

# INOV8

## INOV8 BIO-FUEL BURNING SYSTEM(S)

### EQUIPMENT OVERVIEW

INOV8 Bio-fuel Burning Systems provide energy efficiency and clean burning of a variety of bio-fuels, including vegetable oil, fryer oil, bio-diesel, and other approved bio-fuels. Fuel oil or diesel can be used if the bio-fuel is depleted. Businesses which generate waste fryer oil can now support renewable and “green” energy programs while saving heating costs for space heating or production of domestic hot water. Two INOV8 burners provide fuel options based on individual preference as shown below. A newly released **Gas-Oil Burner** was designed for applications that require reliable back-up of natural gas, but want the benefit of energy saving from burning available oil. This “state-of-the-art” burner will fire at full gas, a mixture of gas and fryer oil, or full fryer oil. It will detect loss of oil flame or other conditions and automatically revert to burning 100% gas by means of an electronic PLC control (defined later). Complimentary equipment for either burner is a boiler to provide space heating and/or domestic hot water or the INOV8 space heating unit heater. INOV8’s heating systems have been tested and are certified to US and Canadian safety and combustion standards by Intertek-ETL Semko, an internationally recognized third-party test agency.

#### Burner – two options:

- Standard waste oil burner, model S200 for any approved liquid petroleum, vegetable or other biofuel
- Combination waste oil burner, model G-series – fueled by gas or oil, or the combination at half firing rates

#### Space Heating Options:

- Space Heater – model F240 furnace (optional ductible fan)
- Triad vertical boiler, BTU ranging from 210,000 to 900,000
- Viessmann cast iron boiler, BTUs ranging from 133,000 to 300,000

#### Domestic Hot Water Options:

- Triad vertical boiler, BTU ranging from 210,000 to 900,000
- Viessmann cast iron boiler when combined with indirect water heater or flat plate heat exchanger, sizes ranging from 135,000 to 300,000 BTUs per hour.

#### Accessories:

- Tanks – any size or configuration available, steel, glass lined or plastic
- Indirect fired water tank or flat plate heat exchanger (to produce domestic hot water with conventional boiler)
- Draft inducer
- Transfer pump for “hot” fryer oil
- Oil filtration systems, low volume or high volume
- Air compressor – tank type or tank-less air compressor

#### Burner Options



S200 waste oil burner



G-series gas-oil burner with PLC control panel

#### Heating Appliance Options



F240 Furnace



V-135 hot water boiler



HW-210 for space or domestic hot water

## SYSTEM DESIGN

INOV8's technical sales staff (which has many years of experience burning bio-fuel) will evaluate individual needs and design a system to best accommodate those needs. There are many considerations for a proper design beyond the ability to burn the oil, for example, it is important to consider the handling and storage of the oil. Complete the check list on page 5 to receive a no-obligation quote from INOV8.

- Oil Filtering & Storage Considerations - INOV8 has learned that food debris from fryer oil will settle out within a couple days if the oil is kept over 120 degrees. If oil is not given time to settle but allowed to cool too soon, the food debris will be more difficult to remove and cause filter blockages, so warm filtering of oil and settling time are vital.
- Burner Selection Criteria - INOV8 recommends the gas-oil burner with the PLC automated control if one or more of these conditions exist: 1) available oil is less than 30 gallons per week, 2) the oil has more than 3% water content, 3) it has a low BTU content oil (such as glycerin), or 4) the user cannot risk loss of heat or hot water.
- Space Heating or Domestic Hot Water Criteria – This is based on customer preference, but INOV8 will provide guidance based on the size of the utility room and the quantity of oil. Up to 50 gallons per week (gpw) INOV8 will recommend the production of hot water for domestic purposes, 50 to 100 or more gpw qualifies for space heating system. Consider that 100 gallons of fryer oil yields 13 million BTUs of available energy. That equates to 130 Therms of natural gas that can be saved each week.
- System Size in BTU or Water Volume – generally the size can be compared to an existing furnace or water heater. If this information is not available then a standard heat load calculation can be used. INOV8 can assist in sizing the proper replacement system.
- Payback Periods - The energy costs to produce domestic hot water in medium sized restaurants can be nearly eliminated with about 40 gallons of oil per week. This will yield a payback on the equipment cost of about two years. High quantities of oil will allow for options of space heating yielding even faster payback periods.

## CERTIFICATIONS AND APPROVALS

- The **INOV8 burners** are tested and listed by Intertek-ETL Semko to the following standards: 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.
- The **INOV8 PLC Control Panel** has been tested and listed to UL 873 – Safety for Temperature-Indicating and Regulating Equipment, Eleventh Edition, Dated December 22, 1994 and CSA C22.2 No. 24-03 Temperature-Indicating and regulating equipment.
- The approved **INOV8 selected boilers and furnace** have these ratings for installations in the United States: ASME – Boiler and Pressure Vessel Code. The Triad boiler has vessel pressure rating of 125 PSIG. Some Viessmann and Buderus boilers have an Energy Star Rating. In Canada the boilers have the required CRN registration. INOV8 furnaces are listed to UL296A – waste oil burning appliances.

## SHIPPING & RECEIVING THE INOV8 SYSTEM

Equipment is typically shipped via freight and will require a lift to unload and move into position. Most components are pre-assembled, the burner will be separately packaged for protection. The burner installation is simple in that all electrical connections are “quick-disconnect” type. Gas connections and main electrical supply must be installed by qualified installer. Detailed instruction manuals accompany the equipment covering: 1) installation, 2) normal operation & maintenance, and 3) troubleshooting.

## CHALLENGES OF BURNING BIOFUELS SUCH AS VEGETABLE OIL

Burning biofuels as fuel in heating appliances has some challenges. The flash point of most vegetable oil ranges from 500 to 600 degrees F, nearly double that of typical waste petroleum oil. BTU values range from 98,000 to 146,000 BTUs per gallon. Sampling reveals a fairly high percentage of water in the oil. Fryer oil has varying characteristics of pourability and gel temperature while others contain additives that can cause blockages in filters and oil lines. Animal fats can do the same in a filter as they do in a human body. When properly combusted however, there is no residual smell and no unburned oil.

Despite these challenges many benefits can be realized. According to an article published in the July 2009 issue of Appliance Design Magazine written by Steve Wichelecki about burning biofuels in a standard fuel oil burner, the emissions yielded “approximately a 25 percent reduction in NOx emission and SO<sub>2</sub> by 97 percent”. There is clearly a significant advantage to using waste fryer oil for energy recovery.

## INOV8 TECHNOLOGY

The difference in successful combustion of biofuels, particularly high flash point waste fryer oil is the patented technology in INOV8 burners combined with many years of research and development on these products:

- **Standard Waste Oil Burner** – Since 1990 this burner has been set apart from standard waste oil burners because of the patented technology that covers the pre-heating of the oil under high velocity conditions, filtering the heated oil, the removal of vapor created during the heating process, a needle that seals in the nozzle, and delivering consistent oil pressure at the nozzle. This technology combined with a flame safeguard that provides unmatched safety and a digital temperature control for on-site easy adjustment for high flash point oil is what allows for the successful burning of biofuels.
- **Gas-Oil burner**—The newly “safety certified” G-Series burners use natural gas or propane as a base fuel. The patented features of the standard burner allow the option of burning waste oil or the combination of gas and oil. In response to the fast food industry, INOV8 developed a system that automatically reverts the fuel to natural gas in the event of depletion of the fryer oil for complete reliability. The automatic features are controlled by a PLC.
- **PLC Overview** – A Programmable Logic Controller (PLC) is a tiny computer with a built-in operating system. The PLC is primarily used to control machinery. A program is written which turns on and off outputs based on input conditions. This process of recording inputs, running the program and setting outputs is continually repeated many times per second. INOV8 wrote a program to monitor and control switches, solenoids, valves and a temperature sensor in the gas-oil burner. The results are a burner with automated fuel selection based on availability of waste oil and individualized “operator” preference. Following is a list of the basic functions of INOV8’s PLC program.

1. Monitors the oil temperature and assures that it reaches a pre-set level prior to allowing the oil to be used as fuel. Once the pre-set temperature is reached the PLC energizes the air and oil solenoids, valves allowing atomized oil to flow to the nozzle for combustion.
  2. Based on the fuel selection, the PLC controls two oil solenoids. One is used to control the oil flow at 50% of the desired BTU value, and a second solenoid is to control the oil flow at 100% of the BTU value.
  3. Based on the fuel selection, the PLC also monitors and controls two gas valves; one to control the gas pressure at 50% of the desired BTU value, and a second valve to control the gas pressure at 100% of the BTU value.
  4. The PLC does self-checking of the fuel valves in the burner to assure they are performing as intended. For example, if the gas is supposed to be operating at 50%, then the proper valve must be activated. The PLC checks many times per second to assure it's proper operation.
  5. The PLC works in conjunction with the flame safety control which monitors the flame, and together they provide the safety checks to handle all burner operational circumstances.
  6. The PLC is connected to an oil pressure switch that will deliver a signal if oil pressure is lost in the supply line from a blockage, dirty filter or loss of oil. The PLC then reverts the fuel supply to full gas pressure and signals the "operator" that he must correct the oil supply. In the meantime the system is operating on gas.
  7. The PLC allows for "operator" input for customizing settings. Two examples are: the oil temperature can be raised or lowered as needed and the over-lap time of running gas and oil can be shortened or lengthened as needed. Other options such as auto restart after power failure can be set as desired.
- **System Evaluation & Testing** - INOV8 has performed many years of evaluation and testing on the combination of our burners with various heating appliances. In addition to proper handling of the oil in storage, filtering, pumping and pre-heating, INOV8 has found that it is vital to provide a proper combustion zone environment. INOV8 assures complete combustion by controlling the combustion zone environment. The result is nearly 100% consumption of the oil and full benefit of the available BTUs. Combustion tests yielded very low CO readings, lower than average CO<sub>2</sub>, low chimney temperatures, smoke patch tests of zero or one, and efficiencies ranging from 85% to 91%.