

# OPERATING INSTRUCTIONS MANUAL

(Please retain for future reference)

For

## FVO-400 INDIRECT FIRED SPACE HEATERS



**CERTIFIED FOR USE IN CANADA AND U.S.A.**  
**As per CSA B140.8 Portable Oil Fired Heaters / CSA B140.02003 Oil Burning Equipment**  
**Construction Heaters Unattended Type.**  
**UL 733 Oil-fired Air Heaters**

Issue date October 1, 2015



**FLAGRO INDUSTRIES LIMITED**  
**ST. CATHARINES, ONTARIO**  
**CANADA**

**GENERAL HAZARD WARNING:**

**FAILURE TO COMPLY WITH THE PRECAUTIONS AND INSTRUCTIONS PROVIDED WITH THIS HEATER, CAN RESULT IN DEATH, SERIOUS BODILY INJURY AND PROPERTY LOSS OR DAMAGE FROM HAZARDS OF FIRE, EXPLOSION, BURN, ASPHYXIATION, CARBON MONOXIDE POISONING, AND/OR ELECTRICAL SHOCK.**

**ONLY PERSONS WHO CAN UNDERSTAND AND FOLLOW THE INSTRUCTIONS SHOULD USE OR SERVICE THIS HEATER.**

**IF YOU NEED ASSISTANCE OR HEATER INFORMATION SUCH AS AN INSTRUCTIONS MANUAL, LABELS, ETC. CONTACT THE MANUFACTURER.**

**WARNING:**

**FIRE, BURN, INHALATION, AND EXPLOSION HAZARD. KEEP SOLID COMBUSTIBLES, SUCH AS BUILDING MATERIALS, PAPER OR CARDBOARD, A SAFE DISTANCE AWAY FROM THE HEATER AS RECOMMENDED BY THE INSTRUCTIONS. NEVER USE THE HEATER IN SPACES WHICH DO OR MAY CONTAIN VOLATILE OR AIRBORNE COMBUSTIBLES, OR PRODUCTS SUCH AS GASOLINE, SOLVENTS, PAINT THINNER, DUST PARTICLES OR UNKNOWN CHEMICALS.**

**WARNING:**

**NOT FOR HOME OR RECREATIONAL VEHICLE USE.**

**WARNING:**

**INTENDED USE IS PRIMARILY THE TEMPORARY HEATING OF BUILDINGS UNDER CONSTRUCTION, ALTERATION, REPAIR OR EMERGENCIES ONLY.**

**This heater is designed and approved for use as a construction heater under CSA B140.8 Portable Oil Fired Heaters / CSA B140.02003 Oil Burning Equipment. UL-733 Oil Fired Air heaters**

**We cannot anticipate every use which may be made of our heaters. CHECK WITH YOU LOCAL FIRE SAFETY AUTHORITY IF YOU HAVE QUESTIONS ABOUT APPLICATIONS.**

**Other standards govern the use of fuel gases and heat producing products in specific applications. Your local authority can advise you about these.**

### SPECIFICATIONS

Model .....	FVO-400
Input .....	Range
	325,000 – 390,000
Fuel .....	No.1, No. 2, diesel or kerosene
Fuel Pressure .....	170 psi
Nozzle .....	2.25 x 45B
	390,000 Btu
	2.00 x 60B/W
	353,000 BTU
	1.75 x 60B/W
	325,000 BTU
Ignition .....	Direct Spark
.....	Thermostat Control
Air Circulation .....	2500 cfm
Fuel Consumption .....	2.75 Gal/hr
Approved .....	cETLus listed

## INSTALLATION:

The installation of this heater for use with No.1, No.2, Diesel or Kerosene and shall conform with local codes or, in the absence of codes, with the National Fuel Gas Code ANSI Z223.1/NFPA 54. Installation of the unit shall be in accordance with the regulations of the authorities having jurisdiction or the CSA Standard B139.

### CLEARANCE TO COMBUSTIBLES:

<u>TOP</u>	<u>FRONT</u>	<u>SIDES</u>	<u>REAR</u>	<u>FLUE PIPE</u>
3 ft	10 ft	3 ft	3 ft	3 ft

**FUEL:** This heater will operate with No.1, No.2, Diesel or Kerosene.  
**Note:** No.1 Fuel Oil or Kerosene must be used for temperatures less than  $-10^{\circ}\text{C}$  ( $8^{\circ}\text{F}$ ).

### REMOTE TANK OPTION:

The FVO-400 may be installed with a remote fuel tank providing the manufacturer approved FVO-TLS remote fuel kit is used. This kit includes the tiger loop filter system using a single line supply and pressure relief valve (FVO-TLPRV) This system prevents overpressure fuel supply and stops the fuel flow in the case of a leak in the fuel line where pump vacuum pressure is lost. A maximum of 50ft supply hose must be used with this installation.

All installations must conform to local installation codes and authorities having jurisdiction.

### ELECTRICAL:

#### WARNING Electrical Grounding Instructions

This appliance is equipped with a three-prong (grounding) plug for your protection against shock hazard and should be plugged directly into a properly grounded three-prong receptacle.

115v supply must be available. Please note that the heater requires 15 amps for proper operation. Ensure appropriate gauge extension cord is used.

- 12/3 AWG at 50 Feet
- 10/3 AWG at 100 Feet

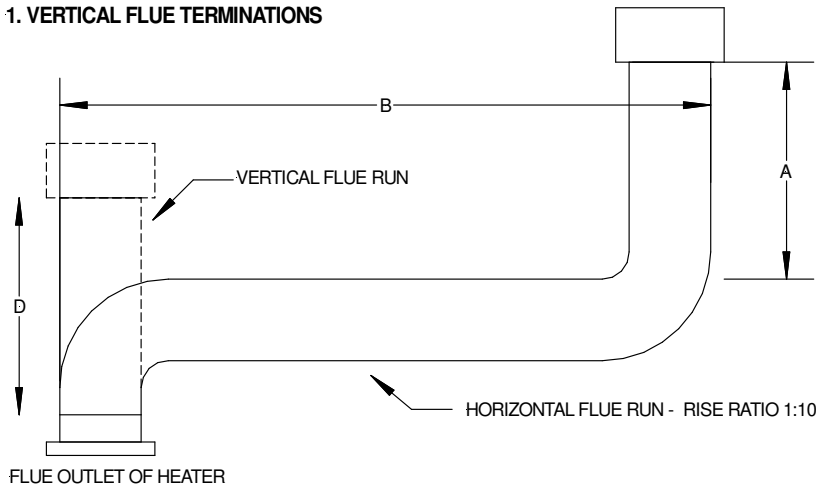
**FLUE PIPE:**

Flue pipe connection must terminate with a vertical run at least 2ft long.

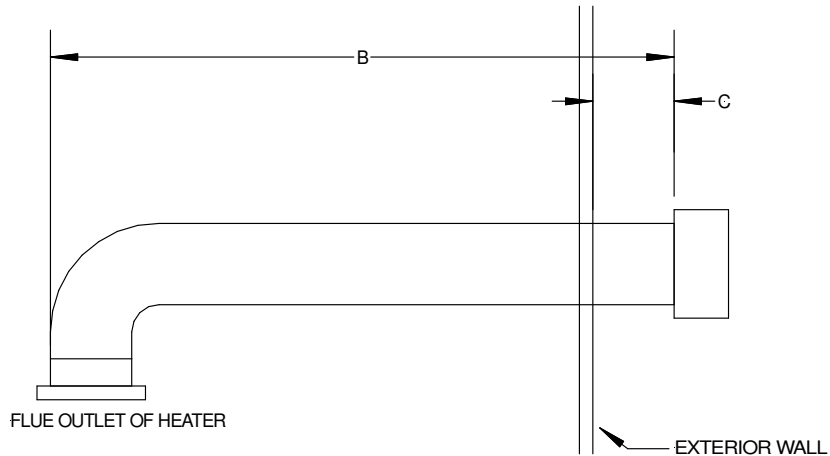
The vent outlet on the heater is 6" diameter. Certified venting must be used at all times. Vent cap should be installed in situations where downdrafts occur. All venting must correspond with the CSA B149 standard or in its absence, local codes.

**FV SERIES CONSTRUCTION HEATER – VENTING REQUIREMENTS**

**1. VERTICAL FLUE TERMINATIONS**



**2. HORIZONTAL FLUE TERMINATIONS**



- A - VENT TERMINATION MUST BE A MINIMUM OF 2FT HIGHER THAN ANY POINT WITHIN 10FT.
- B - MAXIMUM HORIZONTAL RUN IS 30FT.  
NOTE: 90deg ELBOW = 10ft HORIZONTAL VENT ALLOWANCE  
45deg ELBOW = 5ft HORIZONTAL VENT ALLOWANCE

C - VENT TERMINATION IN HORIZONTAL POSITION MUST BE MINIMUM 4ft FROM ANY COMBUSTABLE SURFACE

D - EXTERIOR VERTICAL VENT TERMINATION MUST BE A MINIMUM OF 2ft.

NOTE: ALL VENT TERMINATIONS MUST HAVE A RAIN CAP INSTALLED AS PER LOCAL CODE REQUIREMENTS.

**DUCTING:** Hitex heater duct with a minimum temperature handling of 300 deg F. including wire reinforcement to prevent collapsing. Heater is designed for use with 2 x 12" (FV-HD12) diameter or 1 x 16" (FV-HDG16) ducting equipped with pin lock coupling or cuff & buckle. Ducting should be inspected periodically for tearing and/or wear marks. Ducting should be stored in a dry area when not in use.

#### **MAINTENANCE:**

1. **Every construction heater should be inspected before each use, and at least annually by a qualified service technician. Incorrect maintenance my result in improper operation of the heater and serious injury could occur.**
2. Service and Maintenance only to be performed by a qualified service technician.
3. The hose assemblies shall be visually inspected prior to each use of the heater. If it is evident there is excessive abrasion or wear, or the hose is cut, it must be replaced prior to the heater being put into operation. The replacement hose assembly shall be that specified by the manufacturer.
4. The flow of combustion and ventilation air must not be obstructed. Be sure to check the fan assembly and ensure that the motor and blade are operating properly.
5. Compressed air should be used to keep components free of dust and dirt build up. Note: Do not use the compressed air inside any piping or regulator components.
6. Change fuel filter insert (Part# FVO-419) once per month. Change fuel filter cartridge (Part# FVO-418) once every 6 months.
7. Change oil nozzle once per year. FV-435B (2.00 X 60B/W), FV-435WC (1.75 X 60B/W)
8. Fan Limit Switch (Part# FV-407A) should be replaced if the fan motor does not shut off after the heat exchanger has cooled down.

9. The High Limit Switches (Part# FV-406 & FV-437) should be checked each season. These limit switches will ensure the burner shuts down if the temperature exceeds 150° F at rear of unit and 250° F at the outlet.

10. Fuel tank should be drained on a regular basis by removing drain plug.

**CAUTION:** Do not have any source of ignition near the heater when draining tank.

**NOTE:** No.1 fuel oil or kerosene is recommended for temperatures below  
-10° C / 8° F

11. Heat Exchanger should be cleaned if smokey conditions continue even after the air adjustments on the burner are made.

## **START UP INSTRUCTIONS:**

1. Position heater on level surface
2. Ensure the toggle switch is in the “OFF” position.
3. Ensure burner “air gate” is properly set at 4.5
4. Ensure electrical cord is grounded and plugged into a 115V 15AMP outlet. Verify cord size – 12/3AWG at 50 FT or 10/3AWG at 100ft
5. The indicator light on the control box will engage. If the green light illuminates, you have proper power supply. If not, refer to the label on the heater to verify power supply issue(s). Correct the power supply issue(s) before operating the heater.
6. Move switch to “MANUAL” position for manual control.
7. Move switch to “THERMOSTAT” position for thermostatic control.

### **Please Note:**

1. If using Thermostat on unit, unit must be started in Thermostat position.
2. When changing between manual and thermostat operation, the heater must be left in the “OFF” position for 30 seconds to prevent the burner from locking out.
3. When using a generator for electrical supply, make sure the generator is properly grounded and generator is at a 60Hz frequency.
4. In the event that a Generator is being used and the generator runs out of fuel, make sure the heater switch is in the “OFF” position before restarting generator, failure to do so may damage heater.

## **TO SHUT DOWN:**

1. Move Burner switch to "OFF" position.

**NOTE:** Fan will continue to operate after the burner shuts down. Once the unit cools down, the fan will stop.

## **IF HEATER FAILS TO START:**

1. Press manual reset button at rear of burner. (Red button).
2. Check fuel level. There must be 2-4 gallons of fuel in the tank for the heater to start properly.
3. Make sure there are no air locks in fuel lines or filter.
4. Ensure proper power supply and extension cord is being used.
5. Check for dirty fuel filter or blocked fuel supply line.
6. Check burner nozzle assembly.

**NOTE:** IF THE BURNER HAS BEEN RESET SEVERAL TIMES THERE MAY BE AN ACCUMULATION OF OIL IN THE CHAMBER! DO NOT CONTINUE TO TRY AND START THE HEATER!

DRAIN OIL FROM HEAT EXCHANGER USING DRAIN HOLE AT FRONT OF HEAT EXCHANGER FOR 15-20 MINUTES BEFORE ATTEMPTING TO RELIGHT. LET REMAINING EXCESS OIL BURN OFF BEFORE CHECKING COMBUSTION OF UNIT.

## **SAFE OPERATION PRECAUTIONS:**

1. Do not fill fuel tank while heater is operation.
2. Do not attempt to start heater if excess oil remains in the heat exchanger.
3. Use switch to shut down the heater. Do not try to shut down the heater by unplugging the electrical cord.



4. Do not plug anything other than the thermostat into the “Thermostat” plug.
5. Do not use any fuel other than those listed on rating plate.
6. Follow electrical requirements shown on rating plate and/or Electrical requirements section of this manual.
7. Before removing any guards or performing any maintenance, be sure that the main power supply is disconnected.

## COMBUSTION AIR ADJUSTMENTS:

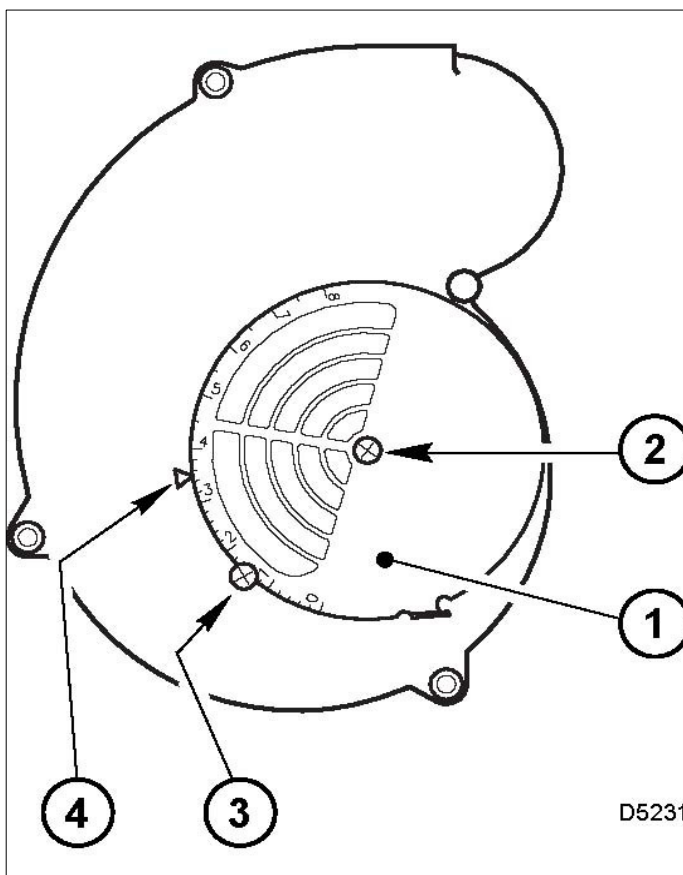
**NOTE:** Proper combustion air adjustment must be achieved using a certified combustion analyzer and smoke tester to ensure complete combustion.

The air adjustment should be made to achieve 10% CO<sub>2</sub> and No. 1 or “trace” smoke. (Bacharach Scale)

## SETTING THE AIR ADJUSTMENT PLATE

**A)** Regulation of the combustion air flow is made by adjustment of the manual AIR ADJUSTMENT PLATE (1) after loosening the FIXING SCREWS (2 & 3). The initial setting of the air adjustment plate should be made according to Column 5 in the Burner Set-up Chart.

**B)** The proper number on the manual AIR ADJUSTMENT PLATE (1) should line up with the SETTING INDICATOR (4) on the fan housing cover. Once set, the air adjustment plate should be secured in place by tightening SCREWS 2 and 3.



**C)** The final position of the air adjustment plate will vary on each installation. Use instruments to establish the proper settings for maximum CO<sub>2</sub> and a smoke reading of zero.

**NOTE:** Variations in flue gas, smoke, CO<sub>2</sub> and temperature readings may be experienced when the burner cover is put in place. Therefore, the burner cover **must** be in place when making the final combustion instrument readings, to ensure proper test results.

## BURNER SET-UP CHART

1	2	3		4	5
ACTUAL FIRING RATE ± 5%	NOZZLE SIZE	PUMP PRESSURE		TURBULATOR SETTING	AIR DAMPER SETTING
GPH	GPH	PSI	BAR		
2.75	2.25 x 45°	170	10	5	4 - 6
	2.00 x 60°	170	10	5	4.5
	1.75 x 60°	170	10	5	4.5

\* Note – Air damper setting is typically set at 4 for operation in colder temperatures. A combustion analyzer should always be used when setting the burner.

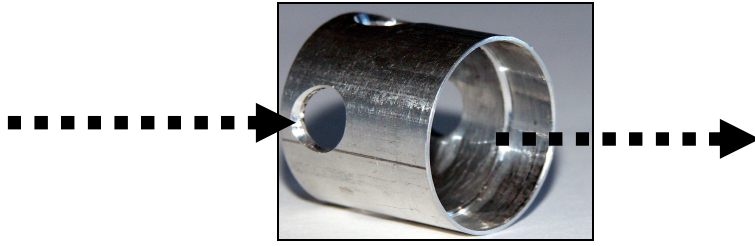
## TEMPERATURE FEELER GAUGE ADJUSTMENT (ATTACHED TO FAN SWITCH)

The temperature feeler gauge is required to be always touching the heater exchanger.

The temperature feeler gauge controls the air flow over the fan switch, which eliminates any unnecessary fan cycling. The temperature feeler gauge can be adjusted for different outside temperatures, by rotating the location of the temperature feeler gauge holes. This will provide maximum performance of the unit in different applications.

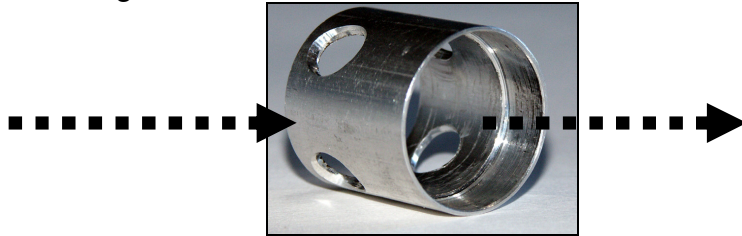
If supply air is warm (-5° C, indoor application):

Turn the temperature feeler gauge so that the holes are parallel with the heat exchanger. This will help the fan switch to remain cool and not overheat. See following:



If supply air is cold (under -5°C):

Turn the temperature feeler gauge so that the holes are closed off as the air goes over the heat exchanger. This will reduce fan cycling and the unit from shutting down. See following:



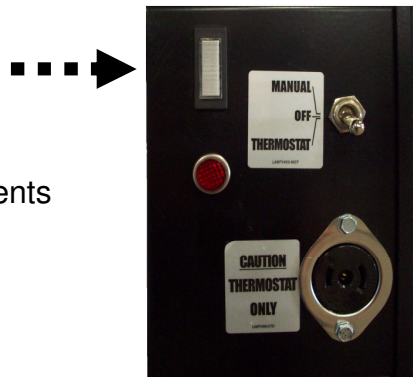
In extreme cold conditions, cover the holes on the temperature feeler gauge using foil tape. Ensure that the temperature feeler gauge is readjusted for warmer weather conditions. Failure to do so may result in burning out fan switches- not covered under warranty.

**POWER SUPPLY INDICATOR LIGHT:**

The power supply indicator light will help detect any faulty power supplied to the heater such as; grounding issues, reverse polarity or missing/poor connections.

**Warning Light Indications**

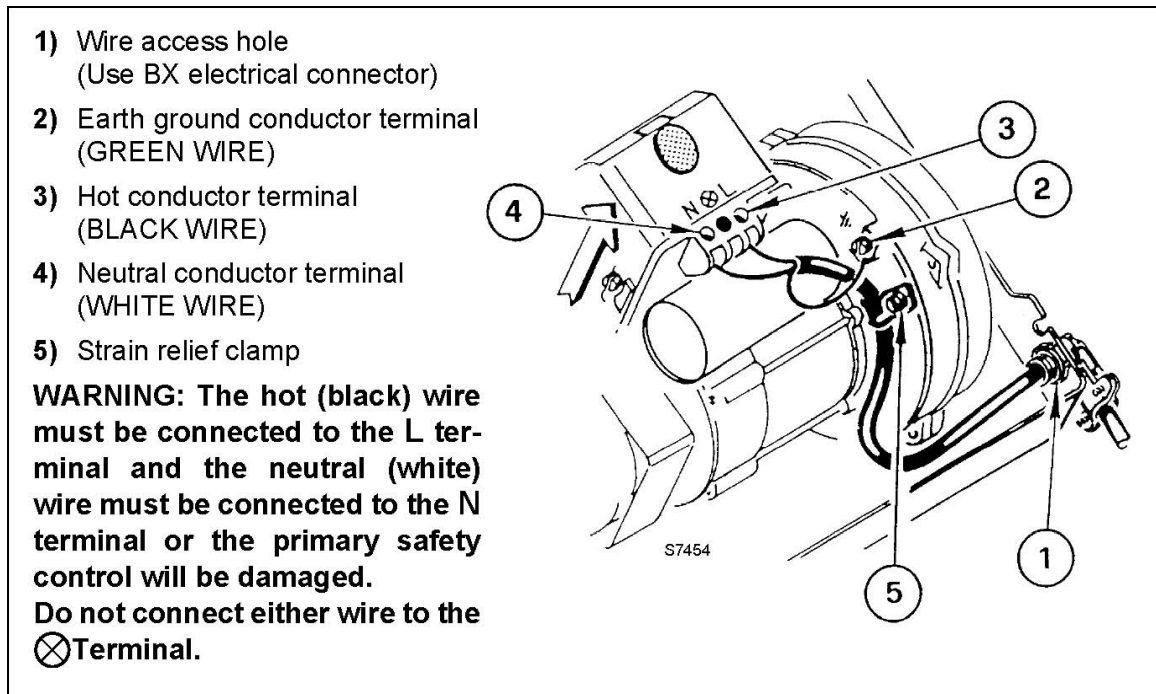
- Green Light ..... Meets Power Requirements
- Solid Red Light..... Reverse Polarity
- Solid Red & Green Light... Ground Issue



**ATTENTION: IF SOLID RED & GREEN IS INDICATED, MAKE CORRECTIONS TO POWER SUPPLY BEFORE TURNING HEATER ON. FAILURE TO DO SO WILL VOID ANY WARRANTY.**

## ELECTRICAL CONNECTIONS

It is advisable to leave the control box off the sub-base while completing the electrical connections to the burner.



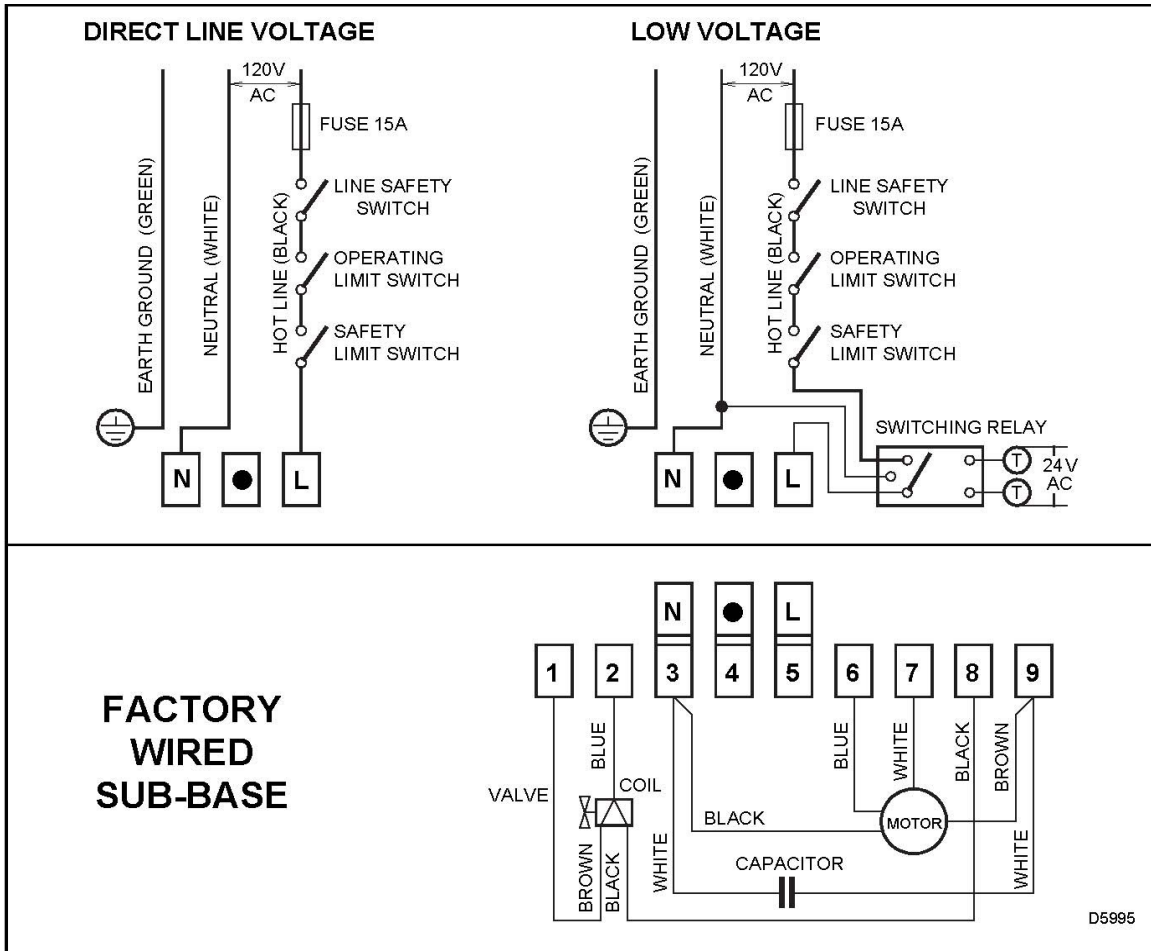
The burner may be controlled using either a DIRECT LINE VOLTAGE control circuit (120V AC 60 cycle) **OR** a LOW VOLTAGE control (24V AC 60 cycle) using a R8038A Honeywell switching relay or equivalent.

Using the appropriate diagram below, make electrical connections to the burner. All wiring must be done in accordance with existing electrical codes, both national and local.

When all electrical connections have been made, the control box may be put back in place on the sub-base.

**WARNING: DO NOT activate burner until proper oil line connections have been made, or failure of the pump shaft seal may occur.**

# APPLICATION FIELD WIRING

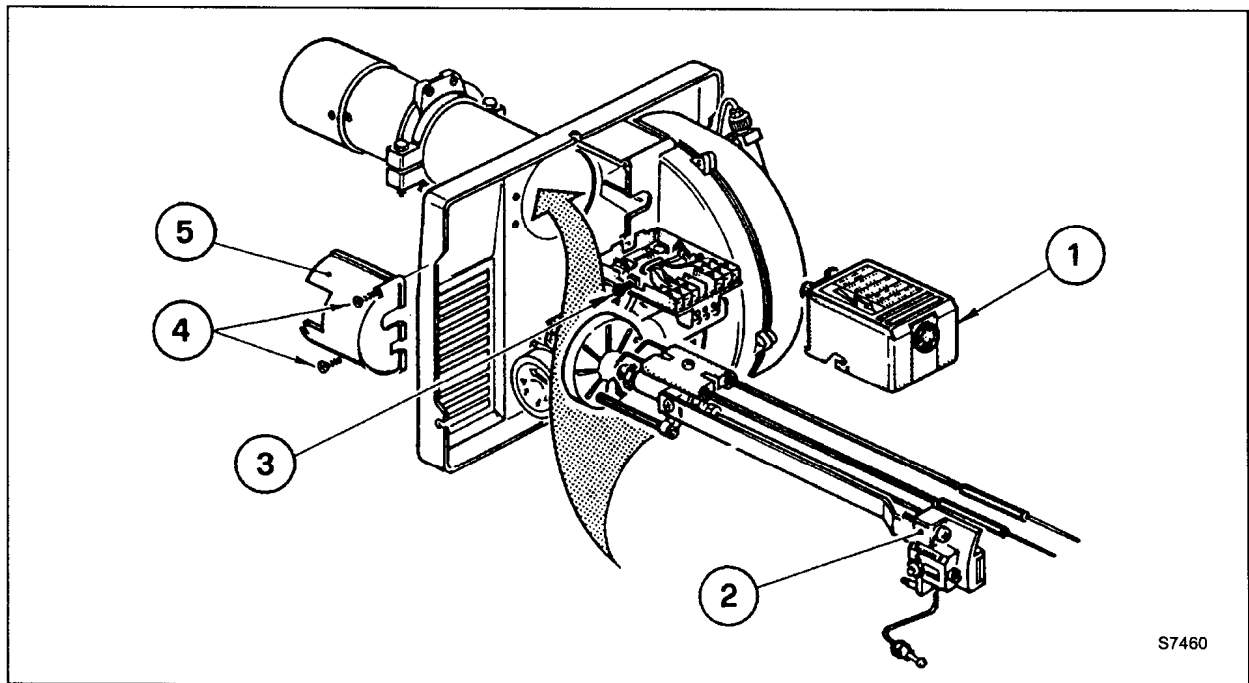


**REMOTE SENSING OF SAFETY LOCKOUT:** The SAFETY SWITCH in the 530SE CONTROL BOX is equipped with a contact allowing remote sensing of burner lockout. The electrical connection is made at terminal 4 (●) on the SUB-BASE. Should lockout occur the 530SE CONTROL BOX will supply a power source of 120Vac to the connection terminal. The maximum allowable current draw on this terminal (4) is 1 Amp.

**WARNING:** If a neutral or ground lead is attached to this terminal, the CONTROL BOX on the burner will be damaged should lockout occur.

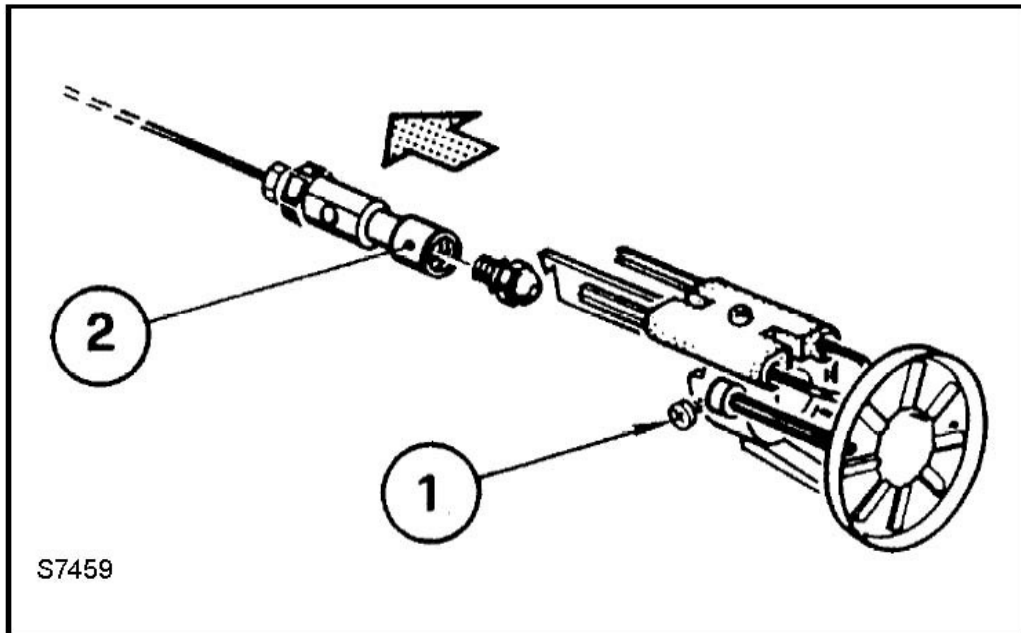
## INSERTION / REMOVAL OF DRAWER ASSEMBLY

- A)** To remove drawer assembly, loosen SCREW (3), then unplug CONTROL BOX (1) by carefully pulling it back and then up.
- B)** Remove the AIR TUBE COVER PLATE (5) by loosening the two retaining SCREWS (4).
- C)** Loosen SCREW (2), and then slide the complete drawer assembly out of the combustion head as shown.
- D)** To insert drawer assembly, reverse the procedure in items A to C above, and then attach fuel line to the pump.



## NOZZLE PLACEMENT

- A) Remove the NOZZLE ADAPTER (2) from the DRAWER ASSEMBLY by loosening the SCREW (1).

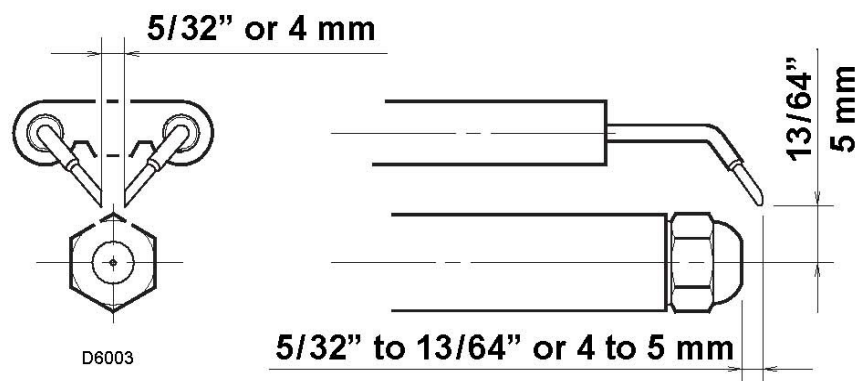


- B) Insert the proper NOZZLE into the NOZZLE ADAPTER and tighten securely (Do not over tighten).
- C) Replace adapter, with nozzle installed, into drawer assembly and secure with screw (1).

## ELECTRODE SETTING

**IMPORTANT:**

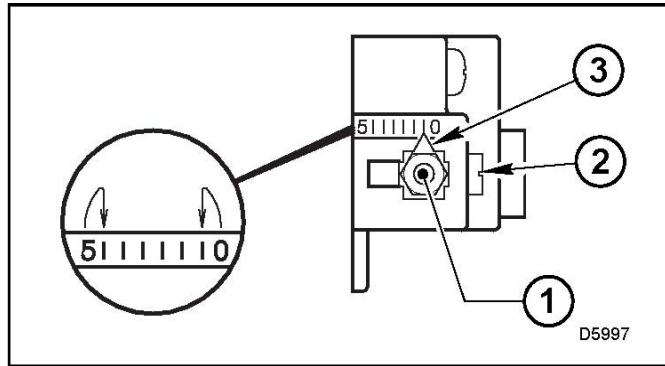
**THESE DIMENSIONS MUST BE OBSERVED AND VERIFIED.**



## TURBULATOR SETTING

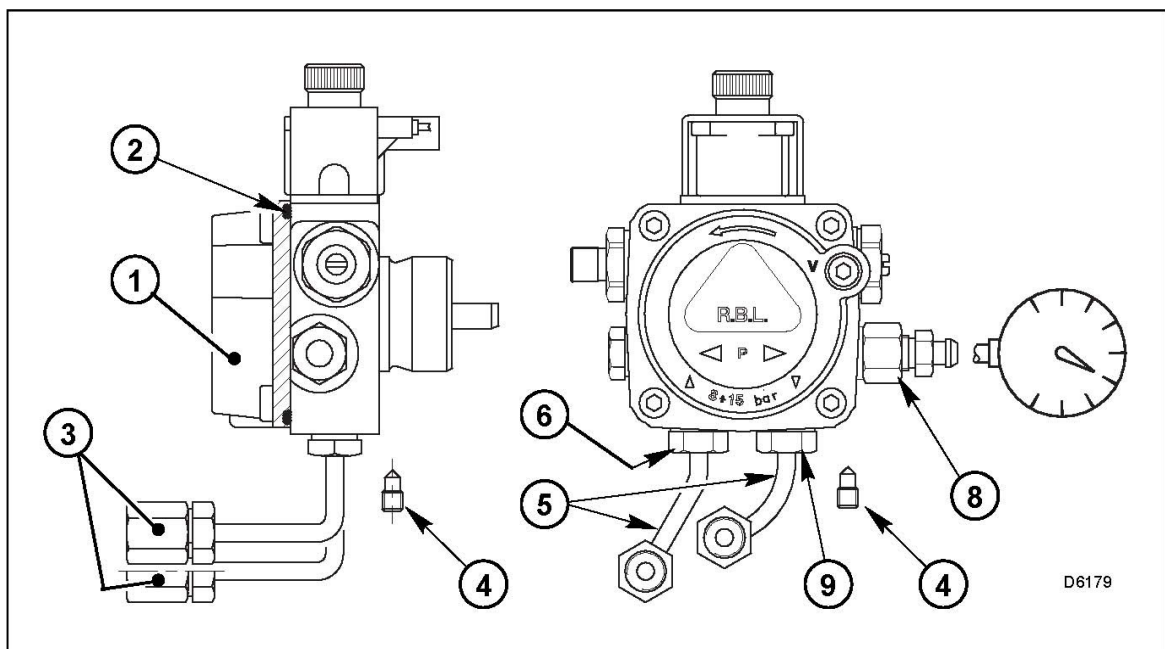
- A)** Loosen NUT (1), then turn SCREW (2) until the INDEX MARKER (3) is aligned with the correct index number as per the Burner Set-up chart, on page 12.
- B)** Retighten the RETAINING NUT (1)

**NOTE:** Zero and five are scale indicators only. From left to right, the first line is 5 and the last line 0.



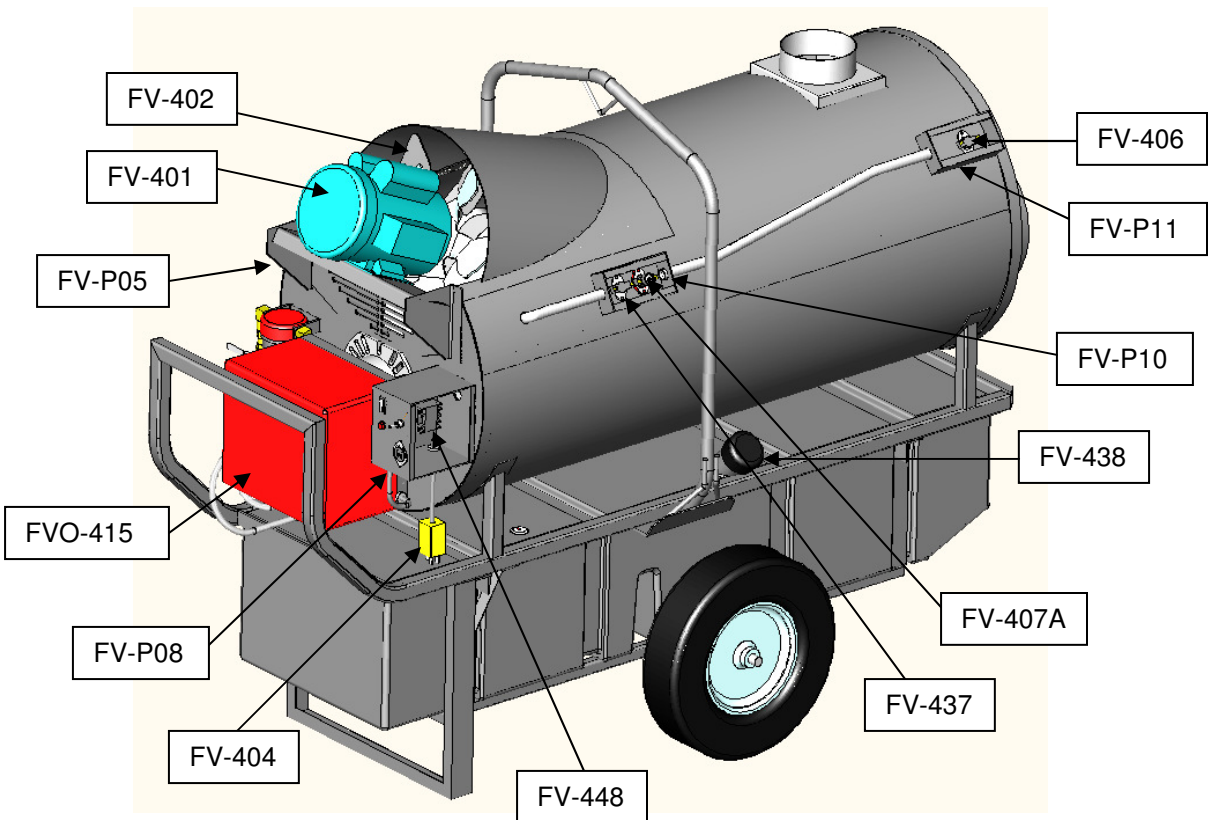
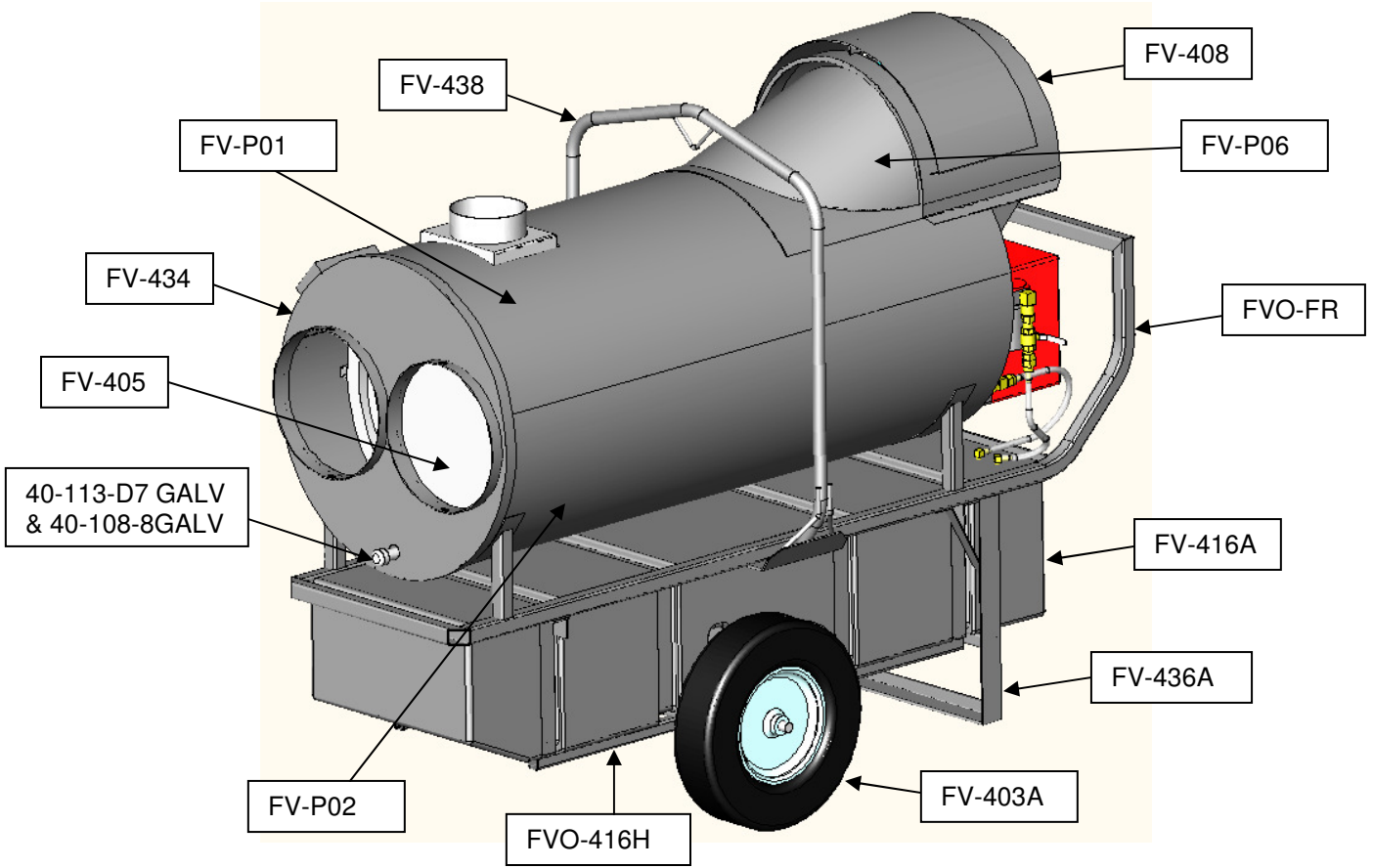
## OIL LINE CONNECTIONS

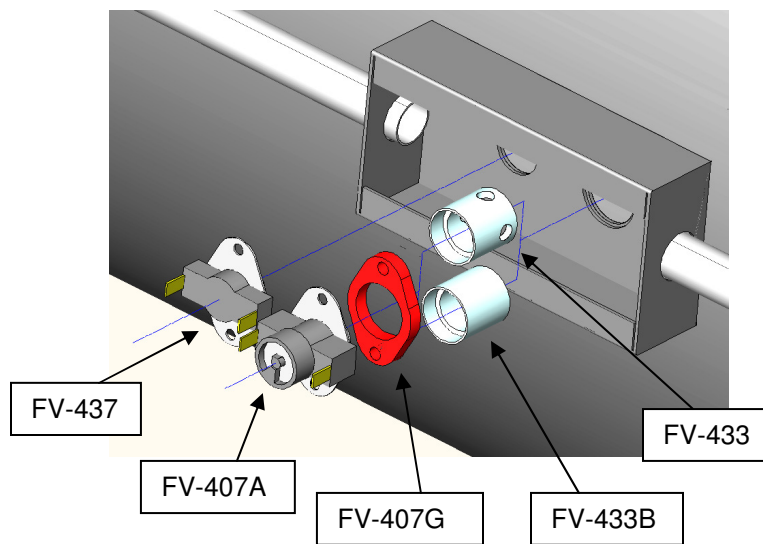
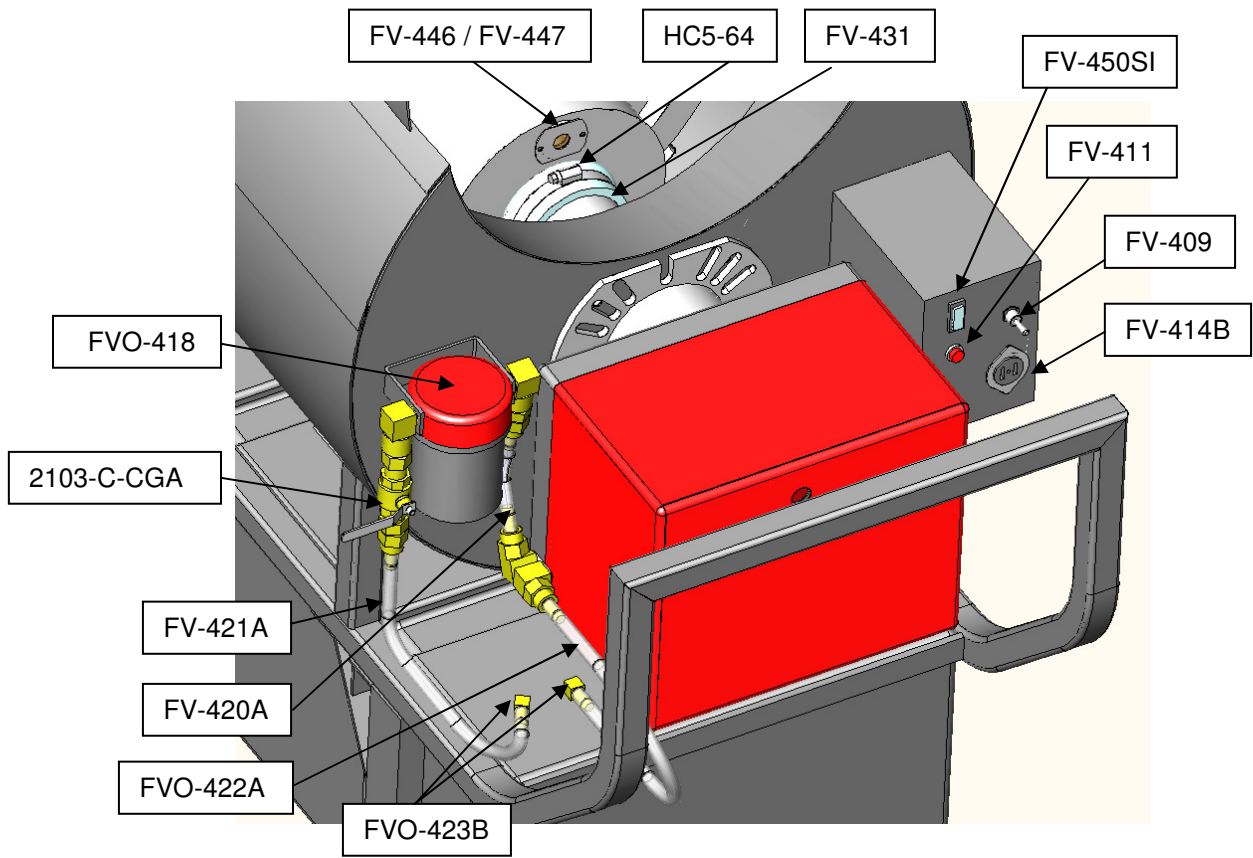
**Note:** Pump pressure must be set at time of burner start-up. A pressure gauge is attached to the PRESSURE PORT (8) for pressure readings. Two PIPE CONNECTORS (5) are supplied with the burner for connection to either a single or a two-pipe system. Also supplied are two ADAPTORS (3), two female 1/4" NPT, to adapt oil lines to burner pipe connectors. All pump port threads are British Parallel Thread design. Direct connection of NPT threads to the pump will damage the pump body. Riello manometers and vacuum gauges do not require any adaptors, and can be safely connected to the pump ports. An NPT (metric) adapter must be used when connecting other gauge models.





# PARTS DIAGRAM – FVO-400





# PARTS LIST FOR FVO-400

Part Number	Part Description
FV-401	PRIMARY FAN MOTOR
FV-402	16" FAN BLADE
FV-403A	16" WHEEL - FLAT FREE
FV-404	18" POWER CORD C/W PLUG END
FV-405	SS HEAT EXCHANGER
40-113-D7GALV	1/2" X 7" GALVANIZED NIPPLE
40-108-8GALV	1/2" GALVANIZED CAP
FV-406	HIGH LIMIT SWITCH (OUTLET)
FV-407A	FAN LIMIT SWITCH (ADJUSTABLE)
FV-407G	FAN LIMIT SILICONE GASKET
FV-408	FAN MOTOR CANOPY
FV-P02	BOTTOM BODY PANEL
FV-P01	TOP BODY PANEL
FV-P05	MOTOR MOUNT BRACKET
FV-P06	FAN HOOD
FV-P08	CONTROL BOX
FV-P09	CONTROL BOX LID
FV-P10	LIMIT BOX (DOUBLE HOLE)
FV-P11	LIMIT BOX (SINGLE HOLE)
FV-P12	LIMIT BOX LID
FV-409	TOGGLE SWITCH (ON CONTROL BOX)
FV-410	GREEN LIGHT (ON CONTROL BOX) PRIOR TO 2009
FV-411	RED LIGHT (ON CONTROL BOX)
FV-414B	THERMOSTAT PLUG (ON CONTROL BOX) 2011>
FV-415A	MALE CONNECTOR FOR FV-THB
FVO-415	RIELLO BURNER (OIL)
FV-416A	42 US GALLON OIL TANK (POLY TANK)
FVO-416H	42 US GALLON OIL TANK HARNESS (POLY TANK)
FVO-416G	FUEL GAUGE (PLOY TANK)
FVO-417B	OIL TANK CAP (POLY TANK)
40-121-6GALV	OIL TANK DRAIN PLUG (FOR POLY TANK)
FVO-418	FUEL FILTER (COMPLETE)

FVO-419	FUEL FILTER (INSERT ONLY)
FVO-420A	CLEAR FUEL LINE 14" (TANK TO FILTER)
FVO-421A	CLEAR FUEL LINE 6.5" (FILTER TO BURNER)
FVO-422A	CLEAR FUEL LINE 14" (BURNER TO TANK)
FVO-423A	PICK UP TUBE C/W ELBOW (POLY TANK)
FVO-423B	RETURN LINE ELBOW (POLY TANK)
48-6C	BRASS FITTING (POLY TANK TO FILTER)
2103-C-CGA	3/8" SHUT OFF VALVE
122-C	3/8" BRASS HEX NIPPLE
49-6C	3/8" MP X 3/8" M.FL BRASS ELBOW
49-6B	1/4" MP X 3/8" M.FL BRASS ELBOW
FV-431	BURNER GASKET
FV-433	FEELER GAUGE
FV-433B	FEELER GAUGE - SOLID
FV-434CB12	FRONT FACE PLATE (2 X 12")
FV-434CB16	FRONT FACE PLATE (1 X 16")
FV-435H	OIL BURNER NOZZLE (HI ALTITUDE) (1.75 X 60W)
FV-435B	OIL BURNER NOZZLE (2.00 X 60W)
FV-436A	SUPPORT LEG (POLY TANK)
FV-437	HIGH LIMIT (REAR)
FV-438	LIFTING HARNESS
FVO-440A	WHEEL AXLE - (POLY TANK)
FV-446	SIGHT GLASS C/W FIBER GASKET
FV-447	SIGHT GLASS WASHER
FV-448	MAIN RELAY
FV-450SI	POWER SUPPLY INDICATOR FOR FV-SERIES 2014>
FV-461	PUMP INLET/OUTLET ADAPTER
FVO-3000443	PUMP DRIVE KEY
FVO-3002278	SUB-BASE FOR BURNER
FVO-3002279	COIL
FVO-3002280	PHOTO CELL
FVO-3005844	CAPACITOR
FVO-3005854	SEMI FLANGE FOR F10 BURNER (FVO-400)
FVO-3005855	MOUNTING FLANGE
FVO-3005869	ELECTRODE PORCELAIN
FVO-3005891	ELECTRODE ASSEMBLY

FVO-3006553	COIL U-BRACKET C/W KNURLED NUT
FVO-20136491	CONNECTION FOR THE NOZZLE HOLDER
FVO-20136639	NOZZLE HOLDER
FVO-3006966	ELECTRODE SUPPORT
FVO-3006978	TURBULATOR DISC.
FVO-3006980	NOZZLE OIL TUBE 10"
FVO-3006983	END CONE ADAPTER (F10 BURNER)
FVO-3006992	PIPE CONNECTOR - SUPPLY
FVO-3006993	PIPE CONNECTOR - RETURN
FVO-3007077	CRUSHABLE METAL WASHER
FVO-3007087	NOZZLE OUTLET WASHER FOR F10 BURNER
FVO-3007203	VALVE PLATE FOR OIL BURNER
FVO-20136636	BURNER BACK COVER
FVO-3007268	NOZZLE OUTLET FITTING FOR F10 BURNER
FVO-3007317	AIR TUBE COVER PLATE FOR F10 BURNER
FVO-3007357	ACOUSTIC LINER FOR BURNER BACK COVER
FVO-3007568	BLEEDER SCREW
FVO-3949072	LONG COMBUSTION HEAD FOR F10 BURNER
FVO-20136488	FUEL PUMP
FVO-C700-1029	IGNITION MODULE
FVO-C7001034	BURNER MOTOR

<b>ACCESSORIES</b>	
FV-HD12	12" X 12-FT HITEX VINYL DUCTING (pin lock)
FV-HD12X25	12" X 25-FT HITEX VINYL DUCTING (pin lock)
FV-HD16x25	16" X 25-FT HITEX VINYL DUCTING (cuff & buckle)
FV-THB	THERMOSTAT C/W 25FT CORD/MALE PLUG END (AS OF 2011)
FV-VK	6" X 3FT C-VENT C/W RAIN CAP
FVO-C7001001	EMERGENCY SERVICE KIT
FVO-C7050010	VACUUM & PRESSURE TESTER MANIFOLD
FVO-TLS	TIGERLOOP SYSTEM C/W FILTER
FVO-TLPRV	PRESSURE RELIEF VALVE FOR TIGERLOOP

# FV-400 SERIES - WIRING SCHEMATIC 2011

