General Burner Information

Model Identification

The numerical suffix after the letter "C" denotes the burner frame size. The letter "R" inserted immediately after the letter "C" denotes an inverted blower configuration. All new *Paraflow*™ units have this inverted configuration.

The alphabetical designation immediately following the frame size indicates the fuels to be used: "G" is for gas only; and "GO" is for combination gas/oil.

The two numbers following the fuel designation denotes the standard gas train size. (Selected components may be of different pipe sizes than the nominal train size coded).

20 - 2" Gas Train
25 - 2-1/2" Gas Train
30 - 3" Gas Train

Example:

Type **Frame Size** **Fuel (gas/oil)**

CR4 - GO - 25

Standard Gas Train Size (2-1/2")

The model number listed in the example below is depicted throughout this section of the manual. This burner is used on the *Paraflow*™ YPC-DF-16G unit. Other burners will vary in physical size but will have the same configuration.

Unpacking and Handling

The units are shipped with the burner(s) pre-wired to the appropriate control panels. A remote fuel oil pump set is shipped separately on gas/oil fired units. Gas train components will be shipped separately and will require field mounting.

Remove shrink wrap from burner carefully and check all parts received against the computer generated Burner As Built Specification Sheet supplied by the burner manufacturer. Components that were not mounted on the burner (Ship Loose) are designated with an "L" on the sheets. Claims of damage or shortage must be immediately filed with the carrier.

Gas Trains

Gas trains consist of components as shown in the figure below. The required components are job specific and will depend upon local, state and federal codes.

Refer to As Built Burner Piping Diagrams supplied with burner for specific gas train details.

Burners

The two types of burners presently used on *Paraflow*™ units are Power Flame and Weishaupt.

Power Flame Type C burners incorporate the principles of pressure atomization for oil operation and venturi operation for gas firing.

The burners range in inputs from 2553 MBH for the smaller S-series models to 10418 MBH for the larger sizes.

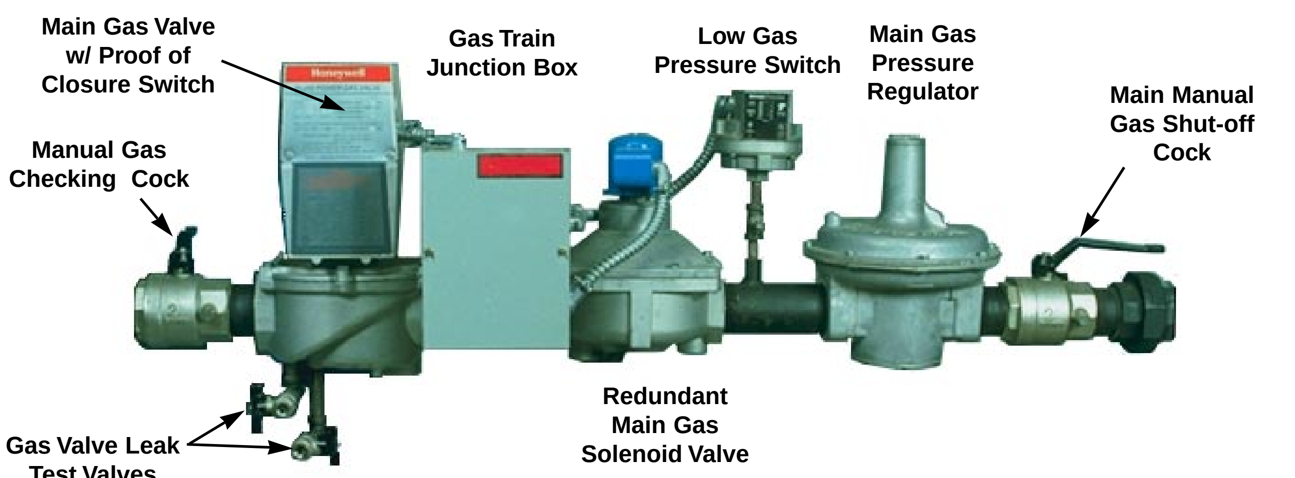
They can either be fired using gas (natural or propane) and #2 fuel oil.

A gas pilot burner is used for both gas and oil operation.

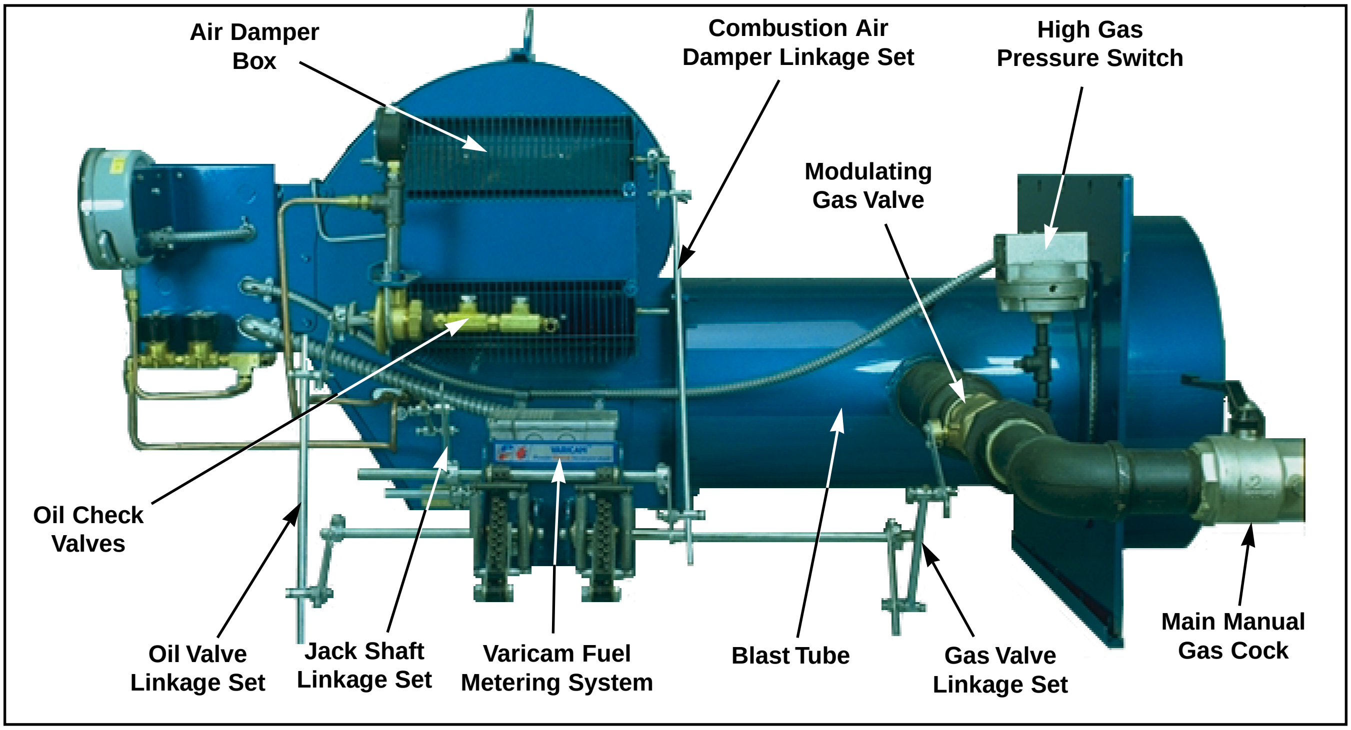
Refer to **Table BT1** for standard burner information for all Model *Paraflow*™ Units.

For information on Weishaupt Burners, refer to IOM manual supplied with burner.

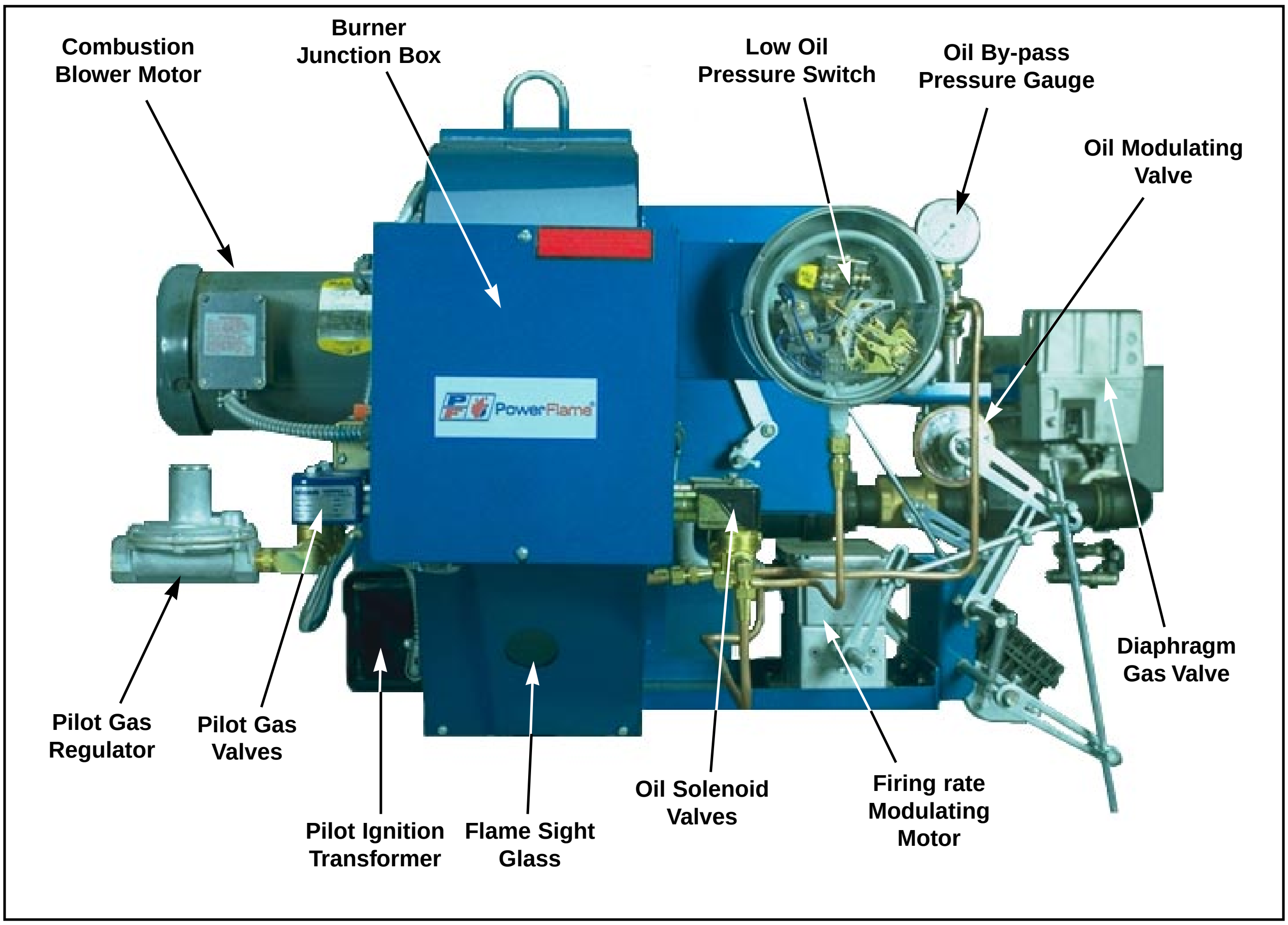
A typical burner is illustrated on the following two pages. The basic components for a gas/oil combination burner are illustrated.



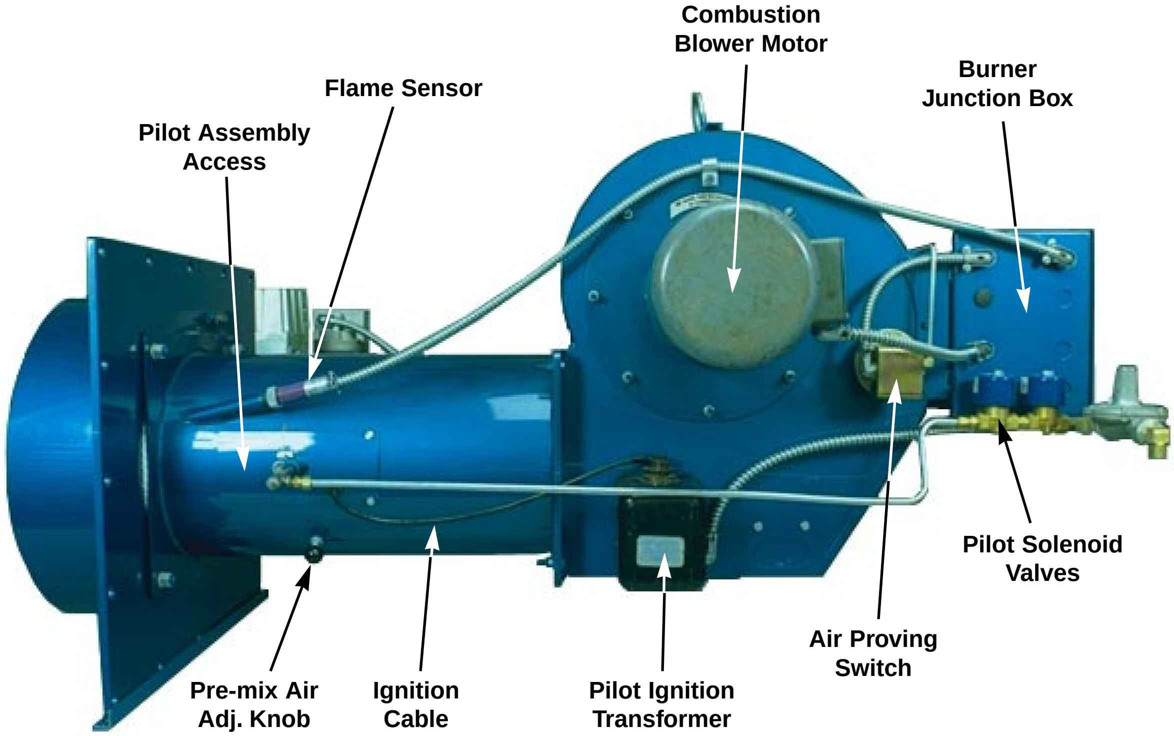
2-1/2" - UL Listed Gas Train

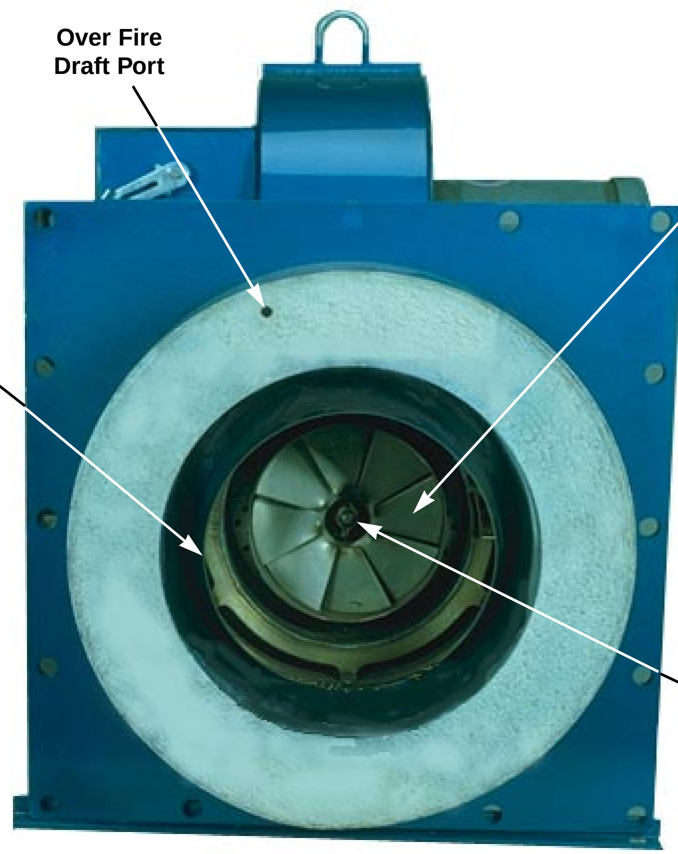


Air Damper Box
Combustion Air Damper Linkage Set
High Gas Pressure Switch
Modulating Gas Valve
Oil Check Valves
Oil Valve Linkage Set
Jack Shaft Linkage Set
Varicam Fuel Metering System
Blast Tube
Gas Valve Linkage Set
Main Manual Gas Cock



Combustion Blower Motor
Burner Junction Box
Low Oil Pressure Switch
Oil By-pass Pressure Gauge
Oil Modulating Valve
PowerFlame
Diaphragm Gas Valve
Pilot Gas Regulator
Pilot Gas Valves
Pilot Ignition Transformer
Flame Sight Glass
Oil Solenoid Valves
Firing rate Modulating Motor





The components and arrangements shown in this section are typical for a model CR4-GO-25 burner. Gas only units will have similar components, however, all oil components shown will not be present. For specifics on your system, refer to the technical information supplied with the burner.

Table BT-1

York Mod # YPC-DF-	Burner Model #	Min.Firing Rate (MBH)	Max.Firing Rate (MBH)	Max. Oil Flow (GPH)	Standard Gas Train Size (in.)	Gas Pressure Required (W.C.) min./max	Separate Driven Oil Pressure Pump	
							Motor H.P.	Suction Capacity (GPH)
12SC/13S	CR2-G(O)-20B	750	2553	22	2	4.8/14	1/3	40
13SC/14S	CR3-G(O)-20	900	2891	26	2	5.9/14	1/2	105
14SC/15S	CR3-G(O)-25	900	3613	33.7	2.5	7.0/14	1/2	105
15SL	CR4-G(O)-25	1300	4508	45	2.5	8.0/14	3/4	135
16S	CR4-G(O)-25	1300	5010	45	2.5	8.0/14	3/4	135
16SL	CR4-G(O)-25	1300	5634	45	2.5	8.0/14	3/4	135
17S	CR4-G(O)-25	1300	6261	45	2.5	8.0/14	3/4	135
18S	CR4-G(O)-30	2459	7230	56	3	12.1/14	3/4	135
19S	CR5-G(O)-30	3000	8765	75	3	19.9/28	1	250
16G	CR4-G(O)-25	1300	5950	45	2.5	8.0/14	3/4	135
16GL	CR4-G(O)-25	1300	6300	45	2.5	8.0/14	3/4	135
17G	CR4-G(O)-30	2459	7258	56	3	12.1/14	3/4	135
18G	CR5-G(O)-30	3000	8936	75	3	19.9/28	1	250
19G	CR5-G(O)-30	3000	10418	75	3	19.9/28	1	250
19GL	CR5-G(O)-30	3000	10418	75	3	19.9/28	1	250
20G	CR4-G(O)-30*	2459	7258	56	3	12.1/14	3/4	135
21G	CR5-G(O)-30*	3000	8936	75	3	19.9/28	1	250
22G	CR5-G(O)-30*	3000	10418	75	3	19.9/28	1	250

* Units Equipped With Two Burners.

This information is of a general nature only. Please refer to Burner As Built Data (supplied with burner) for specific job details.

Combustion Theory

The two most common fuels used to fire Direct Fired *ParaFlow*™ units are Natural Gas and #2 Fuel Oil. Propane can also be used if available.

The three essential components necessary for combustion to occur are fuel, air and heat. If any of these components are removed, the combustion process will stop.

The fuels listed above, each have the following components which are of interest when analyzing the combustion process: Carbon (**C**), Hydrogen (**H**) and Sulfur (**S**).

The following components each react with the oxygen present in the air to produce the following:

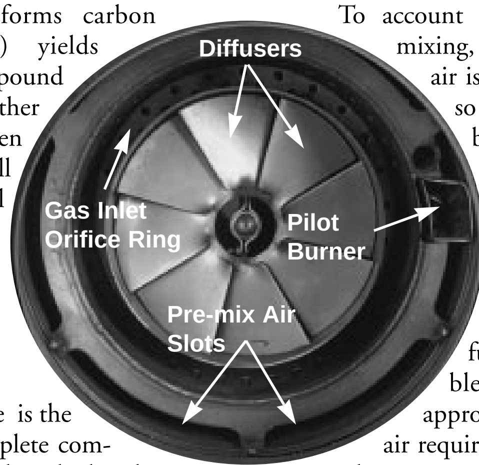
$$C + O_2 \rightarrow CO_2 + 14,500 \text{ BTU/LB}$$
$$2H + .5\, O_2 \rightarrow H_2O + 61,100 \text{ BTU/LB}$$
$$S + O_2 \rightarrow SO_2 + 3,983 \text{ BTU/LB}$$

Air contains approximately 21% oxygen by volume. The heat necessary to start the combustion process is accomplished through the use of a spark ignitor and pilot flame. The spark ignitor lights the pilot flame, and the pilot flame in turn lights the main burner flame.

When carbon burns, one carbon atom and two oxygen atoms combine to form one carbon dioxide molecule and heat. Each pound of carbon burned generates 14,500 Btu's.

If **too much oxygen** (excess air) is supplied the mixture is considered **lean** and the fire is said to be oxidizing. This extra oxygen plays no part in the process.

If too much fuel (**not enough oxygen**) is supplied the mixture is said to be **rich** and the fire is reducing. With insufficient oxygen available, the carbon atoms do not complete the process of forming carbon dioxide (CO_2). Instead carbon monoxide (CO) is formed which will burn to carbon dioxide when more oxygen is introduced. This incomplete combustion which forms carbon monoxide (CO) yields 4,350 BTU's per pound of carbon. Further addition of oxygen and re-ignition will yield an additional 10,150 Btu's.



What is Carbon Monoxide?

Carbon Monoxide is the product of incomplete combustion as earlier described and is a flammable, colorless and odorless gas. Carbon monoxide is the same density as the air that we breath, therefore easily mixes to form a deadly atmosphere.

The major hazards of carbon monoxide are its flammability and toxicity. Carbon monoxide becomes a combustible gas when its concentration exceeds 12.5% by volume (125,000ppm)

Carbon monoxide is also classified as a chemical asphyxiant which produces a toxic action by preventing the blood from absorbing oxygen. Since the affinity of CO is 200-300 times that of oxygen in the blood, even small amounts of CO in the air will cause toxic reactions to occur.

If breathed for a sufficiently long time, a carbon monoxide concentration of only 50 ppm will produce symptoms of poisoning. As little as 200 ppm may produce slight symptoms such as headaches or discomfort in just a few hours. The effect at higher concentrations may be so sudden that a person has little or no warning before collapsing.

Stoichiometric Ratio

Every fuel has an ideal amount of air that must be blended with it for all the carbon and hydrogen to burn. This ideal mixture of fuel and air is called the stoichiometric ratio. Generally, it is impossible to blend fuel and air sufficiently so that every atom of carbon and hydrogen comes in contact with the oxygen atoms. To account for this incomplete mixing, an <u>excess</u> amount of air is mixed with the fuel so that complete combustion can take place.

Although the ratio of carbon, sulfur and hydrogen atoms differs from fuel to fuel, it is possible to establish the approximate amounts of air required for stoichiometric combustion. As a rule of thumb, for every 1000 BTU's of fuel input, 10 cubic feet of air must be added for stoichiometric combustion.

Excess Air and How it Affects Efficiency

The amount of excess air introduced into a system affects the efficiency of the combustion process as well as the efficiency of the overall system. If the excess air quantity is too low, some of the fuel will not burn and will go up the stack. On the other hand if the excess air values are too high, a greater volume of flue gases will be produced. As the volume of flue gases increase, they will travel through the *ParaFlow*™ unit at a faster rate. Because of this increased flow rate, heat transfer to the solution in the generator will be reduced and the exiting flue gas temperature will increase.

The key is to find the point where all the fuel is burned using as little excess air as possible (acceptable CO and Smoke levels).

Flue Gas Temperature Vs. Efficiency

The temperature of the flue gas should be as low as practical. Low flue gas temperatures are indicative of good combustion, and also good heat transfer to the solution.

"The Three T's of Combustion"

Simply adding the correct amount of air will not ensure complete combustion. Three factors must be present for complete combustion to take place : Time, Temperature, and Turbulence.

Time

Time is required for all the fuel to burn. Although we may think of combustion as an instantaneous process, the chemical reaction involved requires a finite time to assure that all the fuel is consumed.

Fuel must be in its gaseous form to burn. Natural gas and propane burn without any special treatment. # 2 fuel oil on the other hand must be broken up into small droplets (atomized) and heated to increase the surface evaporation so combustion can take place in a short time period. This atomization is accomplished through the use of an oil nozzle.

Temperature

The fuel/air mixture must be ignited for combustion to take place. In reality, the temperature of only a portion of the fuel/air mixture is raised above the ignition temperature and combustion begins. The heat released by this reaction heats the nearby fuel and air and the flame will spread. If for some reason, the fuel air mixture is cooled below the ignition temperature, the flame is extinguished.

Turbulence

Turbulence provides the rapid and complete mixing of the fuel and combustion air. Turbulence is introduced into the process by the burner design. On *Paraflow*™ units, the combustion air is forced into the combustion chamber and the gas or oil mixture is mixed near the burner outlet. Diffusers as shown the diagram on the previous page cause the air to swirl as it is forced out of the burner head, thus facilitating better fuel/air mixing. Some of the air/gas is pre-mixed which can lead to smoother burner operation.

Fig. B1

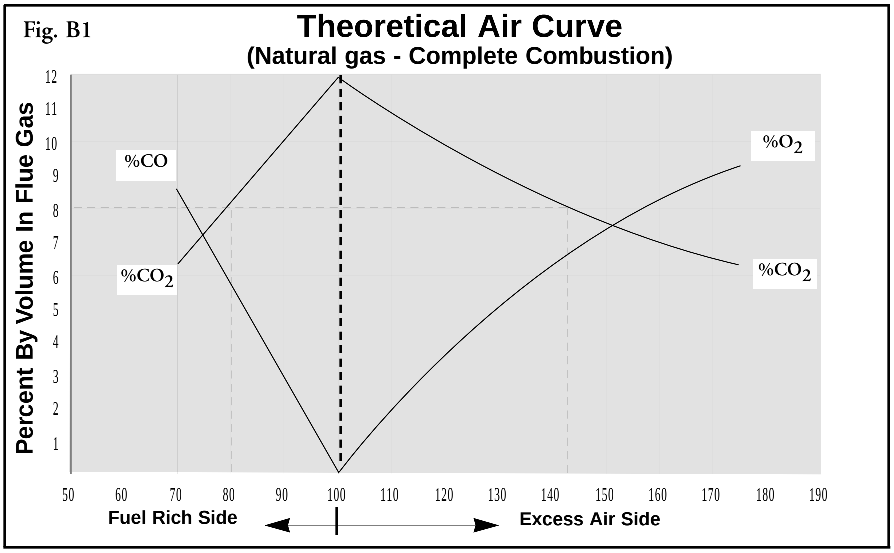
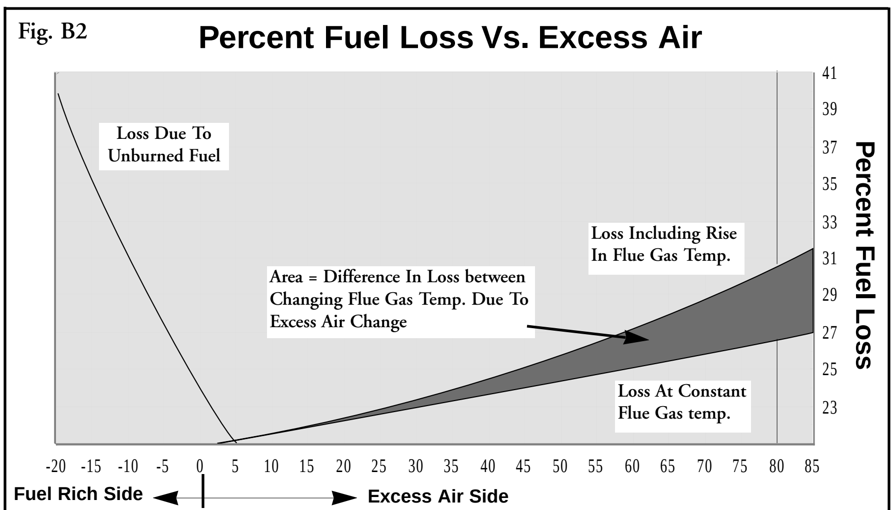


Fig. B2



Combustion Testing

Combustion testing is a method of determining the combustion and heat transfer efficiency of a *ParaFlow*™ Unit. The procedure is to sample the flue gasses as they leave the unit to determine the percentages of O_2 and/or CO_2. These readings along with the net flue gas temperature will allow the efficiency to be read from charts, graphs, or directly from a meter. The net flue gas temperature is the difference between the stack temperature read at the outlet of the unit, and the ambient or combustion air temperature.

Several types of combustion testing equipment are available today. Two of the more common are described below.

Chemical Absorption Type

Chemical testers are available to determine the level of either O_2 or CO_2. A sample of the flue gas is pumped by a hand squeeze bulb into the test device. Fluid in the tester absorbs a portion of the flue gas, increasing its volume. A scale on the side indicates the concentration of the gas being tested.

The combustion efficiency can be determined if the O_2 or CO_2 value is known along with the net stack temperature as measured with a stack thermometer.

One of the problems with using CO_2 measurements is that you will get a reading even if an oxygen starved condition is present. An oxygen starved condition is caused by no excess air being admitted, causing unburned fuel to go up the stack. An inspection of **Figure B1** shows how CO_2 varies as you go from an oxygen starved condition to one of excess air (top curve). Notice that a reading of 8% CO_2 can mean operating at 43% excess air or at a 21% deficient condition. If CO_2 testing is all that is to be performed, care must be taken to assure that the *ParaFlow*™ Unit is operating in an excess rather than a deficient air condition.

Operating a burner in an oxygen starved condition lowers the efficiency much faster than operating with too much excess air. This is illustrated in **Figure B2.** From both an economical and safety standpoint, operating with too much air is always preferable to operating with not enough air.

Note: In general, if only one test is to be performed on the unit, oxygen should be the gas tested.

Electronic Combustion Test Analyzers

Most electronic combustion testing equipment is set up to monitor the oxygen in the flue gas as well as to determine the net stack temperature. A probe is inserted into the stack and the device will read the % O_2 and net-stack temperature. From these two values, the device calculates other important data such as CO_2, % Excess Air, Combustion Efficiency, etc. Some of the testers also have provisions for monitoring CO (Carbon Monoxide) , NOx (Nitrous Oxides) and Smoke as well.

Most regulations require that the CO value be less than 50 PPM (check local codes). In some areas of the country NOx values must also be controlled. Local, State and Federal Codes will govern what these acceptable values are.

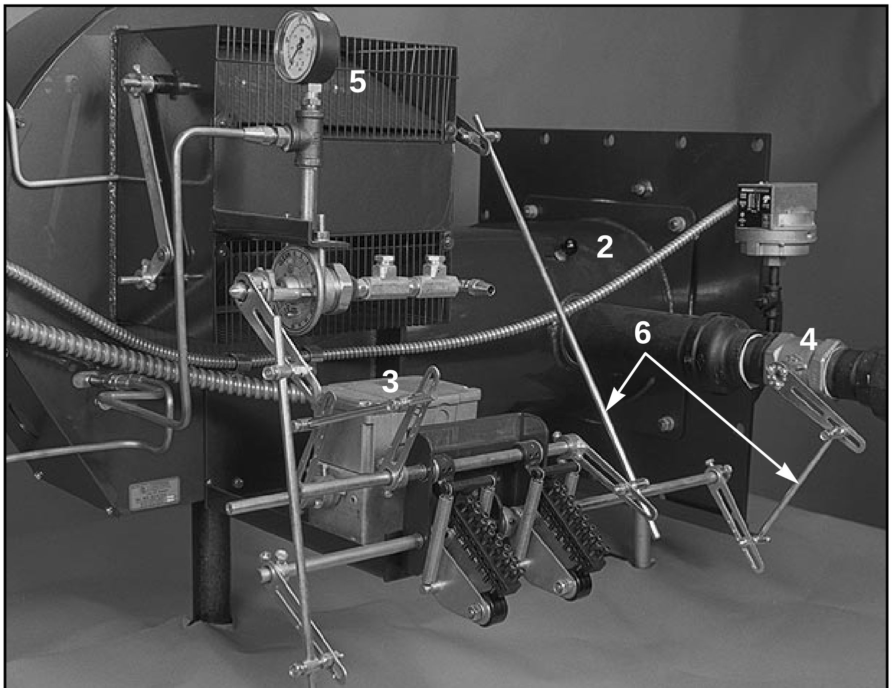
A smoke test is used to determine the amount of soot present in a sample of flue gas. The burner should be adjusted so that only a trace of smoke appears on the test material.

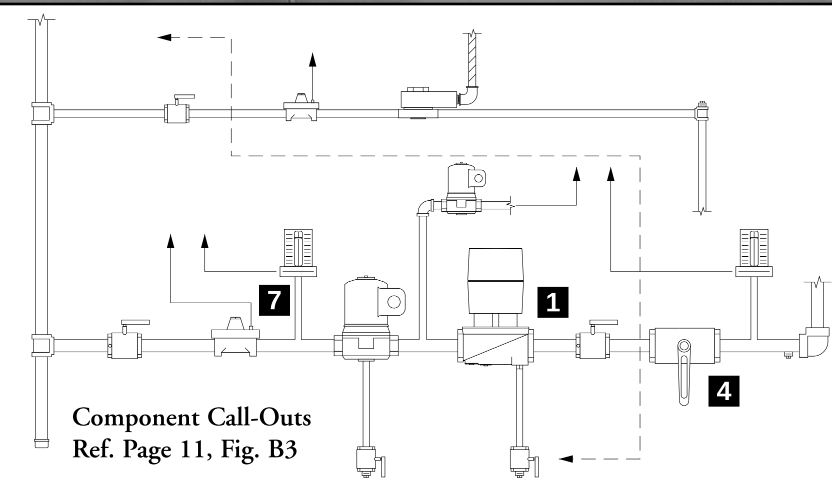
One of the advantages of using electronic testers is that a continuous test can be performed. If a burner needs adjusting, the adjustment can be made and a readout will be immediately available. This greatly reduces the time required to set up a burner. The disadvantage is the electronic testers cost considerably more than the chemical ones.

NOTICE
SAFETY WARNING

An electronic combustion analyzer is a necessary piece of equipment when starting up a Paraflow™ Direct Fire Unit. The chemical testers should be used as a check or for minor service procedures only.

Burner with Full Modulation Fuel /Air Control (Gas Operation)





Component Call-Outs Ref. Page 11, Fig. B3

The gas full modulating system uses a **Diaphragm Type Gas Valve** (1) to ensure opening and positive closure of the gas source to the **Firing Head** (2).

A **Modulating Motor** (3) controls the positioning of a **Butterfly Gas Proportioning Valve** (4) and movable **Air Dampers** (5) through **Mechanical Linkage** (6).

The gas flow control rate is accomplished through adjustment of the **Main Gas Pressure Regulator** (7) and the **Butterfly Gas Proportioning Valve**.

A proven spark ignited gas pilot provides ignition of the main flame. When the gas pilot has been proven by a flame detector, the **Diaphragm Gas Valve** opens and allows gas to flow to the burner head for main flame low fire light off. The rate of gas flow is controlled by the **Butterfly Gas Proportioning Valve**.

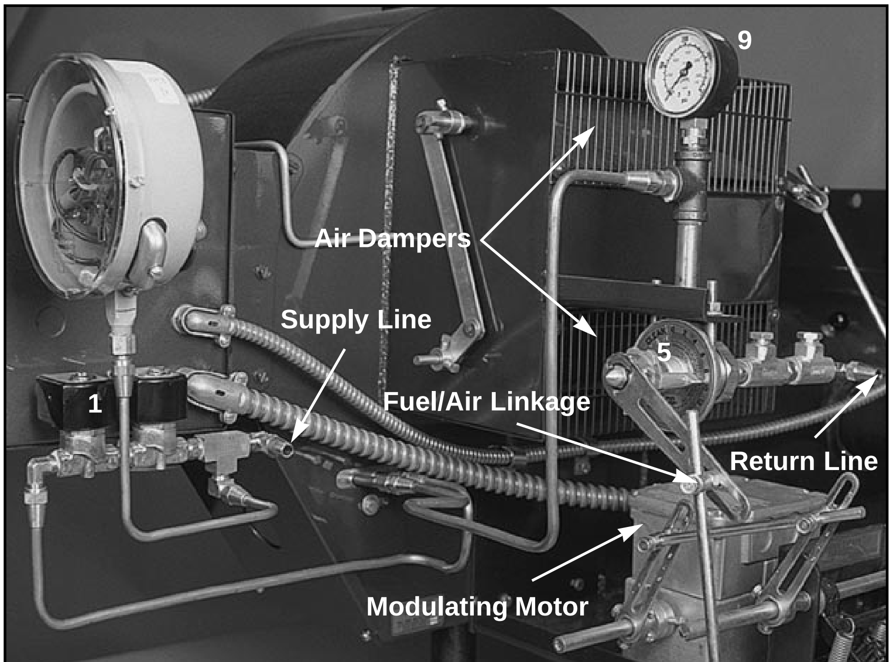
After a short period of time at the low fire position, the burner will modulate between low and high fire depending on the milli-amp signal that it is receiving from the *ParaFlow*™ ISN Control Center (Signal varies with leaving chilled water temperature).

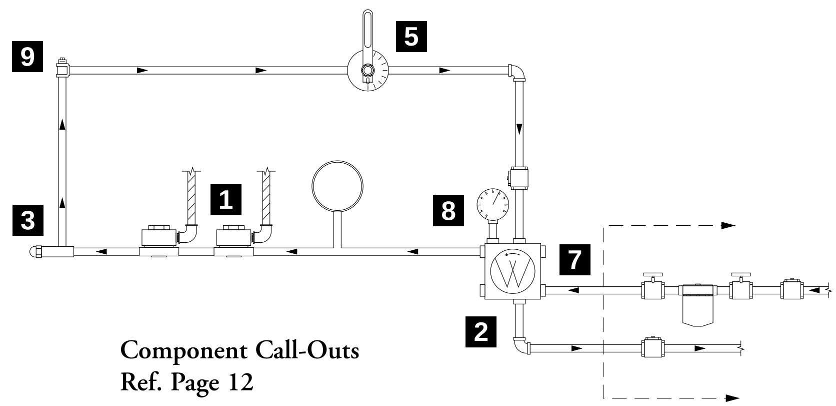
When the leaving chilled water temperature drops to 3° F below its set-point, the **Diaphragm Gas Valve** closes (normally the burner will be at its low fire position at this time) and the **Air Dampers** will go to the low fire light off position in preparation for the next firing cycle.

Note: Component operational sequencing will vary with Specific Flame SafeGuard Control being used. Refer to the specific Flame SafeGuard Control bulletin supplied with the burner.

Refer to Burner Electrical section for further operational details.

Burner with Full Modulation Fuel /Air Control (Oil Operation)





Component Call-Outs
Ref. Page 12

The oil full modulation system uses a **Two Stage Oil Pump (2)** with an internal bypass type **Oil Nozzle (3)**. A **Modulating Motor** controls the positioning of the **Air Dampers** and the **Modulating Oil Valve** (5) in the nozzle return line through mechanical linkage.

A spark ignited gas pilot is used to light off the main flame.

At main flame light off the normally closed **Oil Valve(s) (1)** is energized allowing flow to the nozzle (codes require either one or two oil solenoid valves).

The **Modulating Oil Valve** is adjusted to allow a controlled amount of oil to bypass the **Nozzle**. This reduces the pressure to the **Nozzle** for low fire light off.

Nozzle oil supply pressure is set by adjusting the oil pump pressure regulating 1/8" allen wrench fitting (refer to Adjustment of Oil Supply Pressure Regulator).

The low fire nozzle pressures should be taken at the plugged **Oil Pump Gauge Port (8)** and should be approximately 300 PSI (but could be as low as 240 PSI on certain inputs of the C4 and C5 models) with pressure at the **Nozzle Bypass Gauge (9)** from 60-100 PSI. These pressures will vary with nozzle size and job conditions.

A typical low fire oil flow setting on the Modulating Oil Valve would be number 7 on the dial, but will vary with job conditions.

After a brief period of time, to allow for the low fire flame to stabilize and stack to heat up, the burner will modulate from between low and high fire depending on the milli-amp signal that it is receiving from the *ParaFlow*™ ISN Control Center (Signal varies with leaving chilled water temperature).

When the leaving chilled water temperature drops to 3ºF below its set-point, the normally closed **Oil Valve(s)** will be de-energized and the **Modulating Motor** will position the **Air Dampers** and **Modulating Oil Valve** back to its low fire position light off position. It will remain in this position until the next start-up sequence.

Refer to Burner Electrical section for further operational details.

Gas Piping Design

Prior to designing\installing gas piping systems, all national, local and other applicable codes should be reviewed to ensure total compliance.

Gas piping should be sized to provide required pressure at the burner train inlet manual shut off cock, when operating at the maximum desired fuel input.

All gas piping should be appropriately pressure tested to ensure leak free operation. It is mandatory that a drip leg be installed in the gas supply system just ahead of the manual main shutoff cock as shown in **Figure B3 pg. 11**

When testing with pressures higher than the maximum pressure ratings on the gas train components, be sure to isolate these components and test their piping for gas leaks with correct pressures only. On some burners, the maximum main gas train and/or pilot gas train components pressure is 1/2 PSIG (14" W.C.).

Refer to **tables below** for information relating to the sizing of gas supply piping. These charts are based on the general flow characteristics of commercially produced black wrought iron pipe. If in doubt regarding flow capabilities of a chosen line size, the next largest size is recommended.

Capacity of pipe - Natural Gas (CFH)
With Pressure Drop of 0.3" W.C. and Specific Gravity of 0.60.

Length (ft.)	Pipe Size - Inches (IPS)						
	1	1 1/14	1 1/2	2	2 1/2	3	4
10	520	1050	1600	3050	4800	8500	17500
20	350	730	1100	2100	3300	5900	12000
30	285	590	890	1650	2700	4700	9700
40	245	500	760	1450	2300	4100	8300
50	215	440	670	1270	2000	3600	7400
60	195	400	610	1150	1850	3250	6800
70	180	370	560	1050	1700	3000	6200
80	170	350	530	990	1600	2800	5800
90	160	320	490	930	1500	2600	5400
100	150	305	460	870	1400	2500	5100
125	130	275	410	780	1250	2200	4500
150	120	250	380	710	1130	2000	4100
175	110	225	350	650	1050	1850	3800
200	100	210	320	610	980	1700	3500

Correction Factors
To be used for other specific gravities and pressure drops.

Specific Gravity Other Than .60		Pressure Drop Other Than .3	
Specific Gravity	Multiplier	Pressure Drop	Multiplier
0.50	1.10	0.1	0.577
0.60	1.00	0.2	0.815
0.70	0.926	0.3	1.00
0.80	0.867	0.4	1.16
0.90	0.817	0.6	1.42
1.00	0.775	0.8	1.64
Propane - Air		1.0	1.83
1.10	0.74	2.0	2.58
Propane		3.0	3.16
1.55	0.622	4.0	3.65
Butane		6.0	4.47
2.00	0.547	8.0	5.15

Equivalent Length of Fittings in Feet

Pipe Size (IPS) SCH. 40	1	1 1/4	1 1/2	2	2 1/2	3	4
Std. Tee through Side	5.5	7.5	9.0	12.0	14.0	17.0	22.0
Std. 90 Elbow	2.7	3.7	4.3	5.5	6.5	8.0	12.0
Std. 45 Elbow	1.2	1.6	2.0	2.5	3.0	3.7	5.0
Plug Cock	3.0	4.0	5.5	7.5	9.0	12.0	16.0

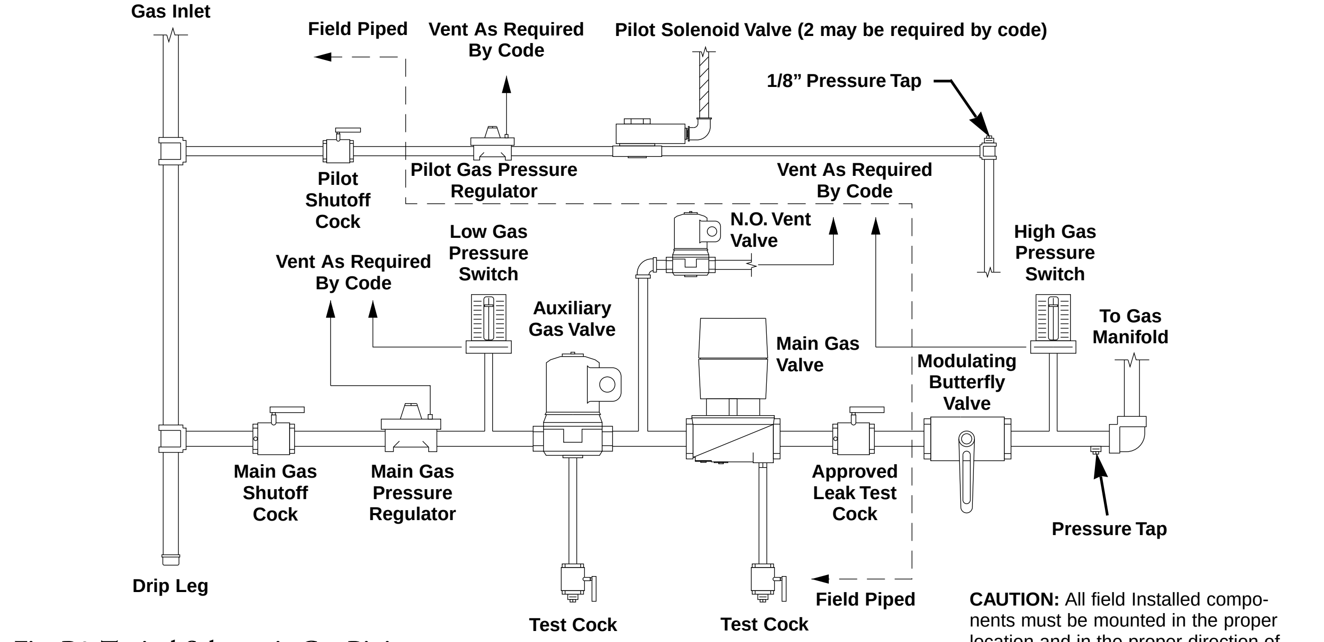


Fig. B3 Typical Schematic Gas Piping

Oil Piping Design

ParaFlow™ Units are designed for use with #2 fuel oil only.

Prior to designing/installing oil piping systems, all national, local and other applicable codes should be reviewed to ensure total compliance.

A two pipe (separate suction and return line) system must always be used. The oil pumps are preset at the factory for use only with a two pipe system. **The pump warranty will be voided if a one pipe system is installed.**

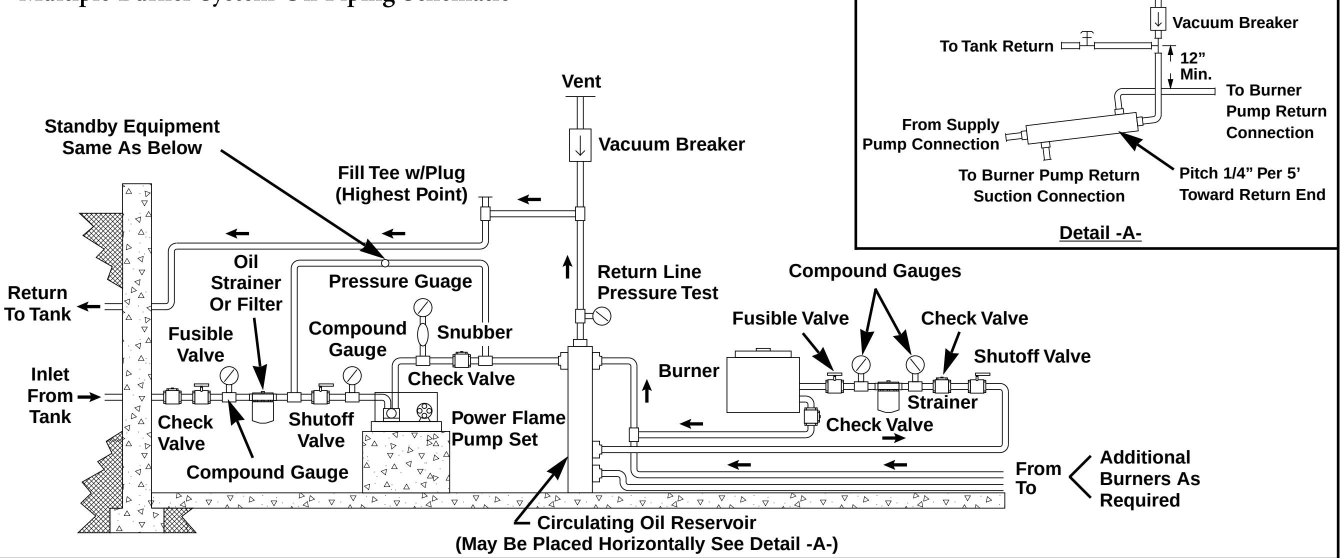
Do not use Teflon Tape. The pump warranty will be voided if it is used.

Rigid pipe connected to the pump may cause excessive vibration. It is recommended that the connection to the pump be of copper tubing, complete with a vibration dampening loop, on both the suction and return lines.

Do not install manual valves in the return line between the pump and the tank unless required by a specific code. If a manual valve is required, an automatic relief valve must be installed across the manual valve to ensure that oil will bypass directly back to the tank in the event that the manual valve is inadvertently left in the closed position.

Copper tubing with flare fittings or iron pipe is to be used on all installations.

Multiple Burner System Oil Piping Schematic



Use the proper size and type of suction line oil filters (**refer to table BT2 below**).

Utilize fusible link and/or overhead anti-siphon valves as applicable.

Oil Tanks

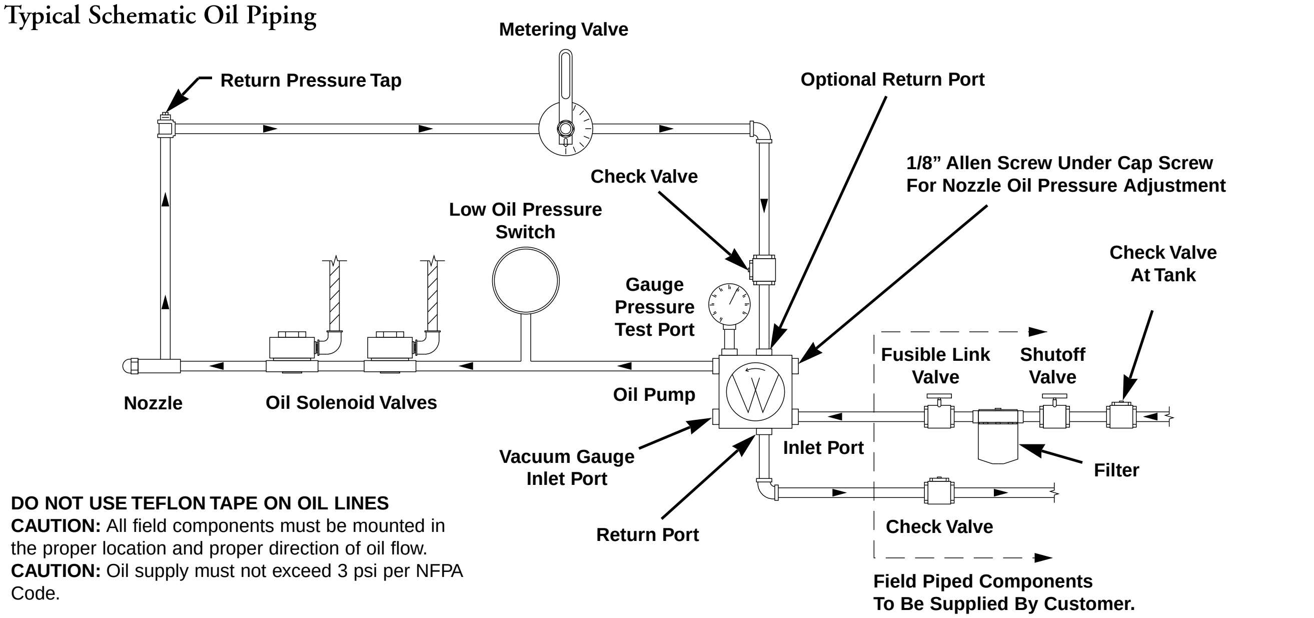
If the oil storage system has been used with fuel heavier than #2 fuel oil, the entire system should be thoroughly cleaned and flushed before filling the tank with the new #2 fuel oil for the first time.

If iron pipe oil lines are used on underground tanks, swing joints utilizing nipples and elbows must be used and joined together, making certain the piping connections are tightened as the tank settles. Keep swing joints in the suction and return lines as close to the tank as possible.

Under ground tanks should be pitched away from the suction end of the tank to prevent sediment from accumulating at the suction line entrance. Install the suction line a minimum of 3” from the bottom of the tank.

Before starting up the system, all appropriate air and oil leak tests should be performed. Make certain that the tank atmospheric vent line is unobstructed.

Typical Schematic Oil Piping



DO NOT USE TEFLON TAPE ON OIL LINES
CAUTION: All field components must be mounted in the proper location and proper direction of oil flow.
CAUTION: Oil supply must not exceed 3 psi per NFPA Code.

Table BT2

York Mod # YPC-DF-	Suction Capacity (GPH)	Power Flame Oil Filter Model	Alternate Oil Filter
12SC/13S	40	70101-100	73410 (Fulflo FB-6)
13SC/14S	105	70101-100	73410 (Fulflo FB-6)
14SC/15S	105	70101-100	73420 (Fulflo FRB-10)
15SL	135	70101-100	73420 (Fulflo FRB-10)
16S	135	70101-100	73420 (Fulflo FRB-10)
16SL	135	70101-100	73420 (Fulflo FRB-10)
17S	135	70101-100	73420 (Fulflo FRB-10)
18S	135	70101-100	73420 (Fulflo FRB-10)
19S	250	70101-100	731290 (#72 1 Hayward w/ 100 mesh basket)
16G	135	70101-100	73420 (Fulflo FRB-10)
16GL	135	70101-100	73420 (Fulflo FRB-10)
17G	135	70101-100	73420 (Fulflo FRB-10)
18G	250	70101-100	731290 (#72 1 Hayward w/ 100 mesh basket)
19G	250	70101-100	731290 (#72 1 Hayward w/ 100 mesh basket)
19GL	250	70101-100	731290 (#72 1 Hayward w/ 100 mesh basket)
20G	2@135	70101-100	73420 (Fulflo FRB-10)
21G	250	70101-100	731290 (#72 1 Hayward w/ 100 mesh basket)
22G	250	70101-100	731290 (#72 1 Hayward w/ 100 mesh basket)

Oil Line Sizing

It is very important to properly size the oil suction line and oil filter, to provide fuel flow to the burner without exceeding 10” suction pressure (vacuum) at the oil pump suction port.

The method to properly size copper tubing is outlined below. Consult the burner manufacturers service department for sizing assistance regarding iron pipe.

1. Check oil pump “GPH Suction Capacity” shown in table BT2 on the previous page.

2. Measure total tube length (horizontal and vertical) from the end of the line in the tank to the connection at the oil pump.

3. Choose the appropriate graph below, based on the tubing size. Read up from the horizontal axis “total feet of copper tubing” to “Suction capacity in GPH.

4. Read to the left until the vertical axis is reached. This is the vacuum required to draw oil through the length of tube selected.

5. If the installation has lift (vertical distance the fuel unit is above the top of the tank), add 1” of vacuum for every 1 foot of lift.

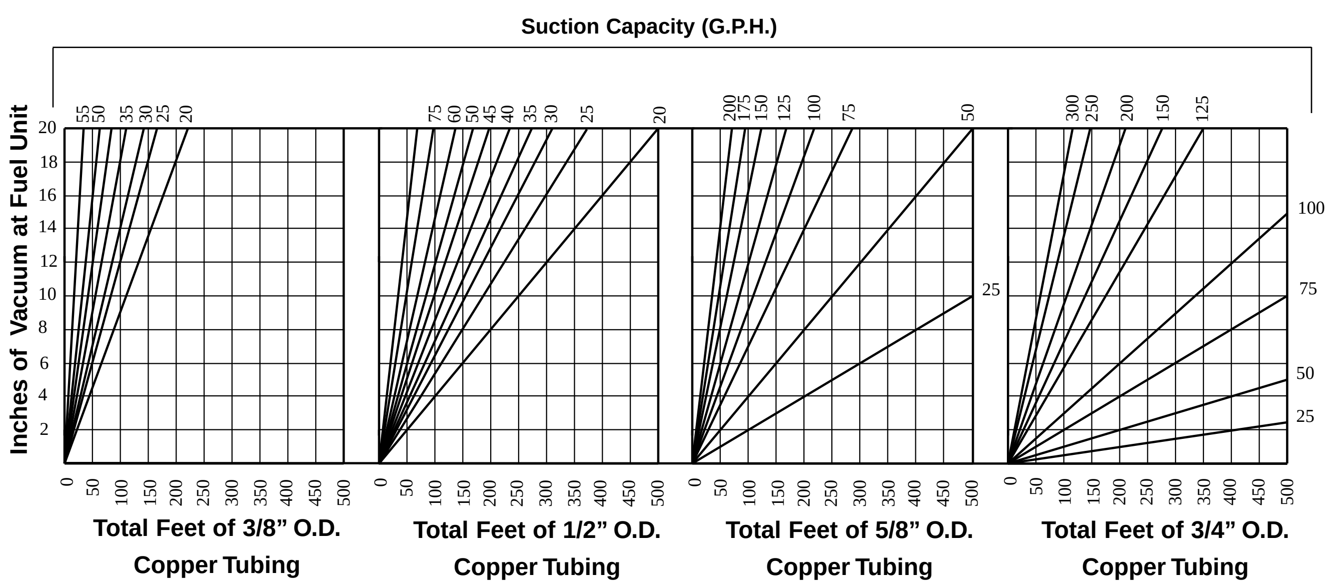
6. Add the two values obtained in steps 4 and 5.

7. If the total obtained in step 6 is over 10” vacuum, move to the next chart to the right (increase tubing size) and re-calculate the total inches of vacuum.

8. These instructions do not allow for any added restrictions, such as the line filter, elbows, sharp bends, check valves, etc. Suction line vacuum values will vary from one manufacturer to another. A good rule of thumb to determine total vacuum for suction line sizing is to add 10% to the vacuum obtained in step 6.

> NOTICE
> SAFETY WARNING
> ***It is always safe to size the return line from the pump to the tank at the same size as the selected suction line.***

Oil Line Sizing (Copper Tubing - #2 Fuel Oil)



Draft Theory

Draft control serves two important functions for *Paraflow*™ Direct Fired Units:

1. It removes the combustion products from the living or work space.

2. Minimizes excess draft which pulls useful heat out of the unit and lowers its efficiency.

Draft depends on two important factors:

1. The temperature difference between the flue gas and the outside air.

2. The height of the chimney.

Temperature Difference

Chimney draft is the force created by the difference in temperature between the flue gases and the outside ambient air. The magnitude of this temperature difference is directly proportional to the draft created. Temperature difference causes draft because gases such as air occupy different volumes at different temperatures.

For example: one cubic foot of air weighs .0834 pounds at a temperature of 0°F. This same cubic foot of air at 450°F weighs only .0422 lbs.. The amount of mass per specific volume is referred to as density. Density decreases as temperature increases and lighter (lower density) air rises while heavier more dense air sinks.

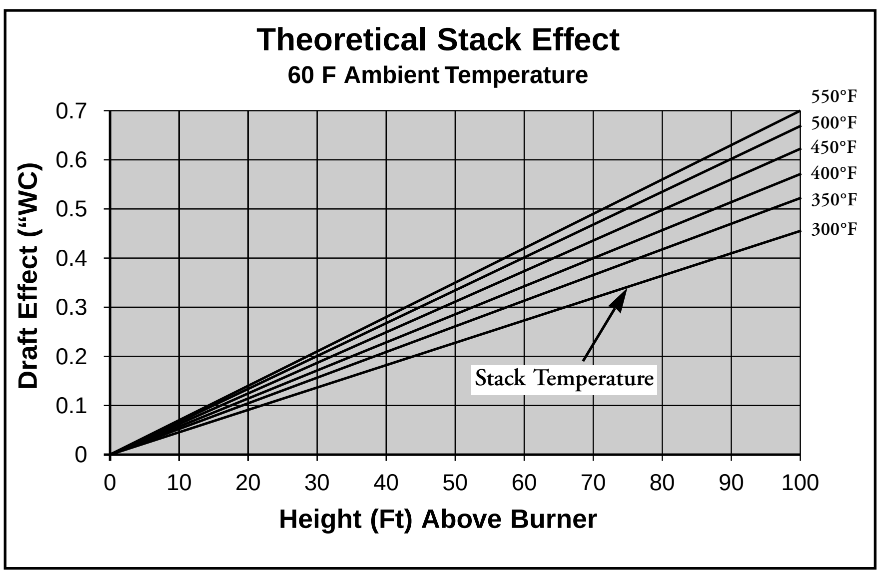
This is the same phenomenon that leads to air stratification in buildings. The temperature in a room at the thermostat may be 70° F, but the temperature near the ceiling may be 80° F.

Heated combustion gases being less dense than the cooler outside air rise and flow out of the top of the chimney and create a partial vacuum. This causes a negative pressure at the chimney inlet that pulls in more gas for venting. This pulling force is referred to as chimney draft.

Because *Paraflow*™ units are capable of operating in both the heating and cooling modes, the outdoor air temperatures will change significantly from the summer (cooling season) to the winter (heating season). These wide temperature swings must be accounted for during burner start-up. The larger the temperature difference the greater the draft. Therefore, when the unit is operating during the colder months more draft will be produced. It is essential that the chimney system be designed using summer ambient conditions so as to avoid under sizing the draft system.

Chimney Height

Chimney height is another major factor influencing the intensity of the draft. Higher chimneys, produce more draft. The graph below shows the relationship between Stack Height, Temperature and Draft



Chimney Design Theory

The following is a discussion of the basic terms and approach used in chimney design. It is not the intent of this section to address the fine details of proper chimney design. Because of the large number of variables, this must be addressed on an application specific basis by an experienced designer knowledgeable in chimney systems, draft control, and local code requirements.

Theoretical Draft (Dt)

The definition of Theoretical Draft is the natural draft or "Chimney Effect" produced by difference in densities of hot exhaust gas relative to cooler ambient air.

Available Draft (Da)

The Available Draft is the draft required at the outlet exhaust flange of the High Temperature Generator.

Pressure Drop (dP)

Frictional losses in the chimney system which act against theoretical draft. The chimney draft needed to overcome chimney frictional losses is described as follows:

Dt = dP + Da

Proper chimney design balances the theoretical draft (Dt) against the pressure drop (dP) of the chimney system in order to provide the required available pressure (Da) at the outlet of the chiller-heater.

Proper chimney design must provide the required (Da) under all operating conditions. Because the difference between summer and winter ambient conditions can result in Dt variations of 50% and greater, some method of draft control is usually required in order to maintain Da.

Chimney Application

The York direct-fired chiller/heater is equipped with a forced draft burner capable of firing on a variety of fuels, including natural gas and/or No. 2 oil and/or propane. As such, the unit will require a properly designed chimney system to control draft and discharge flue gases from the unit to the atmosphere.

The combustion chamber of the chiller-heater is engineered to produce a positive gauge pressure of 0.05 to 0.15 in. of water at the outlet of the first stage generator with an exhaust temperature of 400°F+/-50°F. As such the chimney design must provide a method for maintaining the pressure at all ambient conditions. Because York chiller-heaters operate at “high fire” throughout the summer months, it is important to design the chimney system for summer ambient design conditions to avoid under sizing. It is recommended that the chimney itself should be designed for a Da of 0 (zero) in. of water column. This will prevent the chimney from becoming pressurized at any point along the flue gas path.

CAUTION
GAS LEAKAGE

IF THE STACK / CHIMNEY PRESSURE IS EVER ABOVE 0 (ZERO) INCHES OF WATER COLUMN THERE IS A CHANCE OF FLUE GAS LEAKING INTO THE EQUIPMENT ROOM.

There are two commonly used ways to maintain the pressure at the outlet of the chiller-heater. Either manual or automatic/motorized draft control can be used. All York direct-fired chiller-heaters will come standard with a manual draft control damper. This damper can be modified for motorized operation either in the factory (if ordered) or in the field if site conditions require.

Manual Draft Control

Manual draft control is suitable for applications where each gas fired appliance will have its own dedicated chimney and draft control system. With this type of system, a (field supplied) barometric draft regulator is used in series with the factory supplied manual backdraft damper. With maximum economy employed in the chimney design, Dt would exactly equal dP + Da during the summer design ambient conditions with the barometric regulator closed. In reality, some degree of conservatism should exist in the design, causing the barometric regulator to be open slightly even during summer design conditions. As ambient temperatures drop, Dt would increase, if not for the barometric draft regulator. With the regulator in place, mechanical room air is introduced into the chimney system in response to the impressed draft, thus stabilizing the gauge pressure just upstream of the barometric regulator. Most barometric regulators can maintain -0.06 in. water column gauge pressure when properly sized for a particular application.

With the gauge pressure stabilized upstream of the barometric regulator, the factory supplied manual backdraft damper can be adjusted to a fixed position which will provide the pressure drop to yield the required positive pressure at the exhaust flange of the chiller-heater.

Motorized Draft Control

Motorized draft control is suitable for applications where multiple gas fired appliances will be ducted into one common chimney system. In this case each unit will require its own draft control system. (Motorized draft control may be used for one chiller-heater/one chimney applications as well if it is desired over manual control.) Sequential draft control systems, which incorporate a motorized damper whose position is automatically adjusted as a function of available draft at the outlet of the chiller, can be used as a means of draft control. The York supplied backdraft damper at the outlet of the chiller can be modified (in the factory if ordered, or in the field) to mount the motor driver. The motor is controlled from a draft control panel which senses the pressure at the outlet of the chiller-heater. The draft control panel is available from York to ship with the chiller. The panel is wired to the burner panel and damper motor in the field, and the pressure is sensed through a small line field connected to the outlet of the chiller-heater.

Special Problems and Maintenance

Factors causing draft variations during normal operation include: wind and weather factors, inadequate chimney construction or system installation, location of installation or inadequate system maintenance.

Wind and Weather

Windy conditions will tend to increase the draft in the chimney as the wind helps to remove the combustion products leaving the chimney at a much faster rate. Down draft may occur causing a temporary positive pressure in the chimney system. The stack should be designed to prevent not only wind, but rain and snow from entering the stack. A flue cap should be installed.

Inadequate System Installation

If the diameters of the chimney system are too restrictive, the combustion products and flue gases may not be allowed to leave the system. On the other hand if the flue passages are too large, the chimney is never given a chance to completely warm due to the large surface area of the flue. This situation may cause poor draft and flue gas condensation which can corrode the chimney. To allow the chimney system to heat up faster, insulation should be installed on all exposed flue piping. Insulation is also a good safety measure (often required by code) as the breaching and flue pipes will heat to temperatures in excess of 400°F.

Location of installation

Consideration should be given to the location of the stack in comparison to building intake and exhaust vents, cooling towers, etc. The effect of wind patterns around a building can create surface pressures and eddy currents that could lead to draft problems or contamination of other systems.

Inadequate System Maintenance

Inadequate system maintenance may lead to burner sooting. If left unattended for long periods of time, the flue passages can become restricted reducing the draft. Flue gas should be sampled on a regular basis to check for proper fuel/air ratios.

For More Information

For information regarding chimney and breaching design procedures, refer to ASHRAE 1992 Systems and Equipment Handbook, Chapter 31 and the National Fuel gas code (NFPA 541992). For information regarding the effects of airflow around buildings refer to ASHRAE 1993 Fundamentals Handbook chapter 14.

Also, independent companies exist which design and supply stack materials. These companies have engineering programs to design chimneys for specific application considerations. When contacting such a company expect to need certain information including: Fuel type and consumption, design ambient temp. (it is best to design for the hottest summer day), flue gas temp., expected height of stack, number of expected fittings (elbows, T's, etc.).

Combustion and Ventilation Air Requirements

NOTICE ***Jurisdictional authority relating to combustion and ventilation air requirements vary widely. In order to make certain of compliance, the controlling authorities must be consulted.***

Fresh air required to support combustion, as well as to provide adequate location ventilation, must be supplied.

All types of fuel require approximately 10 cu.ft.. of standard air (sea level at 60°F) per 1000 BTU/HR burner firing rate, for theoretically perfect combustion. In actual practice, a certain amount of excess air is required to ensure complete combustion, but this can vary significantly with specific job conditions. Additional air is also lost from the mechanical room through barometric draft dampers if used.

Ventilation air should be brought in directly from the outside whenever possible.

The following is standard field practice and should be used as a minimum.

All confined mechanical rooms and spaces shall be provided with two permanent openings. One commencing within 12 inches (30cm) of the ceiling and one commencing 12 inches (30cm) from the floor.

Refer to diagram below for different options.

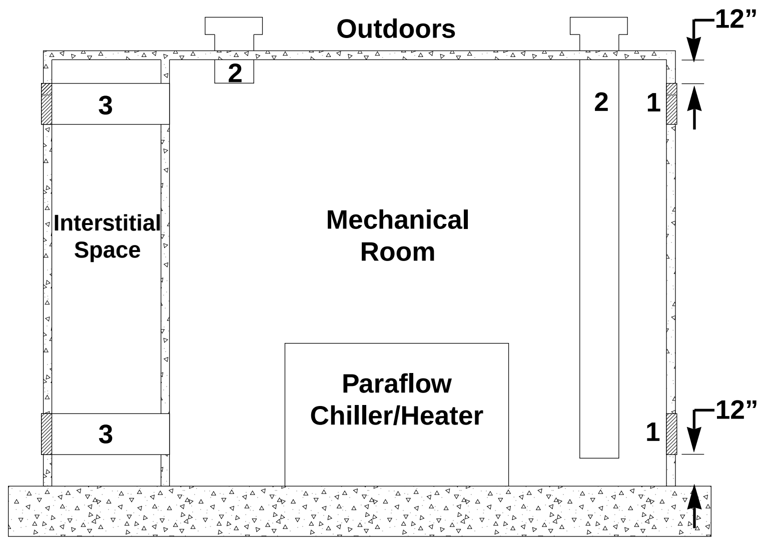
1. If these openings **directly communicate with the outdoors** (on an outside wall), **each opening** must have a minimum free area of 1 square inch per **4,000 BTU/HR** (5.5 cm^2 per kw) of the total input rating of all equipment in the enclosure.

2. If these openings **communicate with the outdoors through vertical ducts**, **each opening** must have a minimum free area of 1 square inch per **4,000 BTU/HR** (5.5 cm^2 per kw) of the total input rating of all equipment in the enclosure.

3. If these openings **communicate with the outdoors through horizontal ducts, each opening** must have a minimum free area of 1 square inch per **2,000 BTU/HR** (11 cm^2 per kw) of the total input rating of all equipment in the enclosure.

Note: If ducts are used, they shall be of the same cross-sectional area as the free area of the openings to which they connect.

Combustion and Ventilation Air in Mech. Rooms



Louvers and Grills

In calculating free area, consideration is to be given to the blocking effect of louvers, grills and screens protecting the openings. Do not use screens which have a mesh size smaller than 1/4" (6.3 mm).

If the free area through the design of louver or grill is known, use it to calculate the size opening required to provide the free area specified. If this value is not known, the following rules of thumb may be used.

Wood louvers will have 20-25% free area and metal louvers and grills will have 60-75% free area.

NOTICE ***Fix louvers and grills in an open position or interlock them with the unit(s) so they open during operation. The latter is preferred so that the temperature in the mechanical room will not drop to a point which may facilitate crystallization in the event of a power failure. All dampers should be allowed to close during a power failure***

To insure that a safe and satisfactory installation has been made, a pre-start inspection is necessary. This inspection must be performed by an individual who is thoroughly familiar with all aspects of chiller/burner installation and how it interfaces with overall plant operation.

The following is a recommended pre-start inspection check list.

General

❒ The burner(s) should be checked for damaged and/or loose components as these conditions can occur during shipment, through improper handling, tampering, or improper care and storage at the job site.

Check For:

❒ Damage to housing, combustion air inlet and all factory mounted components.

❒ Tightness of fasteners, tube fittings, plugs, etc.

❒ Tightness of electrical connections and terminals.

❒ Tightness of adjustment mechanisms such as ball-joint swivel connectors and control arms.

❒ Accumulation of oil, dust, dirt, water or other foreign matter on, in or near the burner.

Note: Repair and/or clean any deficiencies.

❒ Have the following persons been informed of the start-up?

❒ Owner's Representative
❒ Mechanical Contractor's Representative
❒ Electrical Contractor's Representative
❒ Local Gas Utility Representative

❒ Make sure that the installed Burner, Gas Train and other related components are those which were specified in the Burner As Built Specification Sheet (Supplied by Burner Manufacturer)

❒ Make a general inspection tour of the equipment room to ensure that the installation is complete (i.e. piping, controls, wiring, etc.).

❒ Has the burner support stand been installed.

❒ Determine that the voltage supply is correct to the motor starter line connections (L1,L2,L3) and control circuit line connections.

❒ Check blower (and oil pump motor if applicable) rotation by momentarily making contact of the motor starters. Proper rotation is imprinted on the fan housing and (if supplied) the remote oil pump set assembly.

❒ Have piping systems been properly purged of air and filled with water.

❒ Are all system valves and pumps set for the proper operating mode.

❒ Has the cooling tower been filled and put into operation.

❒ Has sufficient load been connected to the unit so that it can fire continuously at full fire rating.

❒ Have the Chilled Water, Condenser/Absorber and Hot Water (where applicable) Pumps been interfaced properly with the appropriate Micro-Panel Contacts (refer to Controls Section for details)

❒ Remove Flame Safe Guard Control from its sub-base and tighten all connections.

❒ Check fuses in main panel and burner control cabinet for continuity.

❒ Have the boiler breeching connections to the stack been completed and are they open and unobstructed.

❒ Has the draft control equipment been installed properly (i.e. Barometric Draft Damper, Manual Back Draft Damper, etc.).

❒ Is the High Stack Temperature (700ºF) Sensing Device(s) installed properly.

Note: *ParaFlow*™ 20G direct fired units require one sensor for each burner (2 total)

Gas Firing

❒ Are all gas train components installed, and have they been properly assembled (refer to Burner Manufacturer's As Built Specification Sheet).

❒ Have properly sized vent lines been installed on all gas train components which require venting? This includes pressure regulators, normally open vent valves, diaphragm valves, low and high gas pressure switches, etc.

❒ Have gas train piping and components been tested and proven gas tight ?

❒ Purge both main and pilot gas lines.

❒ Is the proper gas pressure available at the inlet to the controls which meets the requirements shown on the Burner As Built Specification Sheet, as provided by the Burner Manufacturer ?

Oil Firing

❒ Is the oil tank installed and filled with #2 fuel oil.

❒ Have oil supply and return lines been properly sized to meet the maximum pumping capacity of the pump.

❒ Has the oil piping system been leak tested and purged of air.

❒ Is the proper oil pressure available at the inlet to the controls.

Burner Set-up and Linkage Adjustment Overview

Burners on *Paraflow*™ Units utilize a Honeywell Modutrol Motor with a 90º Stroke to modulate the gas input from low to high fire. This motor receives a 4 to 20 MA signal from the *ParaFlow*™ ISN Control Center depending on the leaving chilled or hot water temperature (cooling or heating mode respectively).

The burners have either 3 or 4 linkage sets depending on whether the unit is gas only or combination gas/oil.

All linkage sets consist of the following components:

2 - Slotted Linkage Arms
1 - Linkage Rod
2 - Ball Joint Connectors
1 - Driver Component
1 - Driven Component

Setting up the burner is as simple as setting up the linkage sets and adjusting the fuel/air ratios to achieve proper combustion and flame appearance at a number of points from low to high fire. The Varicam is used to fine tune the burner only. *It is not always necessary to adjust the Varicam.*

What characteristics should a "good" flame have?

The appearance of a burners flame offers a good preliminary indication of combustion conditions. It is difficult to generalize the characteristics of a "good" flame because of the variations due to burner design and operating conditions.

As the ideal situation is to operate with low excess air, one must be familiar with the conditions this will create compared to high excess air conditions.

Reduced oxygen levels leads to increased flame length because it takes more time to burn completely. The flame actually grows in size, filling the combustion chamber more completely.

It exhibits a lazy rolling appearance. Instead of intense highly turbulent flames, low-oxygen flames may appear to move somewhat more slowly through the combustion chamber.

It has an overall color that may change as excess oxygen is decreased. Natural gas flames for instance, become more visible or luminous with yellow or slightly hazy portions. Oil flames become darker yellow and orange and may appear hazy in spots.

Although low excess air operation is important for good fuel economy, it is sometimes not possible to operate this way due to combustion related problems (refer to Combustion Theory Section for more information).

Jack Shaft Linkage Set

The jack shaft linkage set is used to adjust the stroke of the Varicam (refer to Jack Shaft Linkage Adjustment Procedure for details).

The jack shaft acts as the driver for the Air Damper Linkage Set.

Air Damper Linkage Set

The air damper linkage set is used to control the amount of combustion air that enters the burner as it modulates from low to high fire. This linkage set is adjusted only once, for gas operation. (refer to Combustion Air Damper Section for Further Details).

Fuel Linkage Sets

The two remaining linkage sets, proportion the correct amount of fuel for the desired input. The gas input is modulated using a butterfly gas modulating valve, while on the oil side, an oil modulating valve is used. (refer to appropriate sections for details)

Varicam Adjustments

The Varicam System is designed to fine tune the burner only.

Burner Set-up

The objective when setting up the burner is two fold.

1. The burner should be capable of delivering the desired input to the unit at both high and low fire positions.

Paraflow™ units require approximately a three to one turn down when modulating from high to low fire. The maximum gas input can be determined from either the Burner As Built Specification Sheet as supplied with the unit, the original sales order, or the Factory Start-Up Report.

The low fire input can be determined by simply taking 30% of the high fire input.

High Fire Input X .30 = Low Fire Input

2. The burner should be set to achieve optimal fuel/air ratios along the entire range from low fire to high fire.

The optimal fuel/air ratio for the burner will produce approximately 9.5% CO_2 in the flue gas analysis (gas firing) at all points along the range. The 9.5% CO_2 value should be accompanied by 0% CO (< 50PPM) or a #0 to #2 smoke reading for oil. CO will be produced only in an air starved condition (no excess air). If it is impossible to achieve the above conditions, a CO_2 value somewhere in the range of 7-10% should be used at all times. In other words, the highest CO_2 value in this range is desired while at the same time keeping the CO (Gas), Smoke (Oil)readings at an acceptable level.

The chart below shows the typical ranges of CO_2 and O_2 for *Paraflow*™ units.

Tips to Setting Linkages:

Refer to Linkage and Valve Adjustment Section for details. Each section is broken down into sub-sections as follows.

Description - Explains the purpose of the component.

How It Works - Describes the operation of both the driven component and the linkage set that is driving it.

Driven Item Adjustment Procedure- Procedure for adjusting driven component (i.e. Modulating Gas Valve, Combustion Air Dampers, etc.) Has initial start-up positions listed also.

Linkage Adjustment Procedure
Describes in detail how to set the linkage for the above driven component.

Visual aids are used as much as possible.

The linkage is pre-set at the factory for test conditions and should require minor adjustments only. Mark all linkage positions before any adjustments are made.

CAUTION
EQUIPMENT DAMAGE

LINKAGES SHOULD BE SET SO THEY DO NOT BIND AT ANY POINT ALONG THEIR TRAVEL FROM LOW TO HIGH FIRE.

Firing Rate	% O_2	% CO_2 Nat. Gas	% CO_2 #2 Oil	Smoke	CO*
Low Fire	3 - 7	7.8 - 10	10 - 13	#0 - #2	< 50ppm
Mid Fire	3 - 7	7 - 9	9 - 11	#0 - #2	< 50ppm
High Fire	3 - 4	9.5 - 10	12.3 - 13	#0 - #2	< 50ppm

Notes: Smoke reading applicable for #2 oil, CO applicable for natural gas.
Smoke readings listed are taken from a Bacharach tester.
* CO values of 50 ppm may be too high in some areas (refer to local and state codes to verify correct CO limits).

This will allow the linkage sets to be put back into their original positions should problems arise.

Read over all adjustment sections before attempting to start a burner. Most of the sections have directions for settings to be used ***for initial start-up***. These settings are to be used as a starting point only and may need to be changed later.

Note: The pre-start check list should be completed before start-up.

The following test equipment is required to ensure proper start-up and adjustment of burner equipment to obtain maximum efficiency and reliability of operation.

Any Fuel

1 - CO_2 indicator or O_2 analyzer.
2 - Stack Thermometer.
3 - Draft gauge or inclined manometer.
4 - Combination volt/ammeter.
5 - D.C. micro-ammeter or D.C. Voltmeter depending on the Honeywell Flame Safeguard Control used.

R4140L - D.C. Ammeter, cable connector.
RM7840L - D.C. Voltmeter

Gas Fired Units

1 - CO indicator.
2 - U-tube manometer or calibrated 0-10” and 0-35” W.C. pressure gauges.
3 - 1/4” MPT barbed hose fitting.
4 - Plastic hose.
5 - Cup or glass filled with water.

Oil Fired Units

1 - Compound vacuum/pressure gauge (0-30” vacuum / 0-30 psig).
2 - 0-400# oil pressure gauge.
3 - Smoke Tester

General Start-Up All Fuels

A thoroughly qualified burner technician should be employed to provide the initial burner start up, as well as any subsequent servicing.

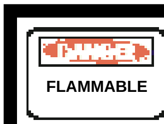
Before attempting a start up for the first time, the technician should study and become completely familiar with the exact sequence of operation and all other details of the specific flame safeguard control system being used. This information will be found in bulletins printed and supplied by Honeywell Inc. A copy of this bulletin was supplied with the burner. The technician should also be familiar with the sequence of operation of *ParaFlow*™ 2 Stage Absorption Units and the ISN *ParaFlow*™ Control Center (refer to Electrical Section for Details).

For combination gas/oil fired units; the gas side operation should be set up first to clock the gas meter, allowing precise gas inputs to be determined. Once the gas operation is complete, the oil side can be set up by correlating the CO_2 - O_2 values of the two fuels.

1. Complete Pre-Start Burner Check List before proceeding.

2. Close main, pilot, and gas checking cocks. Open suction line manual oil valves and others where applicable.

3. Check operating controls, limit controls, flame safeguard control reset, high and low gas pressure switches and all other applicable interlocks. All contacts should be closed except the low gas pressure switch. It will be open until the main gas valve is manually opened. For combination gas/oil units, the low oil pressure switch will remain open until the oil pump is running and the low oil pressure cut in point is reached.



Do not repeatedly recycle the burner. Unburned fuel may accumulate in the combustion chamber causing an unsafe condition.

Settings:

All fuel/air adjustments should be set to achieve required input rate, satisfactory combustion test values, flame stability and appearance.

Combination Gas/Oil Full Modulation Systems

The gas system uses an automatic diaphragm or motorized gas shut off valve to control the on/off flow of the gas. The oil system, uses an oil solenoid valve to control the on/off flow of oil to the oil nozzle. A modulating motor controls the positioning of a butterfly type gas proportioning valve while a V ported metering oil valve provides the modulating function in the oil nozzle return line. The modulating motor also controls the positioning of the combustion air dampers, through appropriate sequencing, providing low fuel/air input for a smooth low fire start and a finite number of fuel/air positions between low and high fire.

When firing gas, the oil metering valve will open and close because it is linked to the modulating motor, however, oil will not flow because the oil solenoid shutoff valve remains closed. Similarly in oil operation the motorized gas shutoff valve will stop gas flow.

Gas Start Up

1. Shut off control power switch to burner panel.

2. Prior to burner start up, contact the local gas company and obtain the following information.

• High (gross) Heating Value (calorific value)
Must be given in **BTU/SCF**.

• Standard temperature and pressure that the gas company uses to define a **SCF** of gas.

SCF - Standard Cubic Foot

This information will be used later to determine the heat input to the Paraflow Unit.

3. Remove the pilot assembly and check for proper settings of the spark gap, tightness of electrode in its bracket and firm connections of the electrode cable (refer to Electrode Adjustments Section).

4. Close main, pilot and gas checking cocks. Install one gas pressure gauge to read burner firing head pressure (use a 0-10" W.C. gauge or manometer). Use 1/4" pressure tap at inlet of burner just below the High Gas Pressure Control. Install a second gas pressure gauge to read the gas supply pressure between the main gas cock and the inlet to the main gas pressure regulator (use a 0-35"W.C. gauge or manometer).

5. Slowly open the main gas cock in order to determine that the incoming gas pressure is within the specified limits of the main and pilot gas pressure regulators, automatic fuel valves and gas pressure switches. The maximum value will be listed on the As Built Burner Specification Sheet supplied with the burner.

6. Disconnect pilot line at the inlet to the pilot gas pressure regulator and purge it of air. Purging should be done in accordance with NFPA 54 of the National Fire Protection Association's National Fuel Gas Code. After the air is purged from the pilot supply line, close the pilot cock and reconnect the pilot line. Leave the pilot cock closed and check for gas leaks.

7. Install required system measuring devices:

a) Appropriate **flame signal meter** to the flame safeguard control.

b) **Manometer** (or 0-10"W.C. gauge) in the pilot test tee port.

c) **Stack thermometer** and **CO_2 or O_2** sample line to the breaching.

d) **Draft gauge** to the combustion chamber test point.

8. Perform a "bubble leak test" on the main gas valve(s) as described in appropriate section of this manual.

9. Set low gas pressure switch to its lowest setting, and the high gas pressure switch to its highest setting (refer to Adjustment of low and high pressure gas switches for additional information).

10. Set the air dampers approximately 1/4" open (adjust linkage rod to air damper driven arm). With both the pilot and leak test gas cocks closed, manually open the main gas cock to allow the low gas pressure switch to make. With the burner control switch in the off position, apply power to the burner panel through the main disconnect switch.

Gas Pilot Set-Up

Pilot Failure and Spark Pickup Tests

Purpose For Tests:

Proves that the flame safeguard control will lockout the burner in the event that the pilot flame is not established within the allowable time period.

1. Turn on control power switch located on burner panel.

2. Start the burner by switching the start/run/stop-reset switch on the Micro-Panel momentarily to the start position. If no faults are present, the burner will start.

> **CAUTION**
> **EQUIPMENT DAMAGE**
>
> ***CHILLED AND CONDENSER WATER SHOULD BE FLOWING THROUGH THE MACHINE FOR ALL BURNER TESTS. DO NOT JUMPER ANY SAFETY CONTROLS WHEN STARTING BURNER UNLESS INSTRUCTED TO DO SO IN THIS MANUAL.***

With the pilot gas cock closed the burner will go through a pre-purge period, after which the gas pilot ignition transformer will be energized, although no pilot will be established (At no time should there be any flame signal reading, nor should the main gas valve attempt to open). At the end of the pilot trial for ignition and blower purge period, the flame safeguard control should shut the system down in a safety lock-out mode, requiring manual reset of the flame safeguard control to restart the burner (wait approx. 3 minutes).

The reset button on the flame safeguard controls are located as follows:

Honeywell R4140L - Red but ton above timer motor.

Honeywell RM7840L - Reset button lower left hand corner.

Reset and restart the burner with the pilot gas cock now open. When the blower pre-purge period ends, pilot ignition will occur and this time a pilot flame should be established. As soon as a pilot flame is sensed, move the run/test switch located on the flame safeguard control to the test position. The switch is located as follows:

Honeywell R4140L - Rear under left side of controller.

Honeywell RM 7840L - Rear upper left hand corner of controller.

A right angled tool such as an Allen key may need to be used to reach this switch.

This will interrupt power to the timer and allow pilot set up.

Refer to charts below for acceptable pilot flame signals and pilot gas pressures.

Acceptable Flame Signals

Control Type	Signal Range
R4140L	3.5-7.5 DCMA
RM7840L	1.25-5.0 VDC

Acceptable Pilot Gas Pressures

Burner Model #	Pressure (“W.C.)
C2-G(O)-20A(B)	1.5-3.0
C3-G(O)-20(25)	1.5-2.0
C4-G(O)-25(30)	1.5-2.0
C5-G(O)-30(30B)	1.5-2.0

Excessive gas pressure and insufficient air are the most common causes of pilot ignition failure.

Read pilot gas pressure using the installed 0-10” W.C. gauge or Manometer. Look for stability of gas pressure at all times.

Air damper openings should be at least 1/4” open for each damper. For dependable pilot ignition, always use the air damper setting that will provide the most air and lowest pilot gas pressure setting allowable for a good pilot signal at all times.

Observe pilot gas signal using the appropriate measuring device and reduce gas pressure to a point where the signal is erratic or reduced substantially from the initial reading using the pilot gas pressure regulator.

Raise the pilot gas pressure to the point where the signal is again stable. Remove scanner and use a mirror to view the pilot flame through the scanner pipe (a live flame from a cigarette lighter or torch may be needed to keep scanner actuated). The pilot flame should completely cover diameter of scanner pipe. Re-install scanner. Return test switch to its run position and the timer should finish its cycle. Because the main manual gas cock is still in the closed position, the unit will trip on flame failure.

Once again reset the flame safeguard control. Restart burner, when pilot flame is established make sure flame signal is still steady and within the specified range. If pilot flame is normal proceed on. If the flame signal is poor, once again put the test/run switch into the test position and adjust as previously described.

Gas Pilot Flood Test (Optional)

Once the pilot is adjusted and felt to be correct, perform the following test to further verify that the pilot will be reliable.

1. Turn the burner off and shut off the manual leak test cock in the main gas train. (This valve should always be closed when making pilot adjustments).

2. Place the flame safeguard control in the test position as previously described.

3. Install a 0-10” W.C. gas pressure gauge or manometer in the pilot test tee fitting. Plug an appropriate flame signal meter into the flame safeguard control if not already installed.

4. Disconnect the high tension ignition lead wire at the ignition transformer secondary terminal. Either hold onto the insulated portion or let the free ignition wire hang loose, so that it is not able to come in contact with the bare ignition terminal on the transformer.

5. Start the burner and let it go through its pre-purge period. As soon as the pilot ignition circuit is energized (listen for the sound of the solenoid valve opening or watch the pilot gas pressure gauge. Let about 3-4 seconds lapse and then carefully touch the ignition lead wire to the transformers secondary terminal.

CAUTION
HIGH VOLTAGE

THE IGNITION TRANSFORMER HAS A SECONDARY VOLTAGE OF 6000 V.

If the pilot fuel/air mixture and ignition electrode are adjusted correctly, the pilot will light instantly and the flame signal reading will be steady and of the correct magnitude. If the pilot doesn’t light instantly, then re-adjust the pilot gas pressure and/or air dampers and/or ignition electrode setting according to the appropriate sections of this manual.

6. Turn the burner off. Reconnect the ignition lead wire to the ignition transformer secondary terminal. Set the “test” switch on the flame safeguard control to the run position. Open the gas checking cock. Turn the burner on and verify that the pilot lights and proves instantly, providing good, smooth ignition of the main gas flame.

7. If the Pilot Gas Flood Test is successful, it is not always a guarantee of correct pilot air/fuel mixture, but a failure will almost always indicate an excessively rich mixture (try opening the combustion air dampers a bit more).

Start burner and allow the timer to go through its complete cycle. When the main automatic gas valve begins to open, slowly open the main manual gas cock to light off the main flame. The main flame should light immediately, if not, it may be necessary to purge air from the main gas line and/or adjust main pressure regulator flow rates.

Adjust the burner as necessary to provide smooth ignition of the main flame. If the flame signal drops significantly when the main automatic gas valve opens, slightly increase the pilot gas pressure to once again obtain a stable pilot flame signal.

Pilot Turndown Test

This test must be performed on all new start-ups and should be performed at each yearly inspection.

The purpose of the Pilot Turndown Test is to ensure that the main flame will light off when the pilot pressure is reduced to its absolute minimum value before tripping the Flame Safeguard Control.

1. Close the manual main gas cocks.

2. Connect a manometer to measure pilot gas pressure during the turn down test if one is not already installed.
3. Open the manual pilot shutoff valve.

4. Start the burner by switching the start/run/stop-reset switch on the Micro-Panel momentarily to the start position. If no faults are present, the burner will start.

5. When the blower pre-purge period ends, pilot ignition will occur and this time a pilot flame should be established. As soon as a pilot flame is sensed, move the run/test switch located on the flame safeguard control to the test position.

6. Turn the pilot pressure down very slowly using the manual pilot gas cock. Read the manometer as the pressure drops. Stop instantly when the Flame Safeguard Control enters its safety shutdown mode..

R4140L - Relay 2K on Flame Safeguard Control will de-energize.

RM7840L - The Flame LED goes out.

7. Note the pressure at the dropout point. The pilot is know at its turn down position. Quickly open the manual pilot gas cock to prevent the Flame safeguard from locking out the burner.

8. Repeat steps 6 and 7 to verify the pilot gas pressure reading at the exact point the flame safeguard control senses no flame.

9. Again increase the pilot gas pressure immediately to prevent the flame safeguard control from locking out and then turn the pressure down slowly to obtain a reading just above the dropout point.

10. Set the "run/test" switch in the **RUN** position and let the sequence proceed. At ten seconds into the ignition trial period, (make sure the automatic main fuel valves open) slowly open the manual main gas valve and watch for main burner ignition. If the main burner flame is established, go to step 16.

11. If the main burner flame is not established within 10 seconds, or within the normal light off time specified by the Flame Safeguard Control manufacturer. Close the main manual gas shutoff valve and shut the burner off using the control power switch located on the burner electrical panel.

Note: If the light off was rough, the pilot flame size is too small.

12. Wait approximately three minutes. Reset the Flame Safeguard Control if it is tripped. Turn on the Control Power Switch and repeat steps 10 and 11.

13. If this second attempt is unsuccessful, adjust the Flame Detector position so that a larger pilot is required to hold in the Flame Delay 2K of LED. This may require relocating the Flame Detector to sense further out on the pilot flame or adding an orifice.

14. Measure the pilot flame signal after adjusting the Flame Detector to make sure it is stable and above the minimum specified.

15. Repeat steps 4 through 14 until the main burner positively lights with the pilot flame just holding in the Flame Safeguard Control.

16. Repeat the light off of the main burner several times with the pilot at turndown.

17. When the main burner lights reliably with the pilot at turndown, disconnect the Manometer and turn the pilot up to normal. If used, remove the bypass jumpers from the low fuel pressure limits. Reset fuel pressure limits if required.

18. Run the system through another cycle to check for normal operation.

Burner Set Up

ParaFlow™ direct fired models can operate in any of three modes, depending on the options purchased: Cooling only, heating only, and simultaneous heating and cooling (with optional high temperature heat exchanger only). The unit should be started in the cooling or simultaneous heating and cooling mode whenever possible.

The unit being fired must be connected to a large enough load to allow the burner to be fired at full load for an extended period of time without overheating the first stage generator. The generator temperature should be kept below 320°F at all times and is set to cut out at 330°F.

It will be necessary to modulate the burner during set-up from low to high fire and also to points in between. For start-up, the Micro-Panel should be put in the service mode, and the load, unload and hold keys should be used to obtain the desired test positions.

To put the Micro-Panel in the Service Operating Mode, follow steps 1-8 on the following page and then press the **MODE** key.

a) Keep pressing the **ADVANCE DAY /SCROLL** key until the following message is displayed.

SERVICE OPERATING MODE SELECTED.

b) Press the **ENTER** key.

c) Press the **PROGRAM** key.

To verify that the Service operating mode has in fact been selected, Press the mode key and the following message should be displayed.

SERVICE MODE

The following set points must be set as follows to allow complete control of the load, unload and hold keys.

"Max. Allowed Loading" - 100%
"Auto Temp Control Delay"- Disabled.
"Pulldown Demand Limit" - 0 min., start 100%, stop 100%

To change the set-point values, follow the procedure below to gain access to the program mode. Then refer to the specific procedure for each set point.

1. Press **ACCESS CODE** key.

2. ENTER VALID ACCESS CODE is displayed.

3. Using entry keys enter **1380.**

4. As each digit is entered, the characters **YORK** are displayed.

Note: If digits other than **1380** are entered, **YORK** is still displayed.

5. Press **ENTER** key.

Note: If digits other than **1380** were entered in step 4, **INVALID ACCESS CODE** is displayed when the **ENTER** key is pressed. If this occurs, enter the correct access code and proceed.

6.ACCESS TO PROGRAM KEY AUTHORIZED is displayed.

Note: Unless terminated by pressing the **ACCESS CODE** key again, the operator will have access to **PROGRAM** key for ten minutes. When 10 minutes have elapsed, access to program key will automatically be disabled and the operator must return to step 1 to gain access. Whenever **PROGRAM** mode is in effect, each key closure will re-initialize the ten minute timer. Automatic exiting of the program will occur only if no key has been pressed during the last ten minutes.

7. Press the **PROGRAM** key.

8. PROGRAM MODE SELECT SET POINT is displayed.

Change set points to the above settings as follows:

When all set-points have been changed, press the ACCESS CODE key to exit PROGRAM mode.

<u>"MAX. ALLOWED LOADING"</u>

1. To enter max. allowed loading, press and release the **LOAD** key. The following message is displayed.

MAX. ALLOWED LOADING,
COOL=XXX%: HEAT=XXX%

2. Using the entry enter 100% for both heating and cooling. If the cancel key is pressed, the default value of 100% appears.

3. Press **ENTER** key.

PROGRAM MODE SELECT SET POINT is displayed.

<u>"AUTO TEMP. CONTROL DELAY"</u>

1. Press the **WARNING RESET** key.

2. Use the **ADVANCE DAY/SCROLL** key until the following message is displayed.

AUTO TEMP CONTROL RESET DISABLED

Note: Each time the key is pressed a different message appears.

3. Press **ENTER** key.

PROGRAM MODE SELECT SET POINT is displayed.

<u>"PULLDOWN DEMAND LIMIT"</u>

1. Press the **PULL DOWN DEMAND** key.

2. The following message is displayed.

SETP=XMIN;START=XXX%;STOP=XXX%

3. Input 0 Min,Start=100%;Stop=100%

4. Press the **ENTER** key.

The only way to accurately determine gas inputs is to clock the meter. Refer to appropriate section to clock the meter. It is essential that the meter is reading only the gas consumption from the unit. If the gas meter is common to several appliances, shut off all other gas equipment for this test or install a temporary meter.

Step 1. Adjust the Jack Shaft Linkage Set so that cam Screw #14 is centered on the Cam Roller for low fire, and Cam Screw #1 is centered on the Cam Roller for High Fire. The modulating motor should stroke 90° (refer to Jack Shaft Linkage Adjustment for Details).

Initial adjustments should be made in the low fire gas position. Turn the burner on and let it advance to the main flame light off position. Hold the burner in the low fire position. The gas valve should be approximately 15° open (refer to Modulating Gas Valve Adjustment Procedure for further details)

Step 2. With the burner in the factory set low fire position, adjust Air and Gas Linkage Sets to obtain an acceptable fuel/air ratio.

Step 3. Modulate the burner to high fire using the load and hold key on the Micro-Panel.

Step 4. Set the manual back draft damper to achieve +.15" of draft before the damper.

Note: To smooth out a flame it may be necessary to increase the draft to a point greater than the +.15". A positive combustion chamber pressure is required at all times.

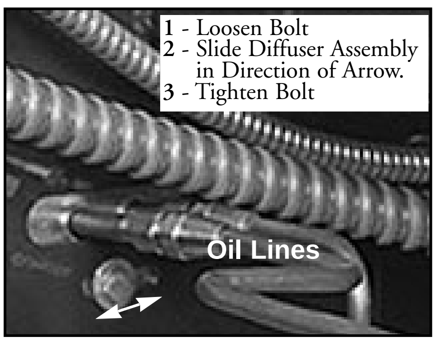
Typically most *Paraflow*™ units operate quite satisfactory when modulating between .05" and .15".

If at any point during the start-up procedure the flame becomes very noisy and it is difficult to achieve a good fuel/air ratio,

the following adjustments should be attempted.

Air Diffuser Adjustment

Air diffuser movement (fore and aft) may be necessary to produce the best flame pattern and/or smoothest operation. Moving the blast tube diffuser assembly fore and aft on both gas or oil firing will move the flame front (point of retention) in order to obtain the quietest/smoothest operation. If the initial midway factory point setting does not provide satisfactory results, move adjustment arm backwards in small increments until the best combustion results are achieved.



If the unit is oil or combination gas/oil (**as shown in figure above**), the attached copper oil nozzle line will move fore or aft with the assembly. When firing on oil, moving the assembly forward will tend to broaden the flame pattern and moving it backwards will tend to narrow the flame pattern. Similar results are obtained on gas, but observation of sound and combustion tests are the best determinants of results on either gas or oil.

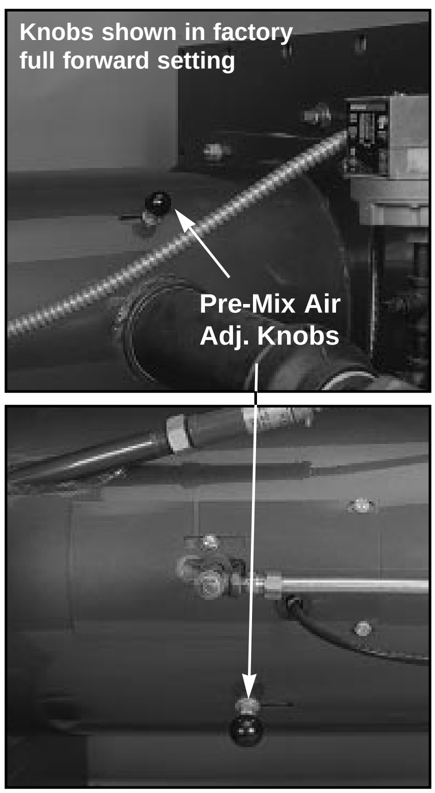
Burner Fuel/Air Premix Adj.

The adjustable pre-mix blast tube (standard) as shown in the **figure at right**, incorporates an adjustable gas/air premix within the burner firing head. Moving the adjustment knobs back, increases the premix air. Moving the knobs forward decreases the pre-mix air. Generally the best (quietest/smoothest) is in the full forward position (factory setting) with minimum pre-mix air. To obtain the best combustion results for specific job conditions, change position in small increments.

Step 5. Adjust the Modulating Gas Valve Linkage Set so that the Modulating Gas Valve is in its full open (Parallel) position.

Step 6. Adjust the Combustion Air Damper Linkage Set so that the dampers are full open.

Step 7. Adjust the main gas pressure regulator until the high fire gas pressure shown on the As Built Burner Specification Sheet is obtained at the burner manifold pressure gauge or manometer. This pressure should be used as a starting point only.



Step 8. Once a good fuel/air ratio is obtained, clock the meter to determine the actual gas input to the burner.

Step 9. Continue to make adjustments to the pressure regulator or modulating butterfly valve until the desired high fire input is obtained.

Note: If in doubt, it is better to slightly under fire the unit rather than over fire it. Over firing can lead to high generator temperature and pressure conditions and also increased inhibitor depletion and unit corrosion. NOx's can also be formed at these high temperatures.

Step 10. Again take a flue gas reading and determine if the optimum fuel/gas ratio is obtained. Adjust combustion air damper until you are satisfied with readings.

Once the desired value is obtained, the regulator and the stroke settings going to high fire should not be touched again. Mark high fire linkage settings using a different color marking pen then that used to mark factory settings. Fill out the high fire section of the burner start-up sheet.

Step 11. Modulate the burner back down to the low fire setting and clock the meter to achieve the desired low fire input.

Note: The low fire input will be the high fire input multiplied by .30 (30% of high fire).

Step 12. Adjust the modulating gas valve off of its 15° position to achieve the desired low fire input.

Step 13. Again take a flue gas reading and determine if the optimum fuel/gas ratio is obtained. Adjust combustion air damper until you are satisfied with readings.

Note: At low fire only small changes to settings can have large effects on fuel/air ratios and subsequently CO and CO_2

values.
Once the desired fuel/air ratio is obtained. Mark low fire linkage settings using a different color marking pen then that used to mark factory settings.

Fill out low fire section of the burner start-up sheet.

<u>Record Data on Start-up Sheet</u>

Record data for several points in-between low and high fire. This will allow one to trend the behavior of the unit. This information can then be used to set the Varicam.

Once the two end points are set, fuel air ratios between low and high fire can be changed by adjusting the angle of either the combustion air damper slotted actuator arm or the modulating gas valve actuator arm (refer to appropriate sections).
If, for example, the excess air values were high between low and mid fire (too much air too fast - low CO_2 values) The gas valve could be set to open quicker at the beginning of the stroke and slower at the end. (Remember the stroke of both the gas valve and dampers must remain the same).

This portion of the start-up procedure requires experimentation and experience. The more burners you start up the better you'll become.

Once you are satisfied with all the linkage settings, mark all linkage positions with a permanent marking pen.

If it is felt that even better fuel/air ratios could be achieved, proceed to the Varicam Adjustment Section of this manual.

Final Safety Checks

1. Set and check operation of low gas pressure switch and high gas pressure switch. Refer to appropriate sections of this manual.

2. Set and check operation of combustion blower air flow switch.

Burner Motor Full Travel Calibration

The following procedure should be performed only after the linkage is adjusted as previously described.

Burners used on gas/oil fired units are usually capable of firing rates higher than the required unit rated capacity. Over firing the unit will waste fuel and cause damage to the unit. The burner firing rate must be limited, therefore, to the MBH heat input (for heating or cooling mode, whichever is higher) specified in the factory test report or burner specification sheet. The burner modulating motor will be at maximum travel (full load) when it receives a 100% load command from the Micro Computer Control Center and minimum travel (minimum load) when it receives a 30 % load command.

The Burner Motor Full Travel Calibration Procedure as described below is necessary because the position of the burner stroke is displayed on the keypad display (via the Display Data Key) in terms of % Load. Minimum travel is displayed as a 30% load command and full travel is displayed as 100% load command. However, since there is no position feedback from the burner, the actual position must be derived from the current output from the Control Center to the burner.

During unit operation, the burner is modulated over the range of minimum travel to full travel by a 4-20 MA output from the I/O expansion board. Typically, a 4MA output will drive it to the minimum travel position (low fire). A 20MA signal will drive it to the full travel position (Full Fire). Due to variations in burner stroke tolerances, different burners could require more or less current to reach full travel extremes. For example, one burner may be at minimum travel at 3.8MA and full travel at 18.5MA. Another might be at minimum travel at 4.5MA and full travel at 20.5MA. To establish what output current is required to drive the motor to full travel, the calibration procedure listed below drives the burner to full travel and stores the current output value as the "100% Load Command". It then drives the motor to minimum travel and stores this current output value as the "30% Load Command". After the calibration procedure has been completed, whenever the burner drive current is that which was stored at minimum travel,

LOAD COMMAND = 30%
is displayed.

When the current reaches that which was stored for full travel,

LOAD COMMAND = 100%

is displayed via the **DISPLAY DATA** key.

The % load command displayed between these two values is a linear function of the current output.

% Load CMD =
$$(\text{Actual} - I_{30\%}) \times [70 / (I_{100\%} - I_{30\%})] + 30$$

Calibration Settings

The following procedure pertains to both single and dual burner units. For single burner units, two people are required - one at the burner to observe the modulating motor rotation and one at the Micro Computer Control Center to capture the burner control current value. For dual burner units, three people are required - one at each burner and one at the Micro Computer Control Center.

With dual burner units, both burner controls are wired in series. The 4-20MA control signal from the I/O Expansion Board travels through the first burner control, then through the second burner control and returns to the I/O Expansion Board. If both modulating motors were ideally matched for rotation, for the same output current, either burner motor could be used for calibration purposes. However, burner tolerances require that both motors be considered.

"Full Travel" as discussed in step 6 on the following page is the point where the (last) modulating motor stops rotating while opening its gas valve. "Minimum Travel" as discussed in step 7 is the point where the (last) modulating motor stops rotating while closing its gas valve. This guarantees that both gas valves will fully open and close for the 4 - 20 MA control signal. This may introduce some slack at the top and/or bottom for one or both burners, depending upon the degree of match in rotation of the two motors.

Pencil marks should be made on the motor, prior to the procedure below, to mark the limits of travel.

1. The unit must be running in the service operating mode.

2. Micro Board jumpers JP1 (gas/oil units) and J51 (limit override) must be installed.

3. Enter **PROGRAM** mode using access code **1-3-8-0**.

PROGRAM MODE SELECT SET POINT is displayed.

4. Press the **AUTO** key.

PERFORM BURNER CALIBRATION? (1=YES; 0=NO) is displayed. If it is desired to perform the following procedure, press 1. Otherwise Press 0 to exit.

The following message is displayed.

PROGRAM MODE, SELECT SET POINT

Note: If at any point during the calibration process it is desired to terminate the procedure, press the "*" key. All previously programmed calibration values are retained. Also, any unit shutdown during calibration terminates the procedure.

5. Press **ENTER** key.

BURNER CONTROL CURRENT = XX.X MA is displayed.

The burner will be driven open until it reaches the full travel position and stops rotating. The current displayed is that which is being output to the burner control. It will increase as the motor rotates toward the full travel position.

6. At the instant the motor reaches its full travel position, the person at the burner must signal the person at the Micro Computer Control Center to capture the motor current value. This is done by pressing the **HOLD** key. For YPC-DF-20G units, both burner persons must signal with the last burner signal used as the capture. The lowest current value that will be accepted for full travel is 18.3MA. Lower current values will be ignored by the software. Pressing the **HOLD** key also causes the motor to reverse direction and travel toward the minimum travel position.

7. When the motor reaches its minimum travel position, the person at the burner must signal the person at the Micro Computer Control Center to press the **HOLD** key to capture the motor current value. For YPC-DF-20G units, both burner persons must signal with the last burner signal used as the capture. The highest current value that will be accepted for minimum travel is 5.0 MA. Higher current values will be ignored by the software.

8. FULL FIRE CONTROL RANGE= XX.XMA TO XX.XMA is displayed.

9. Press the **ENTER** key.

PROGRAM MODE, SELECT SET POINT is displayed.

10. Press **PROGRAM** key to exit.

11. Remove micro board program jumper **J51**.

Oil Burner Set -Up (Where Applicable)

Once the burner is set up in the gas operating mode, the oil side should now be set-up.

Refer to gas pilot set-up section and confirm that pilot burner operation satisfies all required tests. Make pilot and/or electrode adjustments as necessary.

Note: Adjust Low Oil Pressure Cut Out Switch so that it is well below normal operating conditions.

Step 1. Install oil pressure gauge (refer to oil Pump Gauge Port Location). The return pressure gauge should already be installed. Check suction line to be sure that all manual oil valves are open and that all check valves are installed in the proper direction of flow. Install suction vacuum gauge in the suction line.

Step 2. Check oil filter for tightness.

Note: There should be no manual valve in the return line from the pump to the tank (unless required by code).

Step 3. Install required system measuring devices.

a) Appropriate Flame Signal Meter to the Flame Safeguard Control.

b) Stack thermometer, CO_2/O_2 and smoke test sample lines in the breeching.

c) Draft gauge to combustion chamber test point.

Step 4. Appropriate steps must be taken to transfer the oil from the tank to the burner. It is imperative that the system be primed prior to operation. The system priming may be achieved by closing the manual valve in the oil suction line and priming the oil pump through the pump gauge pressure port. Priming can also be accomplished through the oil filter on the suction line if it is a removable top type. When replacing the oil filter cap, be sure to obtain a vacuum tight seal. Start with the suction line manual valve closed. Let the burner run until the vacuum gauge indicates a high vacuum, then quickly open the manual valve in the suction line.

This combination of priming and high suction should pull the oil from the tank to the burner, provided there are no leaks and the line is properly sized.

Step 5. Start the burner and allow normal sequencing to occur. Use the load, unload and hold keys in the service mode to hold the burner in its low fire position.

Note: Do not repeatedly recycle the burner, such as to allow any accumulation of unburned fuel in the combustion chamber.

A modulating motor is connected by linkage through the Varicam Fuel Metering System to the fuel metering valve located in the oil return line. The metering valve modulation controls the fuel input to the burner from low to high fire.

DANGER

Because the combustion air dampers were set for gas operation, it is important that only the fuel linkage set be adjusted for oil firing (Do not re-adjust the air dampers).

Step 6. With the burner in the factory set low fire position, adjust the oil linkage set to obtain an acceptable fuel/air ratio.

Note: The pointer on the modulating valve should be set between 6 - 7 for low fire operation and should modulate towards the 0 position (high fire setting)

Step 7. Modulate the burner to high fire using the load and hold key on the Micro-Panel.

Step 8. Adjust the oil linkage set so that the pointer on the oil modulating valve is in its 0 (fully closed) position.

Step 9. Adjust the nozzle (pump discharge) pressure to 300 PSI (refer to Oil Pump Adjustment Section for details).

Step 10. Continue to adjust this pressure until an optimum high fire fuel/air ratio is obtained. If a CO_2 indicator is being used, use the CO_2 - O_2 ratio chart to determine the CO_2 value needed for oil firing (refer to Oil Modulating Valve Adjustment Section).

If an O_2 indicator is being used, simply match the O_2 reading that was obtained and recorded for the high fire gas sample and adjust the oil nozzle pressure until the same O_2 value is achieved for the high fire oil sample.

Take a smoke reading at this O_2 setting and make sure the reading is acceptable.

Once the desired value is obtained, the oil pressure regulator setting should not be touched again.

Record full fire nozzle pressure and all other high fire data on the start-up sheet.

Step 11. Modulate the burner back down to low fire. Again correlate the CO_2 or match the O_2 values from those recorded for low fire gas operation.

Step 12. Adjust the oil linkage set once again until the desired CO_2 or O_2 value is obtained.

Note: Once again modulate the burner to its high fire position and make sure that the oil modulating valve is in the 0 position at high fire. Make minor adjustments as necessary.

Step 13. Once the two end points are set, fuel air ratios between low and high fire can be changed by adjusting the angle of the oil modulating valves slotted actuator arm (refer to Oil Modulating Valve Adjustment Section for details).

Repeat adjustment until the correlated CO_2 or O_2 values that were obtained during gas start-up (for various points between low and high fire) are equal to those for oil firing.

Step 14. Permanently mark the oil linkage set at its final position.

Step 15. If additional adjustments are necessary, proceed to the Varicam Adjustment Procedure)

Final Safety Checks

1. Check operation of low oil pressure cut out switch. Set at 80% of low fire oil pressure.

Full Fire Mode Set-Point

Units that operate in both cooling and heating modes, usually require a different maximum burner output for cooling and heating. Some units require a maximum burner output for cooling that is higher than that for heating. Other units require the opposite. The mode requiring the highest maximum output becomes the full fire rate of the unit. The maximum burner output of the remaining mode is considered a percentage of the full fire rate of the unit. For example, if the unit is in the heating mode and full fire position and it has a heating mode burner travel from 4.7MA (min.) to 18.7MA (max. travel) and the cooling mode requires a full fire rate that is 70% of the heating mode, then the full travel of the cooling mode will be from 4.7MA (min. travel) to 13.1MA (max.travel ;70% of 18.7MA). In the cooling mode the current will be limited to 13.1MA and **LOAD COMMAND = 100%** will be displayed (via the **DISPLAY DATA** key) at this value.

Heating Mode

% Load	30%	50%	65%	100%
Current	4.7MA	8.7MA	11.7MA	18.7MA

Cooling Mode

% Load	30%	50%	65%	100%
Current	4.7MA	8.7MA	11.7MA	18.7MA

LOAD COMMAND = 30%
will be displayed when the current is reduced to 4.7MA.

The percent load command between these extremes is a linear function of the current output. This example is diagrammed in the figure below.

This procedure must be performed on all installations.

The program value for the maximum firing rate of the LESSER of the two modes (cooling or heating) as previously described in the burner calibration procedure cannot be mathematically derived but must be found by manually loading the unit to the maximum heat input specified for the lesser mode while clocking the gas meter to the burner. The "Percent Load Command" displayed at this point is the value which is entered in the procedure below.

The percentage cannot be determined by dividing the lesser required maximum heat input (MBH) by the greater required heat input (MBH).

1. Clock the meter and adjust the load unload and hold keys in the service mode, until the desired high fire input for either heating or cooling (whichever is lower) is found. Record this percentage.

2. Gain access to the **Program** mode using access code 1380.

PROGRAM MODE SELECT SETPOINT is displayed.

3. Press the **Hold** key

"FULL FIRING MODE = 0 (0 = CLG ;1=HTG)" is displayed.

4. Using the **ENTRY** keys, enter 0 or 1 as appropriate or press the **ADVANCE DAY/SCROLL** key to advance to the next prompt. If the **CANCEL** key is pressed, default value 0 is displayed.

Either cooling or heating should be selected during this step. The mode selected should be that mode which has the higher maximum high fire input.

Note: If the unit operates in one mode only, select the proper mode of operation in this step.

The mode selected will operate at the end points as determined in step 9 of the burner calibration procedure and its display will automatically be set to 100% at the high end of the range and 30% at the low end of the range.

5. Press the **ENTER** key.

6. Press the **ADVANCE DAY / SCROLL** key.

"MAX MMM INPUT = XXX% OF FULL FIRE" is displayed.

"MMM" is automatically replaced by the alternate mode from that which was designated in step 4.

7. Using the **ENTRY** keys, enter the desired percentage of full fire for this mode (**Value obtained in step 1**).

If the unit is to operate in only one mode, or both modes have the same high fire input enter 100%.

8. Press the **ENTER** Key.

9. Press the **PROGRAM** key to exit. The normal foreground message is displayed.

The burner set-up is now complete. Make sure all start-up data is properly recorded and left in the burner panel for future reference.

"Clocking The Meter"

The only accurate way to determine gas input to the unit is by clocking the meter. It is essential that the meter is reading only the gas consumption from the unit. If the gas meter is common to several appliances, shut off all other gas equipment for this test (or install temporary gas meter to unit to be tested)..

If you have not already done so, contact the local gas company and obtain the following information.

• High (gross) Heating Value (calorific value)

Must be given in **BTU/SCF**.

• Standard Temperature and Pressure that the gas company uses to define a SCF of gas.

SCF - Standard Cubic Foot

Record data below or on a separate worksheet.

High Heating Value BTU/SCF = ____________
Standard Temperature = ____________
Standard Pressure = ____________

Perform The Following Calculations:

1. Determine the Actual Cubic Feet per Hour (ACFH).

Two things have to be determined in this step.

a. Units on the meter dial. (ie, 10, 100, etc.)

b. Time it takes for the selected dial to make one revolution.

Put these two values into the equation below and solve for the **ACHF**

$$\frac{3600}{\text{Seconds Per Revolution of Meter Dial}} \times \text{Units of Measured Meter Dial} = \text{Actual Cubic feet Per Hour (ACFH)}$$

2. Measure the Temperature and Pressure at the Gas Meter.

Take a pressure reading at the gas meter while you're clocking it. The temperature of the gas will most likely be the pipeline temperature, 60°F .

3. Convert Measured ACFH to SCFH using the equation below.

$$\text{SCFH} = \text{ACFH} \times \frac{\text{Standard Temperature (°F)} + 460}{\text{Measured Gas Temp. (°F)} + 460} \times \frac{\text{Measured Gas Pressure (psia)}}{\text{Standard Gas Pressure (psia)}}$$

4. Multiply Heating Value/SCF By SCFH to get BTU/Hr.

Example:

Step 1

A 10 Cubic Ft. Dial on a gas meter takes 8 seconds to make one revolution.

3600/8 X 10 = 4500 Actual Cubic Ft. (**ACFH**)

Step 2

Pressure at the meter with the unit running was measured at 4.5 psig.

Temperature at the meter is assumed to be 60 °F.

Step 3

The Local Utility Co. reports that the high heating value of their gas is 1098 BTU/SCF

Their Standard Cubic Foot is based on 14.65 psia @ 60 °F

Use values above to determine Standard Cubic Foot Per Hr. (**SCFH**)

(4.5 + 14.7)/14.65 X (60 + 460)/(60+ 460) X 4500 ACFH = 5897.61 SCFH

Step 4

5897.61 SCFH X 1098 BTU/SCF = 6,475,576.8 BTU/HR or 6475.58 MBH

Main Gas Valve Bubble Leak Test

Purpose for Test:

This is a test for checking the closure tightness of the auxiliary (where applicable) and main gas shutoff valves.

Test Procedure:

Equipment needed :

1 - 1/4" MPT barbed hose fitting.
1 - Cup or glass filled with water.
1 - Plastic hose for fitting.

For *ParaFlow*™ applications using redundant gas valves, the aux. gas valve will be checked first followed by the main gas valve.

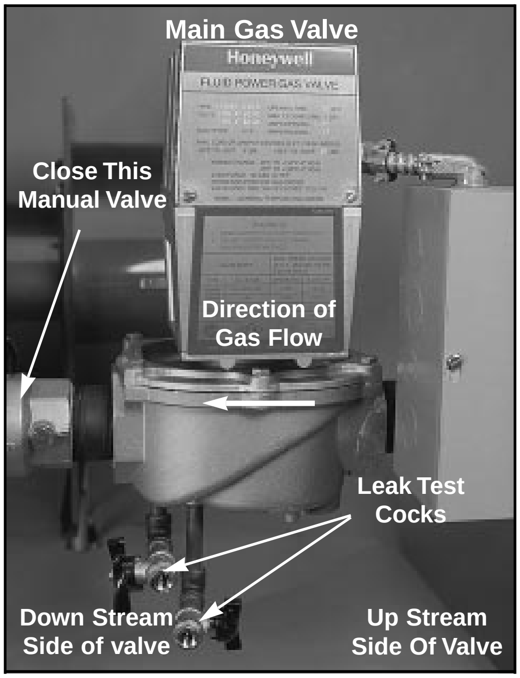
If a N.O. vent valve is used, it must be energized at all times during this procedure.

Auxiliary Gas Valve Test (where applicable)

1. Close both test cocks.

2. Close manual gas cock located on the down stream side of the main gas valve.

3. Install test apparatus on pressure tap located on the up stream side of the main gas valve.



4. Momentarily energize the aux. gas valve to fill line between to valves with gas. Both valves are electrically connected in parallel so it will be necessary to separate the power leads to the valves.

5. Open up stream test cock.

6. After initial pressure is bled off no bubbles should be noticed. If any bubbles at all are noticed, the auxiliary gas valve should be replaced.

7. Remove apparatus and plug pressure tap. Always install new pipe joint compound to plugs when re-installing.

Main Gas Valve Test

1. Close all test cocks.

2. Close manual gas cock located on the down stream side of the main gas valve.

3. Install apparatus on pressure tap located on the down stream side of the main gas valve.

4. Energize aux. gas valve (where applicable) and momentarily energize main gas valve..

5. Open down stream test cock.

6. After initial pressure is bled off no bubbles should be noticed. If any bubbles at all are noticed, the main gas valve should be replaced.

7. Remove apparatus and plug pressure tap.

8. Once again energize gas valve(s). Using soap bubbles, check for gas leaks.

9. Reconnect wires to proper terminals. Open manual gas cock at the outlet of the main gas valve.

The following information shall be recorded for each burner start up:

Job Name ______________________________ Start-Up Date ________________

Burner Model #________________ Invoice #______________ Serial #________________

Unit Model # ________________ Unit Serial # ____________ York Contract # ______________

Start-Up Technician __________________________ Company __________________________

Type of Burner: Gas Only ❐
Combination Gas/Oil ❐

Type of Gas: Natural ❐
Propane ❐

General

Gas Pressure at Pilot Test Tee
__________ "W.C.

Power Supply
Volts______ Ph______ Hz______
Control Circuit Volts _________VAC
Blower Motor Amps at High Fire ____A

Remote Oil Pump Motor Amps at High Fire ________A

Type of Flame Safeguard Control

R4140L ❐
RM7840L ❐

Gas Firing

Gas Pressure at Train Inlet
Burner in Off Position ___ " W.C.

Gas Pressure at Train Inlet
Low Fire _____ "W.C.
High Fire _____ "W.C.

Gas Pressure at Firing Head
Low Fire _____ "W.C.
High Fire _____ "W.C.

Flame Signal Readings

Pilot Only _____MA _____ VDC
Low Fire _____MA _____ VDC
High Fire _____MA _____ VDC

Control Settings

Low Gas Pressure Switch ______ "W.C.

High Gas Pressure Switch _____"W.C

Oil Firing

High Fire Vacuum Reading at Oil Pump Inlet _________ " HG

Oil Nozzle Supply Pressure
Low Fire _____ PSI
High Fire _____ PSI

Oil Nozzle Bypass Pressure
Low Fire _____ PSI
High Fire _____ PSI

Flame Signal Readings

Pilot Only _____MA _____ VDC
Low Fire _____MA _____ VDC
High Fire _____MA _____ VDC

Control Settings

Low Oil Pressure Switch ______ PSI

NOTES:

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Gas Start-Up Data Sheet

% Firing Rate	% CO_2	% O_2	% (ppm) CO	Input (BTU/HR) *	Over Fire Draft (“W.C.) (Opt.)	Stack Outlet Draft (“W.C.)	Cam Screw #
30% Low Fire							#14
100% High Fire							#1

Note: * The meter should be clocked to determine the burner input at the following firing positions: Low Fire, Maximum Burner Input (cooling or heating whichever is **higher**) (Located on Burner as Built Specification Sheet) and Maximum Burner Input (cooling or heating whichever is **lower**) (Located on Start-Up Report). Over fire draft can be taken for future maintenance purposes (refer to maintenance sec tion for details).

Oil Start-Up Data Sheet

% Firing Rate	% CO_2	% O_2	Smoke #	GPH Firing Rate	Over Fire Draft (“W.C.) (Opt.)	Stack Outlet Draft (“W.C.)	Cam Screw #
30% Low Fire							#14
100% High Fire							#1

Note: The oil side is set up simply by matching the O_2 values obtained during gas operation for various firing rates. (For example: if 5% O_2 was the reading at 30% firing rate at low fire for gas operation, adjust the oil input until this same 5% O_2 is achieved for oil operation. remember that the smoke value must also be in the acceptable range. If CO_2 is being tested, use Figure B8 on page 37 to determine the required CO_2 value. **Do not change the combustion air setting during oil set-up as this will affect gas operation.**

Butterfly Gas Valve

Description

The butterfly gas valve (shown in **Figure B4**) is a fuel throttling device which proportions the gas in proper ratio to the combustion air. The valve body is constructed of cast iron. This is a non-tight shutoff valve, therefore, a positive shutoff valve will be needed to stop gas flow when the burner cycles off (refer to Gas Train Details for Main Gas Valve Information).

How It Works

The valve is opened or closed by a Honeywell actuator motor. Linkage arms and rods are used to transmit the movement of the motor (90º Stroke) to the Varicam and finally to the gas valve. Since the amount of air available for combustion is controlled by the same actuator motor, a proper fuel/air ratio is maintained at all times (refer to Varicam Adjustment Procedure for further details).

Gas Valve Adjustment Procedure

1. Use a box end or socket wrench to loosen or tighten the ball joint connectors.

2. To adjust low fire (minimum) fuel setting, loosen ball-joint connector holding drive rod and manually position butterfly disc to desired opening, then retighten connector.

Note : Slot in end of butterfly shaft indicates position of internal disc. If slot is parallel to the gas flow it is fully open. It will be fully closed in the perpendicular position.

For initial start-up: Position actuator arm so that the internal disc is approximately 15º open. It should stroke to fully open at high fire.

Linkage Adjustment Procedure

1. Use a box end or socket wrench to loosen or tighten the ball joint connectors.

2. To adjust the amount of travel (stroke), loosen base of ball-joint connector located in slotted (gas valve) actuator arm and reposition to desired setting, then retighten connector.

Moving the linkage in the following directions holding all others constant will (Figure B4):

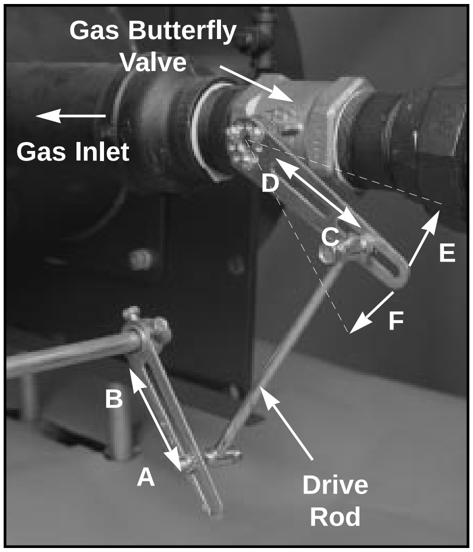


Fig. B4 Gas Valve Linkage Adjustment

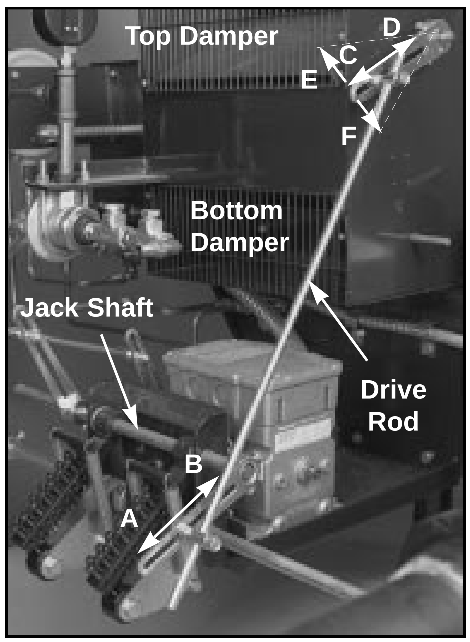
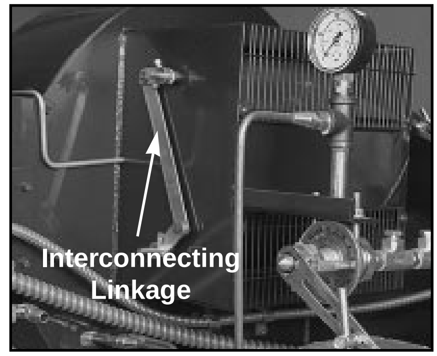


Fig. B5 Air Damper Linkage Adjustment

A - Increase Gas Valve Opening.
B - Reduce Gas Valve Opening.
C - Reduce Gas Valve Opening.
D - Increase Gas Valve Opening.
E - Quickens travel of gas valve between low and mid fire.
F - Slows travel of gas valve between low and mid fire.



Combustion Air Damper

Description

The amount of air available for combustion is controlled by adjustable dampers located in the air box as shown in **Figure B5**. The dampers are interconnected by a flat linkage bar (shown above) which allows movement of both dampers with only one drive rod.

How It Works

The damper opening and travel is controlled by adjusting the linkage set from the jack shaft as shown in **Figure B5** to obtain the desired opening and stroke. The Honeywell Modutrol Motor indirectly drives the dampers open or closed depending on the load signal coming from the Micro-Panel. The dampers will move from approximately 1/4" open at low fire to full open at high fire.

Damper Adjustment Procedure

Adjust the air linkage set in the gas operating mode. If a combination gas-oil burner is used, the air damper linkage is to be set only once; during gas set-up. The input from the oil fuel side will be adjusted for these air settings.

For initial start-up: Set both dampers so that they are open 1/4” at the low fire setting.

Some applications may require the burner to operate at the low end of its rated capacity. As a result, the two combustion air inlets may supply more air than is needed for efficient combustion. In some instances it may be desirable to operate the system using only one air damper and inlet. This may be accomplished by removing the interconnecting linkage as shown in the diagram on the previous page, and locking the unused damper in a fixed closed position.

Typically it is not necessary to fix one damper in the closed position. This should only be done when all other possibilities have been explored.

Linkage Adjustment Procedure:

1. Use box end or socket wrench to loosen ball-joint connector.

2. Retighten ball-joint connector.

To adjust the amount of travel (stroke), loosen base of ball-joint connector located in the slotted (damper) actuator arm and reposition to the desired setting. Retighten the connector.

Moving the linkage in the following directions holding all others constant will (Figure B5):

A - Increase Damper Opening
B - Decrease Damper Opening
C - Decrease Damper Opening
D - Increase Damper Opening
E - Slows opening of damper between low and mid fire.
F - Quickens opening of damper between low and mid fire.

Oil Modulating Valve

Description

Oil burners which have low fire start fuel control systems, must deliver oil to the nozzle at reduced pressure for low fire.

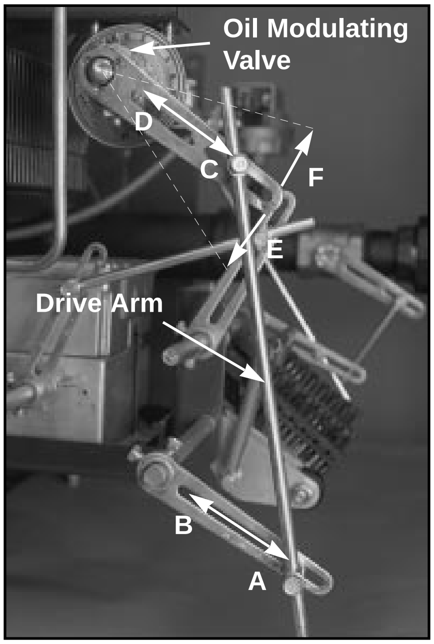


Fig. B6 Oil Valve Linkage Adjustment

This is accomplished by diverting a portion of the oil pump delivery through a bypass return line and back to the storage tank.

The amount of oil delivered to the nozzle versus that returned to the tank is controlled by a device which limits or meters flow, thus an oil modulating valve (**Figures B6-B7**) is used for this purpose.

How It Works

An oil modulating valve works on the principle of limiting flow by constricting the area through which the oil must pass. In order to vary the orifice area, mechanical movement must take place, thus the oil metering valve requires an actuator to do this job. By interconnecting a common actuator to the combustion air control and the oil metering valve, this allows the fuel (oil) to be proportioned in precise ratio to the amount of air available for combustion. This feature is essential on modulating type fuel control systems.

Oil Valve Adjustment Procedure

The amount of travel to be used is dependent upon the required turn down ratio (flow rates) between high-fire and low-fire and the flow characteristics of the particular valve.

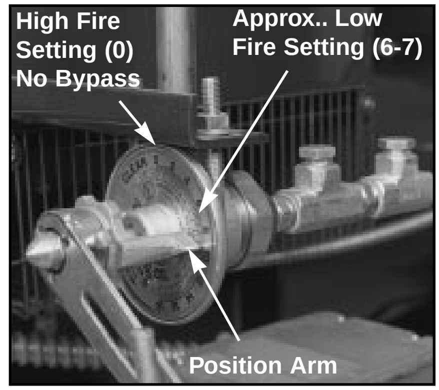


Fig. B7 Oil Modulating Valve Adjustment

For Initial Start-Up: Use Factory Setpoints

After the gas side has been set up and the combustion air dampers adjusted accordingly, adjust the high fire supply oil pressure to obtain a flue gas analysis as shown in **Figure B8** on the following page.

Figure B8 correlates the relative values of O_2 and CO_2 for the fuels listed, as well as the percentage of excess air at given O_2 and CO_2 values.

Example:

Locate the dashed vertical line intersecting 4% O_2 on the horizontal axis. Move up this line until it intersects with curve “D”. From this point move horizontally to the right until it intersects with the right vertical axis. This shows that a **4% O_2** reading is equal to **23% excess air**.

Continue to move up the dashed vertical line until it intersects line A (Natural Gas). Move horizontally to the left hand vertical axis (% CO_2). 4% O_2 and 23% excess air correlate to 9.5% CO_2 for Natural Gas and 12.5% CO_2 for #2 Fuel Oil.

This chart must be used if a CO_2 measuring device is used to set up the burner. ***If an electronic O_2 combustion analyzer is used to set-up the burner, simply set the O_2 values for oil equal to the O_2 values for gas at***

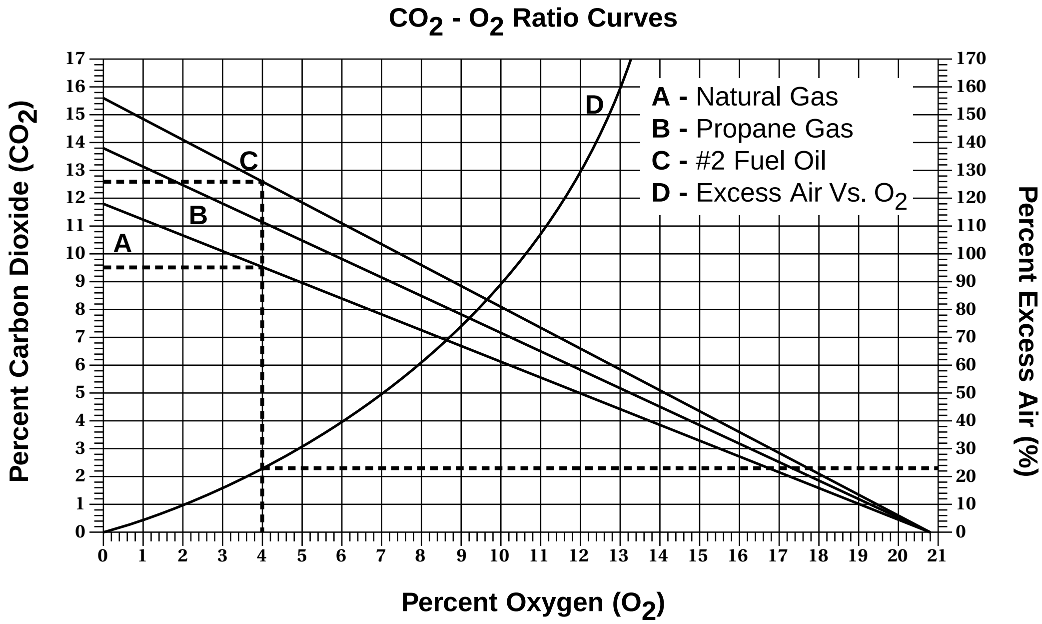


Figure B8

each measured point going from low fire to high fire. *Do not readjust the combustion air linkage.*

Adjustment requirements cannot be finally established until after the burner is fired. The valve should work from approximately mid-open to a closed position. At high fire, all the oil flow should go to the nozzle. Typical valve settings at low fire are approximately 6-7 on the dial (**refer to Figure B**7).

Linkage Adjustment Procedure

To adjust amount of travel, loosen the base of the ball joint connector located in the slotted actuator arm and reposition to the desired setting. Re-tighten the connector.

Moving the linkage in the following directions holding all others constant will (Figure B6):

A - Increase Oil Valve Opening.
B - Decrease Oil Valve Opening.
C - Decrease Oil Valve Opening.
D - Increase Oil Valve Opening.
E - Slows travel of oil valve between low and mid fire.
F - Quickens travel of oil valve between low and mid fire.

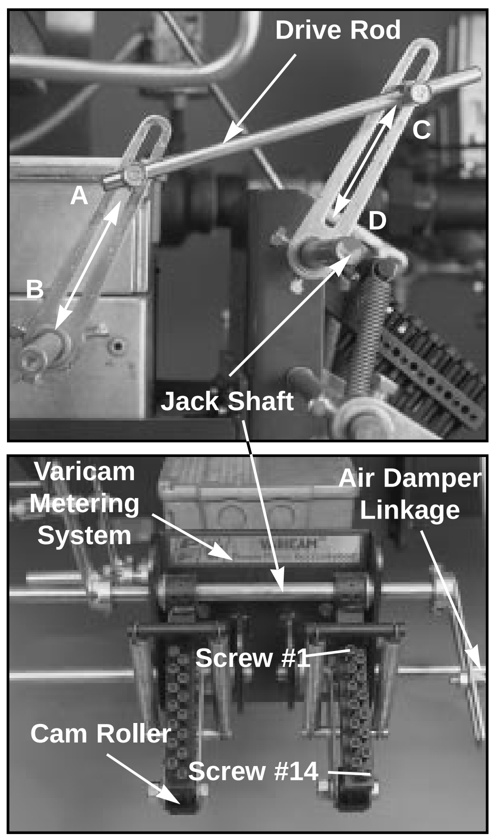


Fig. B9 Jack Shaft Linkage Adjustment

Jack Shaft

Description

The Jack Shaft is used to transmit movement from the Honeywell Modutrol Motor to the Varicam System and combustion air dampers. The Varicam System will proportion the correct amount of gas or oil (where applicable) to mix with a desired amount of combustion air (refer to Varicam Adjustment Procedure for details).

Jack Shaft Linkage Adjustment

To adjust amount of travel, loosen the base of the ball joint connector located in the slotted actuator arm and reposition to the desired setting. Re-tighten the connector.

Adjust linkage so that Cam Screw # 14 is centered on the Cam Roller for low fire, and Cam Screw # 1 is centered on the Cam Roller for high fire. The Modulating Motor should stroke 90°.

Figure B9 to the left is shown in its low fire light off position.

Moving the linkage in the following directions holding all others constant will (Figure B9):

A - Increase Jack Shaft Angle Of Rotation.
B - Decrease Jack Shaft Angle Of Rotation.
C - Decrease Jack Shaft Angle Of Rotation.
D - Increase Jack Shaft Angle Of Rotation.

In most cases, the slotted actuator arms should be set parallel to each other as shown in **Figure B9**.

Varicam Adjustment Procedure

The unit being fired must be connected to a large enough load to allow the burner to be fired at full load for an extended period of time. The firing rate should be manually adjusted in the service mode in conjunction with the load, unload and hold keys (refer to Form 155.17-02, Absorption Micro-Panel Operations Manual or Start-Up section for more information).

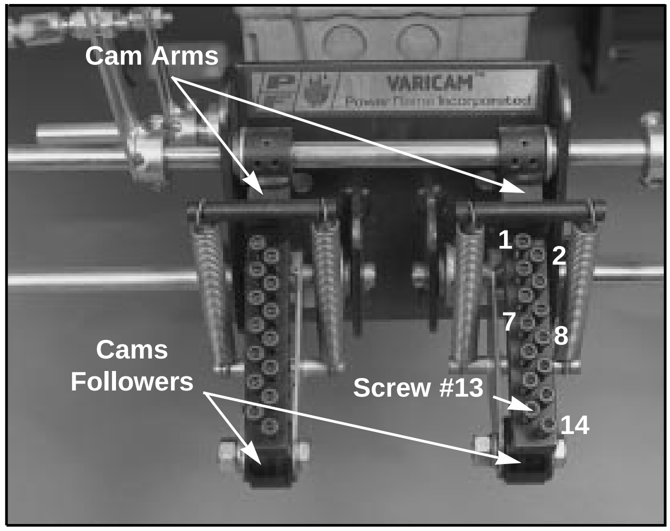
CAUTION
EQUIPMENT DAMAGE

THE CHANGE IN LEVEL BETWEEN ADJACENT CAM SCREWS SHOULD NOT EXCEED 3/8". LEVELS GREATER THAN 3/8" REQUIRE EXCESSIVE OPERATING FORCES WHICH MAY CAUSE ERRATIC MOVEMENT OF THE LINKAGE, EXCESSIVE WEAR, OR JAMMING OF THE MECHANISM.

The thread binding set screws are nylon tipped. Their function is to hold any adjustment point to which the cam screw is set.

The Varicam should only be adjusted after the burner has been set-up and the linkages and valves are in their final marked positions. Varicam adjustment is not necessary if the fuel/air ratios are acceptable for all points from low to high fire (refer to Burner Start-Up Overview).

1. All the set screws should be set in the mid-point position when the unit is received. At this setting, an equal number of threads will be visible above and below each set screw and the screw tips will form a surface parallel to the cam arm (**see Figure B10**).



Varicam: Arms, Followers and Screws

2. For the initial coarse adjustment, operate the burner at a firing rate that will position the middle two cam screw #'s 7 and 8 on the crown of the cam follower. This rate should be the approximate mid point of the firing rate range of the burner or 65% of full firing rate (**see #2 Figure B11**).

Adjust these two cam screws to obtain the desired fuel/air ratio.

Figure B11 shows this adjustment already made. In this example, screws 7 and 8 were turned CCW about 3 turns in order to achieve the desired fuel/air ratio.

Note: When the cam screws are rotated counter-clockwise, the adjacent cam screws on either side of those being adjusted may begin to engage the cam follower surface as well. **All** cam screws engaging the cam follower surface must be adjusted to obtain the desired change.

3. For the next coarse adjustment, operate the burner at the firing rate that will position cam screw #s 10 and 11 on the crown of the cam follower. This rate should be the approximately 50% of full firing rate of the burner (**see #3 Figure B11**).

Adjust these two cam screws to obtain the desired fuel/air ratio.

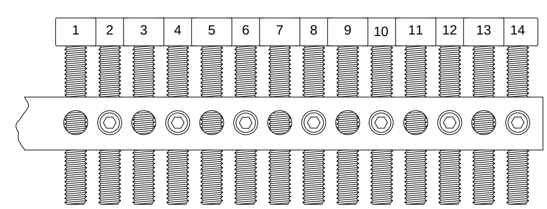


Figure B10

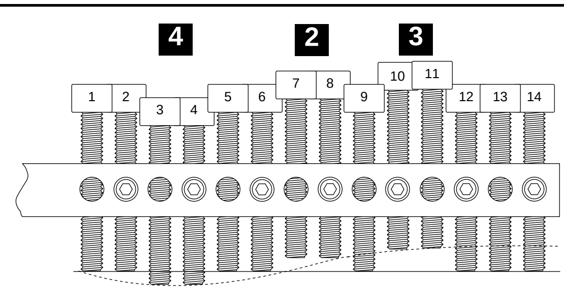


Figure B11

Figure B11 shows this adjustment already made. In this example, screws 10 and 11 were turned CCW about 5 turns in order to achieve the desired fuel/air ratio.

4. For the last coarse adjustment, operate the burner at the firing rate that will position cam screw #s 3 and 4 on the crown of the cam follower. This rate should be approximately 83% of the full firing rate of the burner (**see #4 Figure B11**).

Adjust cam screws 3 and 4 to obtain the desired fuel/air ratio.

Figure B11 shows this adjustment already made. In this example, screws 3 and 4 were turned CW about 3 turns in order to achieve the desired fuel/air ratio.

5. Once course adjustments are made, adjust other cam screws so that the roller moves smoothly across the screws. This can be accomplished by drawing an imaginary cam roller profile (shown in Figure B11) and adjusting the remaining screws to meet this profile (Refer to Figure B12 below).

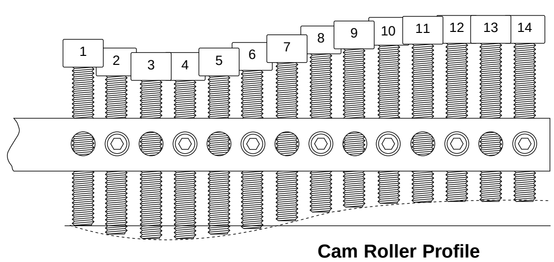


Figure B12

6. Fine Adjustment Procedure

This procedure should only be attempted after all coarse adjustment points of fuel/air ratios have been properly completed. Begin with the burner operating at the low fire point. Re-affirm that the low fire fuel/air ratio is correct, that cam screw #14 is centered on the center of the cam follower and re-adjust if necessary.

a) Adjust the burner firing rate so that cam screw #13 is centered on the center of the cam screw follower. Adjust cam screw # 13 for the desired fuel/air ratio.

b) Repeat step 6a for each cam screw in numerical progression down from cam screw #12 to cam screw #1.

7. Run the burner from low to high fire several times to make sure that no binding occurs.

8. Repeat the above procedures for the oil side where applicable.

Low Oil Pressure Cut Out Switch

Description

The low oil pressure switch (**Figure B13**) is used to insure the oil pressure at the nozzle is adequate for proper atomization of the fuel. The above situation may cause unburned fuel to accumulate in the combustion chamber, causing an unsafe condition.

How It Works

The Bourdon Tube, invented in the 1800's, is one of the oldest forms of pressure measuring devices. It consists of an elliptical section metal tube bent into the form of a 'C'. It is closed at one end and open to pressure at the anchored end. As pressure is applied, more fluid tends to move into the tube. In order to accommodate this increased volume of fluid, the tube tends to become more circular in cross-section and this tends to straighten out the tube.

The movement at the free end of the tube is directly proportional to the applied pressure. As the tube deforms, the attached mercury switch moves and either opens or closes its contacts. The switch will open, if the oil pressure drops below the minimum set point, thus locking out the burner.

Switch Set point

1. This switch can be adjusted externally by hand.

2. Set switch at 80% of low fire oil pressure.

For initial start-up: Adjust to a pressure well below the above setting to allow the burner to be set up.

3. Remember to make final adjustments after the burner set-up is complete.

Note : The minimum differential setting for this switch is 12 PSIG. The range is 10 - 300 PSIG

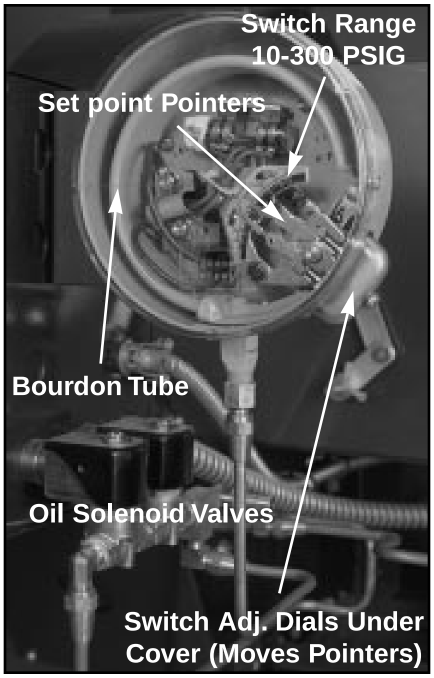


Fig. B13 Low Pressure Oil Switch Adj.

Switch Adjustment Procedure

1. Remove adjustment dial cover using a flat head screw driver. There are two dials located under this cover. The upper dial is used to set the "high" pressure operating set point (cut in). The lower dial is adjusted to the "low" pressure set point (cut out). The difference between the two is the switch differential.

<u>High Pressure Set Point</u>

Turn upper dial CW to increase setting and CCW to decrease setting.

<u>Low Pressure Set Point</u>

Turn lower dial CW to decrease setting and CCW to increase setting.

Blower Combustion Air Flow Switch

Description

Combustion Air Flow Switches on burners are designed to cut out the burner in the event that the combustion air flow is decreased below a set minimum, possibly preventing an unsafe condition.

How It Works

Air flow is sensed by the attached tube as shown in **Figure B14** below. The tube is installed on the inlet side of the combustion blower wheel. When the wheel is moving a suction is created in the tube by air flowing across it. A diaphragm in the switch will move according to two opposing forces. The first is the amount of suction in the tube and switch chamber. The second is the switch adjusting screw position. The adjustment screw will shorten or lengthen the amount of time it will take for the burner to cycle off after a loss or reduction in air flow.

1. Disconnect power to the burner.

2. Disconnect both wires at the air flow switch and temporarily jumper them together. Make sure they cannot ground against anything, since they will be powered with 120V during the test.

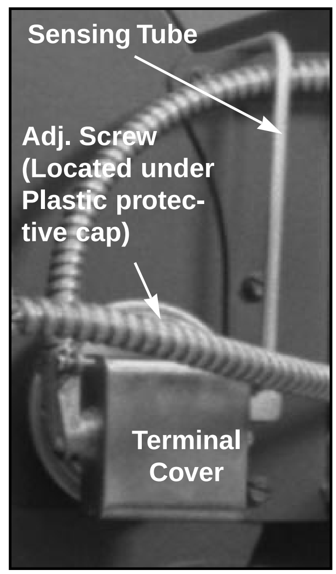


Fig. B14 Combustion Air Flow Switch

3. Put a continuity meter across the common and normally open terminals on the air switch.

4. Close the gas train checking cock.

5. Start the blower motor. The meter should read electrical continuity as soon as the blower starts.

6. Disconnect the blower motor lead wire or the wire which energizes the coil of the motor relay starter, or open the main power disconnect switch to the burner. Within 4 to 5 seconds after the blower motor is de-energized the meter should indicate an open air flow switch circuit (no continuity).

7. If the switch doesn't open within 4 to 5 seconds, readjust accordingly. Turn the air flow switch adjustment screw clockwise to shorten cut-off response time, and counter clockwise to lengthen the cut-off response time.

8. Turn the burner power off. Remove the jumper between the two wires and let them hang loose. (One will be powered with 120V, so don't let them ground out.)

9. Open the gas train checking cock. Turn the burner on. With the wires disconnected, the burner should go into a purge cycle, although neither the ignition or the main fuel valve circuits will be energized. If they do energize, there is a wiring problem. Correct as required.

10. Turn power off. Reconnect the air flow switch wires to their correct terminals.

11. The burner may now be put back into service.

Gas Pressure Switches

Description

Low Gas Pressure

Low gas pressure switches break the electrical circuit on pressure drop at the point when gas pressure falls below the indicated set pressure.

Before the manual reset can be properly latched, gas pressure in the switch chamber must be higher than the indicated setting. The position of the reset latch on the top cover of the switch shows whether the latch is in the on or off position. The reset latch must be in the on position after latching to be properly set.

Fig. B15 High Gas Pressure Switch

Fig. B16 Low Gas Pressure Switch

High Gas Pressure

High gas pressure switches break the electrical circuit when pressure rises above the indicated preset pressure. The reset latch should be latched in the on position if the gas pressure in the switch chamber is below the indicated high setting.

How the Safety Circuit Works

If either of these two pressure switches open, power will be sent directly to Relay 41CR. The alarm bell and light on the Burner Panel will be energized and the following message will appear on the Micro-Panel.

BURNER REMOTE ALARM - MANUAL RESET

To restart the unit, push the **UNIT** switch to the **STOP/RESET** position, manual reset gas pressure switch (move latch on top of control to the "**On**" position) after problem has been fixed, then push the **UNIT** switch to the **START** Position.

Control Adjustment Procedure

1. Remove top cover of control by loosening single screw.

2. Adjust dial indicator to desired setting using slotted screwdriver.

Turn Dial:

CW - Lower Set point
CCW - Raise Set point

3. Confirm set point using a manometer or gauge.

(Install manometer or gauge in test plug as shown in **Figure B15** and **B16** above)

For initial start-up: Adjust low gas pressure switch to a lower pressure than that to be experienced for normal operation to allow the burner to be set up. Similarly adjust the high pressure gas switch to a point higher than normal.

Low Gas Pressure Switch Adjustment

Note : With burner control power turned off, remove wire to N.O. contact of low gas pressure switch from left side of terminal # 46 as shown in the **Figure B17**. Exposed end should be taped. Restore control power.

1. Close the main manual gas shutoff valve and install a manometer in the test port directly under pressure switch. The low pressure switch is located on the gas train.

2. Re-open the main manual gas shutoff valve.

3. After setup is complete, cycle burner to high fire and take a gas pressure reading on the manometer. Using the main manual gas shutoff valve, throttle down the gas flow to a point where the manometer reading is approximately 20% below the previous reading.

4. Adjust the low gas pressure switch downward (Clockwise) until it breaks and shuts down the burner.

5. Restore the main manual gas shutoff valve to its full open position.

6. To insure that the switch is functionally sound and properly installed, recycle the burner to high fire and again use the main manual gas shutoff valve to throttle the gas flow. The low gas pressure switch should immediately break and shut down the burner at 20% reduced pressure.

7. Repeat steps 3 to 7 until the low gas pressure switch breaks at 20% reduced pressure consistently.

8. Turn the main manual gas shutoff valve off. Remove the manometer and reinstall test plug (Use fresh pipe joint compound and check for leaks).

9. Restore main manual gas shutoff valve to its full open position.

10. Cycle the burner several times to assure the switch will not cause any nuisance shutdowns as the burner ignites.

11. Turn off power and reconnect wire to terminal # 46 of terminal strip. Restore power.

High Gas Pressure Switch Adjustment

Note : With burner control power turned off remove wire to N.O. contact of high gas pressure switch from left side of terminal # 45 as shown in **Figure B17**. Exposed end should be taped. Restore control power.

1. After setup is complete, cycle the burner to high fire.

2. Slowly adjust the switch downward (CW) until the switch breaks and shuts down the burner.

3. Adjust the high gas pressure switch back upward (CCW) to a pressure setting approximately 20% greater than the reading at which the switch broke. (i.e. if the switch broke and shut down the burner at 4.0" W.C., then set the switch at 5.0" W.C.)

4. Cycle the burner on/off several times to assure the switch will not cause nuisance shutdowns as the burner ignites.

5. Turn off power and reconnect wire to terminal # 45 of terminal strip. Restore power.

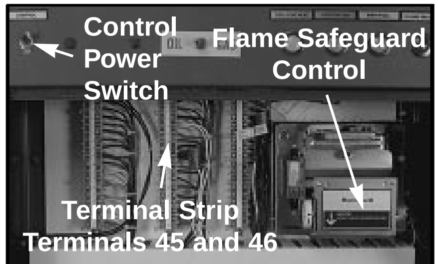
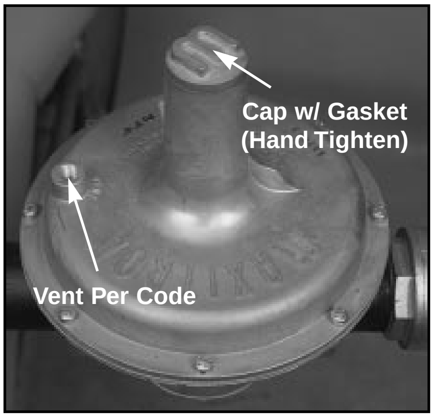


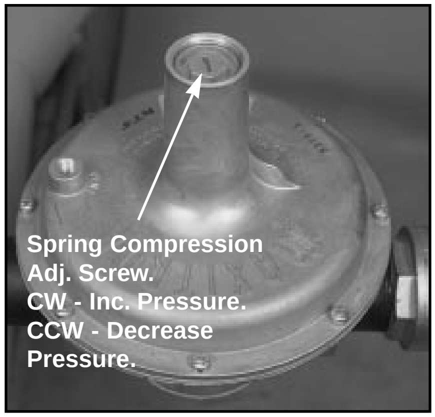
Fig. B17
Location of Terminals 45 and 46

Remove (tape) wire #46 from left side of terminal strip when setting **low gas pressure switch**. (Perform with control power switch turned off)

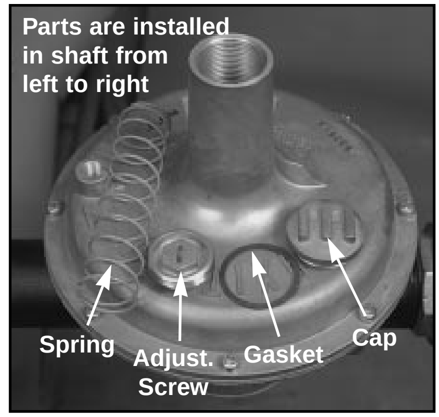
Remove (tape) wire #45 from left side of terminal strip when setting **high gas pressure switch**. (Perform with control power switch turned off)



Gas Regulator Fully Assembled



Regulator with Adjustment Cap Removed



Regulator with Spring Fully Removed

Pilot and Main Gas Pressure Regulators

Description

Gas burners have two gas pressure regulators (**shown above**), one to regulate the pressure to the main flame and the other to regulate the gas pilot pressure. All dual fuel burners used on *Paraflow*™ units are equipped with a gas pilot ignition system, therefore, at least the pilot pressure regulator will be present on all units.

How It Works

Gas flow is controlled by a spring of known load range which works against the supply (from the meter) gas pressure. Accordingly, each regulator must be fitted with the right spring for it to function properly. Additionally, the tension on the regulator spring must be adjusted to obtain the exact gas pressure required at the inlet to the burner and controls.

Adjustment Procedure

1. Remove cap from regulator to gain access to the adjustment screw.

2. Turn adjustment screw clockwise to increase pressure and counter-clockwise to decrease outlet pressure.

Note: If adjustment screw is turned fully clockwise and adequate gas pressure is still not obtained a stiffer spring may be needed or inlet gas pressure is below its rated value.

Replace with correct spring in accordance with Manufacturer's Specifications. Springs are rated for a set inlet pressure. If the actual inlet pressure is below the spring rated inlet pressure, it may be necessary to go to a stiffer spring in order to achieve the desired full load gas pressure.

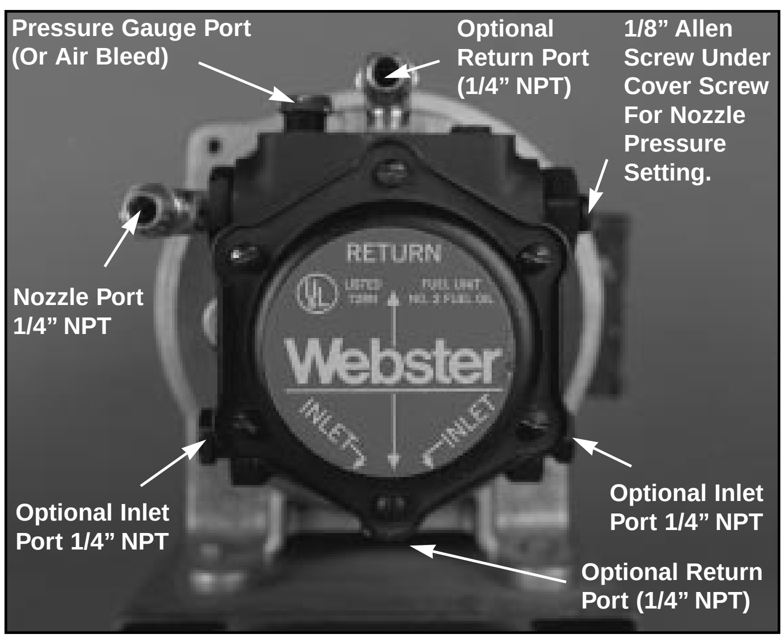
For initial start-up: Pressure at which gas will be delivered to the burner cannot be determined without gas flowing through the regulator. Be prepared to adjust the regulator as the burner is test fired at its high fire position. Once burner has reached its high fire position, set regulator to achieve the desired maximum input (refer to "Clocking The Meter" Section for further details).

3. Reinstall cap after adjustment is complete.

Oil Pump With Integral Regulating Valve

Description

Oil burners require a close regulation of the pressure at which oil is delivered to the nozzle. *ParaFlow*™ Units use a two stage oil pump which have a pressure regulator built in. This delivery pressure can be adjusted in order to obtain the desired high fire oil input.



How It Works

Burner oil pumps are generally identified by the rate at which they can deliver (GPH), the pressure of the delivery (PSI) and the speed of rotation (RPM). The pump is usually capable of delivering more fuel than required to meet the firing requirements. Because of this, the amount of oil flowing to the nozzle must be controlled. This control is accomplished through the use of an adjustable pressure regulating valve which reduces flow to the nozzle by causing more oil to be returned to the tank. Like most regulators, flow is controlled by an adjustable spring and each regulator has a pressure range over which it will reliably operate. Modulation between low and high fire occurs through the use of a oil modulating valve, which bypasses a percentage of the oil flow to the nozzle (see Adjustment of Oil Fuel Modulating Valve for additional information).

Adjustment Procedure

1. Using a flat headed screw driver, remove the cover screw and gasket to obtain access to the 1/8" allen adjustment screw. Refer to above drawing for screw location.

2. Use 1/8" Allen Key to turn pressure adjusting screw:

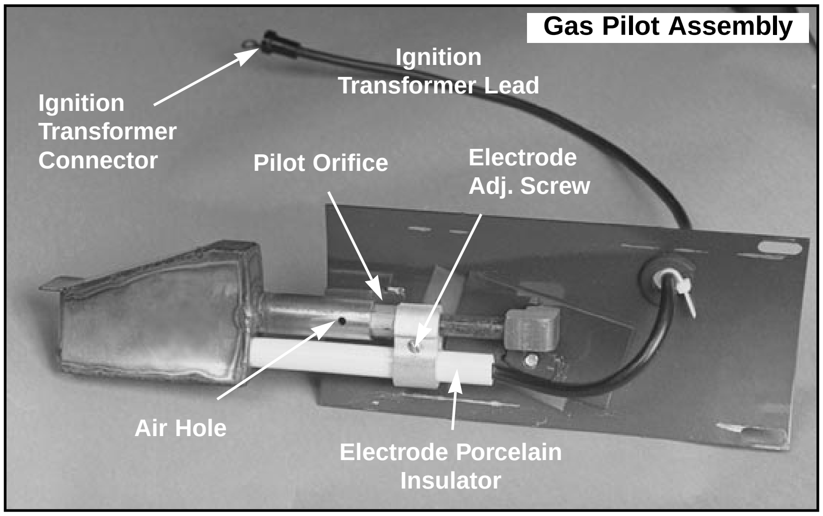
CW - Increase Pressure
CCW- Decrease Pressure

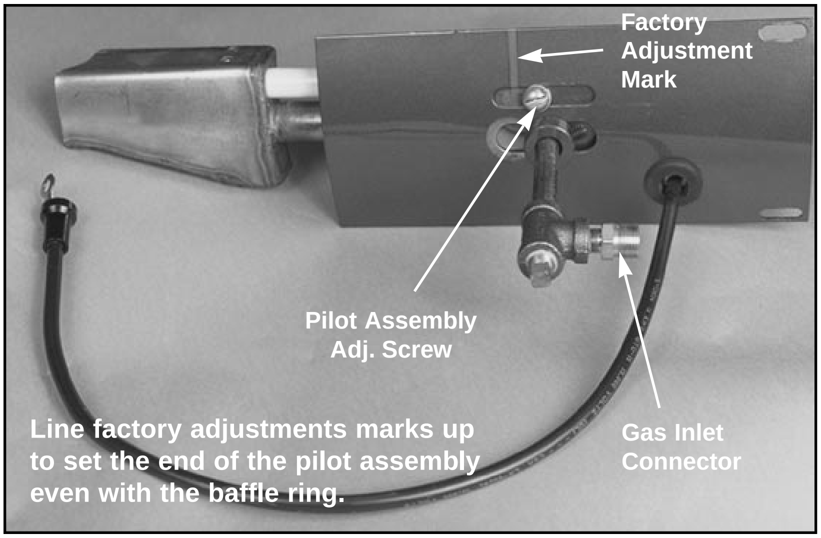
For initial start-up: set at 300 PSI.

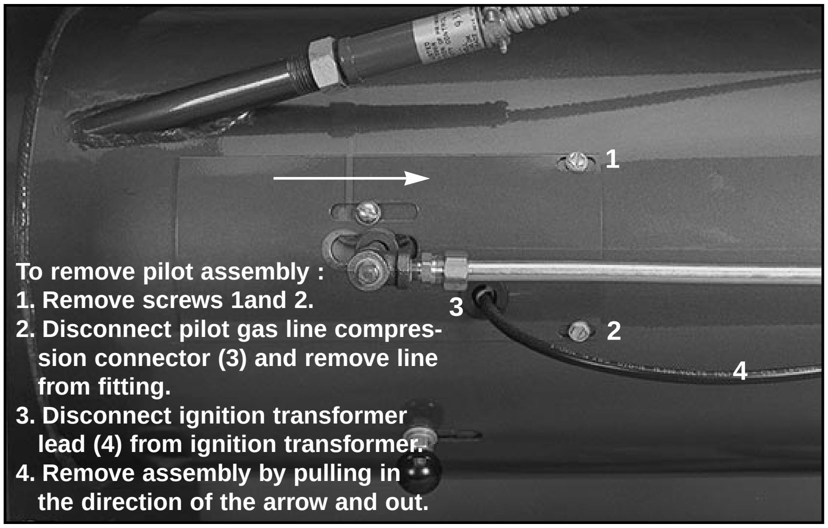
Note: Pressure at which the oil will be delivered to the nozzle cannot be determined until the burner is test fired. Be prepared to adjust the regulator as the burner is cycled through its cycling sequence.

CAUTION
EQUIPMENT DAMAGE

DAMAGE TO THE OIL FUEL REGULATOR WILL OCCUR IF THE INLET PRESSURE TO THE PUMP IS GREATER THAN 3 PSI.







Pilot Case to Gas Manifold Adjustment

Pilot case to gas manifold adjustment is very important. As shown in the figure to the right, the inside radius of the pilot body must be tight against the outside radius of the gas manifold.

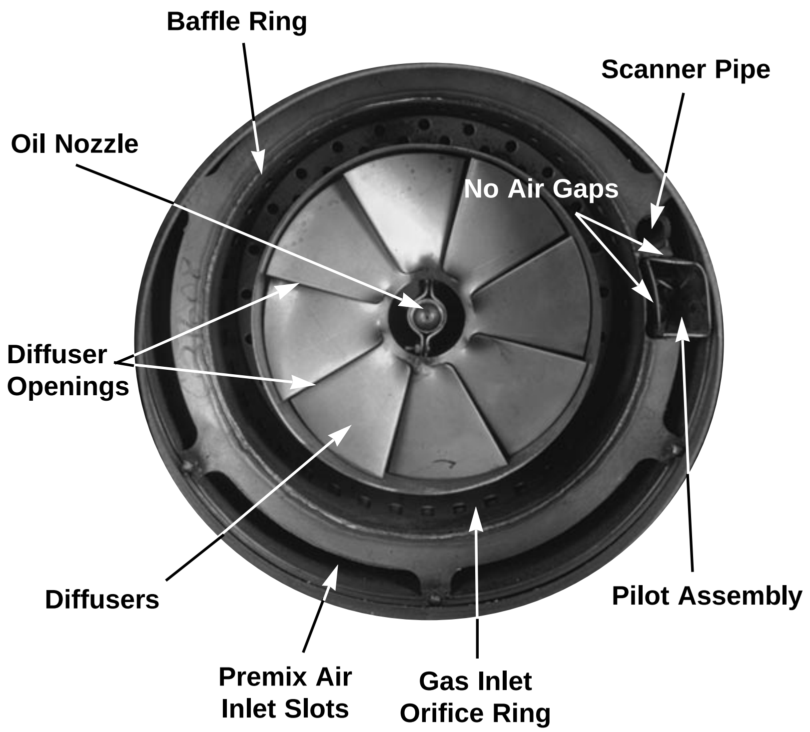
The portion of the pilot body adjacent to the scanner pipe opening must also be tight against the notched portion of the baffle ring. If there is an air gap between the pilot body and the gas manifold and/or the baffle ring, the resulting air flow may prevent the pilot flame from being swept across the scanner pipe. This condition will cause a low or erratic pilot flame signal at start-up. If a stable pilot signal is difficult to achieve through the normal pilot start-up methods, or the flame is not seen across the scanner pipe, the procedure below should be tried.

Adjustment Procedure

1. Remove pilot assembly as shown in figure on previous page.

2. Slightly cock pilot body in the direction which will reduce gap.

3. Re-install pilot assembly and check for stable pilot signal.



Nominal Fan Diffuser Openings

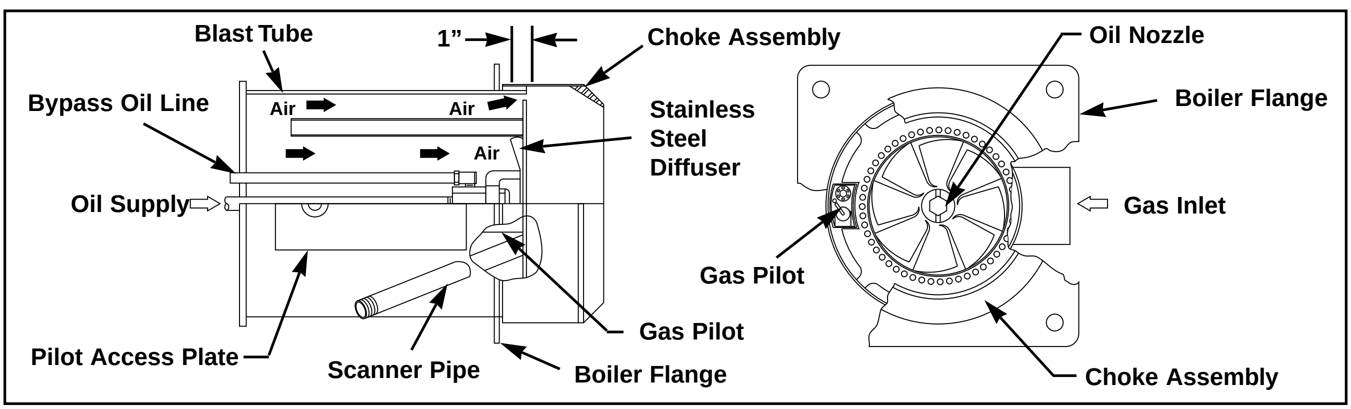
Model C2 burners should have 3/8" diffuser openings. All other model burners should have diffuser openings equal to 5/8".

Diffuser openings are set at the factory. Some conditions may require the openings to be either increased or decreased from their original settings to smooth out the burner flame and increase or decrease flame retention.

Adjustment Procedure

Manually bend diffusers to open or close gap. All gaps should be set equal. This adjustment is rarely needed and should only be used if all other adjustments fail to correct the problem.

Gas/Oil Burner Firing Head Cutaway View

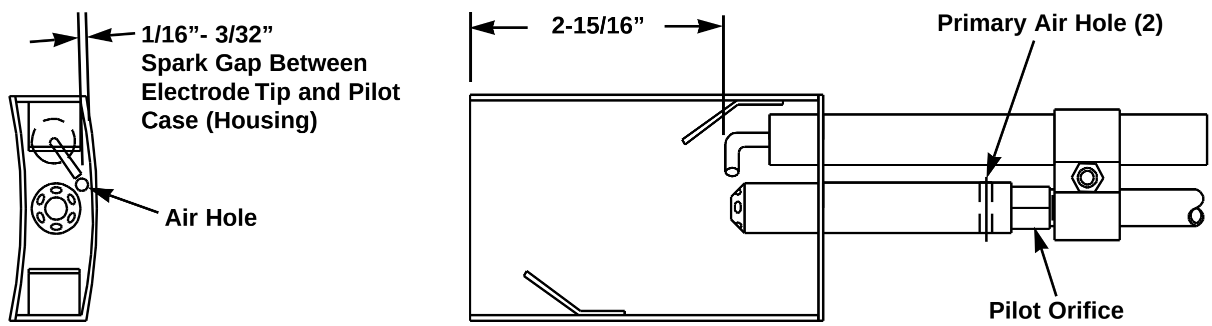


Ignition Electrode Adjustment Procedure

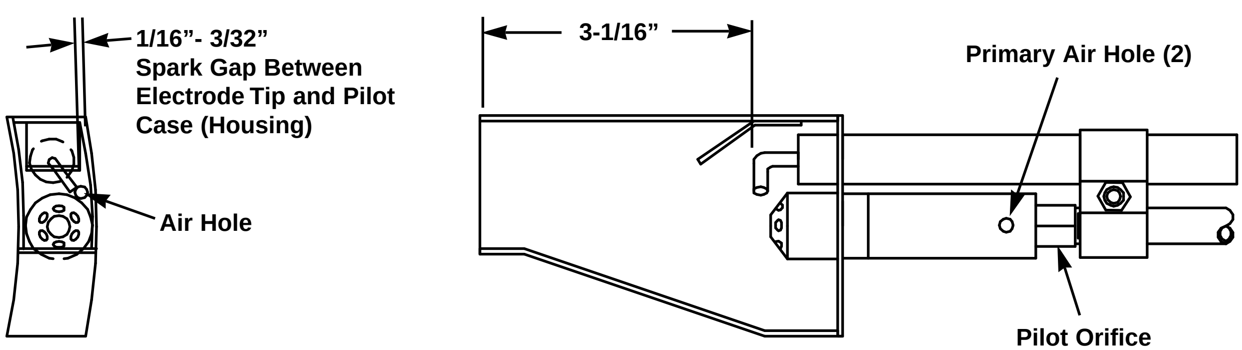
The arc from the electrode tip should jump from the tip to the body of the pilot housing and line up with the hole in the backside of the pilot housing, so that the blower air passing through this hole will cause the arc to "flag" or move around.

Normal spark gap should be between 1/16" - 3/32". The electrode should not be moved so far forward that the pilot flame will impinge on the porcelain insulator. This condition will cause the porcelain to crack and break off at the point of flame impingement.

12SC - 13S Ignition Electrode Adjustment



13SC - 22GL Ignition Electrode Adjustment



Internal Bypass Oil Type Systems (General Information)

1. The oil system is designed to operate at 300 PSI pressure for all inputs (low fire, high fire etc.). The firing rate is changed by an adjustable bypass arrangement that allows more or less oil to bypass the nozzle and flow through the return line. Low fire pressures at the bypass pressure test tee will generally be between 60 and 100 PSI, with high fire bypass pressures between 180 and 225 PSI. These pressures will vary depending upon the nozzle size selection and specific job firing conditions.

2. Smoky fires with apparent large droplet size in the spray pattern are general caused by low nozzle or return flow pressures. To properly check the system, it is necessary to verify both nozzle supply and return pressures. Also check to make sure that the nozzle adapter and strainer are not partially plugged.

3. Careless cleaning and handling of the nozzle may damage the orifice, causing heavy streaks in the oil spray. This will also show up as large droplets or sparks in the flame.

4. Off center fires, low bypass line pressures and safety lockouts (due to poor spray pattern and ignition failure) may result from plugged slots in the nozzle distributor head. When these situations are observed, the nozzle should be removed, disassembled and cleaned (refer to oil nozzle servicing for details).

5. Excessive “after squirt” of the oil is caused by air in the system. Be sure air is not trapped in the pressure gauges, overhead oil lines or fittings. A leaking check valve on the bypass return line can create the same effect.

6. High turn down ratios are a distinct advantage of internal bypass systems. It is possible, however, to adjust for a low fire so small that the flame is being chilled. The fire will look normal and appear bright and uniform, but a combustion efficiency test will reveal high smoke content and low CO_2. To correct this situation, increase the oil flow or decrease the air or a combination of both.

Oil Nozzle Servicing

1. The burners used on *Paraflow*™ units use an internal bypass type oil nozzle to atomize the oil. The oil nozzle has its GPH rating stamped on its side.

2. The nozzle should be removed from its adapter using the proper size box end wrench. They should be disassembled and thoroughly cleaned with a suitable liquid solvent and a brush (Do not use a wire brush as this may damage the nozzle).

Note: Damage to nozzle orifices or spray slots result in off center or “sparky” fires.

3. The nozzle should be seated firmly in the nozzle adapter to prevent leaks.

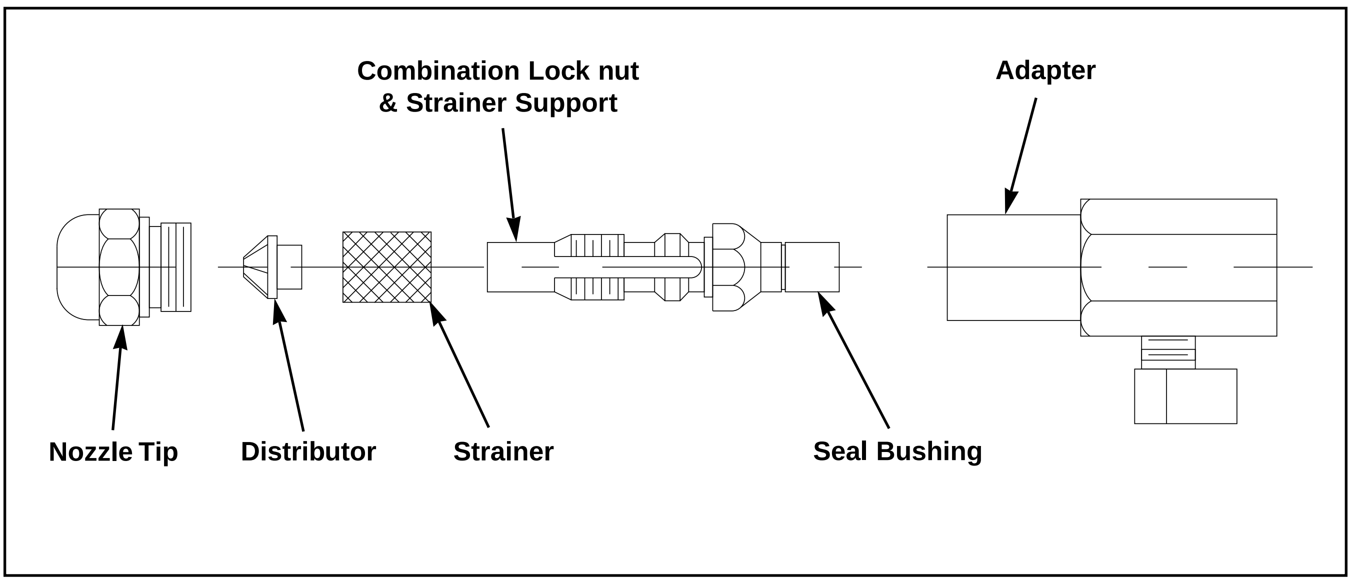
4. When cleaning or taking the nozzle assembly apart, do not force it.

5. The Teflon seal should stay on the nozzle when servicing. If it is damaged, the resulting leak will cause an increase in the burner firing rate, when the bypass line is closed at high fire. If the seal is accidentally removed, the nozzle must be replaced.

Note: On C4 and C5 Burners, Delavan 30630 series nozzles may be used. The teflon seal for the Delavan Nozzle stays in the 3/4” nozzle adapter.

All damaged seals should be replaced.

Internal By-pass Oil Nozzle Components



Oil Nozzle Flow Rate Chart

Internal Bypass Nozzle System (Marnarch F-80 BPS)

	U.S. Gallons Per Hour #2 Fuel Oil Bypass Pressure PSIG													
Nominal Rating GPH-By-Pass Closed, Line Press. 100 #	**0**	**20**	**40**	**60**	**80**	**100**	**120**	**140**	**160**	**180**	**200**	**220**	**GPH By-Pass Closed**	**By-Pass press. with By-Pass Closed**
9.50	3.6	3.7	3.9	4.3	4.8	5.5	6.2	7.3	8.4	9.5	10.6		15.5	210
10.50	3.7	3.7	3.9	4.3	4.9	5.6	6.5	7.6	8.6	9.8	11.2		16.0	220
12.00	4.3	4.4	4.5	4.9	5.7	6.9	8.1	9.5	10.9	12.5	14.0		19.4	210
13.50	6.0	6.0	6.2	6.6	7.5	8.8	10.8	13.0	15.6	18.5	21.6		23.3	210
15.50	6.3	6.3	6.5	6.8	7.3	8.0	9.0	10.4	12.0	13.9	16.5	21.2	25.5	225
17.50	6.8	6.9	6.9	7.3	8.1	9.3	10.9	12.8	14.6	17.0	19.6	22.4	28.2	225
19.50	6.2	6.3	6.4	6.7	7.5	8.8	10.3	12.5	14.8	17.4	20.9	23.6	30.6	235
21.50	7.8	7.8	7.9	8.2	8.9	10.5	11.9	14.2	16.7	19.4	23.2	26.4	33.5	240
24.00	8.4	8.5	8.7	9.2	10.0	11.5	14.4	17.3	20.6	24.3	28.6	33.4	35.1	230
28.00	9.0	9.1	9.6	11.1	13.7	16.4	21.1	26.9	33.7	40.2	47.7		48.7	215
30.00	8.1	8.1	9.0	11.3	13.6	17.7	23.2	28.5	32.2	38.0	43.3	50.6	51.6	225
35.00	10.8	11.0	12.8	15.7	20.0	26.0	32.6	38.4	45.9	38.0			58.5	200
40.00	16.6	16.7	19.0	22.2	27.3	33.5	40.5	47.1	56.5	54.3			68.3	190
45.00	23.1	23.1	26.1	29.4	35.3	42.3	49.6	58.2	71.0	66.0			76.2	180
50.00	29.5	29.7	32.9	37.4	44.0	52.6	61.9	72.9	82.8				83.9	165

Refer to Burner As-Built Specification Sheet supplied with burner to determine Oil nozzle flow rating and spray angle.

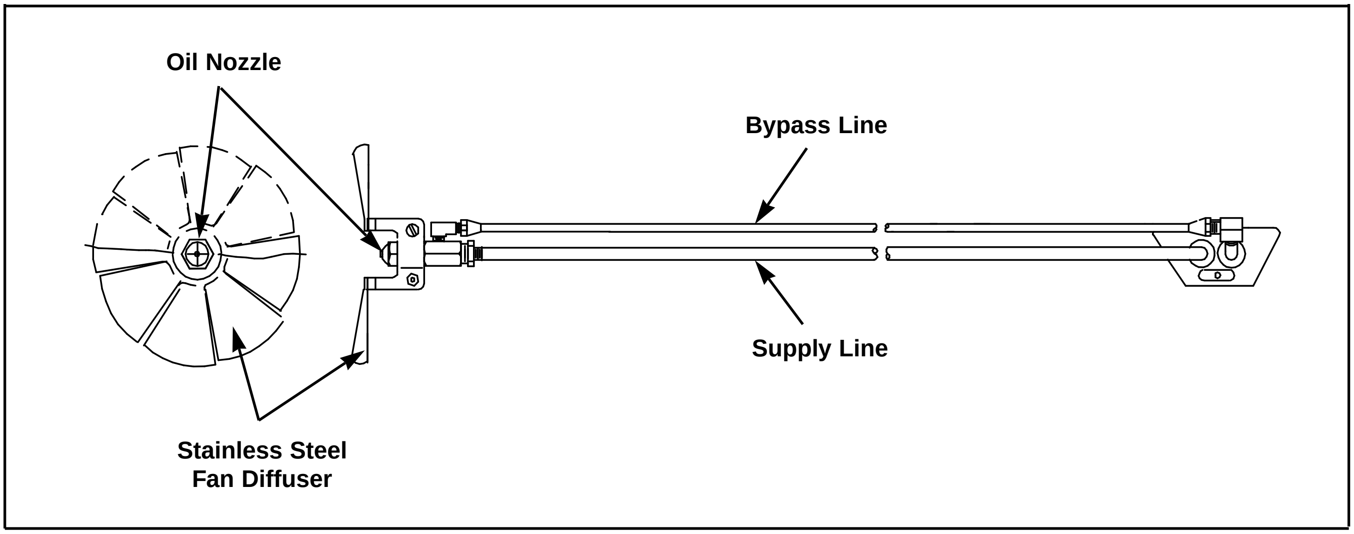
The chart above can be used to determine the approximate flow rate to the nozzle at various by-pass pressures. The GPH with By-pass Closed column is the oil nozzle GPH at high fire.

For example: If the oil nozzle GPH rating is 12.00 at 100 # and the by-pass pressure is 140 PSIG, the oil flow through the nozzle will be 9.5 GPH.

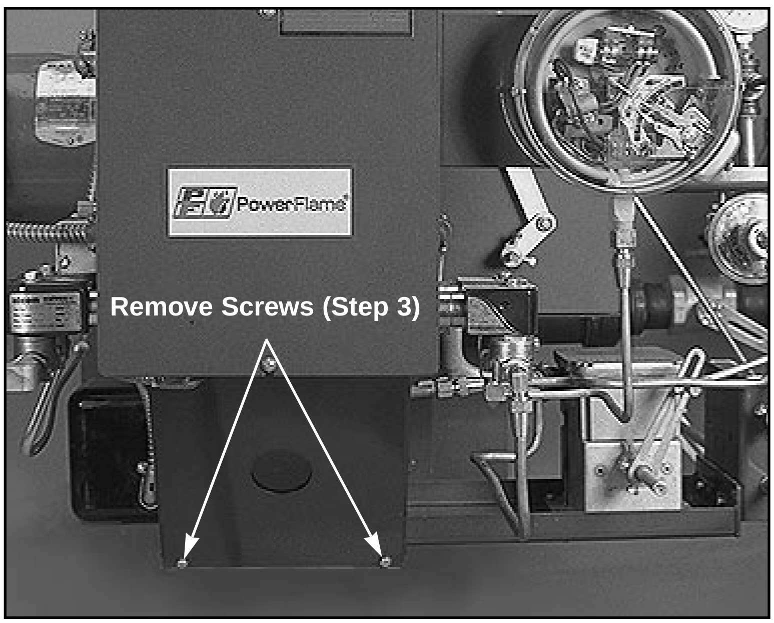
These values are for an oil pump discharge pressure of 300 PSIG.

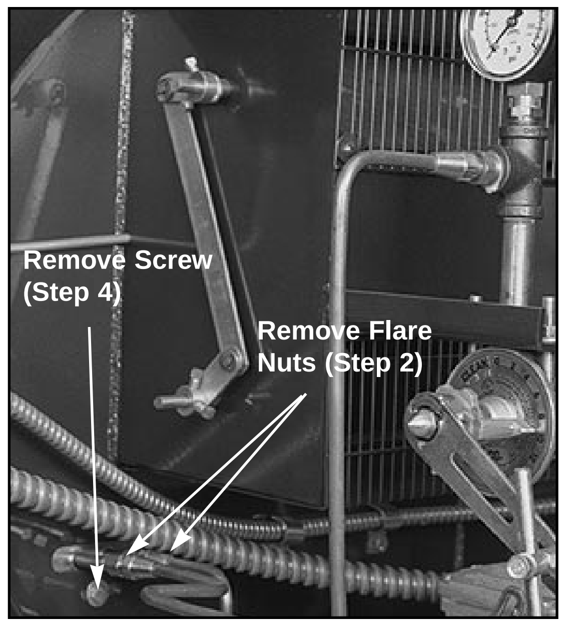
This chart should be used for **Marnarch F-80 BPS** Nozzles only. For other manufacturers nozzles, refer to similar charts furnished with burner.

Typical Oil Drawer Assembly



Removal Of Oil Drawer Assembly





Removal Of Oil Drawer Assembly

The oil drawer assembly can be removed to service the oil nozzle and/or make diffuser adjustments.

1. Put control power switch located on the burner panel into the "off" position.

2. Loosen and remove flare nuts as shown in the above drawing while holding a container underneath to catch any oil left in the lines.

3. Remove screws and remove sight glass panel from end of burner.

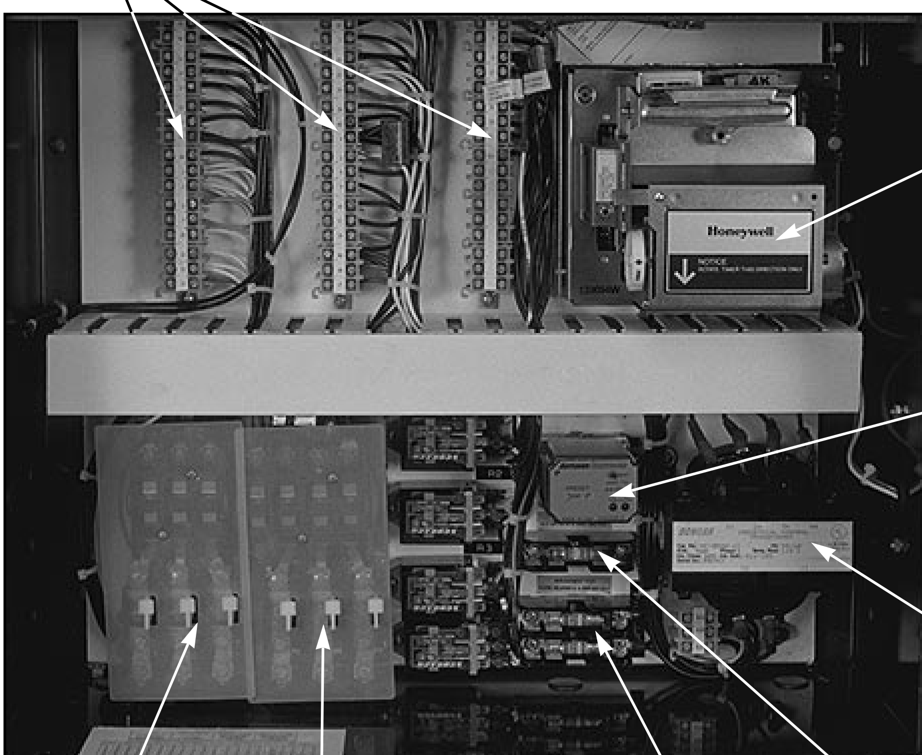
4. Remove oil drawer assembly adjustment screw while holding the oil drawer assembly from the inside.

5. Pull out assembly.

Warning and Status Lamps

1 - Call For Heat
2 - Ignition On
3 - Main Fuel
4 - Flame Failure

Terminal Strips



Honeywell Flame SafeGuard Control (R4140L)

High Limit Stack Thermostat (700°F)

Control Transformer

Oil Pump Motor Contactor

Blower Motor Contactor

Primary Transformer Fuses

Control Fuse

Flame SafeGuard Controls

R4140L

1. On a call for heating or cooling (no faults present), 120VAC will be sent from the MicroComputer Control Center to terminal 5 of the Burner Panel.

2. The "Call for Operation Lamp", located on the burner panel illuminates and power is sent to terminal 4 of the R4140L Flame Safeguard Control.

Pre-Purge Period (60 seconds)

3. Power is applied to terminal 8 (R4140L) starting the combustion air blower motor and the 60 second pre-purge period. The common terminals of the purge interlock (2LS) and the low fire start interlock (3LS) switches located in the Honeywell Modutrol Motor will also receive power. The 3LS switch closed on start-up will allow power to flow to terminal 13 of the R4140L. The 3LS switch must be closed for the burner sequence to start. This is a safety designed so the burner will not start firing if the gas valve is not in its fully closed position. If the valve doesn't fully close, it will allow gas to flow and build in the combustion chamber (during the off cycle) causing an unsafe condition when ignition occurs.

4. At 4 seconds into the cycle, the modulating motor will drive to its high fire (open) position (relay 46CR energized), opening the combustion air dampers and the gas and oil (where applicable) modulating valves. Fuel will not flow to the burner until the automatic gas or oil (where applicable) valves are energized. By opening the combustion air dampers, fresh air is allowed to flow through the combustion chamber and out the stack, thus allowing the chamber to be purged of any raw fuel before ignition occurs. 3LS opens.

Note: If a flame is sensed at any point before or during this pre-purge period, safety shutdown will occur.

5. The timer will stop at 10 seconds and will not continue until the purge interlock (2LS) switch closes.

6. At 45 seconds, the modulating motor will drive towards its low fire (closed) position (relay 46CR de-energized).

7. At 51 seconds, the timer will stop until the low fire start interlock switch (3LS) closes. Once the 3LS switch closes the timer starts allowing ignition trials to begin at 60 seconds.

Ignition Trials (Pilot and Ignition terminate at same time)

8. At 60 seconds, power is applied to terminals 5 (R4140L) energizing the ignition transformer and pilot gas valve(s). The "Ignition On lamp" on the burner panel will illuminate.

9. Pilot and ignition trials will end at 70 seconds. A pilot flame must be established between 60 and 70 seconds or the burner will cycle off on flame failure requiring manual reset of the flame safeguard control.

10. The main gas valve(s) or oil valve(s) will be energized allowing main fuel flow to the burner at 70 seconds. A ten second interrupted pilot/ignition begins.

11. At 80 seconds the 10 second interrupted pilot/ignition is de-energized and the main flame signal should be steady. The "Ignition On" lamp on the burner panel will shut off . Relay 47CR is energized allowing full modulation of the burner system.

Ignition Trials (Early Spark Termination - 5 seconds)

8. At 60 seconds, power is applied to terminals 5 (R4140L) and 18 energizing the ignition transformer and pilot gas valve(s). The "Ignition On lamp" on the burner panel will illuminate.

9. The ignition spark will be shut off when terminal 18 is de-energized at 65 seconds. Terminal 5 (pilot gas valve(s)) will be de-energized at 70 seconds. A pilot flame must be established between 60 and 70 seconds or the burner will cycle off on flame failure requiring manual reset of the flame safeguard control.

10. The main gas valve(s) or oil valve(s) will be energized allowing main fuel flow to the burner at 70 seconds. A ten second interrupted pilot/ignition begins. The "Main Fuel" lamp on the burner panel will illuminate.

11. At 80 seconds the 10 second interrupted pilot/ignition is de-energized and the main flame signal should be steady. The "Ignition On" lamp on the burner panel will shut off. Relay 47CR is energized allowing full modulation of the burner system.

Run Period

Burner is firing and will modulate between low and high fire depending on the leaving chilled water temperature.

Post Purge Period and Shutdown

On a cycling shutdown, the main fuel valve terminal 7 is de-energized shutting off the burner flame. The "Main Fuel" lamp on the burner panel will shut off. The modulating motor will stroke to its low fire (light off) position if not already there and the unit will enter a dilution cycle.

RM7840L

Initiate Cycle (10 seconds)

The RM7840L enters the initiate sequence when the relay module is powered. The initiate sequence lasts for ten seconds unless certain voltage or frequency tolerances are not met in which case the control will be locked out. Once this ten second check is completed the RM7840L will enter the standby mode.

Standby

The RM7840L is ready to start an operating sequence when the operating control input determines a call for either cooling or heating is present.

1. On a call for heating or cooling (no faults present), 120VAC will be sent from the Micro Computer Control Center to terminal 5 of the Burner Panel.

2. The "Call for Operation Lamp", located on the burner panel illuminates and power is sent to terminal 6 of the RM7840L Flame Safeguard Control.

Pre-Purge Period (60 seconds)

3. Power is applied to terminal 5 (RM7840L) starting the combustion air blower motor and (oil pump motor where applicable) . The common terminals of the purge interlock (2LS) and the low fire start interlock (3LS) switches located in the Honeywell Modutrol Motor will also receive power. The 3LS switch closed on start-up will allow power to flow to terminal 18 of the RM7840L. The 3LS switch must be closed for the burner sequence to start. This is a safety designed so the burner will not start firing if the gas valve is not in its fully closed position. If the valve doesn't fully close, it will allow gas to flow and build in the combustion chamber (during the off cycle) causing an unsafe condition when ignition occurs.

4. The modulating motor will drive to its high fire (open) position (Relay 59CR Energized), opening the combustion air dampers and the gas and oil (where applicable) modulating valves. Fuel will not flow to the burner until the automatic gas or oil (where applicable) valves are energized. By opening the combustion air dampers, fresh air is allowed to flow through the combustion chamber and out the stack, thus allowing the chamber to be purged of any raw fuel before ignition occurs. 3LS opens. The pre-purge timing doesn't start until the High Fire Purge Interlock (2LS) switch closes, sending power to terminal 19 of the RM7840L.

Note: If a flame is sensed at any point before or during this pre-purge period, safety shutdown will occur.

5. After the completion of the 60 second pre-purge cycle, the modulating motor will be driven back to its low fire light off position (relay 59CR de-energized). 3LS closes allowing the ignition trials to take place.

Ignition Trials (Pilot and Ignition terminate at same time)

8. At 60 seconds, power is applied to terminals 8 and 10 (RM7840L) energizing the ignition transformer and pilot gas valve(s). The "Ignition On lamp" on the burner panel will illuminate.

9. Pilot and ignition trials will end at 70 seconds. A pilot flame must be established between 60 and 70 seconds or the burner will cycle off on flame failure requiring manual reset of the flame safeguard control. With flame proven, power to terminal 10 is removed shutting off ignition transformer. (Early spark termination).

10. The main gas valve(s) or oil valve(s) (terminal 9) will be energized allowing main fuel flow to the burner at 70 seconds. A ten second interrupted pilot/ignition begins. "Main Fuel" lamp on the burner panel will illuminate.

11. At 80 seconds the 10 second interrupted pilot/ignition is de-energized and the main flame signal should be steady.

Run Period

A ten second stabilization period occurs at the beginning of the run period. Relay 60CR which allows motor modulation will not be energized until after this period has expired.

Burner is firing and will modulate between low and high fire depending on the leaving chilled water temperature.

Post purge Period and Shutdown (15 seconds)

On a cycling shutdown, the main fuel valve terminal 9 is de-energized shutting off the burner flame. The "Main Fuel" lamp on the Burner Panel will shut off. The modulating motor will stroke to its low fire (light off) position if not already there and the unit will enter a dilution cycle. The RM7840L will enter its stand-by mode.

Note: The timing sequence for the RM7840L can be changed. Refer to Manufacturers Flame Safeguard Control sheet supplied with burner.

Micro Computer Control Center

On a call for cooling/heating if no faults are present, the chilled and condenser water pumps are started. As soon as the chilled water flow switch makes, a 120VAC signal is sent to terminal 5 in the burner panel via the 1R relay in the Micro-Panel.

After the Appropriate Flame Safe Guard Control goes through its pre-purge and ignition cycles the main flame is established. At this point relay 46CR in the burner panel is energized closing the circuit between terminals 38 and 39 sending a 120VAC signal to terminal 18 of the Digital Input Board.

The following message is displayed

Heating mode

SYSTEM RUN - LEAVING HOT WATER CONTROL

Cooling Mode

SYSTEM RUN - LEAVING CHILLED WATER CONTROL

Safety Shutdowns

If the following message is displayed the following could be the cause:

SUN 12:00 AM BURNER PANEL MALFUNCTION

The unit has shut down because terminals 38 and 39 (Relay 46CR de-energized) in the burner panel

a) Opened continuously for ten seconds while the unit was running.

b) Did not close within 180 seconds after the start signal is sent to terminal 5 of the burner panel.

Either of these situations could be caused but not limited to the following.

1. Manual switch open.

2. Blown fuse in burner panel.

3. Additional pre-ignition checks used which require greater than 180 seconds to complete. (ie, Combustion air damper motorized control using an end switch to signal burner starting circuit when dampers are in there full open position). It is essential that the end switch makes in < 30 sec. or nuisance shutdowns may occur.

4. High exhaust gas temperature switch tripped.

SUN 12:00 AM BURNER REM ALARM - MAN RESET

The unit has shutdown because Relay 54CR in the burner panel is energized, opening terminals 36 and 37 and disconnecting power from terminal 11 of the Digital Input Board. The alarm bell (if used) and "Flame Failure" lamp located on the burner panel will be energized.

The following safety shutdown could be caused but not limited to the following:

1. Flame safeguard control trips on flame failure. Flame safeguard control will require resetting.

2. Either of the following safety devices opened.

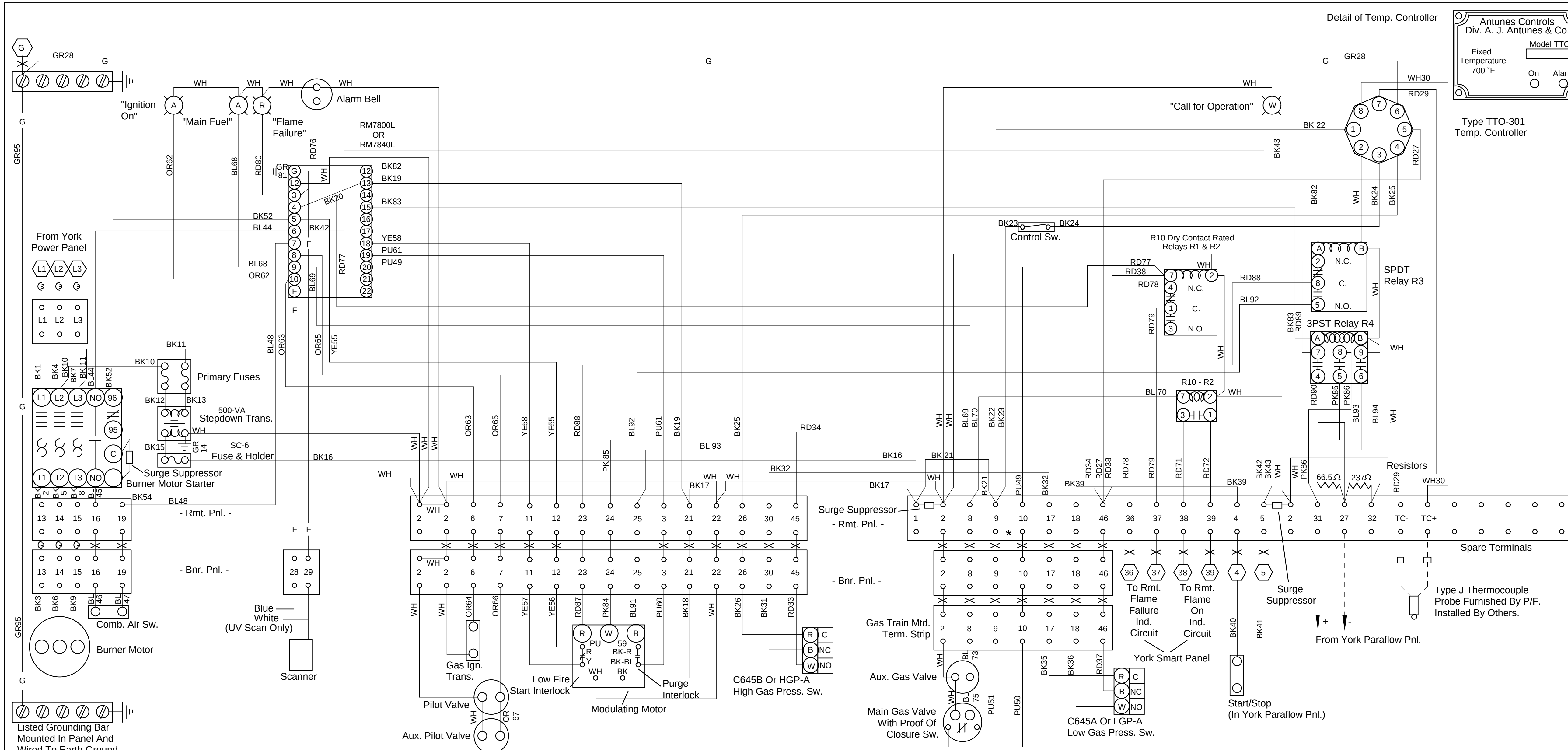
a) Low gas pressure switch

b) High gas pressure switch

To restart the unit if either of the above two conditions exist, Press the UNIT switch to its STOP/RESET position, then to the start position.

The figures on the following pages show general burner wiring schematics for gas only and gas/oil configurations.

For actual wiring schematics refer to As Built Burner Wiring Diagrams supplied with chiller.



Detail of Temp. Controller

Listed Grounding Bar Mounted In Panel And Wired To Earth Ground Lable "Equipment Ground"

"Use Copper Conductors Only."
Caution: Throw All Disconnects To Off Before Servicing.

— G — Equipment Ground Conductor

— F — Flame Circuit : Run In Separate Conduit Or Shielded Conductor

——— Factory Wiring

24V / 115V / 200-575V } York Wiring "See Spec. Sheet For Voltage"

24V / 115V / 200-575V } Field Wiring "See Spec. Sheet For Voltage"

Equipment Shown On Diagram Is Only Provided And Mounted By Power Flame If Specifically Called For On Burner Spec. Sheet.

Cross Reference Relay Legend

	P-T-P		JIC
Diag. No.	G-10028M	-	G-10029L
	R1	-	41CR - Flame Failure
	R2	-	36CR - Flame On
	R3	-	46CR - Open Damper Purge
	R4	-	47CR - Run

Remote Pnl. Must Be Bonded To Burner By Flexible Or Rigid Metal Conduit And Metal Conduit Connectors.

⬡ - Terminals In York Control Pnl.

Neutral Wiring May Not Be Connected As Shown, But May Be Wired To Terminate At Neutral Terminals Such As 2, 2A, T2 Or L2.

Caution: All Field Wiring Must Be Wired As Shown On Wiring Diagram

Single Valve With P.O.C. Sw. May Omit Aux. Gas Valve. (Applicable To Units With Inputs Below 5,000 MBH)

* Jump Term. 9 To 10 Via Purple Lead If Proof Of Closure Is Not Required

Color Code
BK - Black
WH - White
RD - Red
PK - Pink
BL - Blue
OR - Orange
YE - Yellow
PU - Purple
GR - Green

Last Wire No. Used - 95

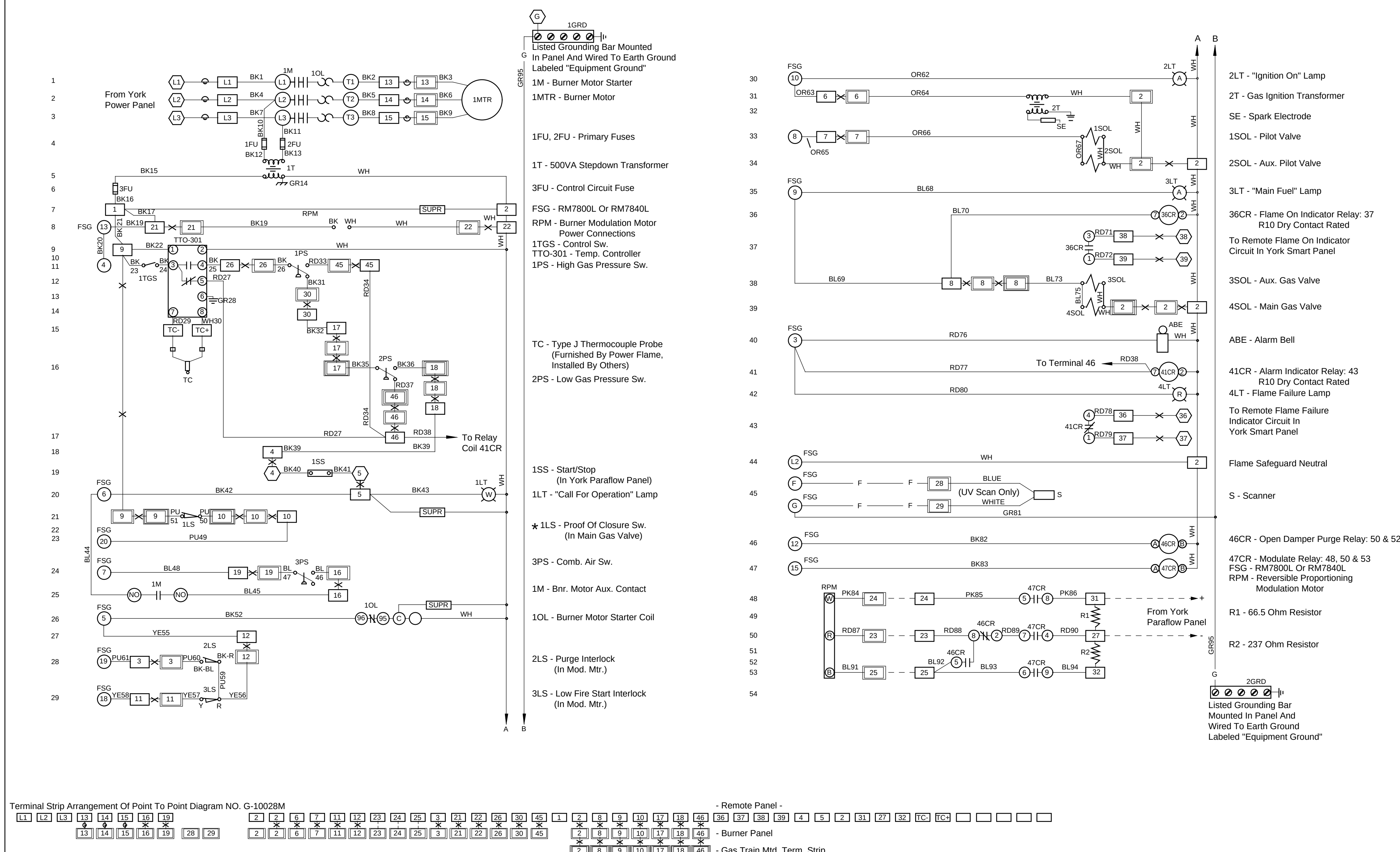
Relays R1 & R2

Ref.	R10 CDR	KUP
Coil	7	A
Neu.	2	B
Com.	1	7,8,9
N.O.	3	4,5,6
N.C.	4	1,2,3

Title: Wiring Diagram

Gas Burner With RM7800L/40L, Modulation, 3PH. Motor, 4 Lights And Scanner.

File: G10028M Revision Date: December 5, 1996



Terminal Strip Arrangement Of Point To Point Diagram NO. G-10028M

- Remote Panel -
- Burner Panel
- Gas Train Mtd. Term. Strip

Remote Pnl. Must Be Bonded To Burner By Flexible Or Rigid Metal Conduit And Metal Conduit Connectors.

* Jump Term. 9 to 10 Via Purple Lead If Proof Of Closure Is Not Required.

Single Valve With P.O.C. Sw. May Omit Aux. Gas Valve. (Applicable To Units With Inputs Below 5,000 MBH)

"Use Copper Conductors Only."

Caution: Throw All Disconnects To Off Before Servicing.

Equipment Shown On Diagram Is Only Provided And Mounted By Power Flame If Specifically Called For On Burner Spec. Sheet.

Neutral Wiring May Not Be Connected As Shown, But May Be Wired To Terminate At Neutral Terminals Such As 2, 2A, T2 Or L2.

Caution: All Field Wiring Must Be Wired As Shown On Wiring Diagram

- Flame Safeguard Terminals
- Remote Panel Terminals
- Burner Panel Terminals
- Gas Train Mtd. Terminals
- Terminals In York Control Panel

G — Equipment Gnd. Conductor
F — Flame Circuit : Field Wired In Sep. Conduit Or Shielded Cable
Factory Wiring
24V / 115V / 200-575V — York Wiring "See Spec. Sheet For Voltage"
24V / 115V / 200-575V — Field Wiring "See Spec. Sheet For Voltage"

Color Code
BK - Black
WH - White
RD - Red
PK - Pink
BL - Blue
OR - Orange
YE - Yellow
PU - Purple
GR - Green

Last Wire No. Used - 95

Relays 36CR & 41CR

Ref.	R10 CDR	KUP
Coil	7	A
Neu	2	B
Com.	1	7,8,9
N.O.	3	4,5,6
N.C.	4	1,2,3

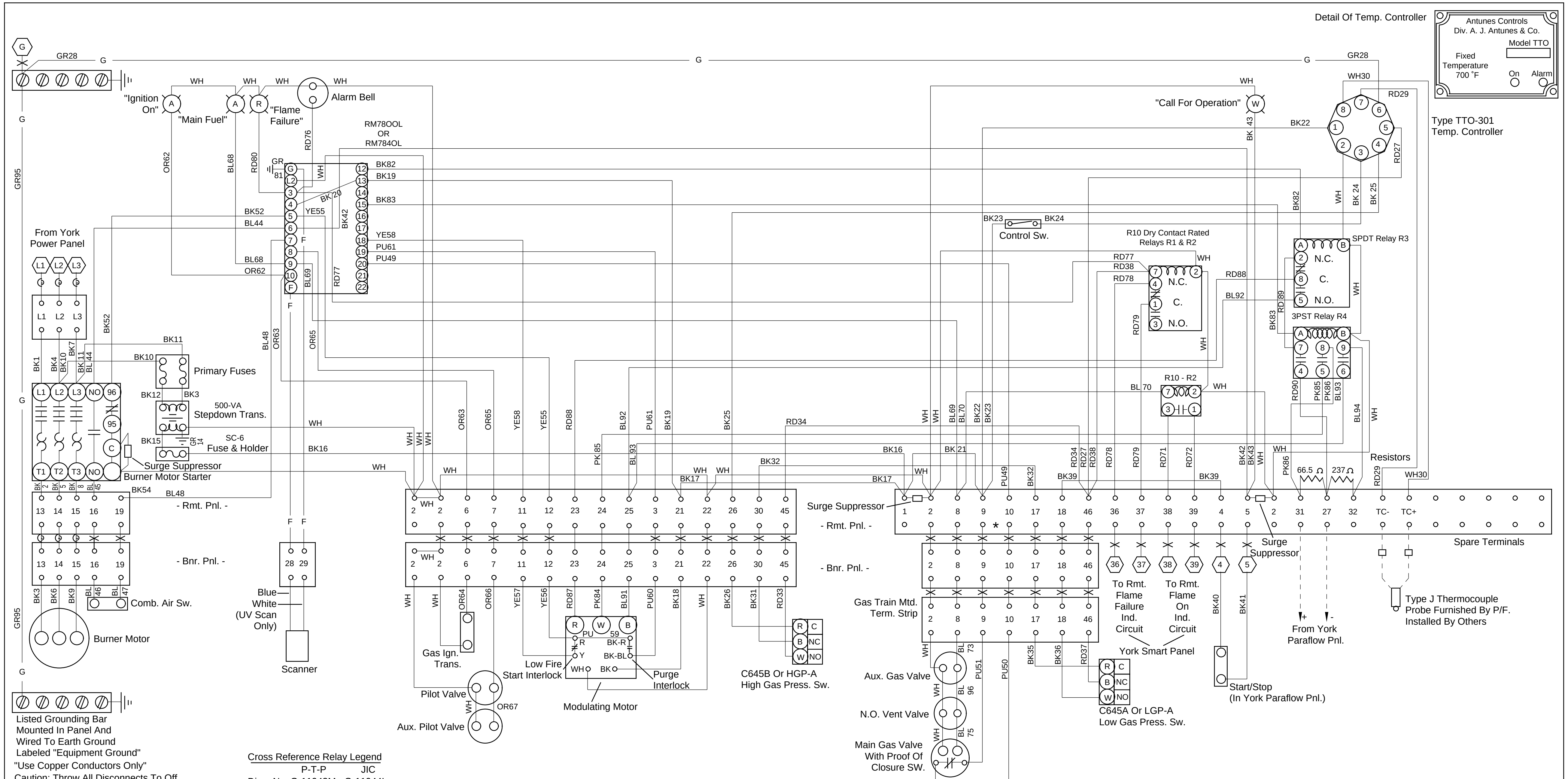
Relay Cross Reference

	JIC	-	P-T-P
Diag. No.	G-10029L	-	G-10028M
	41CR	-	R1
	36CR	-	R2
	46CR	-	R3
	47CR	-	R4

Title: Wiring Diagram

Gas Burner With RM7800L/40L, Modulation, 3PH. Motors, 4 Lights And Scanner.

File: G10029L
Revision Date: December 5, 1996



"Use Copper Conductors Only"

Caution: Throw All Disconnects To Off Before Servicing.

— G — Equipment Ground Conductor

— F — Flame Circuit : Run In Separate Conduit Or Shielded Conductor

Factory Wiring

York Wiring "See Spec. Sheet For Voltage": 24V, 115V, 200-575V

Field Wiring "See Spec. Sheet For Voltage": 24V, 115V, 200-575V

Equipment Shown On Diagram Is Only Provided And Mounted By Power Flame If Specifically Called For On Burner Spec. Sheet.

Cross Reference Relay Legend

	P-T-P		JIC
Diag. No.	G-11943M	-	G-11944L
	R1	-	41CR - Flame Failure
	R2	-	36CR - Flame On
	R3	-	46CR - Open Damper Purge
	R4	-	47CR - Run

Remote Pnl. Must Be Bonded To Burner By Flexible Or Rigid Metal Conduit And Metal Conduit Connectors.

⬡ - Terminals In York Control Pnl.

Neutral Wiring May Not Be Connected As Shown, But May Be Wired To Terminate At Neutral Terminals Such As 2, 2A, T2 Or L2.

Caution: All Field Wiring Must Be Wired As Shown On Diagram

Color Code
- BK - Black
- WH - White
- RD - Red
- PK - Pink
- BL - Blue
- OR - Orange
- YE - Yellow
- PU - Purple
- GR - Green

Last Wire No. Used - 96

Relays R1 & R2

Ref.	R10 CDR	KUP
Coil	7	A
Neu.	2	B
Com.	1	7,8,9
N.O.	3	4,5,6
N.C.	4	1,2,3

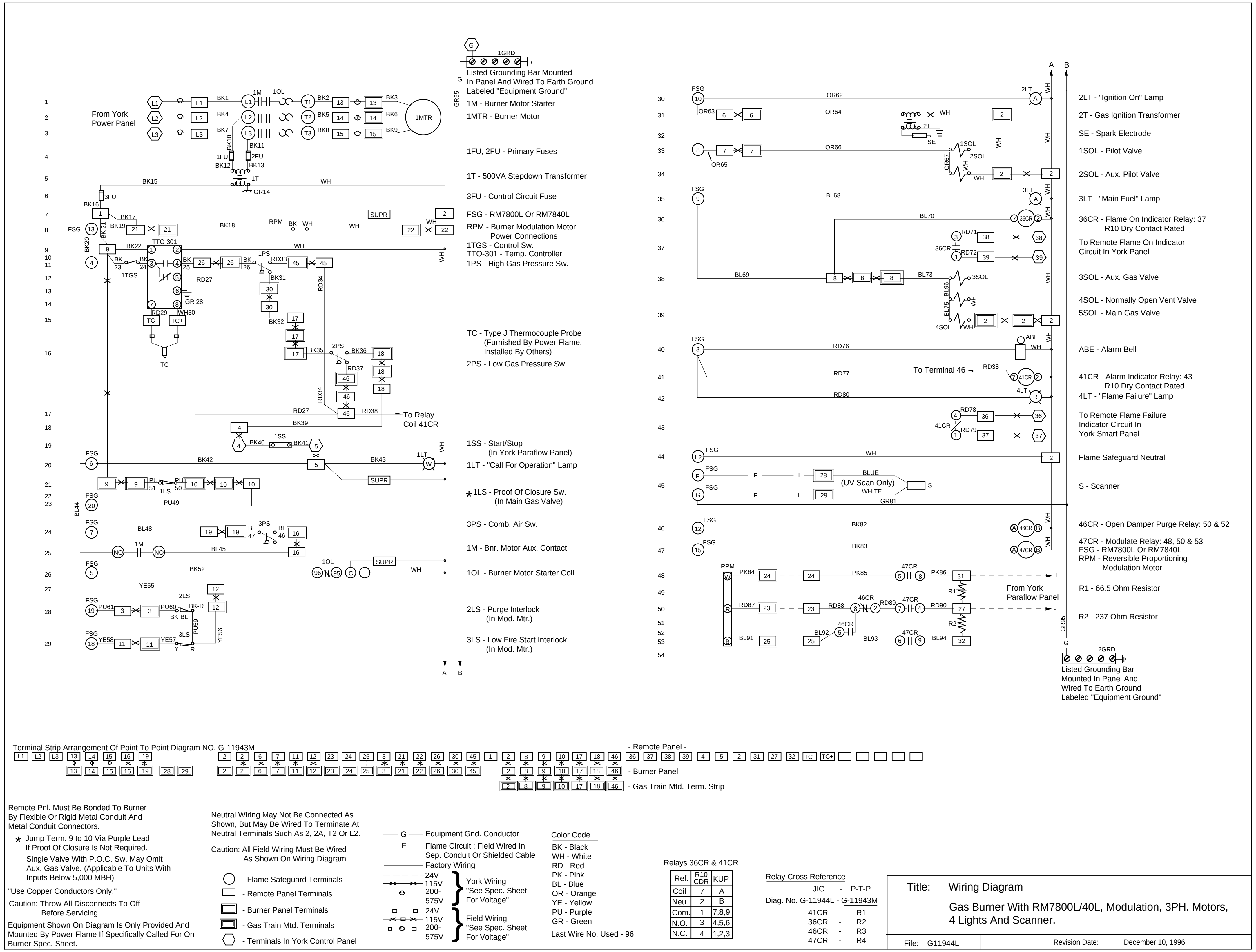
Single Valve With P.O.C. Sw. May Omit Aux. Gas Valve. (Applicable To Units With Inputs Below 5,000 MBH)

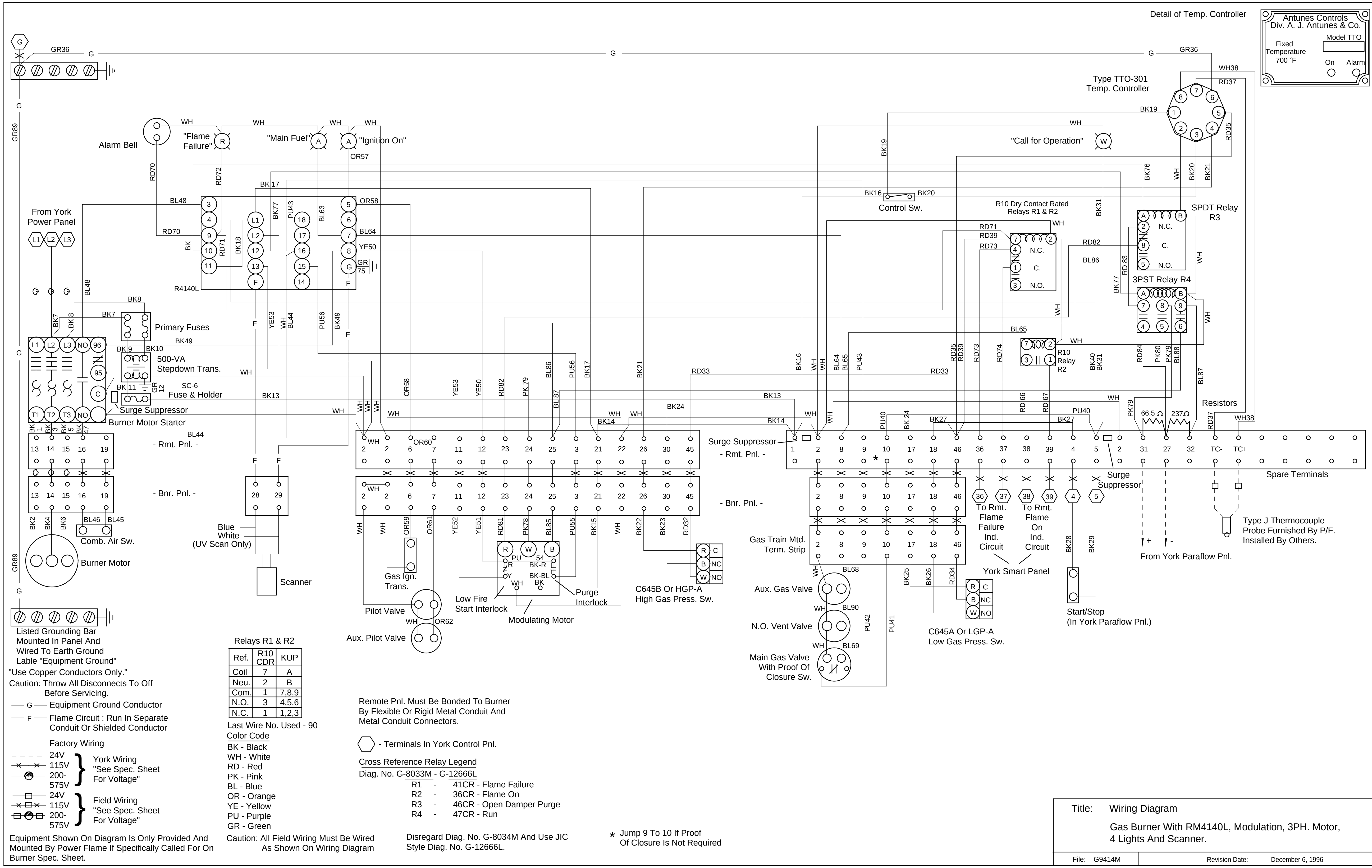
* Jump Term. 9 To 10 Via Purple Lead If Proof Of Closure Is Not Required.

Title: Wiring Diagram

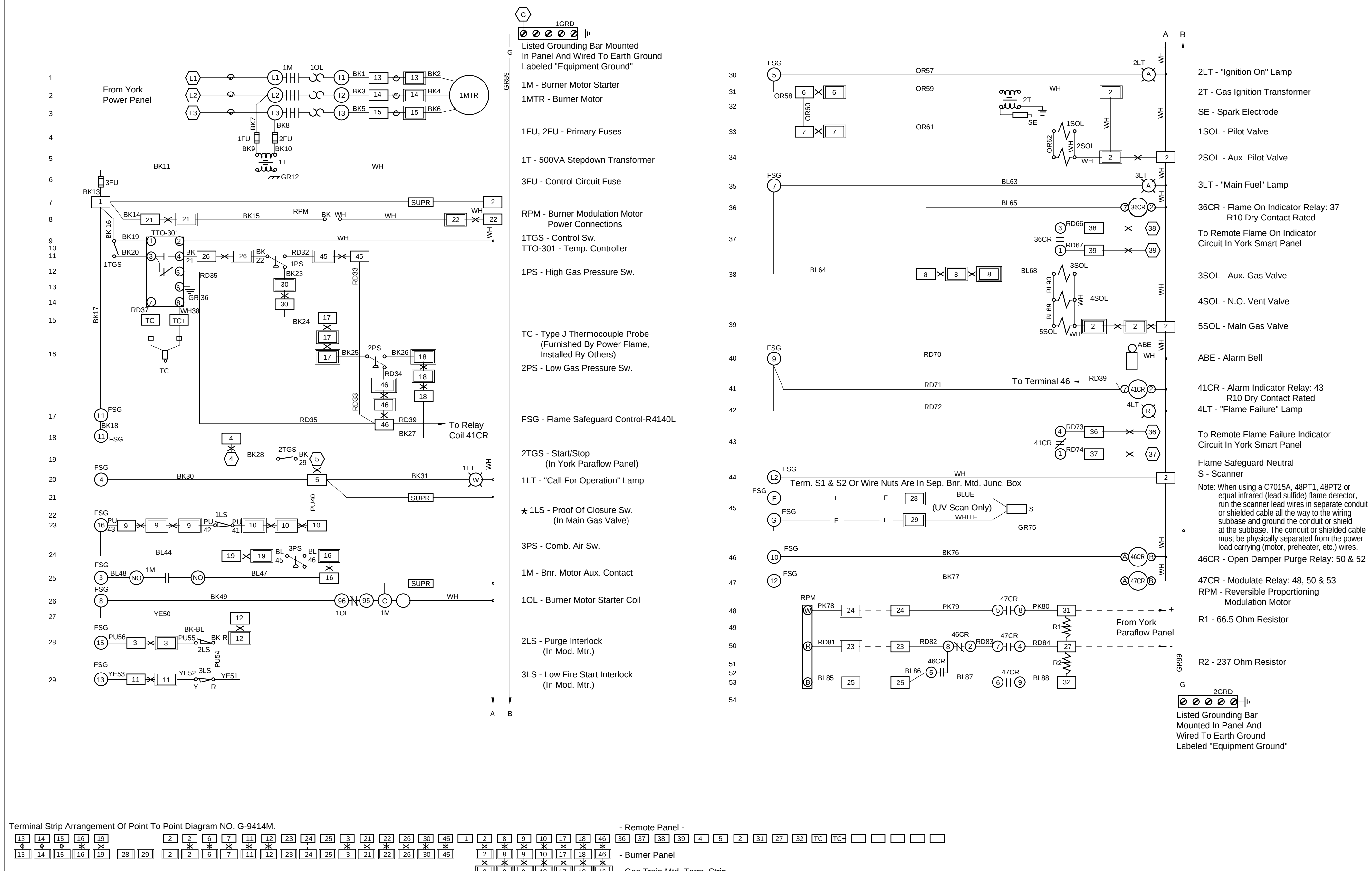
Gas Burner With RM7800L/40L, Modulation, 3PH. Motor 4 Lights And Scanner.

File: G11943M | Revision Date: December 5, 1996


Listed Grounding Bar Mounted In Panel And Wired To Earth Ground Labeled "Equipment Ground"
From York Power Panel
1M - Burner Motor Starter
1MTR - Burner Motor
1FU, 2FU - Primary Fuses
1T - 500VA Stepdown Transformer
3FU - Control Circuit Fuse
FSG - RM7800L Or RM7840L
RPM - Burner Modulation Motor Power Connections
1TGS - Control Sw.
TTO-301 - Temp. Controller
1PS - High Gas Pressure Sw.
TC - Type J Thermocouple Probe (Furnished By Power Flame, Installed By Others)
2PS - Low Gas Pressure Sw.
To Relay Coil 41CR
1SS - Start/Stop (In York Paraflow Panel)
1LT - "Call For Operation" Lamp
*1LS - Proof Of Closure Sw. (In Main Gas Valve)
3PS - Comb. Air Sw.
1M - Bnr. Motor Aux. Contact
1OL - Burner Motor Starter Coil
2LS - Purge Interlock (In Mod. Mtr.)
3LS - Low Fire Start Interlock (In Mod. Mtr.)
2LT - "Ignition On" Lamp
2T - Gas Ignition Transformer
SE - Spark Electrode
1SOL - Pilot Valve
2SOL - Aux. Pilot Valve
3LT - "Main Fuel" Lamp
36CR - Flame On Indicator Relay: 37 R10 Dry Contact Rated
To Remote Flame On Indicator Circuit In York Panel
3SOL - Aux. Gas Valve
4SOL - Normally Open Vent Valve
5SOL - Main Gas Valve
ABE - Alarm Bell
To Terminal 46
41CR - Alarm Indicator Relay: 43 R10 Dry Contact Rated
4LT - "Flame Failure" Lamp
To Remote Flame Failure Indicator Circuit In York Smart Panel
Flame Safeguard Neutral
(UV Scan Only)
S - Scanner
46CR - Open Damper Purge Relay: 50 & 52
47CR - Modulate Relay: 48, 50 & 53
FSG - RM7800L Or RM7840L
RPM - Reversible Proportioning Modulation Motor
From York Paraflow Panel
R1 - 66.5 Ohm Resistor
R2 - 237 Ohm Resistor
Listed Grounding Bar Mounted In Panel And Wired To Earth Ground Labeled "Equipment Ground"
Terminal Strip Arrangement Of Point To Point Diagram NO. G-11943M
- Remote Panel -
- Burner Panel
- Gas Train Mtd. Term. Strip
Remote Pnl. Must Be Bonded To Burner By Flexible Or Rigid Metal Conduit And Metal Conduit Connectors.
* Jump Term. 9 to 10 Via Purple Lead If Proof Of Closure Is Not Required.
Single Valve With P.O.C. Sw. May Omit Aux. Gas Valve. (Applicable To Units With Inputs Below 5,000 MBH)
"Use Copper Conductors Only."
Caution: Throw All Disconnects To Off Before Servicing.
Equipment Shown On Diagram Is Only Provided And Mounted By Power Flame If Specifically Called For On Burner Spec. Sheet.
Neutral Wiring May Not Be Connected As Shown, But May Be Wired To Terminate At Neutral Terminals Such As 2, 2A, T2 Or L2.
Caution: All Field Wiring Must Be Wired As Shown On Wiring Diagram
- Flame Safeguard Terminals
- Remote Panel Terminals
- Burner Panel Terminals
- Gas Train Mtd. Terminals
- Terminals In York Control Panel
G - Equipment Gnd. Conductor
F - Flame Circuit : Field Wired In Sep. Conduit Or Shielded Cable
Factory Wiring
24V 115V 200-575V York Wiring "See Spec. Sheet For Voltage"
24V 115V 200-575V Field Wiring "See Spec. Sheet For Voltage"
Color Code
BK - Black
WH - White
RD - Red
PK - Pink
BL - Blue
OR - Orange
YE - Yellow
PU - Purple
GR - Green
Last Wire No. Used - 96
Relays 36CR & 41CR
Ref. | R10 CDR | KUP
Coil | 7 | A
Neu | 2 | B
Com. | 1 | 7,8,9
N.O. | 3 | 4,5,6
N.C. | 4 | 1,2,3
Relay Cross Reference
JIC - P-T-P
Diag. No. G-11944L - G-11943M
41CR - R1
36CR - R2
46CR - R3
47CR - R4
Title: Wiring Diagram
Gas Burner With RM7800L/40L, Modulation, 3PH. Motors, 4 Lights And Scanner.
File: G11944L
Revision Date: December 10, 1996



Ref.	R10 CDR	KUP
Coil	7	A
Neu.	2	B
Com.	1	7,8,9
N.O.	3	4,5,6
N.C.	1	1,2,3



* Jump Term. 9 to 10 If Proof Of Closure Sw. Is Not Required.

Caution: All Field Wiring Must Be Wired As Shown On Wiring Diagram

"Use Copper Conductors Only."

Caution: Throw All Disconnects To Off Before Servicing.

Equipment Shown On Diagram Is Only Provided And Mounted By Power Flame If Specifically Called For On Burner Spec. Sheet.

Remote Pnl. Must Be Bonded To Burner By Flexible Or Rigid Metal Conduit And Metal Conduit Connectors.

- Flame Safeguard Terminals
- Remote Panel Terminals
- Burner Panel Terminals
- Gas Train Mtd. Terminals
- Terminals In York Control Panel

G — Equipment Gnd. Conductor
F — Flame Circuit : Field Wired In Sep. Conduit Or Shielded Cable
Factory Wiring

24V / 115V / 200-575V — York Wiring "See Spec. Sheet For Voltage"

24V / 115V / 200-575V — Field Wiring "See Spec. Sheet For Voltage"

Color Code
BK - Black
WH - White
RD - Red
PK - Pink
BL - Blue
OR - Orange
YE - Yellow
PU - Purple
GR - Green

Last Wire No. Used - 90

Relays 36CR & 41CR

Ref.	R10 CDR	KUP
Coil	7	A
Neu	2	B
Com.	1	7,8,9
N.O.	3	4,5,6
N.C.	1	1,2,3

Relay Cross Reference

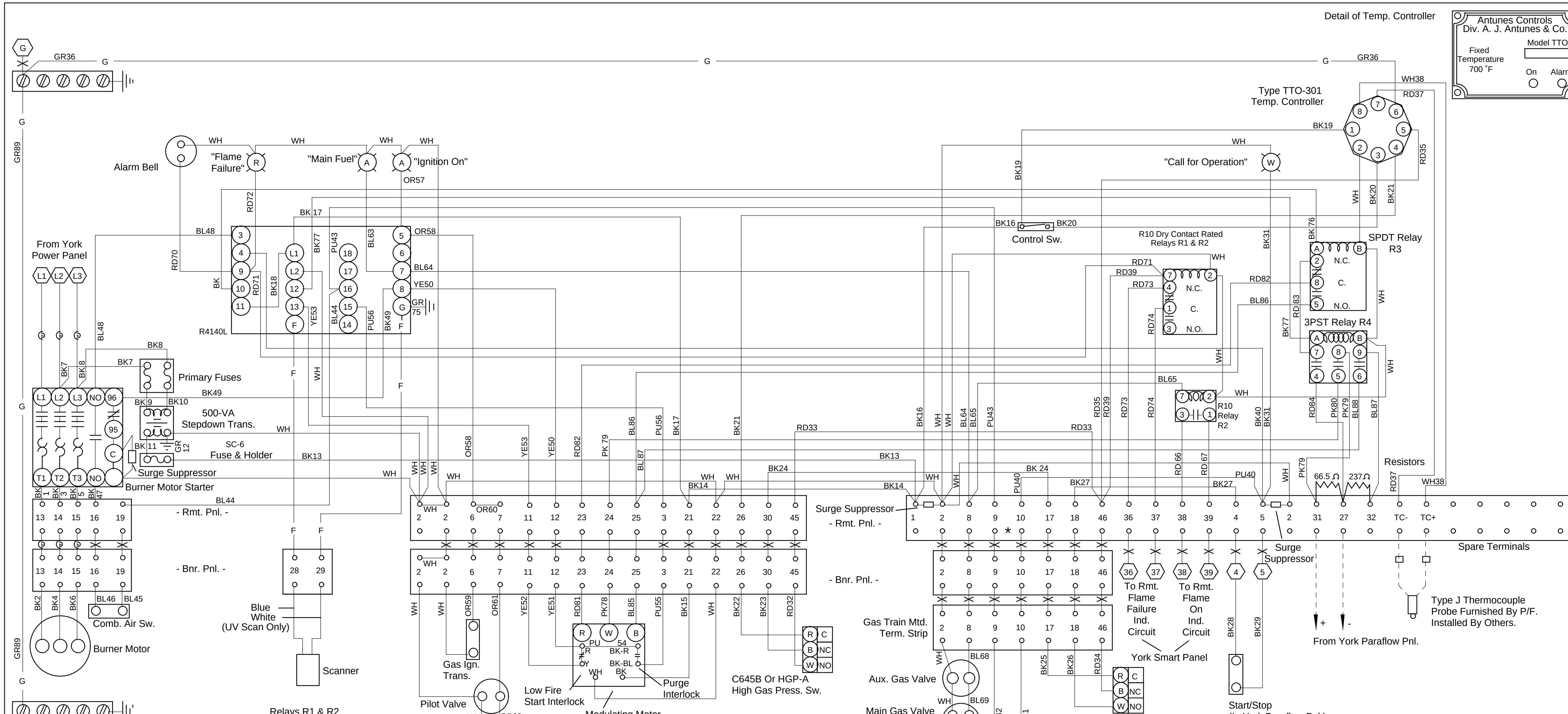
Diag. No. G-12666L - G-9414M

41CR	-	R1
36CR	-	R2
46CR	-	R3
47CR	-	R4

Title: Wiring Diagram

Gas Burner With R4140L, Modulation, 3PH. Motors, 4 Lights And Scanner.

File: G12666L   Revision Date: December 10, 1996



Listed Grounding Bar Mounted In Panel And Wired To Earth Ground Lable "Equipment Ground"

"Use Copper Conductors Only."

Caution: Throw All Disconnects To Off Before Servicing.

— G — Equipment Ground Conductor

— F — Flame Circuit : Run In Separate Conduit Or Shielded Conductor

——— Factory Wiring

York Wiring "See Spec. Sheet For Voltage": 24V, 115V, 200-575V

Field Wiring "See Spec. Sheet For Voltage": 24V, 115V, 200-575V

Equipment Shown On Diagram Is Only Provided And Mounted By Power Flame If Specifically Called For On Burner Spec. Sheet.

Relays R1 & R2

Ref.	R10 CDR	KUP
Coil	7	A
Neu.	2	B
Com.	1	7,8,9
N.O.	3	4,5,6
N.C.	1	1,2,3

Last Wire No. Used - 89

Color Code
BK - Black
WH - White
RD - Red
PK - Pink
BL - Blue
OR - Orange
YE - Yellow
PU - Purple
GR - Green

Caution: All Field Wiring Must Be Wired As Shown On Wiring Diagram

Remote Pnl. Must Be Bonded To Burner By Flexible Or Rigid Metal Conduit And Metal Conduit Connectors.

⬡ - Terminals In York Control Pnl.

Cross Reference Relay Legend
Diag. No. G-8033M - G-9641L
R1 - 41CR - Flame Failure
R2 - 36CR - Flame On
R3 - 46CR - Open Damper Purge
R4 - 47CR - Run

Disregard Diag. No. G-8034M And Use JIC Style Diag. No. G-9641L.

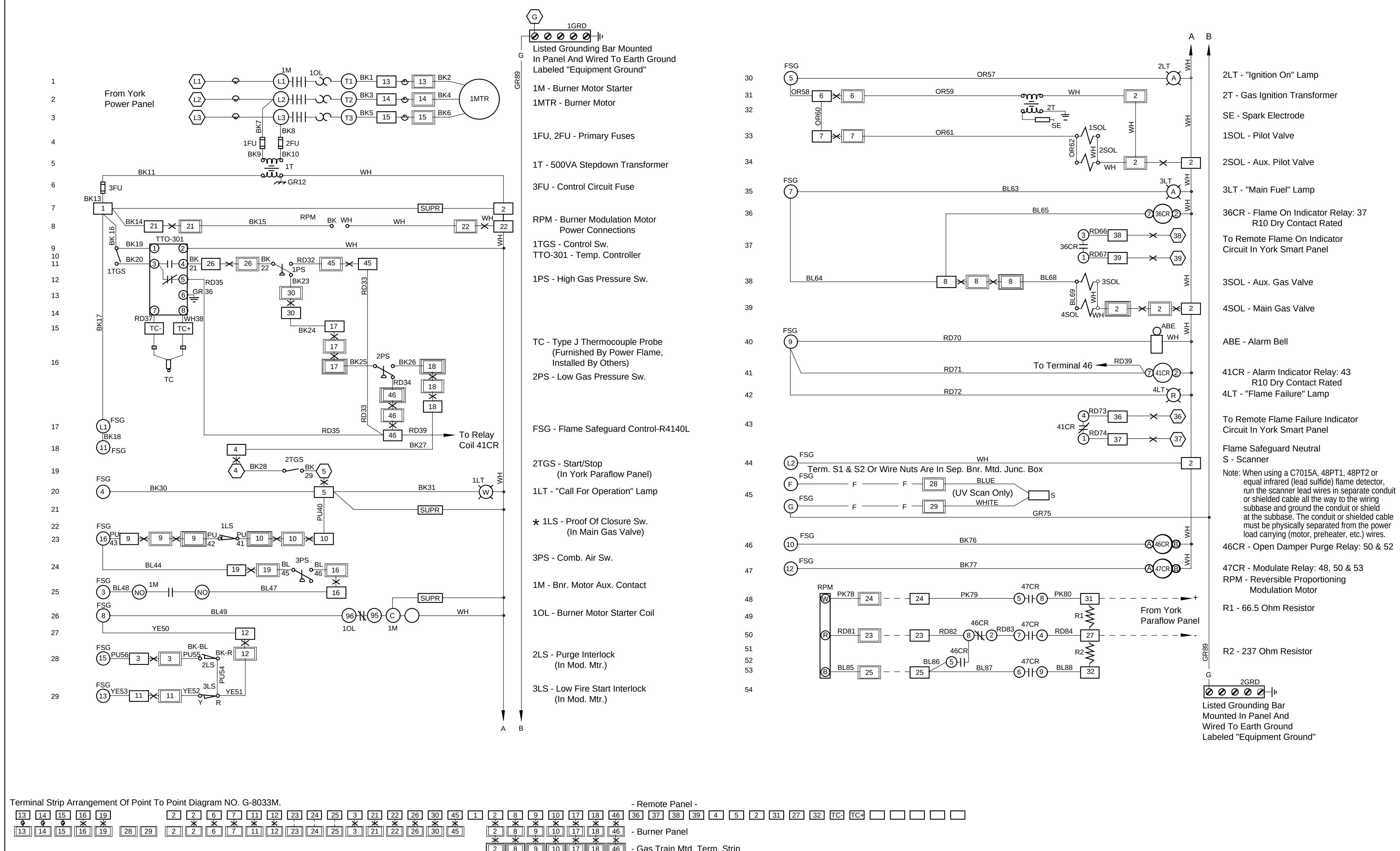
* Jump 9 To 10 If Proof Of Closure Is Not Required

Note: Single Valve With Proof Of Closure Sw.; Aux. Gas Valve Not Required. (May Be Spec. For Inputs Below 5.0 MBH)

Title: Wiring Diagram

Gas Burner With R4140L, Modulation, 3PH. Motors, 4 Lights And Scanner.

File: G8033M | Revision Date: December 11, 1996



★ Jump Term. 9 to 10 If Proof Of Closure Sw. Is Not Required.

Note: Single Valve With Proof Of Closure Sw.; Aux. Gas Valve Not Required. (May Be Spec. For Inputs Below 5.0 MBH)

"Use Copper Conductors Only."

Caution: Throw All Disconnects To Off Before Servicing.

Equipment Shown On Diagram Is Only Provided And Mounted By Power Flame If Specifically Called For On Burner Spec. Sheet.

Remote Pnl. Must Be Bonded To Burner By Flexible Or Rigid Metal Conduit And Metal Conduit Connectors.

Caution: All Field Wiring Must Be Wired As Shown On Wiring Diagram

- Flame Safeguard Terminals
- Remote Panel Terminals
- Burner Panel Terminals
- Gas Train Mtd. Terminals
- Terminals In York Control Panel

G — Equipment Gnd. Conductor
F — Flame Circuit : Field Wired In Sep. Conduit Or Shielded Cable
Factory Wiring
24V / 115V / 200-575V — York Wiring "See Spec. Sheet For Voltage"
24V / 115V / 200-575V — Field Wiring "See Spec. Sheet For Voltage"

Color Code
BK - Black
WH - White
RD - Red
PK - Pink
BL - Blue
OR - Orange
YE - Yellow
PU - Purple
GR - Green

Last Wire No. Used - 89

Relays 36CR & 41CR

Ref.	R10 CDR	KUP
Coil	7	A
Neu	2	B
Com.	1	7,8,9
N.O.	3	4,5,6
N.C.	1	1,2,3

Relay Cross Reference

Diag. No. G-9641L	-	G-8033M
41CR	-	R1
36CR	-	R2
46CR	-	R3
47CR	-	R4

Title: Wiring Diagram

Gas Burner With R4140L, Modulation, 3PH. Motors, 4 Lights And Scanner.

File: G9641L Revision Date: December 5, 1996

GENERAL

1. Burner Fails To Start.

A. Defective on/off or fuel transfer switch.	Replace Switch.
B. Micro-Panel not sending 120VAC to terminal 5 of the burner panel.	Determine cause for lack of power. Refer to Forms 155.17-02, M2 and W1 also 155.19-W1.
C. Motor overloads tripped.	Reset and correct cause for trip.
D. Flame safeguard control safety switch trip out.	Reset and determine apparent cause for flame failure.
E. Loose connections or faulty wiring.	Tighten all terminal screws and consult wiring diagram furnished with the burner.
F. Flame safeguard control starting circuit blocked due to flame relay being energized.	Possible defective scanner. -- Replace. Possible defective amplifier. -- Replace. Scanner actually sighting flame due to leaking fuel valve. -- Correct unwanted flame cause. Defective Flame Safeguard Control. -- Replace.
G. Defective blower motor.	Repair or replace.

2. Nuisance trips for no apparent reason.

A. Gas pilot ignition failure.	Refer to pilot adjustment section and readjust to make certain that the ignition is instant and the flame signal readings are stable and above minimum values. Use a manometer or 0-10” W.C. gas pressure guage on pilot pressure tap to make certain that pressure is as recommended.
B. Verify that there are no cracks in the porcelain of the ignition elec trode and also that the transformer end and electrode end plug in connection are tight.	Repair or replace any defective components.
C. Loose or broken wires.	Check all wire nut connections and tighten all terminal screw connections in panel and elsewhere as appropriate.
D. Ensure that when the main flame lights, the air flow switch is not so critically set so as to allow occasional momentary opening of the air switch contacts.	Re-adjust air flow switch if necessary. Refer to appropriate section of this manual for details on setting switch.
E. Occasional low voltage supply.	Have local utility correct. Make certain that the burner control circuit transformer is correct for the voltage being supplied. 208V and 230/460V primary 120V secondary transformers are used.
F. Occasional low gas pressure supply.	Have local utility correct.
G. Air leak in oil suction line or check valve not holding.	Correct as required.

GAS OPERATION

1. Burner motor runs, but pilot does not light.

A. Gas supply to burner shut off.	Make sure all manual gas supply valves are fully open.
B. Pilot solenoid valve not opening.	Listen and/or feel for valve actuation. Solenoid valve not being powered, check electrical circuitry. Replace coil or entire valve if coil is burned out.
C. Defective gas pilot regulator.	Replace.

D. Gas pressure too high or too low at pilot orifice.	Check orifice size in gas pilot assembly. Replace if incorrect.
E. Defective flame safeguard control or plug in purge card.	Replace as required.
F. Air flow switch not closing.	Check out electrically and correct pressure adjustment on switch if required. Defective air flow switch. Replace switch.
2. Burner motor runs, pilot lights, but main gas flame is not established.	
A. Main shut-off or test cock closed.	Open main gas shut-off valves.
B. Pilot flame signal reading too low to pull in flame safe guard relay.	Refer to gas pilot settings section and readjust as required.
C. Defective automatic main or gas shut-off valves.	Check electrical circuitry to valves. Replace valves or correct circuitry as required.
D. Main diaphragm valve opening too slowly.	Adjust bleed on valve.
E. Defective flame safeguard control or plug in amplifier.	Check and replace as required.
F. Butterfly valve set incorrectly.	Readjust as required to achieve good fuel/air ratios. Refer to start-up section.
G. Main gas pressure regulator atmosphere vent line obstructed.	Remove obstruction.
H. Defective main gas pressure regulator.	Replace.
I. Mis-adjusted main gas pressure regulator.	Readjust at high fire as described in start-up section.
3. Carbon Monoxide readings on gas firing.	
A. Flame impingement on "cold" heat transfer surfaces caused by excessive firing rate.	Reduce firing rate to correct input problem. Clock th meter and match high fire input to value shown on burner specification sheet.
B. Incorrect gas/air ratios.	Readjust burner to correct CO2/O2 levels eliminating all CO formation. Refer to start-up section for details.
4. Gas high fire input can not be achieved.	
A. Gas company pressure regulator or meter operating incorrectly, not allowing required gas pressure at burner train inlet.	Check for proper pressure to burner at full fire. Contact gas company if needed.
B. Gas cock upstream of gas train inlet not fully open.	Check and correct.
C. Gas line obstructed.	Check and correct.
D. Gas train main and/or leak test cocks not fully open.	Check and correct.
E. Gas supply line between gas company regulator and burner inlet too small.	Check supply pressure at meter, determine pressure drop and increase line size as required. Refer to gas piping design section for details. The supply gas pressure can also be increased to compensate for small line sizes.
Note: Do not raise gas pressure so high that under static (no flow) conditions, the pressure in the gas piping exceeds the maximum allowable pressure to the gas train component on the burner.	
F. Burner gas train components sized too small for supply pressure.	Increase component size as required.
G. Automatic gas valves not opening fully due to defective operation.	Replace gas valve.
H. Butterfly valve not fully opening.	Readjust or replace.
I. Defective main gas pressure regulator.	Replace.

J. Incorrect spring installed in main gas pressure regulator.	Replace as required.
K. Main gas pressure regulator vent line obstructed.	Check and correct.
L. Normally open vent valve (if supplied) not closing when automatic gas valve opens.	Replace vent valve if not fully closing.

OIL OPERATION

1. Burner motor runs, gas pilot ignites, but main oil flame is not established.

A. Defective or incorrect size oil nozzle.	Remove and clean or replace.
B. Low oil pressure.	Check with gauge for correct light off pressure.
C. Defective oil pump.	Replace.
D. Defective oil pump motor.	Replace or rebuild motor.
E. Defective oil solenoid valve.	Replace.
F. Low oil pressure switch (if supplied) defective or incorrectly set.	Adjust or replace switch.
G. Air flow switch not making.	Reset pressure setting or replace.
H. Defective flame safeguard control or plug in purge timer card.	Replace defective component.
I. Air dampers held in high fire position due to mechanical binding of linkage.	Readjust linkage.
J. Loose wiring connections.	Check and tighten all connections.

2. Oil flame ignites, but flame safeguard control locks out on safety.

A. Defective oil nozzle causing unstable flame and scanning problems.	Replace oil nozzle.
B. Fuel/air ratios incorrect, resulting in unstable or smokey flame causing scanner flame sighting problem.	Readjust ratios for clean, stable flame.
C. Defective flame safeguard control or amplifier.	Replace as appropriate.

3. Oil flame extremely smokey at light off or in low fire position.

A. Defective or incorrect size oil nozzle.	Replace.
B. Fuel/air ratio incorrect.	Refer to start-up section for details.

4. Light off oil flame is established and proven, but burner will not attempt to go to the high fire position.

A. Loose wires or incorrectly wired.	Verify wiring and tighten all connections.
B. Flame safeguard control or high fire switching relay defective.	Verify and correct as required.
C. Linkage mechanically binding.	Readjust linkage.
D. Defective modulating motor.	Replace motor.
E. Actuator motor not receiving the correct MA signal from Micro-Panel.	Check chilled water temperature set point.
	Check maximum allowed input setting.

5. Low oil flame is established and proven, but flame out occurs in transition from low fire to high fire.	
A. On two-stage oil pump, normally open solenoid valve defective (not closing).	Replace valve or pump.
B. Defective or incorrect size oil nozzle.	Replace.
C. High fire oil pressure too low.	Adjust pressure as per start-up instructions.
D. Air dampers set too far open at low fire, which causes flame to blow out in starting to high fire.	Readjust air dampers.
E. Oil pump coupling loose or defective.	Tighten or replace coupling.
F. Defective oil pump.	Replace pump.
G. Linkage mechanically binding.	Readjust as per start-up instructions.
H. Fuel/air ratios set incorrectly, causing flame to blow out when going from low fire to high fire.	Readjust linkage as per start-up instructions.
6. White smoke formation on oil firing.	
A. Too much excess air, or oil flow is too low.	Readjust for proper fuel input, CO_2, and smoke readings.
7. Grey or black smoke formation on oil firing.	
A. Defective or dirty oil nozzle.	Clean or replace nozzle
B. Incorrect oil/air ratios.	Readjust burner to correct CO_2 and smoke levels.
C. Oil pressure too low, resulting in poor atomization.	Readjust.
D. Impingement of raw oil spray on the blast tube choke ring or oil nozzle.	Make certain the oil nozzle is seated firmly against the oil nozzle adapter shoulder. Position the oil gun assembly fore or aft in the blast tube to assist in the elimination of the oil spray on the blast tube choke ring.
8. Oil high fire input cannot be achieved.	
A. Oil nozzle size is too small.	Remove nozzle and check markings. Replace with correct size nozzle.
B. Nozzle defective or dirty.	Replace or clean nozzle.
C. Oil supply pressure to nozzle too low.	Readjust.
D. Oil pump defective.	Replace.
E. Oil pump coupling loose or defective.	Tighten or replace coupling.
F. Linkage mechanically binding.	Readjust.
G. Oil nozzle return line metering valve set incorrectly.	Readjust to attain required nozzle bypass pressures.
H. Blocked or dirty oil line suction filter.	Replace or clean line.
I. Manual valves in suction line not fully open.	Check and correct.
J. Suction line check or foot valve operating incorrectly.	Check and correct.
K. Vent system on oil tank blocked creating a vacuum on tank. This condition will cause a decrease in oil flow to the burner.	Check and correct.

PERIODIC CHECK LIST

Item	Frequency	Checked By	Remarks
Guages, monitors and indicators	Daily	Operator	Make visual inspection and record readings in log.
Instrument and equipment settings	Daily	Operator	Make visual check against York's recommended specifications.
Firing rate control	Weekly Semi-annually Annually	Operator Service Technician Service Technician	Verify heat exchanger manufacturer's settings. Verify heat exchanger manufacturer's settings. Check with combustion test.
Flue, vent, stack or outlet damper	Monthly	Operator	Make visual inspection of chimney and draft system. Check for proper operation of draft control system.
Combustion air	Monthly	Operator	All sources remain clean and open.
Ignition system	Weekly	Operator	Make visual inspection, check flame signal strength if meter-fitted. (see "Combustion Safety Controls")
Fuel Valves:			
Pilot and main	Weekly	Operator	Open limit switch - make aural and visual check - check valve position indicators and check fuel meters if so fitted.
Pilot and main gas or main or main oil	Annually	Service Technician	Perform leakage tests -refer to bubble leak test procedure in this section.
Combustion Safety Controls:			
Flame failure	Weekly	Operator	Close manual fuel supply for (1) pilot, (2) main fuel cock, and/or valve(s): check safety shutdown timing; log.
Flame signal strength	Weekly	Operator	If flame meter signal is installed, read and log; for both pilot and main flames, notify service organization if readings are very high, very low or fluctuating; refer to flame safeguard manufacturer's instructions.
Pilot turndown tests	As required/annually	Service Technician	Required after any adjustments to flame scanner mount or pilot burner; verify annually - refer to flame safeguard manufacturer's instructions.
High limit safety control	Annually	Service Technician	Refer to start-up section for details.
Operating control	Annually	Service Technician	Check for proper modulation of 4-20MA signal.
Low draft, fan, air pressure and damper	Monthly	Operator	Refer to this manual and control manufacturer's instructions.
High and low gas pressure interlocks	Monthly	Operator	Refer to instructions in this manual.
Low oil pressure interlocks	Monthly	Operator	Refer to instructions in this manual.
Fuel valve interlock switch	Annually	Service Technician	Refer to valve manufacturer's instructions.

PERIODIC CHECK LIST (Continued)

Item	Frequency	Checked By	Remarks
Low fire interlock switch	Annually	Service Technician	Refer to fuel/air control motor manufacturer's instructions.
Automatic changeover control (dual fuel)	At least Annually	Service Technician	Under supervision of gas utility.
Inspect burner components	Annually	Service Technician	Refer to this manual and control manufacturer's instructions.
Remove oil drawer assembly	Annually	Service Technician	Remove and clean.
Check blower motor and blower wheel for cleanliness. Remove and clean as necessary	Annually	Service Technician	Remove and clean.
Remove, inspect and clean gas pilot assembly	Annually	Service Technician	Remove and clean.

If you have any questions about the procedures listed above - or questions relating to components or devices on your unit not specifically covered in the above - contact York Factory Service.