit recovers automatically when the hardware condition has been corrected. Depressing the left arrow button will turn off the audible alarm. Correcting the error will cause automatic reset and return to normal operation. It cannot be reset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

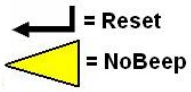
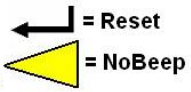
Error Displays that Correct Automatically when Trouble Clears – Category #4

Display	Action	Description
RTD is Open		The oil temperature sensor is open.
TC is Open		The Process temperature sensor is open.
Mode Switch Fail		The mode selector switch has either no mode selected or more than one mode selected.

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.

Display	Action	Description
FTG: Fail on Oil		Burner has failed while in Oil only mode. Operation has been switched to Gas only mode.
FTG: Heater Fail		Oil temperature is failing to rise with the heater on. Operation has been switched to Gas only mode.

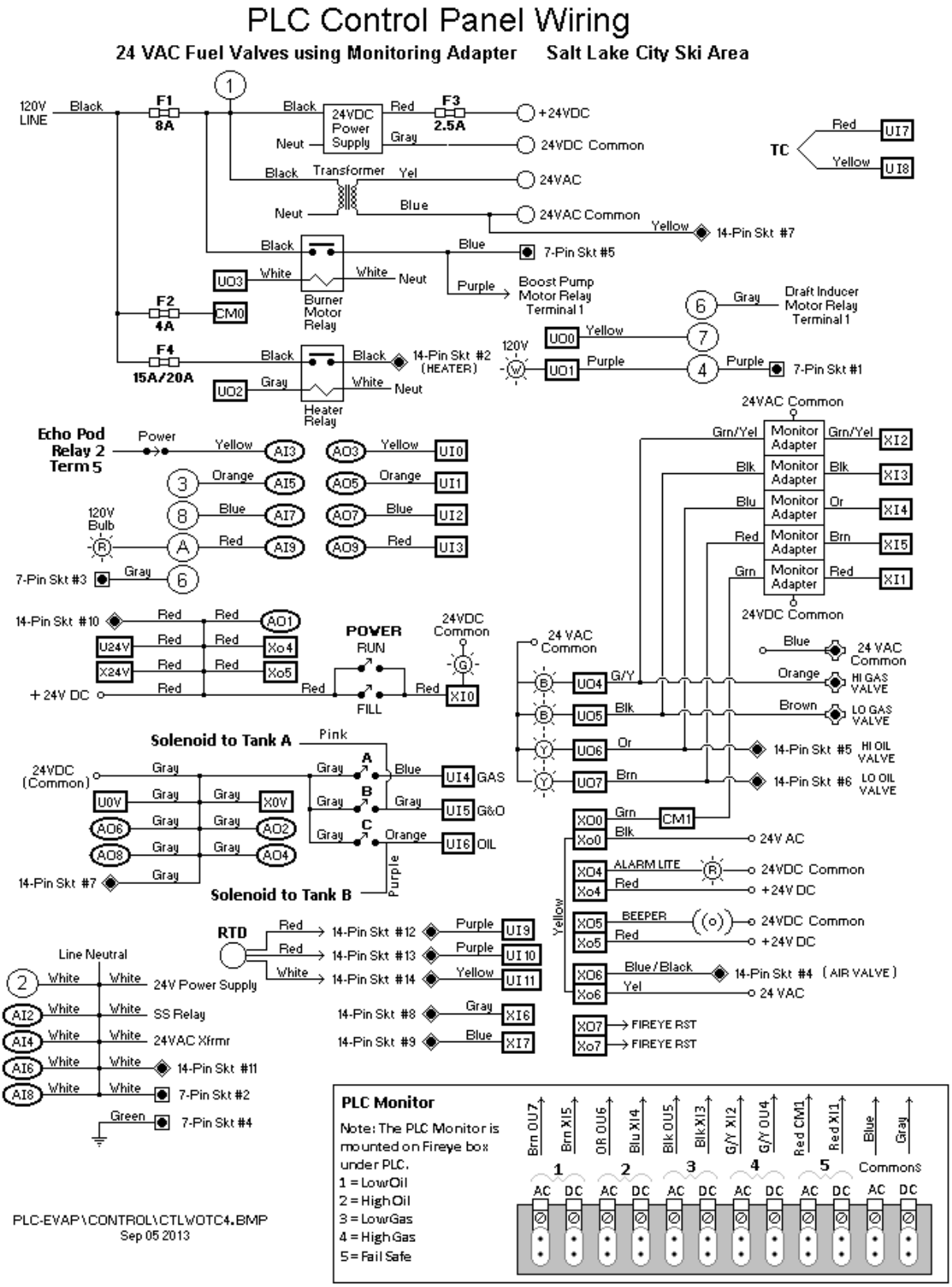
FTG: No Air PSIG		Air pressure needed to atomize the oil is absent. Operation has been switched to Gas only mode.
FTG: No Oil PSIG		Oil pump is putting out too little pressure to burn oil. Operation has been switched to Gas only mode.

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>”.

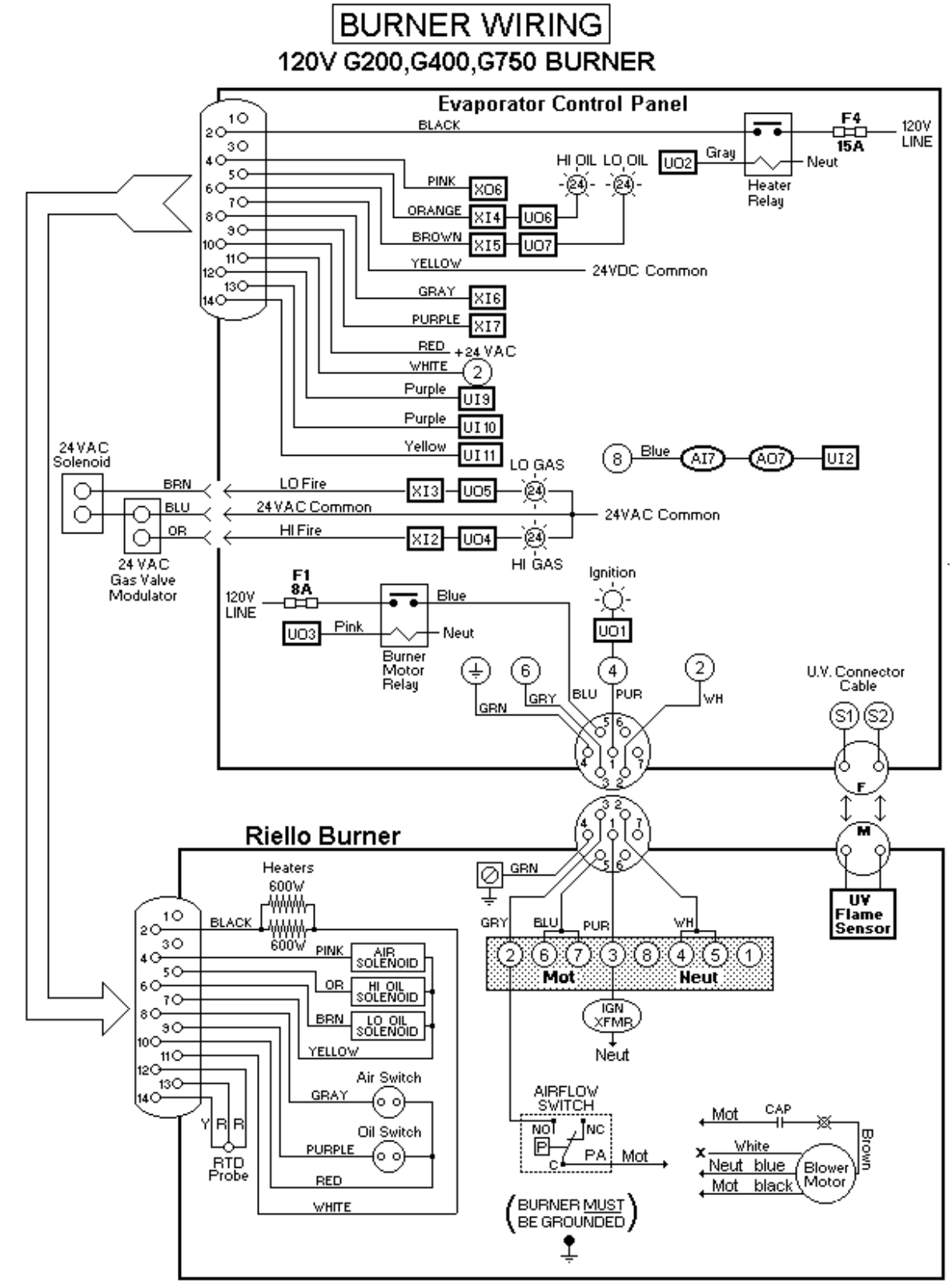
The following will display after failing on Oil and before Fireye is reset. It allows time to see the code displayed in the five lights on the Fireye: “Fireye Alarm code displayed”.

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 service technician for assistance.

ELECTRICAL DRAWINGS FOR PLC CONTROL PANEL



ELECTRICAL DIAGRAM FOR BURNER WIRING



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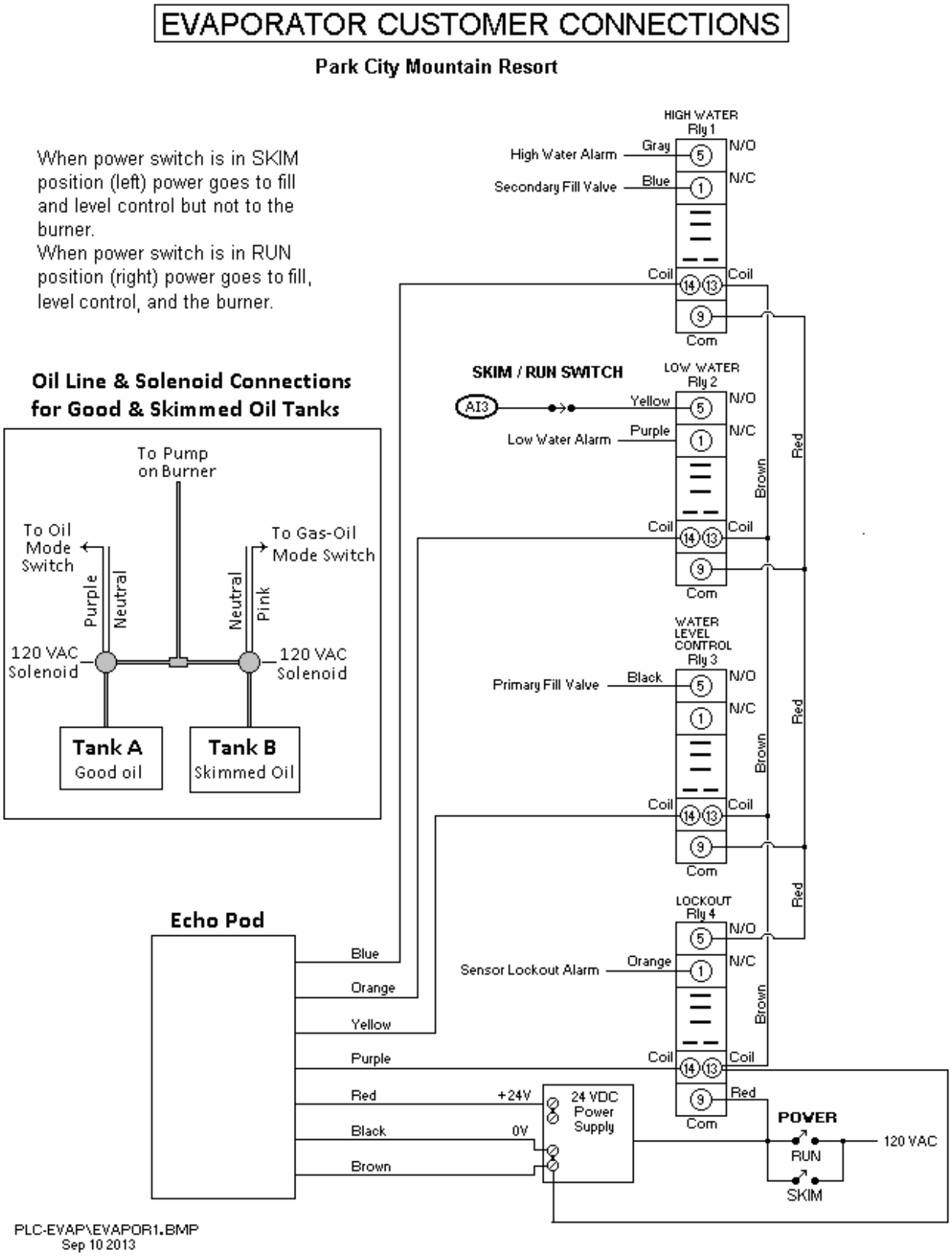
ELECTRICAL DIAGRAM FOR CUSTOMER CONNECTIONS



DEFINITIONS

Air Regulator — The air hose connects to this and regulates the air pressure used to withdraw the needle from the nozzle. It is located on the left side of the burner.

Ash — Each 55 gallon barrel of oil contains 1-1/2 quarts of non-burnable solids that collect in the combustion chamber. This ash consists of the additive package within new lubricating oil plus trace amounts of wear metals.

Check Valve — One is part of the floating pickup and filter assembly which is included in every burner. The check valve holds the oil in the lines to prevent having to prime the pump each time the filter is changed.

Combustion Chamber — The large barrel shaped chamber that the flame is contained in. Unburned ash collects in this combustion chamber.

Combustion Control — This device monitors and controls the combustion and provides numerous safety features. It is the red box on the control panel.

Compression Fitting — A gland fitting for sealing to steel tubing.

Delivery Line — Copper piping, oil-approved hose or steel pipe which connects the oil tank to the oil pump on the burner.

Electrode — A single electrode provides the spark to the gas from the high voltage ignition transformer. The gas flame ignites the oil flame.

Flame Retention Head — Located on the end of the air tube of the burner, the flame retention head mixes the atomized oil with combustion air.

Flared Fittings — The only fitting to be used with soft copper tubing. This fitting is commonly used in refrigeration.

Ignition Transformer — Located behind the air switch for the gas side, the transformer provides spark for ignition.

Manifold — The manifold houses the components that control the oil temperature, oil and air pressure, the oil and air solenoids, the oil & air pressure gauges, and oil & air pressure switches. It is on the burner.

Oil Temperature Control — A probe is located inside the Manifold which reports to the PLC the current oil temperature. The PLC is also where you can change the interlock and operating oil temperatures.

Reinforced Hose — A clear, braided, oil-approved hose, recommended for supply oil line.

Residual Flame — This occurs when oil has accumulated in the combustion chamber. The flame continues after the burner shuts off. The combustion control will not allow operation of the burner while there is residual flame.

Solenoid — There are two oil and one air solenoids are located on the back of the manifold. The solenoids control the flow of oil and air when energized.

Vapor Eliminator — This cast aluminum canister houses a throw-away filter element and provides a settling chamber to collect entrained vapor bubbles for return to the oil tank.