

What is the secret to INOV8's Burner Technology?



INOV8 Approach to Industry Challenges

1. What are the Technical Challenges to Burning Waste Oil?
2. How does INOV8 Solve these Challenges?
3. What are the Features & Benefits included in INOV8 patents?
4. What are the Features & Benefits of INOV8's Burners?



1.1 Technical Challenges To Burning Used Oil

Used Oil Contains:

- Unburned fuel, water, acids, sludge, road dust, antifreeze & many wear metals.
- Varying viscosities of waste oils (from light weight solvents to heavy gear box oils)
- Varying flash points (from gasoline to high temperature vegetable oils)
- High **ash** content from additive package of detergents, wear reduction compounds and viscosity stabilizers



1.2 Challenges, continued

Other issues:

- Waste oil must be pre-heated & atomized
- Any oil must be stirred at a velocity of one foot per second to prevent coking
- As used oil is heated, gases are liberated. These gases will cause erratic and dirty combustion
- Particulates common in oil block nozzle orifice

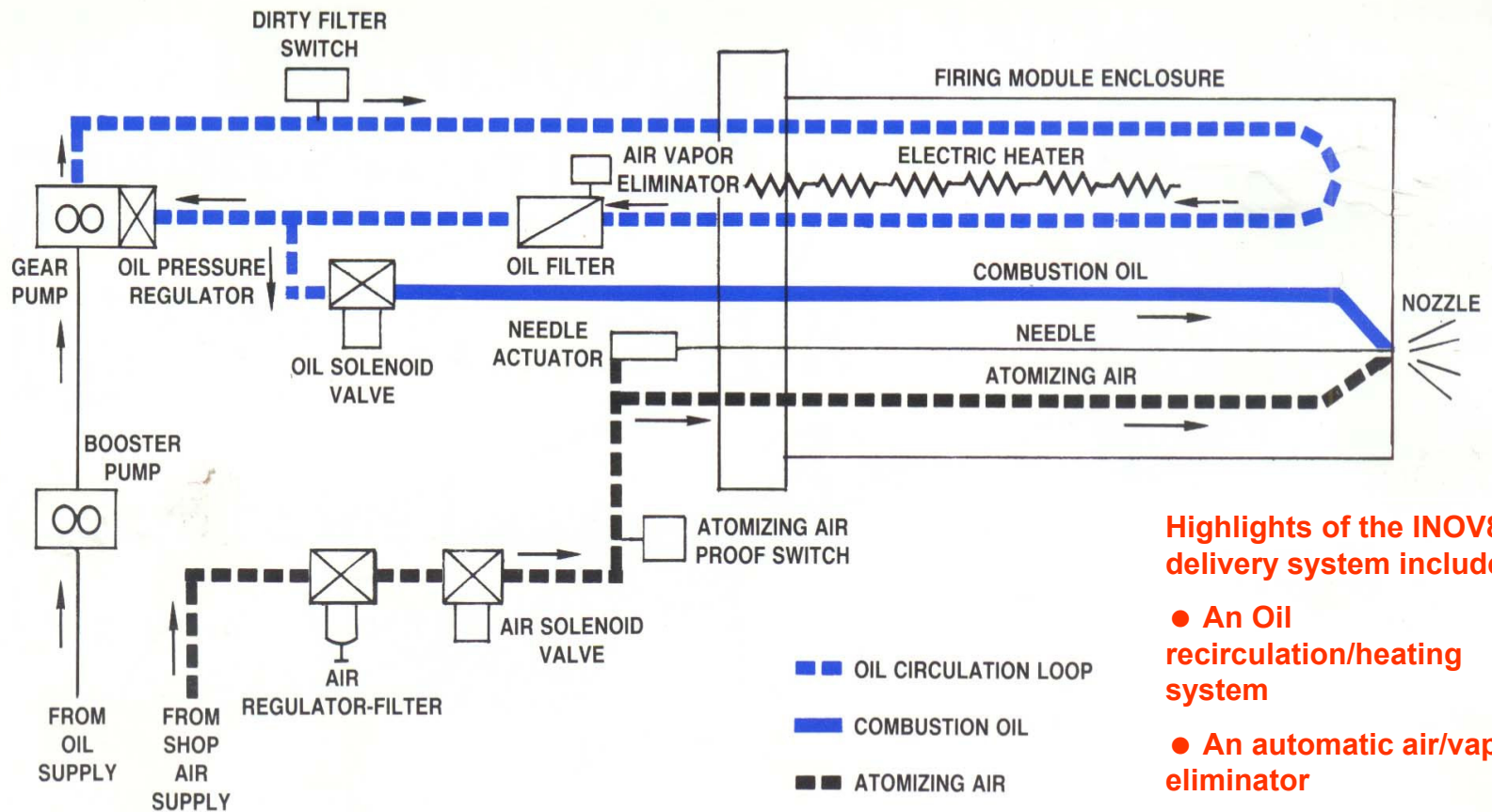


2.0 INOV8 Burner – unique features:

1. Fireeye industrial safety control vs. residential type control.
2. Filters heated oil.
3. Vapor eliminator removes vapor from heated oil.
4. Modular design for quick access to nozzle and electrodes.
5. Modular design houses all small components, for easy shipping if factory support is desired.
6. Integral pump provides preheating & eliminates separate boost pump.
7. Larger motor for durability



2.1 Patented Solution To Industry Challenges



Highlights of the INOV8 oil delivery system include:

- An Oil recirculation/heating system
- An automatic air/vapor eliminator
- An oil shutoff and cleanout needle



2.2 Benefits of INOV8 burners...

Unique To INOV8 Burners

Features:

- Heats oil to high temperature
- Circulates preheated oil with high velocity
- Needle in nozzle
- Filters hot oil
- Highly engineered flame retention head
- Higher air & oil pressures

Benefits:

- Provides clean & complete burning
- Prevents coking & blockages in burner
- Automatically cleans nozzle
- Removes debris
- Eliminates clinker & other nozzle buildup
- Produces finer fuel mist

These features combine to produce nearly **stoichiometric** combustion as evidenced by low stack 8. CO₂, no CO, and a light powdery ash.

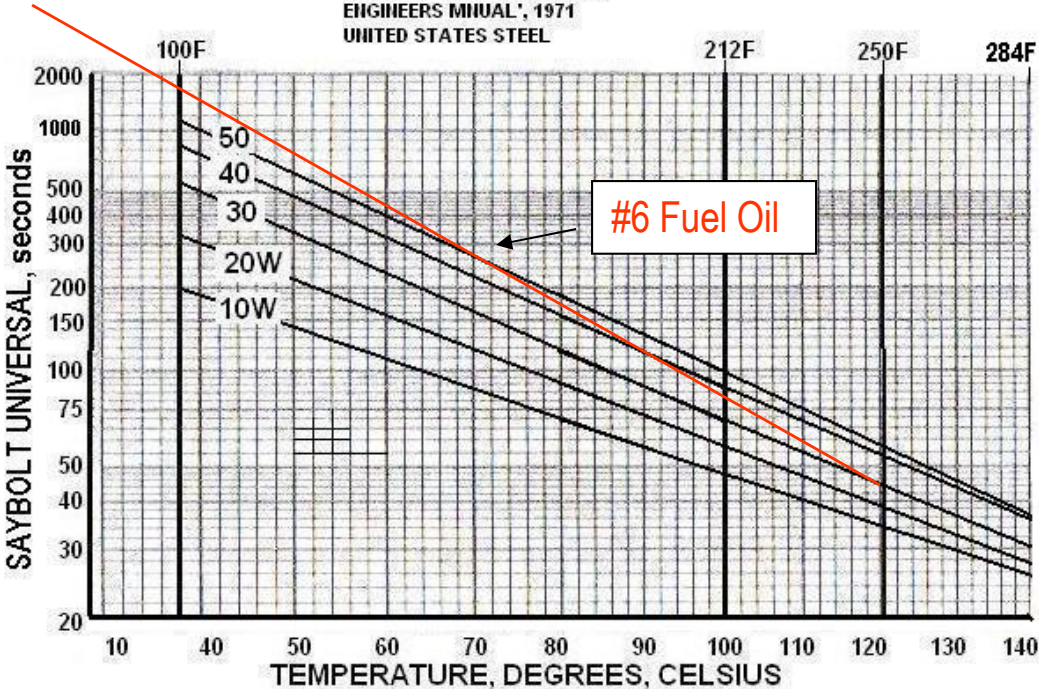


2.3 Viscosity vs. Temperature

This chart simply means that without adjusting, the INOV8 burner can handle any weight of oil from light weight motor oil to heavy gear box oil (or #6 fuel oil).

VISCOSITY vs TEMPERATURE
For Typical Automotive Oils

SOURCE: "THE LUBRICATION ENGINEERS MANUAL", 1971
UNITED STATES STEEL



KINEMATIC VISCOSITY (centistokes) = SAYBOLT UNIVERSAL, sec. X 4.635

VISCOSITY DIFFERENCE AS TEMPERATURE INCREASES			
@ 100F	@ 212F	@ 250F	@284F
500%	108%	60%	27%

LIGHT LIGHT MOTOR OIL	138,000BTU/GAL
LIGHT MOTOR OIL	140,000
MEDIUM MOTOR OIL	142,000
HEAVY MOTOR OIL	145,000
GEAR OIL	148,000
MAX DIFF - 8%	



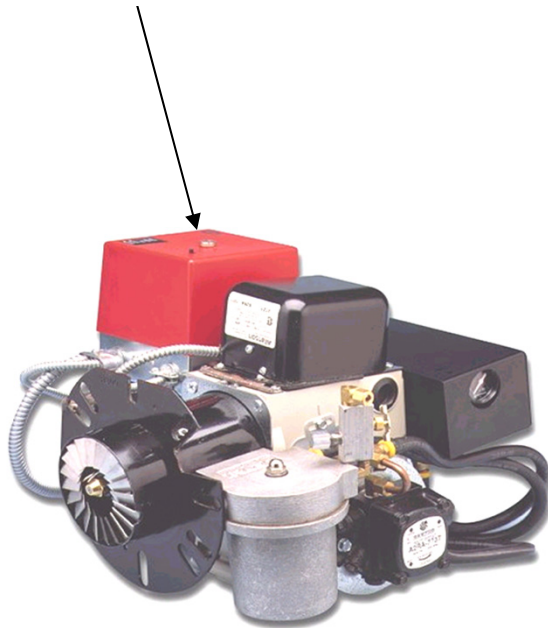
Waste Oils That Can Be Burned

- Used crankcase oil
- Hydraulic oils
- Transmission oils
- Gear box oils
- #6 fuel oil & all lower viscosities
- Mineral spirits
- Machine cutting oils
- Synthetic oils
- Commercial jet fuels
- Military jet fuels
- Crude oils
- Printing inks
- Vegetable oils
- Animal fat



2.5 Safety is Important!

Industrial rated flame safety control is a vital component of every product INOV8 manufactures



Economic, Environmental & Energy Savings

2.6 Safety Control Sequence

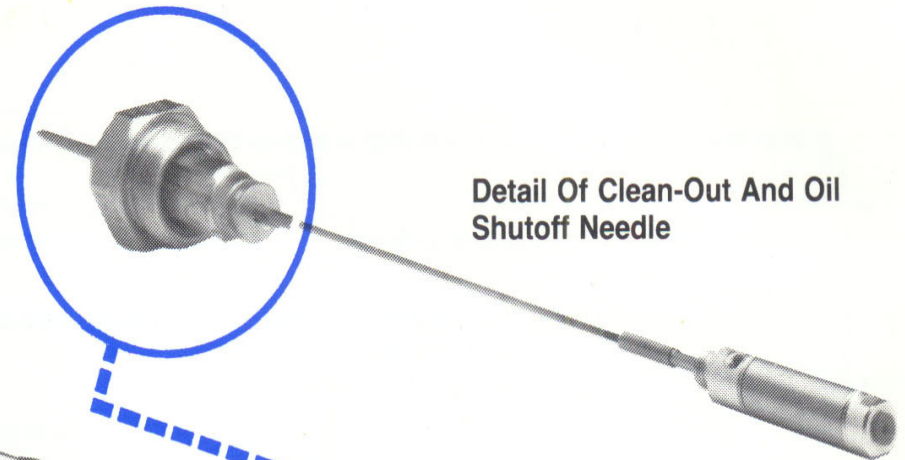
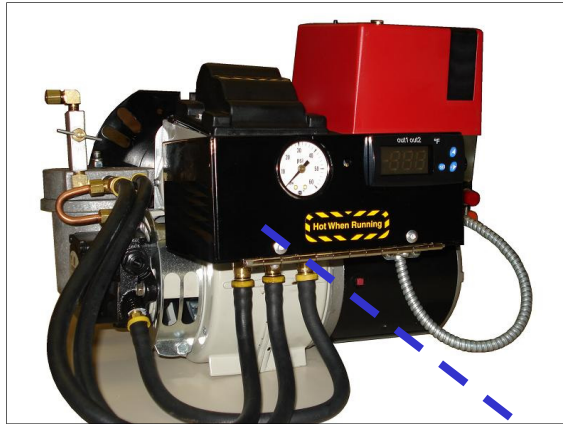
The features provided by the Fireye industrial rated flame safeguard control are considered imperative for safety of personnel and property. This becomes particularly important when dealing with the variations of waste oil.

Operational and safety features of this control system for the INOV8 Waste Oil Burner include:

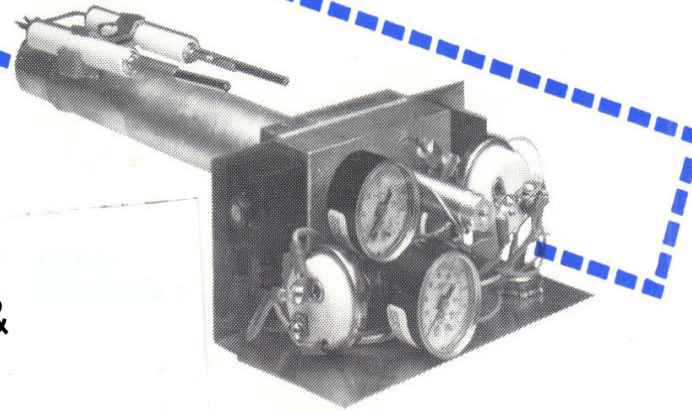
1. INTERLOCK FUNCTION assures proper oil temperature prior to firing
2. Ninety second PURGE to insure venting of explosive vapors before firing.
3. SAFE START cycle that will check all electronic circuits and assure there is no residual flame before firing can take place.
4. Ten (10) second TRIAL FOR IGNITION period. Ignition terminates.
5. Six (6) second MAIN FLAME TRIAL FOR IGNITION period without ignition.
6. Three (3) second period to TERMINATE OIL FLOW IF AN OUTAGE OCCURS after the flame has been established.
7. One attempt to RECYCLE before the control places the burner in a complete 'shut-down' mode, but then, only after purging as described in Item 1.
8. ULTRAVIOLET flame detector, unlike cadmium sensors, will not respond to sunlight or artificial light.



2.7 Patented Solution To Challenges



Detail Of Clean-Out And Oil Shutoff Needle



- The Module is the “heart of the burner
- It contains preheater, switches, solenoids, gauge, needle with Bimba cylinder, nozzle & electrodes
- It is easily removed for service



2.8 Recent improvements on INOV8 Burner

1. In 2008, this burner was listed by ETL as a replacement burner for sales in US & Canada, to burn all fuel oils up to #6 in addition to waste oil & biofuels.
2. Transformer is lightweight, low profile
3. UV sensor now located under the transformer
4. Fireeye control now has “main-flame-trial-for-ignition”
5. Digital temperature controller
6. Gauge relocated to front side
7. Module is now powder coat finished for durability



3.0 Burner choices allow complete fuel flexibility

Standard INOV8 burner S-series, allows many fuel options:

- Crankcase oil
- Transmission & Hydraulic
- Fuel oil up to #6, diesel
- Synthetic lubricating oil
- Mineral spirits, jet fuels, biofuels
- Any approved shop oil



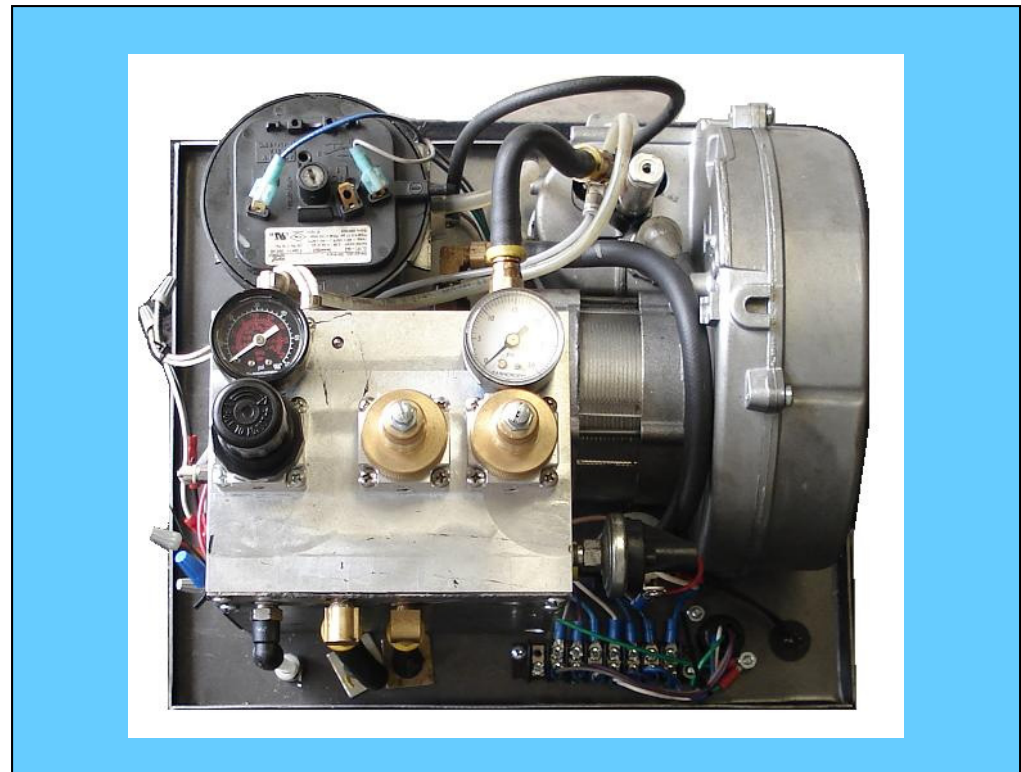
New INOV8 dual-fuel burner, G-series allows these choices:

- Natural or propane gas
- Any waste petroleum or fuel oil or vegetable oil
- Combination of gas and watery oil
- Automatic backup to gas if oil fails



3.1 Features & Benefits of New Dual-fuel Burner

- Burns natural gas or propane only
- Burns petroleum or vegetable oil only
- Burns gas & oil at the same time
- Provides all the safety features of INOV8 standard burners – 90 second pre-purge, 10 second trial-for-ignition, 3-second shutoff, etc.
- Provides reliable fuel backup as required for restaurant applications
- Burns up to 80% water laden oil
- Simple selection controls
- Burns cleanly, safely, efficiently



Note: Fully certified to gas & oil for US & Canada



3.2 Dual-fuel Burner function...

The Dual-fuel burner will operate in three fuel configurations: a) as GAS only, b) as OIL only, or c) as GAS WITH OIL INJECTION - as determined by the position of the **Fuel Selection Switch** on the control panel.

The burner will operate as a gas burner (natural or propane), or as an oil only burner (any new or waste petroleum or vegetable oil) or on both the gas and oil at the same time. When both fuels are fired simultaneously, their respective rates are reduced to 50%. This is useful for burning water-laden oil.

The oil pressure is controlled by two regulators located on the front of the burner with the pressure displayed on an oil pressure gauge. The gas pressure is controlled by a two-stage gas valve.

A PLC (programmable logic control) controls the operation of the two fuels and is designed to sense a loss of oil pressure and automatically revert the fuel to gas. A light is displayed on the control panel to alert the attendant that oil is needed. This system has been installed on a variety of heating appliances, including: boilers, furnaces, water heaters and waste water evaporators.



4.0 INOV8 Products that burn waste oils



Economic, Environmental & Energy Savings

5.0 Safety & Affiliations

- INOV8 furnaces are tested & listed to all current US and Canadian standards for burning waste oils in heating appliances.
- INOV8 burners are tested & listed to current US and Canadian standards for burning fuel oil up to #6.
- In Canada, INOV8 products are listed to CSA Standard B140.4 & B140.2.1.1
- In Europe, INOV8 is registered with CE #3884/97.
- New dual-fuel burner meets all U.S. & Canadian environmental requirements & safety standards.
- Member of Radiant Panel Association since 2003, NFPA, Midwest Renewal Energy Association, Wisconsin Restaurant Association





INOV8 Burners Provide Solutions to Pollution

- Eliminate wastes
- Eliminate or reduce heating costs
- Reduce consumption of new fossil fuels

