



SUBMITTAL FOR INOV8 WASTE OIL BURNING BOILER

EQUIPMENT OVERVIEW

The INOV8 waste oil burning boiler is comprised of the following:

- INOV8's patented waste oil burner, either the oil only burner model S200, or the gas-oil burner with automatic switching of fuels – model G200 or G400.
- An appropriately sized Buderus cast iron assembled boiler, which includes INOV8 modifications to allow the efficient and clean burning of waste petroleum oil.
- Tjernlund draft inducer – appropriately sized,
- Honeywell Aquastat model L7248C1006,
- Smaller components: boiler brushes, a spare filter, spare fuses, oil regulator assembly, two instruction manuals – one covering the Buderus boiler installation, and the INOV8 manual covering the burner operation and the overall boiler system, and various smaller fittings and components to enhance the operation of the system from the oil burning side.
- Optional items include various sizes and configurations of oil storage tanks, gear or diaphragm boost pumps, tank-style air compressors, high temperature limit control, low water cut-out and water side controls.
- The boiler has been de-rated to accommodate an average efficiency of 80% taking into account at clean condition the boiler efficiency is 85% and prior to removing the ash the efficiency will drop.

SHIPPING

The boiler will arrive in two shipments: one directly from Buderus in New Hampshire which will be the boiler steel. The accessory carton is shipped directly to INOV8. It contains the insulation, the outer jacket of the boiler, various fittings, the temperature and boiler pressure gauge, boiler brushes and other assembly parts. INOV8 applies the modifications to the boiler door and adds the burner and accessories and optional items, and ships these within a few days. Generally the complete boiler will arrive within four weeks of placing the order.

THE TJERNLUND DRAFT INDUCER OVERVIEW

INOV8 has used the draft inducer for 20 years with our waste oil boiler. The purpose is to assure a negative pressure over the fire of -0.04 when the boiler is in clean condition. A range is acceptable between -0.02 and -0.06. Draft exceeding that reading may allow the flame to lift off causing instability. A draft below -0.00 will not allow enough air to move through the boiler. Insufficient air will cause sooting and require frequent cleaning. There are larger draft inducers if the one included does not support the required draft. If the draft inducer provides excessive draft, correct that by either adjusting the depth of the fan into the chimney, removing the inducer or adding a barometric damper. The draft measurement should be read in the port located near the sight glass (remove the small brass screw to access opening).



BOILER & BURNER CERTIFICATION

The boiler has these ratings for installations in the United States: ASME – Boiler and Pressure Vessel Code, MEA# 358-91-E, and some sizes have an Energy Star Rating. In Canada the boilers have the following registration: CRN# 1495.9c, 620.T. The INOV8 burners have a listing to ANSI UL296, Issue 1994/06/01, Ed: 10 Rev:2006/02/24, Standard for Safety Oil Burners; CSA B140.0, Issue: 2003/10/01, Ed:3, General Requirements for Oil Burning Equipment General Instruction No 2-4 (R1991) by Intertek ETL-Semko, Report # 3128618CRT-002.

FACTORY START-UP & ONSITE TRAINING

On-site startup and operator training is available at a daily rate of \$575 plus travel expenses.

BUDERUS BOILER SPECIFICATIONS

Boiler with Burner Specifications	B175	B225	B275	B325	B400	B500	B650
Boiler dimensions height, in inches	35	35	35	35	41	41	41
Boiler dimensions width, in inches	23	23	23	56	35	35	35
Boiler dimensions length, in inches	47	51	56	62	60	66	73
Boiler dry weight - pounds	500	600	700	800	1197	1391	1585
Water content - in gallons	16.1	19.3	22.5	25.6	37.8	45.2	52.6
Output BTUs in 1000s	140	180	220	260	320	400	520
Boiler & water side connections:							
Water connection -inches	1.5	1.5	1.5	1.5	3	3	3
Return water connection (NPT)	1.5	1.5	1.5	1.5	3	3	3
Drain connection size - inches	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Flue connection - inches	6	6	6	6	7	7	7
Chimney diameter - inches (minimum)	8	8	8	10	10	10	10
Chimney height - feet (minimum)	15	15	15	15	15	15	15
Clearances (in inches)							
Side wall	6	6	6	6	12	12	12
Side wall - burner door swing	16	16	16	16	43	43	43
Front (boiler length plus 40")	67	72	77	81	79	85	91
Behind (1/2 boiler length plus 20")	34	36	39	46	40	43	46
Top	12	12	12	12	12	12	12
Chimney connector to wall	18	18	18	18	18	18	18
Boiler operating requirements							
Max operating temperature - F	240	240	240	240	240	240	240
Max operating pressure - PSIG	58	58	58	58	58	58	58
Max supply temperature - F	248	248	248	248	248	248	248
Min supply temperature - F	150	150	150	150	150	150	150
Min required draft - inches of WC	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02



Standard features of Buderus Boiler System:

- Factory assembled cast iron sections (can be ordered knocked-down)
- Full-size burner door hinged left or right (field selectable)
- Supply & return connections at rear of boiler
- Blue enamel jacket with 3 1/2" wrap-around thermal insulation
- Flexible GL-180M cast iron with silicon "barrier skin"
- Precision casting eliminates need for manual grinding
- No refractory or target cup needed due to chamber geometry
- Precision machined steel push nipple sectional construction
- Tongue and groove flue side sealing for pressurized operation
- Boiler brushes
- Aquastat- Honeywell model L7248C1006
- Boiler installation manual

Additional items needed for complete boiler installation:

- Low-water cut-off (recommend Hydrolevel Company Safgard - PN#45-175 with probe #EL1214-SV)
- Circulators, mixing valves, zone controls & tubing/piping for water side

Model S200 Burner Specifications

Burner model #	S200	S200	S200	S200	S200	S200	S200
Input BTU (in 1000s)	175	225	275	325	400	500	650
Nozzle size #30609	3.1	3.1	3.1	5	5	5	8
Oil pressure setting	9	11	14	5	7	10	10
GPH	1.25	1.6	1.96	2.32	2.85	3.5	4.6
Burner height, inches	14	14	14	14	14	14	14
Burner width, inches	18	18	18	18	18	18	18
Burner length, inches	16	16	16	16	16	16	16
Compressed air in CFM	2	2	2	3	3	3	4
Compressed air in PSI	30	30	30	30	30	38	38
Air pressure on module in PSI	19	19	19	19	19	19	19
Secondary air band settings	2	2	2 to 3	5	4	2 to 3	2 to 3
Air connection to regulator, NPT	¼	¼	¼	¼	¼	¼	1/4
Electrical requirements (in amps)	20	20	20	20	20	20	20
Volts	120	120	120	120	120	120	120
Hertz	60	60	60	60	60	60	60
Burner Motor - hp	1/5	1/5	1/5	1/5	1/5	1/5	1/3
Fuel Pump connection (3/4" or larger) NPT	1/4	1/4	1/4	1/4	1/4	1/4	1/4
Weight - in pounds	52	52	52	52	52	52	80

Items Shipped with Burner

- Modified Boiler Burner Plate
- Spare fuses - one 4 amp, one 10 amp
- Instruction Manual for burner
- Stainless insert for boiler (shipped with burner)
- Oil Regulator & Gauges Assembly



Spare filter for vapor eliminator

Floating Oil Pickup / Filter Assembly, includes filter mount with filter, floating oil pickup, 2" fitting for tank & check valve

Optional boost pump, includes filter mount with non-bypass filter, & oil strainer & excludes floating oil pickup

Draft Inducer, fit up:

Tjernlund Draft Inducer, model	D-3	D-3	D-3	I	I	I	I
Tjernlund connection size (inches)	8	8	8	8	8	8	8
Shipping weight - lbs.	100	100	120	100	120	120	120

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

Oil line from tank, return line to tank, compressed air supply line, chimney, oil storage tank, electrical supply.

Pre-installation Requirements for Buderus Boilers With S200 Burner

For the INOV8 boiler to operate properly, it is essential that several key issues be reviewed well before installation and early in the planning stages for new construction projects. This document addresses these important topics to insure you have a correct installation. All connection sizes related to the installation of the fuel side of the boiler are detailed in the attached Boiler System Specification Sheet.

Note that detailed installation instructions will be found in the Owner's Manual you will receive with the portion of your boiler that comes from INOV8. Also note that instructions in the INOV8 manual supersede any that accompany the individual components of the boiler system, i.e. draft inducer, boost pump, etc. If you have questions, or need additional assistance, you may also contact the technical support team at INOV8 International.

LOCATION OF BOILER

There are several key aspects of boiler location that must be considered. While it may not be possible to optimize all factors in every installation (especially when adding a boiler to an existing building) they all must be addressed.

INSTALL THE BOILER ON A RAISED PLATFORM

To ease of cleaning of the Buderus and Viessmann Boilers, INOV8 recommends setting them on a raised platform of at least one foot in height. This will allow the maintenance to be done standing rather than kneeling on the floor. The Buderus manual recommends a steel frame be placed over a concrete pad. Many customers have simply used concrete blocks that have been covered with a solid block of concrete. Placing the boiler on top of an "Indirect Fired Domestic Hot Water Tank" also raises the boiler to a good height for servicing.



CHIMNEY OPTIONS/LOCATION

The most critical factor in the installation of your INOV8 boiler is a properly designed, located, and functioning chimney. A good draft (air movement up the chimney) is essential to the safe and reliable operation. Refer to the Boiler Specification Sheet for the required chimney size. While we cannot address all possible chimney installation options, these are some key points to consider:

- Chimney diameter is based on the size BTU input of the boiler – see the specification sheet. Note - the chimney connection on the boiler does not imply the chimney size. In all cases it must be increased to the appropriate size.
- “Class A” chimney must be used from a point 18 inches below the ceiling to the top of the chimney. Single wall can be used from the ceiling connection to the boiler connection. Note that the use of “Class A” chimney is not only to protect combustible materials from 500° temperatures, it also assists draft and helps minimize condensation inside the chimney.
- When using the gas-oil burner option, a double-acting barometric damper is required in the chimney.
- A dedicated chimney is required. DO NOT combine several heating devices into one common chimney.
- A minimum of 15 feet of vertical chimney is required above the flue exit of the boiler for chimneys that go straight up (without bends, offsets etc).
- If at all possible, run your chimney straight up from the boiler and out through the roof. This will provide the best draft.
- If you must offset the chimney to avoid an obstruction, use a mild angle and keep the chimney running as vertically as possible (no 90 degree angles or horizontal runs).
- Note that using any angles, offsets, or elbows will slow flue gasses and require additional chimney height to compensate.
- Use only a short (less than 2 foot) horizontal section of chimney to exit through an exterior wall as a last resort. Avoid this if at all possible.
- While it may be possible to use an existing chimney, including masonry, we strongly recommend installing a new chimney dedicated to your INOV8 boiler. When cold masonry chimneys are difficult to get the chimney to draft properly.
- If the facility has exhaust fans or exhaust systems of any kind that blow inside air to the outside, negative building pressure will result. This will cause a back draft down the chimney with carbon monoxide fumes and boiler shut down. In this case, you will need either a make up air unit or an optional sealed combustion kit on your boiler.

REGULATIONS AND CODES

Boiler installation, location, and chimney requirements may be regulated by local codes in addition to national standards for oil burning equipment.

- The national standards are found in ANSI and NFPA-31. The main requirements of these codes pertain to the safe storage and operation of heating equipment.
- In most locals boilers must be installed in a separate boiler room.
- It is always required that the boiler room have its own fresh air supply.
- Consult with appropriate local inspectors to see if additional or more stringent local codes may apply in your area.



ACCESSIBILITY FOR SERVICE AND MAINTENANCE

The burning of waste oil products is very different than typical boiler applications burning clean fuels. Due to the additives and contaminants typically found in waste oils, more frequent cleaning and servicing of a waste oil boiler is required. As a result, it is important to locate the boiler where there is good access on BOTH the burner and chimney ends. The burner door needs to swing open for cleaning and a boiler brush is as long as the boiler. The chimney end will have a draft inducer installed. Both the chimney and inducer require frequent access for cleaning. Additional suggestions include:

- Don't run hard pipe for oil or air delivery lines all the way to the burner. The boiler is constructed to allow the burner to be swung out either right or left on a hinged door for servicing and that can't happen with rigid plumbing. Run at least the last few feet of oil delivery and vent return line through reinforced plastic hose with enough slack to allow the swing-out.
- Locate the boiler and tank as close to each other as possible. To avoid the need for an auxiliary oil pump, the boiler should be less than 50 feet from the tank and not more than 8 feet above the tank. Note that these are approximate distances only. Actual limits will depend greatly on line size, viscosity of fuel, temperature of fuel etc.
- For ease of venting the storage tank (required in most areas), it is desirable to locate the tank on an outside wall.
- It is very effective to run a loop of copper tubing around the top of the boiler casting to preheat incoming oil. This will be covered by the insulated boiler jacket. This is especially important when the boiler room is below 70 degrees Fahrenheit.

COMPRESSED AIR REQUIREMENTS

A continuous supply of 100 PSI of compressed air is required at all times for burner operation. The burner includes an air pressure regulator rated at 160 PSI that has a ¼" NPT inlet fitting. Install flexible hose the last few feet before the air regulator in order to open the door for servicing. It is also a good idea to install a quick-disconnect where the air line joins to the burner's air regulator. The burner on the boiler will need the following requirements of compressed air:

- Minimum 3.0 CFM and 38 PSI. Boilers with BTUs higher than 500,000 will need up to 100 PSI of air pressure. A regulator on the burner will reduce the air pressure to what is required.
- Minimum of 3/8" reinforced hose or copper.
- Install a trap and valve on the air line to catch and dispose of water that will accumulate in the line.

Note! The boiler requires this air supply at all times when it is in operation. Be sure that your compressor is of sufficient size and duty cycle to supply these continuous needs.

ELECTRICAL REQUIREMENTS

- 120-volt service.
- Dedicated circuit with 20-amp fuse or circuit breaker (unit will draw a maximum of 20 amps when operating).
- Minimum of 12-gauge wiring.

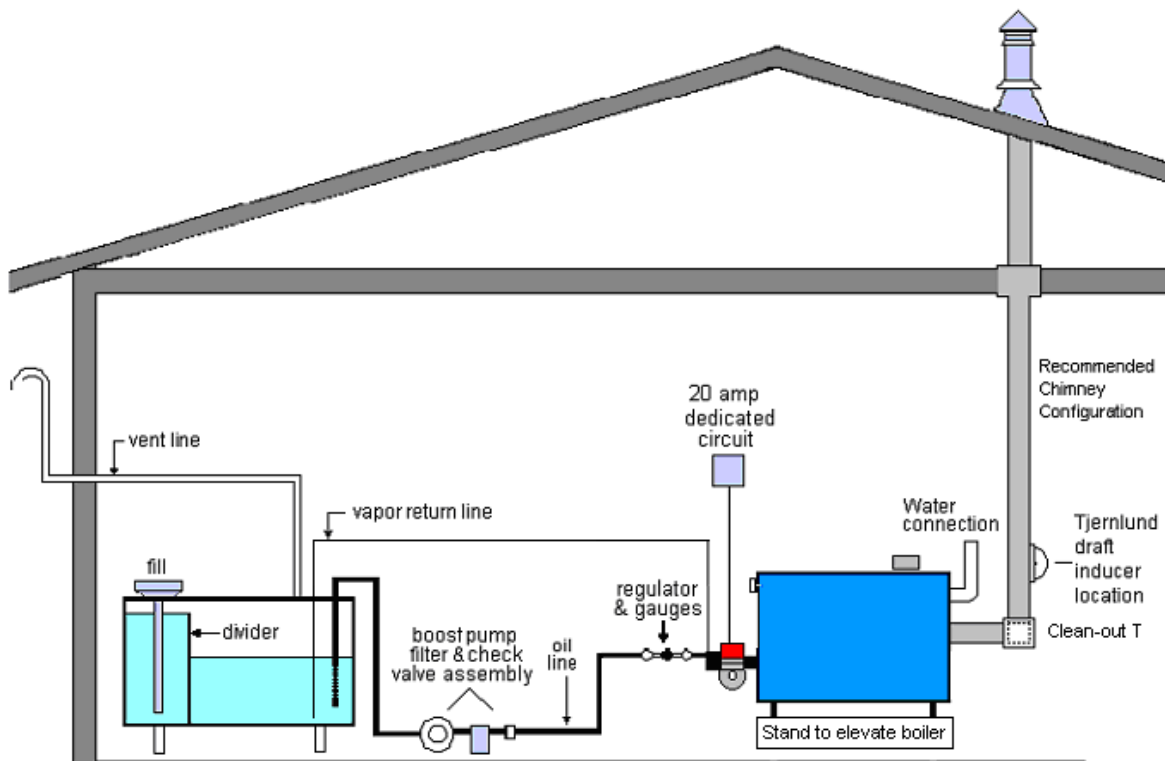


SHOPPING LIST

For a typical installation, the following items will need to be supplied by the customer or the installing contractor.

- Chimney – Minimum of 8 inch (exact size determined by boiler size – see spec chart below) Class “A” (to be run from 18” below the ceiling to the top of the chimney) and single wall as allowed, rain cap, storm collar, flashing brackets, cleanout T and sealant.
- Air supply line – recommend at least 3/8” I.D. of pipe, copper or reinforced hose.
- Oil supply line – at least 1/2” copper or reinforced oil hose, fittings, and hose clamps.
- Oil return line – ¼” copper or plastic line, fittings, and hose clamps.
- Important note - compression fittings must NEVER be used in the suction, oil delivery line.

RECOMMENDED INSTALLATION ILLUSTRATION



Notes:

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

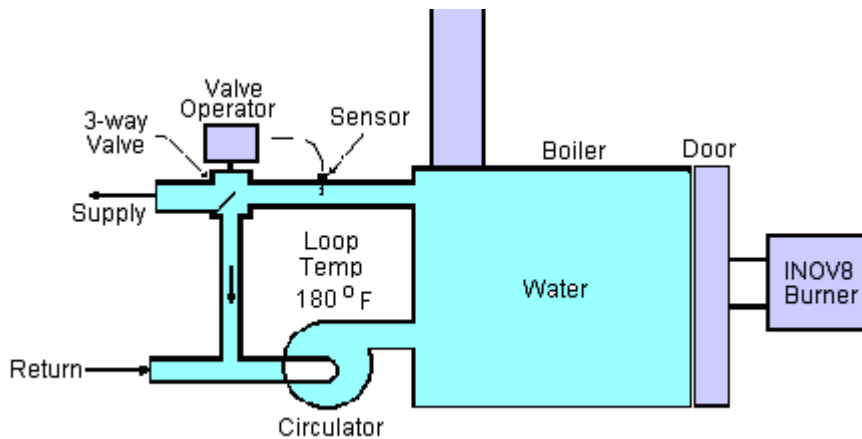


BOILER OPERATING TEMPERATURE

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

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

FIGURE 2 - HYDRONIC CIRCUIT & CONTROL VALVE ILLUSTRATION





OPTIONAL GAS-OIL BURNER WITH PLC CONTROL PANEL

INOV8's latest burner allows users to burn gas alone, oil alone or the combination of the oil has a high percentage of water content. It is operated with a fully certified control panel that contains a Fireeye combustion control and a PLC (programmable logic control). The PLC can sense a loss of oil pressure from a blockage in a filter or depletion of oil and automatically revert the fuel selection to gas, to prevent a loss of heat or hot water. This gas-oil burner is described below.

- INOV8 Gas-Oil Burner – this is the device contained under the red cover on the front of the water heater. The burner consists of components that preheat the oil and control its flow and pressure. There are two pressure settings that determine the firing rate of the oil side of the burner; the high pressure set at the designated BTUs and 50% of that rate. The pressures can be changed by adjusting the oil regulators also on the burner cover. The burner also controls the delivery of natural gas. Gas is used to initiate the burner and to ignite the oil, and then it turns off while the oil is being used as fuel. If the oil is depleted the control will automatically switch the fuel selection to gas, a notification will display on the control panel and the fuel lights will change to indicate gas is in use.
- Control Panel – this contains the main operating controls for the burner. The Fireeye combustion control (the red box) monitors the flame and the PLC allows customer options and notifications, and turns the fuel controls on and off. The PLC also records the hours of use of each fuel.



A Fuel Selection Switch provides three options:

- Gas Only
- Oil Only
- Gas & Oil

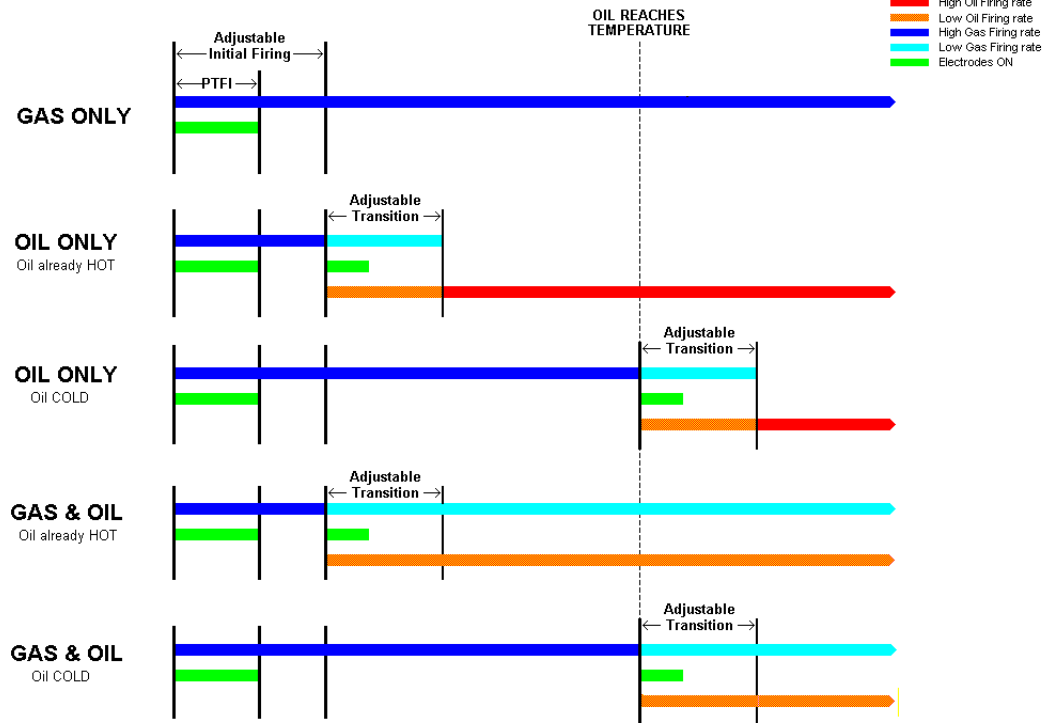
GAS-OIL BURNER OPERATION

Once the settings and fuel selection have been made, the power switch is turned on. That initiates the burner control to perform a “pre-purge” of the flue passages that takes 90 seconds. Then the gas starts on high fire while the oil is being preheated. When the oil reaches the desired temperature, the fuel automatically switches to 50% gas and 50% oil. The burner runs with gas and oil for (an adjustable period of) two minutes until the flame is well-established, then the burner controls automatically switch the fuel to 100% oil. The burner will cycle on and off as hot water is required.

Each time the burner starts the combustion cycle, it will begin with the 90 second pre-purge period, then begin with gas and switch to oil within another minute. Should the oil be depleted the burner will automatically sense the loss of oil pressure and revert the burner to 100% gas. Notification will be displayed on the PLC's LED readout panel and fuel lights will change to indicate that gas is being used. The control panel on the burner performs “self-diagnostics” to assure a safe and reliable operation of the combustion side of the water heater. Should a component fail during operation, the PLC will identify the failed component.



TIMING SEQUENCE OF BURNER CONTROLS



BURNER SETTINGS CHART

		G200	G400
Natural Gas	Supply Natural Gas Pressure	5 to 10	5 to 10
	HI Manifold Pressure for Natural Gas	3.0" w.c.	1.8" w.c.
	LO Manifold Pressure for Natural Gas	2.0" w.c.	0.9" w.c.
	Supply LP/ Propane Pressure	8" to 13" w.c.	8" to 13" w.c.
LP	HI Manifold Pressure for LP/Propane	2.96" w.c.	3.0" w.c.
	LO Manifold Pressure for LP/Propane	1.45" w.c.	1.1" w.c.
	Nozzle Size	3.1	5
OIL	HI Oil Pressure	12 psig	7 psig
	LO Oil Pressure	6 psig	3 psig
	Maximum input of oil – gph or lph	1.68 / 6.0	2.85 / 10.70
	Nozzle tightness (snug), torque =	10 inch-lb.	10 inch-lb.
	Air Gate Adjustment	2 to 4	2 to 4
AIR	Air pressure (gage on oil heater assy)	30 psig	30 psig
	Atomizing Air Pressure (gage on burner)	19 psig	19 psig
	Draft in w.c.	0.02 to 0.04"	0.02 to 0.04"
FLUE GAS	CO in ppm	Less than 100	Less than 100
	CO2	5% to 10%	5% to 10%
	Flue gas temperature	350° to 500° F	350° to 500° F
	Smoke Patch Test – Results	#0 to #2	#0 to #2



LIMITED WARRANTY

This warranty gives you specific legal rights. You may have other rights which vary from state to state or province to province.

Warrantor

INOV8 INTERNATIONAL, INC
67 Kraft Street
La Crosse, WI 54603

Subject to the limitations stated in this warranty, we warrant the applicable INOV8 product to the first buyer, when installed, operated and maintained as required by this warranty and the INOV8 Instruction Manual, to be free of defects in workmanship or material for a period of one year from the date the warranty begins. We will replace any defective component without cost or expense to you except for the costs of delivery and labor for removal and replacement of the defective component. Please refer to the Limited Warranty Period Table for information specific to your unit.

Warranty Begins

The warranty coverage is based on the date of delivery, and the warranty period begins one month following the date of sale. You must be able to verify this date whenever a warranty claim is made. Original bill of sale, installer's invoice or other similar document will suffice. If the warranty beginning date cannot be verified in accordance with the above, we will consider warranty coverage to begin one month after the delivery date.

EXCLUSIVE WARRANTY AND EXCLUSION OF IMPLIED WARRANTIES:

“THIS WRITTEN LIMITED WARRANTY IS THE ONLY WARRANTY MADE BY THE WARRANTOR AND IS IN LIEU OF ALL IMPLIED WARRANTIES INCLUDING THE IMPLIED WARRANTY OF MERCHANTABILITY AND THE IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR USE. THERE ARE NO WARRANTIES WHICH EXTEND BEYOND THE DESCRIPTION ON THE FACE HEREOF.”

What Is NOT Covered

1. Scratches or discoloration of decorative finishes.
2. Normal maintenance items such as filters, fan belts, nozzles, fuses or other consumable items.
3. Damage caused by misuse, failure to maintain properly, accident or acts of God.
4. External wiring, piping, venting or attachment of accessory products not integral to our product, including without limitation, draft inducers, vent dampers, thermostats or other mechanical devices not manufactured by the warrantor.
5. Products that have been operated in a corrosive atmosphere where a concentration of acids, halogenated hydrocarbons or other corrosive elements causes deterioration to metal surfaces or integral components. Corrosion related to normal operating conditions is not intended by this exclusion.
6. Products that have NOT been installed in accordance with:
 - Our published installation instructions
 - Applicable local, state/provincial or national codes
7. Products that have NOT been installed by competent, qualified installers.
8. Products that have been moved from their original place of installation.
9. Products that have been modified in the field without written authorization by INOV8 International, Inc.

Warranty on Replacement Components

Any replacement component furnished by INOV8 under warranty provisions will assume the remaining (unused) portion of the limited warranty.

Consequential Damages

The warrantor shall not be responsible for any consequential damages caused by any defects in the product.



Additional Warranty Period Provisions

In addition to your standard limited warranty there are additional limited warranty periods. See table below. After the first year, in the event that a heat exchanger is no longer being manufactured by the warrantor, the warrantor will allow a credit equal to the then current price of an equivalent heat exchanger towards the purchase of a new INOV8 heat exchanger or furnace.

Warranty Period Table

Category	Model #	Warranty Period
Furnaces – (heat exchangers are prorated 10% per year for 10 years)	F125, F200, F200 SC & F450	Two Years – parts only Limited Warranty on Cabinet
Boilers Systems - (boiler castings are prorated 10% per year for 10 years)	B120, B175, B225, B275, B325, B400, B275, B650, B750, & B1050	Two Years – parts only Limited Warranty on Boiler
Oil Storage Tanks	T300 HB T300 FB	One Year – parts only
Evaporator Systems (tank is prorated 33% per year for 3 years)	EV20, EV30, EV40 & EV60	Burner and Evaporator Controls - One Year parts only Limited Warranty on EV tank for 3 years