Mobile Glassblowing Studios'
Dragon Furnace General Owner's Guide
Comprehensive Safety Systems

Baby, Little, & Big Dragon Furnaces

Welcome to our Growing Global Community!

Dragon Furnace General Owner's Guide
Comprehensive Safety Systems

These instructions are guidelines for use of the **Baby, Little, or Big Dragon Glassblowing furnaces** (including Double Dragon configurations). Please read this manual and all supporting documents carefully prior to using your equipment. Should any questions arise, please contact a representative of Mobile Glassblowing Studios IMMEDIATELY. **844-452-7246 EXT 3** or **229-352-9988 EXT 3**. You can also reach us at mobileglassblowingstudios@gmail.com. We offer complimentary initial support in setting up and operating your Dragon furnace and related equipment. More information about ongoing support is on our website at www.mobileglassblowingstudios.com/customersupport.

You can also refer to the FAQ and Resources pages on our website for more information.

Mobile Glassblowing Studios, LLC, for a period of one year from date of shipment, warrants each system or product of its own manufacture, with the exception of burner tips, crucibles and other refractory materials, to the original Purchaser to be free from defects in material and workmanship under normal use, service and maintenance. Normal use, service and maintenance means: (1) Not exceeding the maximum temperatures, volumes, and other parameters specified in the Company's instructions and/or Owner's Manuals. (2) Using only the fuels specified in the Company's instructions and/or Owner's Manuals. (3) Operation and maintenance in compliance with the Company's instructions and/or Owner's Manuals. Products or goods not manufactured by the Company and supplied in piece, or as components to a system designed or supplied by the company, are not covered by this warranty. Components and parts of the equipment that are not manufactured by the Company are not covered by the Company's warranty, and the Company does not warrant the performance, use and operation of those parts. For complete details, please refer to your Terms, Conditions, and Limited Warranty document or visit www.mobileglassblowingstudios.com/warranty.

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System Specifications: Baby, Little, & Big Dragons

General Specifications:

- Electrical: Blower is 120V AC, 1A (240V available)
- Fuel Type: Propane or Natural Gas, 14" W.C. / 35 mb pressure maximum
- Fuel Consumption: Propane: +/- 1 gallon or +/- 2 kg per hour; Natural gas: +/- 93 cubic ft or 2.8 cubic meters per hour
- Btu/H range: 60,000 – 140,000
- Maximum Temp: 2300° F (1260° C)

Baby Dragon:

- Dimensions (disassembled): 31" D x 34" W x 56" H (79cm D x 86cm W x 143cm H)
- Dimensions (assembled furnace with accessories - not including bench, annealer, marver, etc.): 7.5' D x 4' W x 6.5' H (2.29m D x 1.22m W x 1.98m H)
- Curb Weight (approx.): 550 pounds (249 kg)
- Capacity: 30 pounds (13 kg)

Little Dragon:

- Dimensions (disassembled): 31" D x 34" W x 56" H (79cm D x 86cm W x 143cm H)
- Dimensions (assembled furnace with accessories - not including bench, annealer, marver, etc.): 90" D x 48" W x 78" H (229cm D x 122cm W x 198cm H)
- Curb Weight (approx.): 850 pounds (385 kg)
- Capacity: 60 pounds (27 kg)

Big Dragon:

- Dimensions (disassembled): 31" D x 34" W x 56" H (79cm D x 86cm W x 143cm H)
- Dimensions (assembled furnace with accessories - not including bench, annealer, marver, etc.): 90" D x 48" W x 78" H (229cm D x 122cm W x 198cm H)
- Curb Weight (approx.): 850 pounds (385 kg)
- Capacity: 95 pounds (43 kg)

UNPACKING

The shipping crate should be disassembled starting with the lid, followed by the top half of each narrow side.

Carefully unpack the burner train. Be particularly careful with the burner train, as the pressure gauge and ceramic burner tip can be broken if not handled carefully.

Continue disassembling the crate.

Unpack all parts before removing the furnace.

Look around the crate for any loose hardware, sometimes thumbscrews can come loose during shipping.

The handle including pins was shipped assembled. Make sure to have the pins installed any time you move the furnace by the handle. The handle can be moved to either the front or the back of the furnace. It should be located to the back or completely removed when firing your furnace.

Once all loose parts are removed from the crate, you can remove the furnace from the pallet. Be aware that the Dragon furnaces range from 600-900 pounds. Be extremely cautious when moving the furnace. You will need to fashion a small ramp or use a forklift to remove it from the pallet.

The standard casters were shipped with the brakes “ON”. The brakes will need to be placed in the “OFF” position prior to moving the furnace. The spring loaded casters are not equipped with brakes, you will need to use a chock system once furnace is in position.

SET-UP (before lighting up for the first time)

The initial light-up sequence should take place outdoors or with adequate ventilation, without glass in the crucible. The furnace has been cooked out at the factory but will need an additional firing to finish the process. The furnace should be brought up to glowing orange slowly for the first time, and then allowed to cool before using. There are some noxious fumes that will be emitted during this initial firing, which is why we recommend doing it outdoors for the first time.

Before assembling ANY components (other than the handle) to the Dragon, move it into the position where you will be firing it.

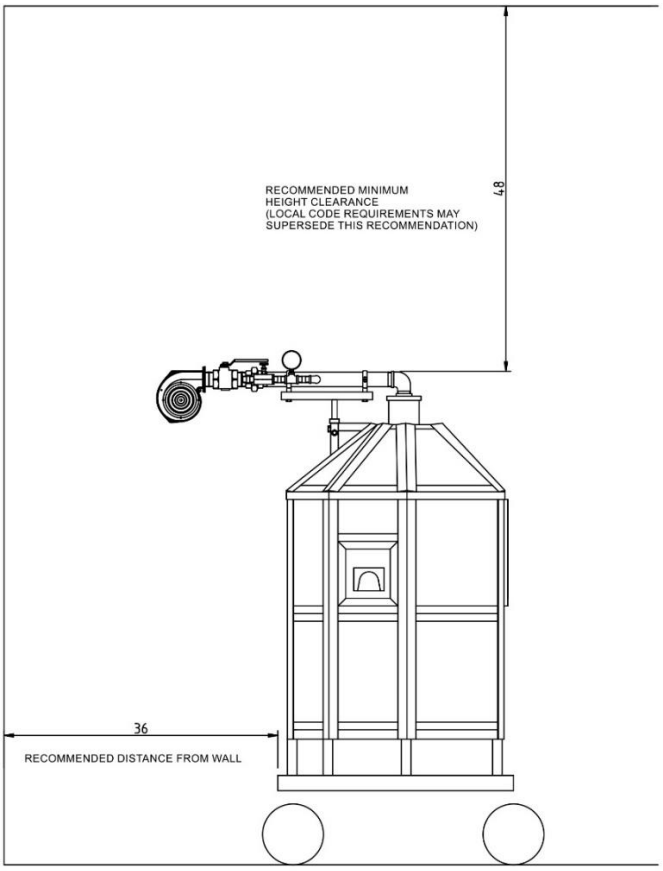
The Furnace reaches internal temperatures over 2000 degrees. Extremely hot air and flame come out of the burner tip area (on top of the furnace) and from the front opening of the furnace.

The outside skin of the furnace, when in operation, will reach high temperatures. DO NOT TOUCH THE OUTSIDE OF THE FURNACE WITH BARE HANDS ONCE IT HAS BEEN TURNED ON.

Set the furnace up in an open outside or well-ventilated area.

Set up away from flammable materials.

Below is a diagram of recommended clearance minimums:



If setting up underneath a covering, the covering must be fire-proof.

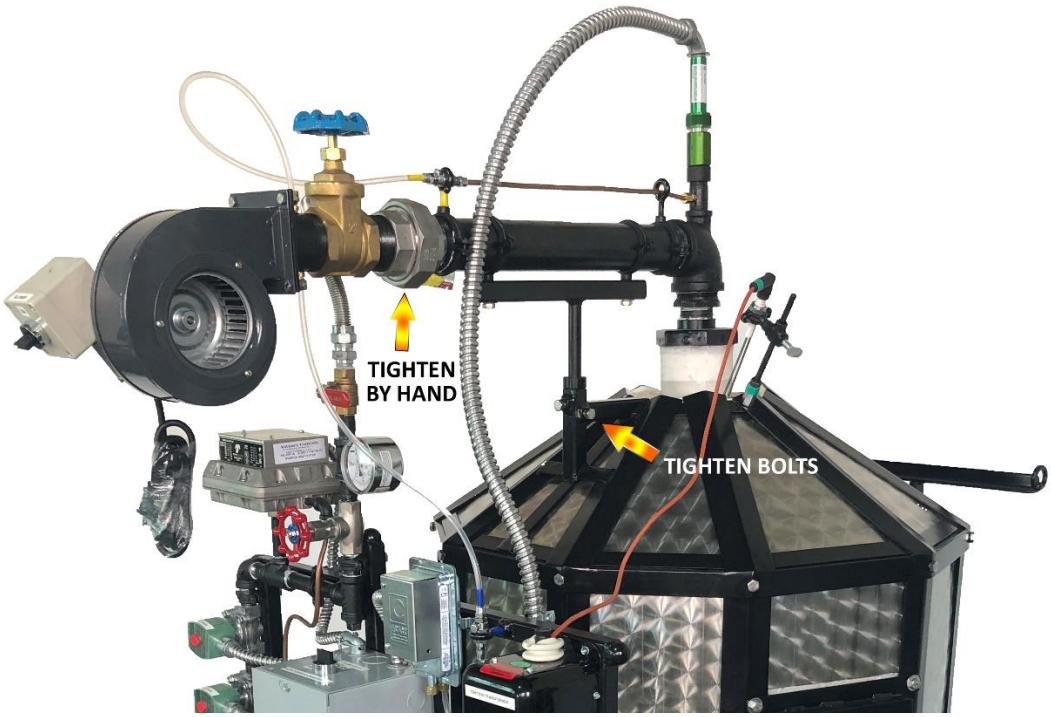
Allow for plenty of ventilation, as the exhaust fumes from propane combustion can be harmful if allowed to build up.

For the initial firing, there will be some smoke and fumes.

We recommend that the furnace is monitored while in operation, however the burner system is equipped with safety systems allowing for continued use.

The burner system with full safety is designed to meet or exceed published TSSA regulations. It is the sole responsibility of the Buyer to have the equipment field certified by ESA and TSSA agents prior to permanent installation. Mobile Glassblowing Studios, LLC is not liable for any expenses incurred by this process, nor can we guarantee the outcome of the field inspection process.

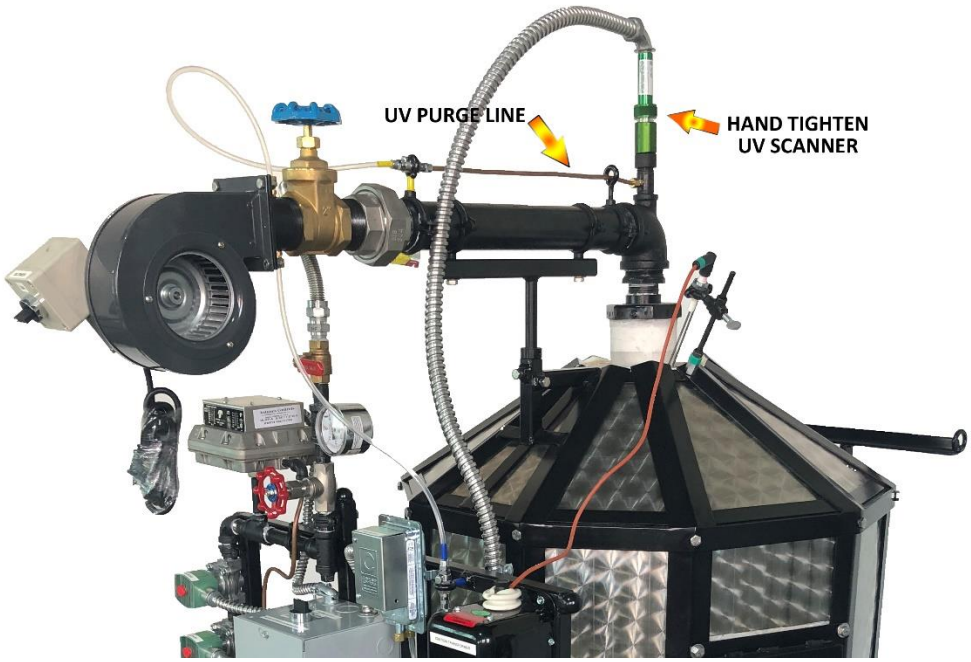
Once the furnace is set up in a safe outdoor location, put the caster brakes to the “ON” position and secure with wheel chocks. Assembly for the initial firing can begin.



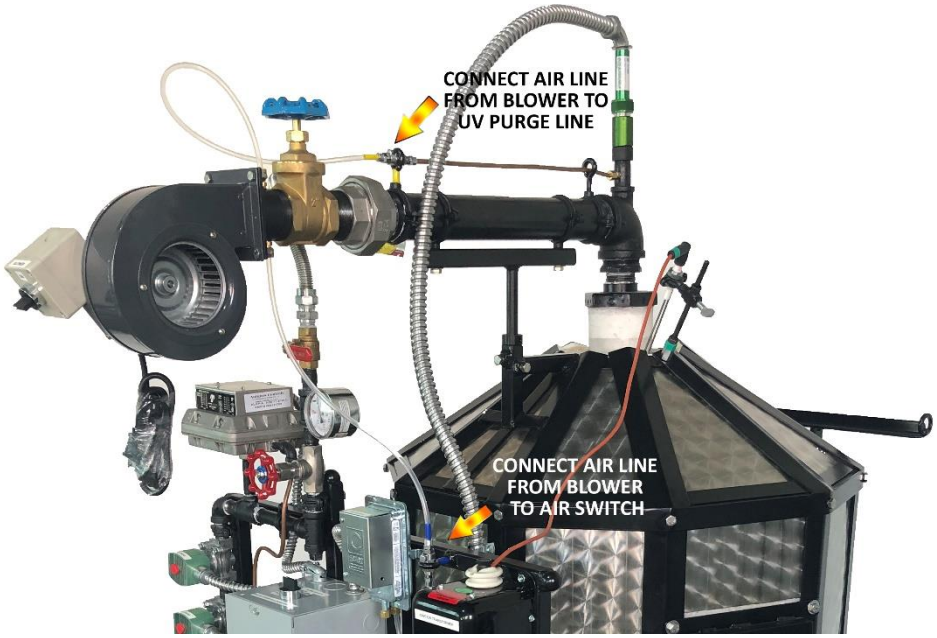
Unwrap burner system and set in place (As pictured). Burner tip should be centered in opening at top of furnace. Stop collar will place at the appropriate height. Tighten both bolts with a wrench or 9/16" socket to secure the burner train in place.

Attach the blower assembly to the burner train by holding in place and tightening the large union – make sure it is snug – tighten by hand.

If your furnace comes with the Air Preheat hose, it is recommended that it is engaged for your initial firing. The Preheat hose creates drag on the air flow, which allows for a slower heat-up.



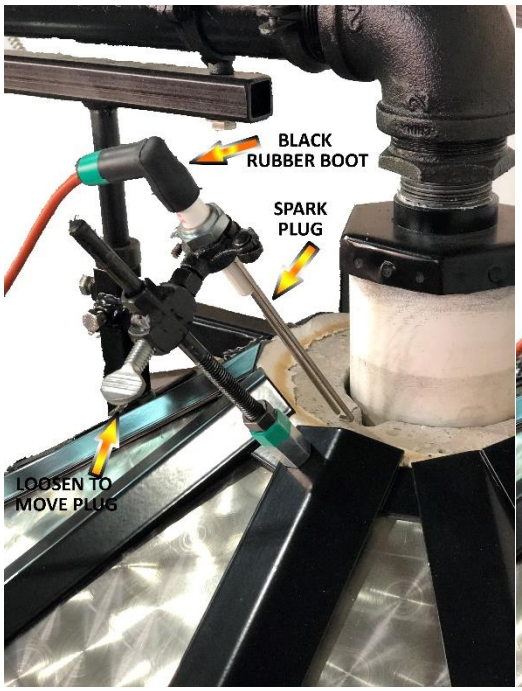
Hand tighten the UV scanner to the green metal tube at the front elbow of the burner train.

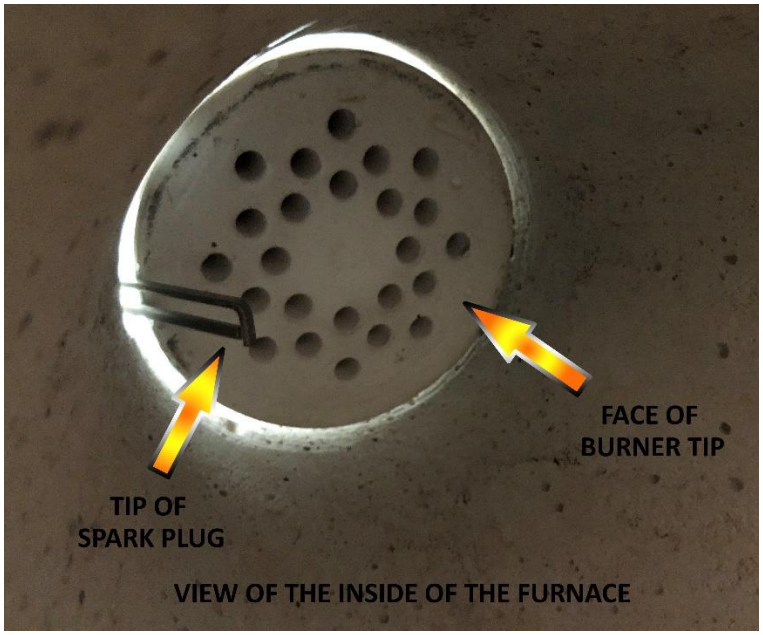


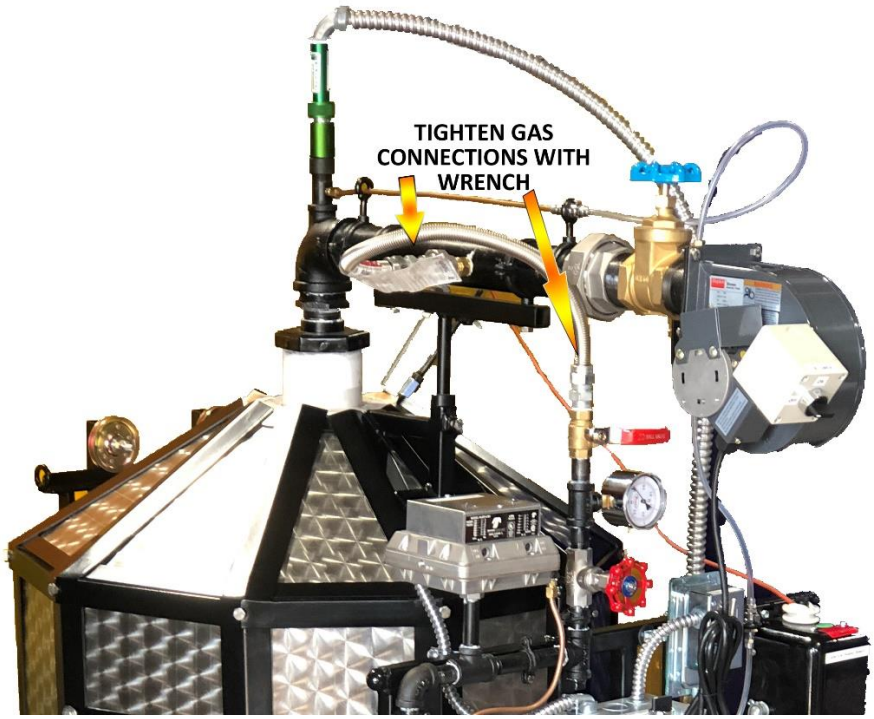
Insert the small quick connect between the blower assembly and the UV purge line.

Insert the small quick connect between the blower assembly and the air switch.

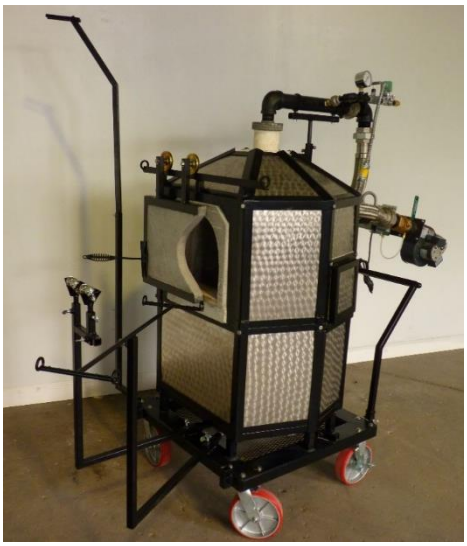
Assemble the spark plug extractor to the furnace frame and screw in the spark plug. Line up the spark plug so that it can be inserted two inches in front of the burner tip and so that the leads of the plug do not come in contact with metal. Connect the black rubber boot over the end of the spark plug, ensuring that the metal clip inside the boot is securely connected to the end of the plug. The plug is designed to lide out from the burn chamber once the burner is ignited.





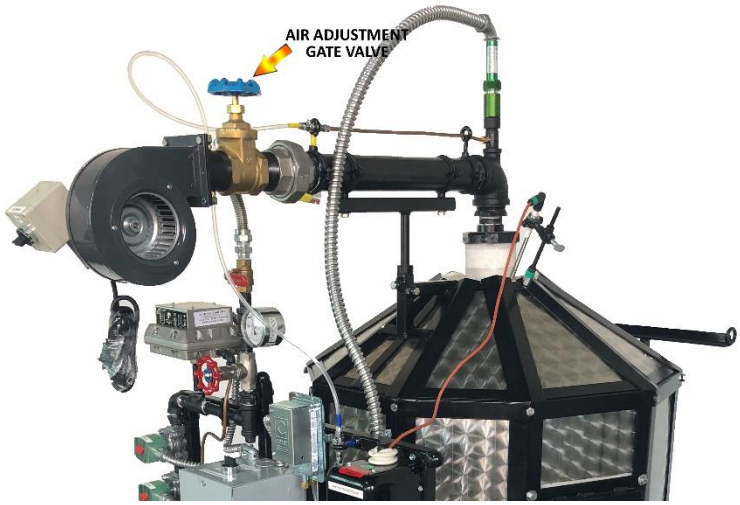


Attach the door, all the accessories, yoke bar & mounts, pipe warmer and pipe hanger as pictured. Tighten thumb screws either by hand or with an adjustable wrench.



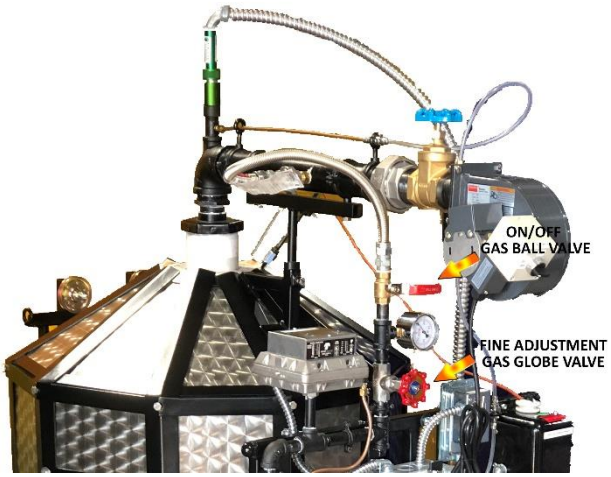
Pre Light-Up Info

The burner system uses a combination of gas and forced air for combustion. The ratio of the gas to air mixture changes the dynamic of the flame. This proportion is changed manually by adjusting the green handle on the butterfly valve and the knob on the needle valve.



The air flow is regulated by adjusting the gate valve located directly in line with the blower. Turning the handle counter-clockwise will open the valve, allowing increased air flow. Turning the handle clockwise will close the valve, decreasing the air flow.

There are two gas valves on this system: an on/off ball valve and a fine adjustment needle valve. The ball valve should be fully in the “off” position when the furnace is not in use or fully in the “on” position when furnace is in use. The needle valve is used to fine tune the amount of gas being fed to the burner and is adjusted as follows: turning the knob counterclockwise will allow gas to flow through the valve, turning the knob clockwise will restrict the flow of gas.



The burner system is set up for low pressure, either propane or natural gas. Do not exceed 14 water column inches of pressure on the output of the regulator. Introduction of higher pressure will result in permanent damage to the gauge and other safety components.

The burner has an output range of 50,000-150,000 BTU/hr. We recommend a minimum of ½” inside diameter for the gas delivery hose. Smaller diameter may impede the flow, and cause the burner to underperform.

The safety system is composed of a number of individual safety components wired in series on a circuit that opens redundant gas solenoid valves to allow gas to travel to the burner, mix with forced air from a powered blower and combust inside the furnaces to heat the interior to over 2100 degrees F. The job of the safety components is to open that electrical circuit if any of the prescribed parameters of the components are violated, thus shutting off the gas flow to the burner. These components include:

High Temperature Limit Switch

Air Low Pressure Switch

High and Low Gas Pressure Switch

Manual Switch

Flame Safety Switch

Once the furnace is lit, the components work as follows.

If the furnace reaches a temperature that is higher than the limit set in the digital High Limit Switch, the switch will open the electrical circuit to the solenoid valves, shutting down the gas flow to the burner.

If the pressure from the blower drops below a preset value, the Low Pressure Air Switch will open the electrical circuit to the solenoid valves, shutting down the gas flow to the burner.

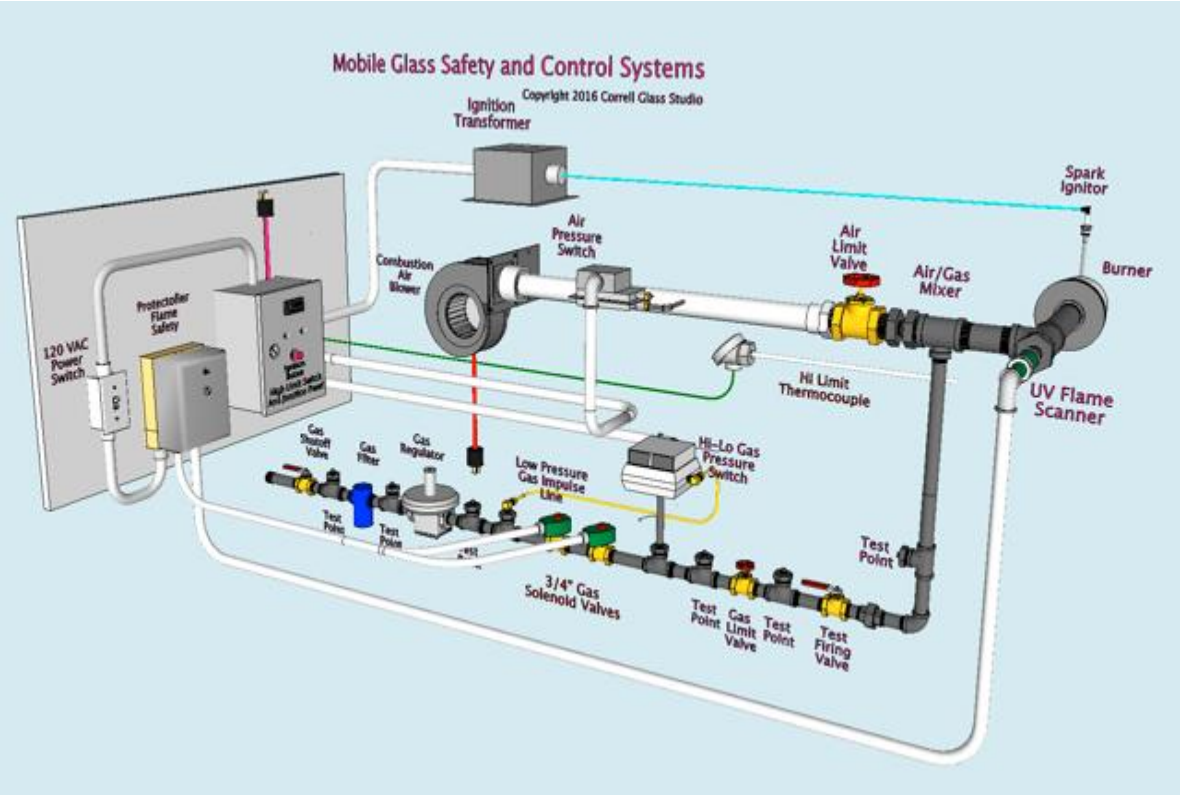
If the pressure of the fuel gas rises above or falls below preset parameters, the Gas Pressure Switch will open the electrical circuit to the solenoid valves, shutting down the gas flow to the burner.

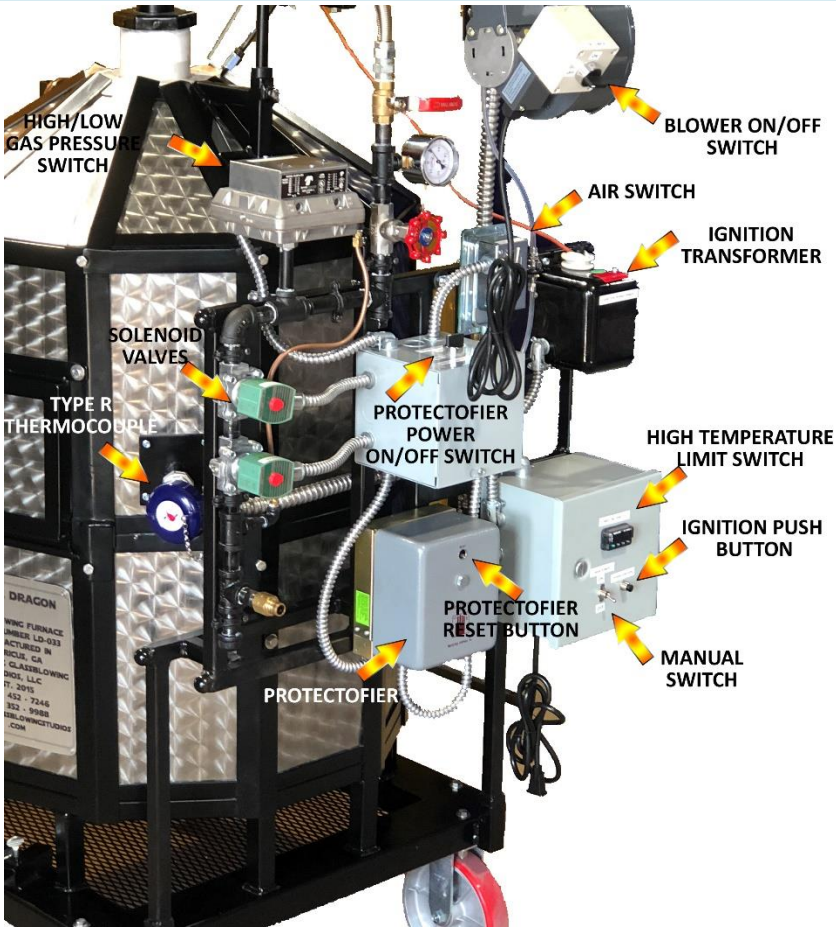
The Manual Switch, as well as aiding in the light up procedure, also acts as an emergency switch to open the electrical circuit to the solenoid valves, shutting down the gas flow to the burner.

If the burner loses flame for any reason, a flame scanner will read No Flame and send a signal to the Flame Safety System causing it to open the electrical circuit to the solenoid valves, shutting down the gas flow to the burner.

A spark plug ignition system with transformer is included for automatic lighting of the burner.

The illustrations on the next page outline the components and their relationships to each other in the system.





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For more information, visit our website: www.mobileglassblowingstudios.com – see FAQ and Support

Light-up & Firing Guidelines

When lighting up, it is a good idea to have a spray bottle with a soap & water mixture for checking for gas leaks at the field connection points. All factory assembled plumbing has been pressure checked prior to shipment. When the system is pressurized, spray the field connection areas with the mixture: if there is a leak, foam will form around the joint. If a leak is detected, shut the gas off at the source and release the gas from the lines (called "bleeding the line"). Once the system has been bled, wrench-tighten the joint that was leaking. Re-test. DO NOT CHECK FOR LEAKS USING A FLAME.

Light up procedure is a specific sequence that must be followed in order to successfully start the furnace. If a step is missed or skipped, the burner system will not ignite and you must start the sequence from the beginning.

1. Attach the gas delivery hose to your regulated fuel source (propane or natural gas) and the burner train in accordance to local regulations.
2. Before opening the gas valve at the fuel source, make sure the on/off ball valve is in the "off" position. The globe valve should be opened to allow gas to flow once the ball valve is turned "on". The initial firing will require adjusting the needle valve a bit in order to dial in the proper fuel/air mix.
3. Make sure the spark plug is in the position described in the "Set-Up" section above.
4. Open the furnace door.
5. Check that the blower power, main power and protectofier power switches are all in the "off" positions.
6. Plug in the blower.
7. Plug in the control panel.
8. Turn the blower switch to the "on" position.
9. Turn on the main power switch on the control panel. The High Limit switch will take a moment to come on line, and will give you a temperature read-out.
10. Check that the "Reset" button on the Protectofier is engaged.
11. Check that both the resets on the high/low gas pressure switch are in the "on" position.
12. Open the air gate valve a couple of turns to allow air to flow into the chamber.
13. Turn on the gas valve at the fuel source. The line will have gas in it up to the solenoid valves. Gas will not flow through the solenoid valves until the entire system is engaged.
14. Turn the gas on/off ball valve to the "on" position.
15. Open the gas globe valve to allow air to flow into the chamber (gas will not flow until step 16 is complete).
16. Turn on the protectofier power switch. There is a 30 second delay, then you will hear the solenoid valves click open, allowing gas to flow through the system. The valves will stay open for a short time, during which ignition takes place. If the system fails to light, the solenoids will close, allowing the chamber of the furnace to "purge" any gas before a second attempt can be made. It is common for the first attempt to result in non-ignition.
17. Once you hear the solenoid valves click, press the ignition button on the control panel. This will send electricity to the spark plug and ignite the gas at the burner tip.

* If the system fails to light, the solenoids will close, allowing the chamber of the furnace to "purge" any gas before a second attempt can be made. It is common for the first attempt to result in non-ignition.

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18. If the furnace does not ignite, the “reset” button on the Protectofier will pop out. Wait 15 seconds and press the “reset” button.
19. Once you hear the solenoid valves click, press the ignition button on the control panel. This will send electricity to the spark plug and ignite the gas at the burner tip.
20. Now that the furnace is lit, using a pair of pliers, loosen the screw at the spark plug and slide the plug away from the heat, retighten the screw.

Once the furnace is lit, use the gas globe valve and air gate valve to adjust the mixture to your desired settings.

Always have the furnace door open when lighting, as this will prevent gas from building up inside the furnace.

For the Initial Firing:

1. Adjust the mix using the air and gas valves as outlined in the “Flame Adjustment” section below. The flame should have a solid roar and a flame with a blue core.
2. Leave the door open for now and let it cook for a couple of hours on a low setting.
3. After several hours, close the door halfway, let it cook for a couple more hours.
4. Close the door so that there is only a half moon opening on the right side and continue to cook until the inside is glowing orange.
5. Shut the furnace off by turning the ball valve to the “off” position
6. Close the valve at the fuel source.
7. Shut off the Main Power switch on the control panel and power switch to the Protectofier.
8. Leave the blower running – this helps to keep the burner tip cool, overnight if possible.

Flame Adjustment

The flame is adjusted by changing the ratio of air and gas.

Too much gas results in a bushy (or lazy) flame, whereas too little gas can result in the flame blowing out.

The desired mix will give you a nice solid roar and a flame with a blue core.

If the sound is sputtering, too much air.

If there is a big yellow flame coming out of the door and or top of the furnace, not enough air.

Once you have an even mix, you can adjust it up or down, to control the speed at which the furnace heats up.

When adjusting the flame, do so in small increments.

To adjust the furnace up (bigger flame, hotter – faster), first increase the gas, then the air. If the air is increased first, the flame could potentially blow out.

To adjust the furnace down, first decrease the amount of air, then the amount of gas.

Do not turn the furnace down to where the air is.

The burner system is manual and will require some getting used to. This takes time and experience. We recommend documenting your firings, to refer to later.

Regular Use & Light Up

The instructions for regular use are very similar to those for the initial firing as far as furnace placement and set-up sequence.

Once you have vacuumed the inside of the furnace, place cullet into the crucible, mounding it up to the top. Another method is to place 15-20 pounds of glass in the bottom & charge 15-20 pounds at a time once the furnace is up to temperature.

Refer to the "Initial light-up" sequence 1-20 to light the furnace. Once lit, you can close the door such that there is only a half moon opening on the right side.

Be sure to empty the crucible completely when finished, this can be accomplished by either gathering, or using a casting ladle to scoop the molten glass out.

Once empty, shut the furnace off by turning the needle valve to the "off" position, close the valve at the fuel source, shut off the power switch to the Protectofier.

Leave the blower running overnight – this helps to keep the burner tip cool.

Things to Note

Quick on and off is abusive to the refractory materials. Though the crown has been cured and cooked carefully, the rapid heat up and cool down may cause the crown to develop cracks, this is normal. These cracks do not adversly affect the functionality, or the longevity of the furnace. This is true for the door as well, small cracks may develop, but the door will stay intact.

The crucible will crack. This is also normal. It is backed up by castable refractory (semi-invested) and will last years after small cracks develop.

The best practice is to allow for a long, slow heat-up and draining as much glass out of the crucible as possible each time before shut down.

The paint around the door will burn away – there is no paint that will withstand the temperatures we are dealing with.

Transport

Do not travel with any components loose in a trailer or back of a truck.

Make sure the furnace is tied down with multiple tie down points. It is much better to over secure than under secure.

The burner tip is ceramic and can break. Use care when moving.

Wiring Diagrams

Below are the wiring diagrams for the burner systems for your reference. It is recommended that should any problems arise, do not attempt to repair or modify the wiring. Contact Mobile Glassblowing Studios at 229-352-9988 ext 3 for troubleshooting advice first before hiring a certified electrician for repairs.

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66 HIDDEN LEDGE, CONWAY, MA 01341
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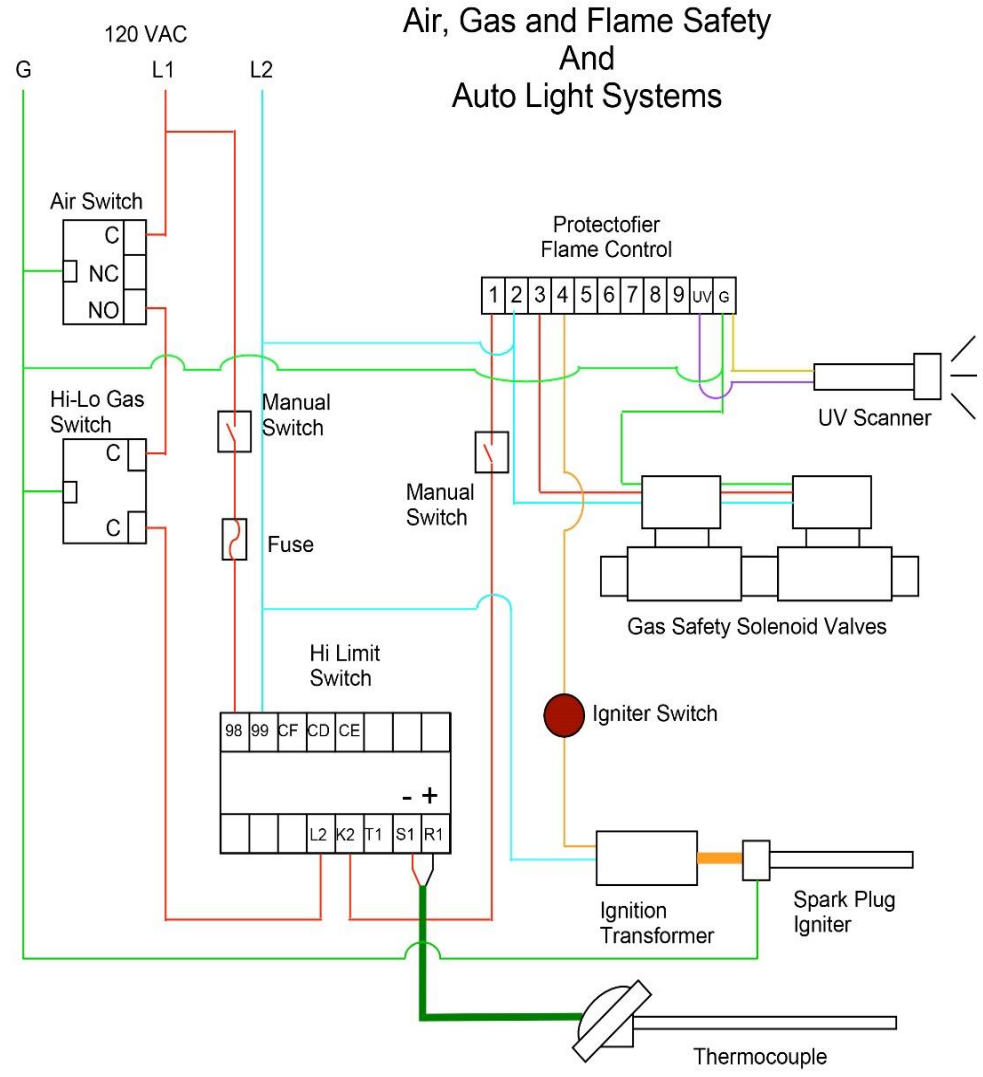

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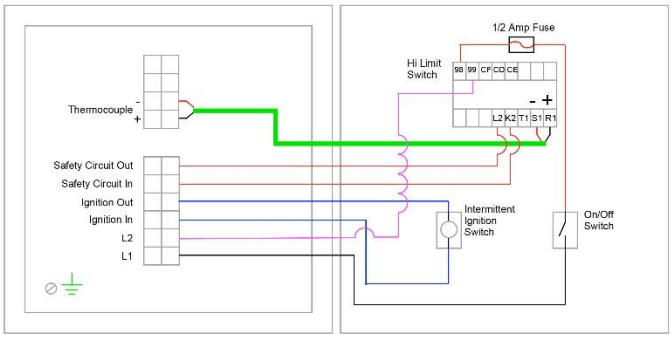
Panel Circuitry for Hi Limit Switch and Ignition



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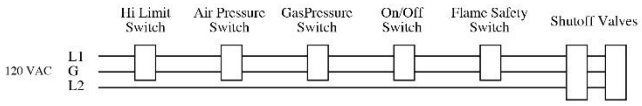
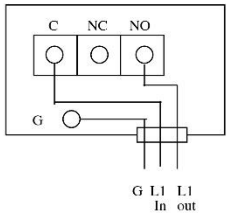
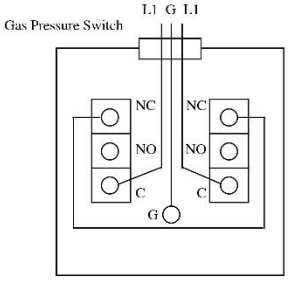
ALL SAFETY INTERLOCKS TO BE WIRED IN SERIES
ANY FAILURE CUTS POWER TO SOLENOID VALVES

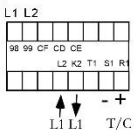


Air Pressure Switch





High Limit Switch

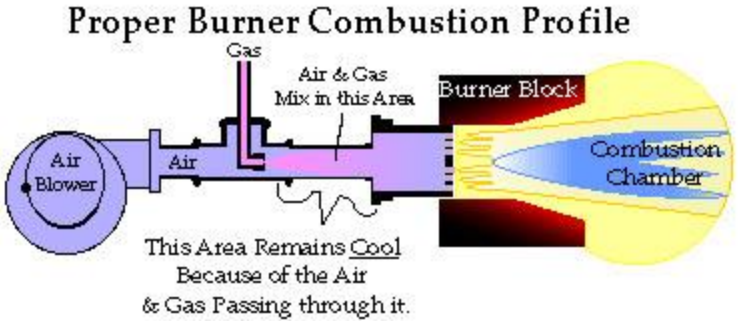


The following is extracted from www.joppaglass.com, written by Dudley Giberson, inventor and manufacturer of the burner tips used on the Dragon furnaces.

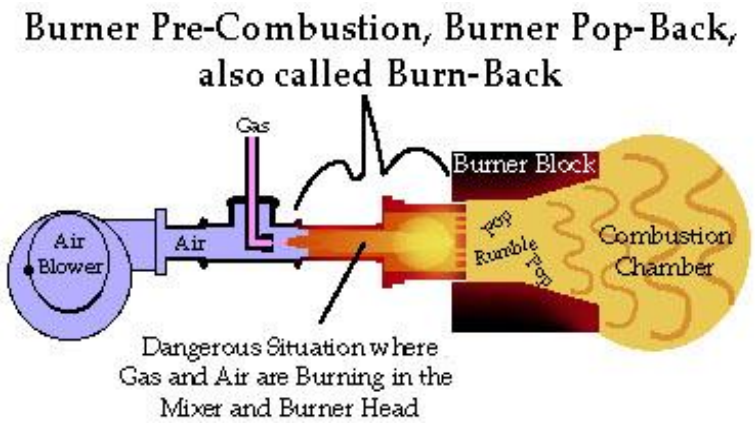
Troubleshooting Burner Instability

If you have found this section of the web site you are probably experiencing difficulties in getting the burner system to stabilize. Or perhaps you are experiencing burner pop-back. Others are prudently looking ahead to ward off any possible difficulty, "to head them off at the pass," so to speak. This is the page where we talk about a seemingly puzzling situation called "pop-back" or "pre-ignition" or sometimes called "burn back". We begin by showing what is a stable situation of ongoing combustion.

Pictured here is an environment (glory hole or furnace) which is burning in a stable manner. The flame has a blue core, the environment is at working temperature, and the burner head and mixer are cool and could pass the touch test. Even the face of the head is relatively cool because of all the combustibles (cool air and gas) which are being pushed through it. The flame is burning quietly, but steadily. This is a happy burner system.



In contrast, this next image shows a burner system with burner pop-back. This is a condition where the mixture of gas and air are burning in the mixer and head area of the burner system. If this condition goes on for a while, the head and pipe work may become cherry red. When the system is shut off and naturally left to cool for a few minutes, it most often can be re-lit and everything is fine. But sometimes there is damage to the pipe and head. An inspection of the head will reveal if there are any serious cracks, and if so the head should be repaired or replaced. If this furnace had a safety system it would have shut down immediately when the flame began to rumble (or flutter). Such a safety system could be hooked to an alarm to notify you of any burner or furnace abnormality.

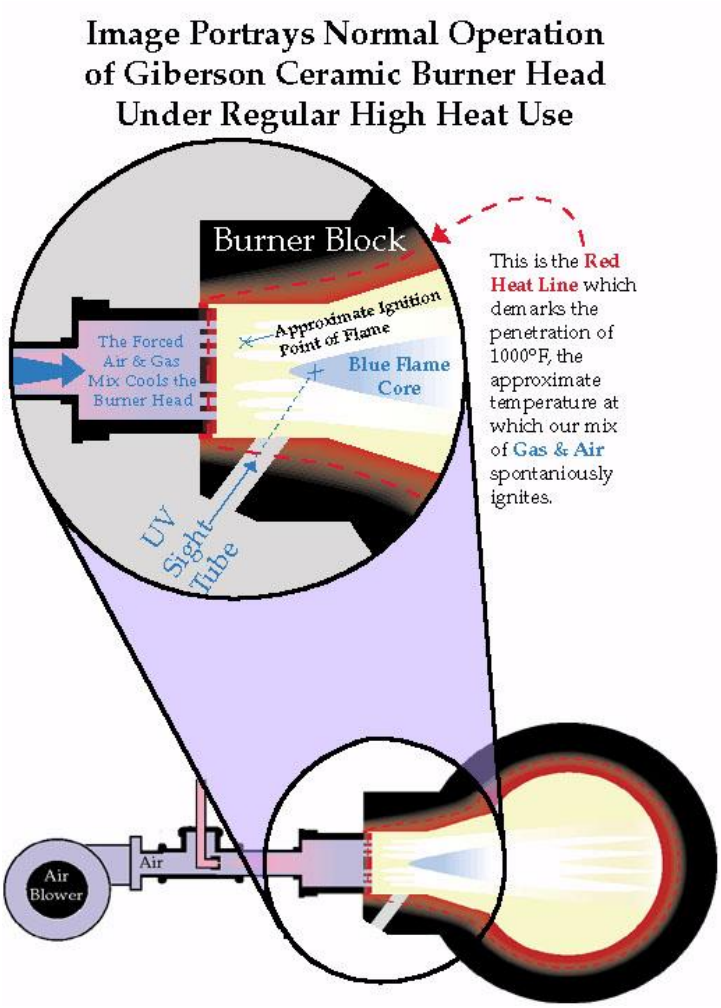


Here is a list of conditions that help identify this situation.

- First, you should always be able to touch the pipe work behind the burner head. Use the old spit on the finger technique. If it really sizzles, it most likely indicates the fire is burning in the head. If this condition is allowed to continue unchecked the entire pipe work can become cherry red as shown in the above image. Not a good situation. **To rectify the problem, turn the gas off and wait for head to cool for a few minutes. Then attempt a re-light. If the head is cracked, you will most likely need to replace the head with a repaired or new one.**
- The paint should not be burnt off the back of the head. If it is, this indicates there is or was a burn-back condition.
- The flame should burn evenly (not "rumbly").

- There should be no popping noise.
- Sometimes, a novice using a Giberson Head will not recognize when it is burning incorrectly, usually at a first start-up. Check using the "spit on finger technique."
- Another indication of "burn-back" is the flame will not go out of reduction, coupled with a "rumbly" burn. Call the factory 229-352-9988 and ask for help.

There are two main causes for this condition:



1. **The gas and air mix is moving too slowly through the system** so that the speed at which this mixture burns is greater than the speed of the mix being pushed through the system. It is like in the movies where the bad guy is going to blow up the bank using his trusty drum of black powder. Not being very organized that morning he's forgotten his roll of fuse material so he pours out a line of powder for some feet, lights it and runs. For the sake of argument and demonstration this highly explosive material does in fact burn with a calculable rate of speed. Gas and air, when properly mixed, have that same property. The small holes in the burner face serve this interesting purpose, they provide the "speedifier effect" where the unburned mixture speeds up through the hole structure and keeps the burning gas/air mix on the far side. What this means is **if you turn down your burner system to a point low enough, you will reach this pop-back point.** This exists in every burner system.
2. There is a second reason for burner pop-back: A given mix of gas and air has a calculable temperature at which it ignites. **If any part of the inside of the burner head reaches that ignition temperature, "pop, bang, rumble!" It is totally predictable**. You could stake your life on it. It is a very simple proposition: the gas/air mix comes through the burner head keeping it cool. When this system of cooling the head gets disrupted, such as by turning the system down off a high temperature condition too quickly, the problem can occasionally show up.

Here is a probable scenario:

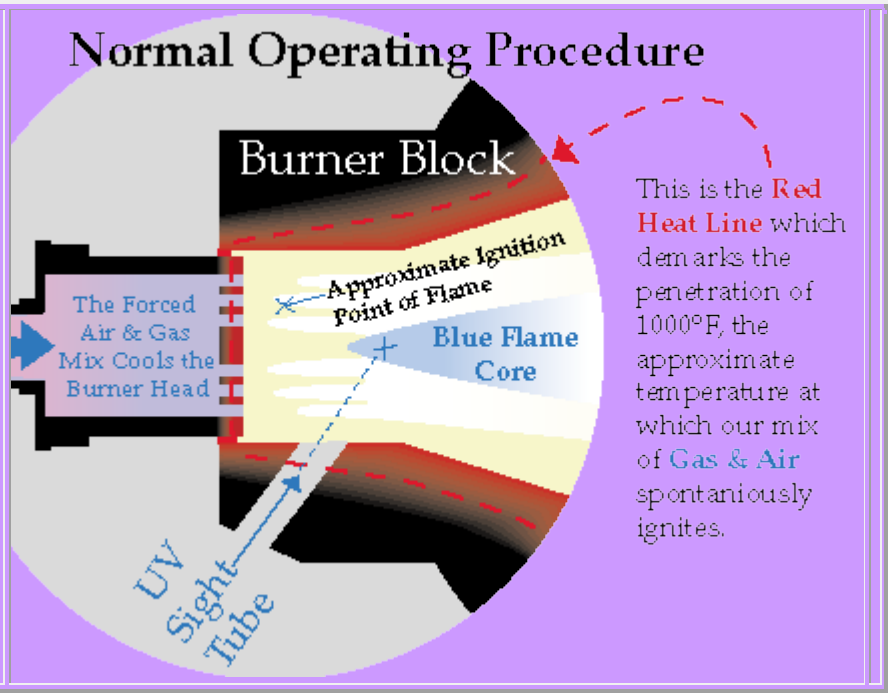
One day a glassblower makes a new melt and really gives it the business, gets the furnace really hot, and on the down side he is in a hurry and wants to plane it off because he has a hot date in a couple of hours. He turns it down to a setting which normally works when the furnace is a bit cooler and off he goes to visit his 'sweety.'

When he comes into his shop the next morning a sense of panic overcomes him. The furnace is roaring and the pipe work near the burner is red hot. The head is perhaps broken. (He did not have a safety system.) And he is indignant!

"That god dammed head! I knew it wasn't any good before I put it on! I saw some air bubbles in it. I think it was defective."

That's when I get a call from Mr. X. It takes me awhile to get Mr. X. back to the real problem and that is how to successfully turn down a burner after a melt and go on a date at the same time. I don't know about the date thing, but we can get the furnace turned down ok.

idea of the red line (the 1000°F heat line).



Don't Blow 'Um Up
Or Whack 'Um with A Hammer Page

“There is another area we have yet to cover as a real trouble spot to the longevity of the burner heads. This is in the area of physical abuse. The most classic is the case of binding the head in the burner port...crack! The casting is 4" in diameter and the burner port is supposed to be 4.5" in diameter. This gives a little slack and allows for some slight movement, but if they are both 4," the slightest movement breaks the head.

Not surprisingly, many people lose their burner heads during a big studio move where the plumber guy applies the hammer to the pipe work to loosen it up a tad, and "whack!" If you pound on the pipe work five feet away the shock still follows the metal all the way to the burner head and plop, on the floor it goes in a couple of big pieces– don't hammer the pipe work. Constant, hard vibration will eventually shake even a good burner head to pieces.

You see, the physical strength of the burner head is not that great. It is probably twice as strong as a soft brick. I did a lot of experimenting trying to strengthen the physical mass, that's easy. I could make it hard as a rock. But the harder I got it the less well it withstood the thermal changes.

Face it, the major threat to a burner head is the thermal stress it must go through each day in its cycle, not the plumber with the hammer. So I made a mix which would take some physical abuse but which was stronger under thermal abuse. I have experimented with a lot of different things but have returned to the original formula for every burner I have ever sold.

While we are on the subject of physical abuse, occasionally I get a customer who will literally blow up a burner, like an old-fashioned pipe-bomb. Well, it's more like a gas cannon. In my youth we'd celebrate appropriate holidays by

shooting off an acetylene and oxygen filled drive shaft housing plugged with a Life magazine. Boom! Instant confetti. At a hundred seventy-five dollars a pop it loses its humor. So, what's happening to cause the explosion?

When a gas/air mix burns it expands rapidly, as much as seven times in volume. If the expansion happens in a closed space, like in the mixer section behind the burner head, we get an explosion. Earlier, I talked about how any burner system will have a pop-back point on the low end. This is true. If you turn down any system low enough it will pop back... boom! It usually is a small boom but what if there's a lot of pipe work of large sizes behind the head? Then we have a large explosion. It is a matter of physics.

Any excess piping and it is almost guaranteed that at some point you will blow the head right up. It may be the first time you light it.

Well that's about it for the exciting stuff. No more explosions. But there is one more caution in the physical abuse section. It is very important to mount the burner system by the iron pipe work behind the head. Use a regular clamp or a "U" bolt and attach it to the frame of the furnace. This provides support for all the weight of the burner/head/mixer, etc… It is especially important not to rest the totality of this weight onto the head and expect it to hold up unscathed. It might hold up for a short while but to be so cavalier is asking for trouble."

To summarize, if you set-up and operate your system by the guidelines in this manual, and use a turndown schedule that keeps the heat out of the head, we eliminate nearly all the bumps in the road.

Component Spec Sheets:

The following are the manufacturer's specification sheets for the solenoid valve, air switch and blower:

ASCO® RedHat

Direct Acting
Gas Shutoff Valves
3/8" to 1 1/4" NPT

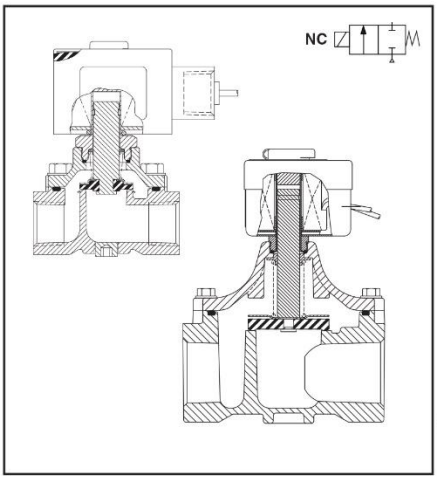
2/2 SERIES 8040

Features

- 2-way normally closed operation
- For gas pilot or main control of commercial and industrial gas burners
- Valves provided with 1/8" NPT upstream and downstream pipe taps with plugs for routine testing
- Mountable in any position

Construction

Valve Parts in Contact with Fluids	
Body	Aluminum
Seals and Disc	NBR
Core Tube	305 Stainless Steel
Core Guide	Acetal
Rider Ring	PTFE
Core and Plugnut	430F Stainless Steel
Springs	302 Stainless Steel
Shading Coil	Copper
Pipe Plug	Zinc-Plated Steel



Electrical

Standard Coil Class of Insulation	Watt Rating and Power Consumption AC Watts	AC VA Holding	AC VA Inrush	Ambient Temp.°F	Spare Coil Family General Purpose AC	Spare Coil Family Explosionproof AC
F	10.1	25	70	-40 to 125	238610	238614
F	15.4	27	160	-40 to 125	099257	-
Standard Voltages: 24, 120, 240 volts AC, 60 Hz (or 110, 220 volts AC, 50 Hz).						

Solenoid Enclosures

Valves with the letter "G" in their catalog numbers, e.g. 8040G021, have RedHat II molded epoxy Types 1, 2, 3, 3S, 4, and 4X combinations General Purpose and Watertight solenoid enclosures with 1/2" conduit hub as standard.

Valves with the letter "C" in their catalog numbers, e.g. 8040C004, have RedHat metal Type 1 General Purpose enclosures with 7/8" hole for 1/2" conduit connection.

Valve Response Time

Opening Time: Less than 1 second; **Closing Time:** Less than 1 second

Approvals

UL listed to standard 429 "Electrically Operated Valves," Guide YIOZ, File MP618 Safety Valves.

FM Approved to Class 7400 "Liquid and Gas Safety Shutoff Valves" (3/8" thru 3/4" only).

CSA Certified to:

1) Standard C22.2 No. 139 "Electrically Operated Valves," File 010381.
2) Automatic Gas Valves Z21.21 (6.5), File 112872.
3) Automatic Gas Safety Shutoff Valves C/I (3.9), File 112872.

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COMBUSTION

ASCO®

Specifications (English units)

Pipe Size (ins.)	Orifice Size (ins.)	Cv Flow Factor	Gas Capacity ① Btu/hr.	Operating Pressure Differential (psi) Min.	Operating Pressure Differential (psi) Max.	Max. Fluid Temp.°F	Catalog Number	Const. Ref.	Agency UL	Agency FM	Agency CSA	Wattage	Approx. Shipping Weight (lbs)
COMBUSTION (Fuel Gas) - NORMALLY CLOSED													
3/8	3/4	3.9	210,000	0	2	125	8040G021	1	❍	❍	❍	10.1	2.8
1/2	3/4	5.4	291,000	0	2	125	8040G022	1	❍	❍	❍	10.1	2.8
3/4	3/4	9.5	512,000	0	2	125	8040G023	2	❍	❍	❍	10.1	2.8
1	1 5/8	16.8	900,000	0	0.5	125	8040C004	3	❍	-	❍	15.4	4.3
1 1/4	1 5/8	19.6	1,100,000	0	0.5	125	8040C005	3	❍	-	❍	15.4	4.3

❍ = Safety Shutoff Valve. ① 1" W.C. Drop @ 2" W.C. Inlet Pressure, 1,000 Btu/cu.ft. or more, 0.64 Specific Gravity Gas.

Specifications (Metric units)

Pipe Size (ins.)	Orifice Size (mm)	Kv Flow (m^3/hr)	Gas Capacity ① Btu/hr.	Operating Pressure Differential (bar) Min.	Operating Pressure Differential (bar) Max.	Max. Fluid Temp.°C	Catalog Number	Const. Ref.	Agency UL	Agency FM	Agency CSA	Wattage	Approx. Shipping Weight (kgs)
COMBUSTION (Fuel Gas) - NORMALLY CLOSED													
3/8	19	3.3	210,000	0	0.1	52	8040G021	1	❍	❍	❍	10.1	1.3
1/2	19	4.6	291,000	0	0.1	52	8040G022	1	❍	❍	❍	10.1	1.3
3/4	19	8.1	512,000	0	0.1	52	8040G023	2	❍	❍	❍	10.1	1.3
1	41	14.3	900,000	0	0.03	52	8040C004	3	❍	-	❍	15.4	2.0
1 1/4	41	16.7	1,100,000	0	0.03	52	8040C005	3	❍	-	❍	15.4	2.0

❍ = Safety Shutoff Valve. ① 1" W.C. Drop @ 2" W.C. Inlet Pressure, 1,000 Btu/cu.ft. or more, 0.64 Specific Gravity Gas.

Capabilities Chart

Solenoid Options				Base Catalog Number	Resilient Materials	Standard Rebuild Kit
NEMA Type 3-9	High Temp.	Junction Box	Wiring Box Screw Terminal	Aluminum	NBR	AC
EF	HT	-	JKF	8040G021	●	306633
EF	HT	JB	JKF	8040G022	●	306633
EF	HT	JB	JKF	8040G023	●	306633
-	HT	JB	JKF	8040C004	●	304079
-	HT	JB	JKF	8040C005	●	304079

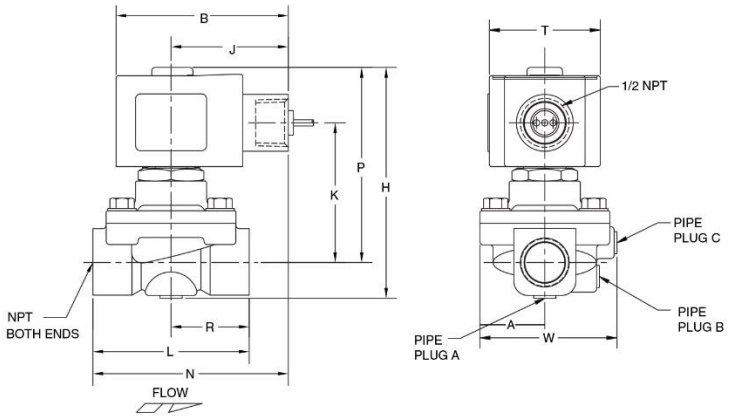
● = Standard. Other options may be available. All option combinations may not be available.

COMBUSTION

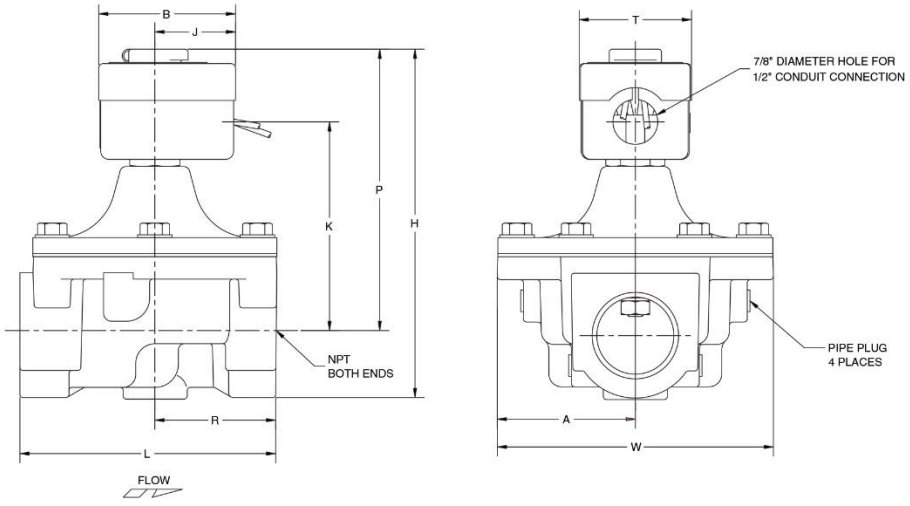
Dimensions inches (mm)

Const. Ref.		1	2	3
A	ins.	1.66	1.66	2.69
	mm	42	42	68
B	ins.	3.03	3.03	2.69
	mm	77	77	68
H	ins.	4.05	4.49	6.81
	mm	103	11405	173
J	ins.	2.04	2.04	1.59
	mm	52	52	40
K	ins.	2.46	2.65	4.09
	mm	62	67	104
L	ins.	2.75	3.31	5.00
	mm	70	84	127
N	ins.	3.42	3.70	-
	mm	87	94	-
R	ins.	1.38	1.66	2.38
	mm	35	42	60
P	ins.	3.44	3.63	5.50
	mm	87	92	140
T	ins.	1.95	1.95	2.22
	mm	50	50	56
W	ins.	2.42	2.39	5.38
	mm	61	61	137
Pipe Plug		B & C	A & C	-

Const. Ref. 1, 2



Const. Ref. 3



COMBUSTION

Cleveland Controls
Division of UniControl Inc.

Model AFS–222

AIR PRESSURE SENSING SWITCH WITH ADJUSTABLE SET POINT RANGE

APPLICATION

Model AFS-222 Air Pressure Sensing Switch is a general purpose proving switch designed for HVAC and Energy Management applications. It may be used to sense positive, negative, or differential air pressure.

GENERAL DESCRIPTION & OPERATION

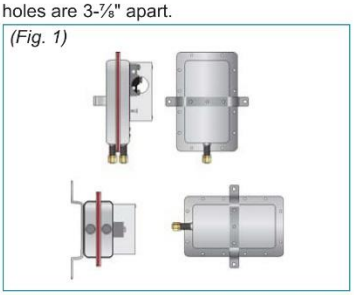
The plated housing contains a diaphragm, a calibration spring and a snap-acting SPDT switch.The sample connections located on each side of the diaphragm accept ¼" OD metallic tubing via the integral compression ferrule and nut.

An enclosure cover guards against accidental contact with the live switch terminal screws and the set point adjusting screw. The enclosure cover will accept a ½" conduit connection.

MOUNTING (SEE FIGURE 1)

Select a mounting location which is free from vibration. The **AFS-222** must be mounted with the diaphragm in any vertical plane in order to obtain the lowest specified operating set point. Avoid mounting with the sample line connections in the "up" position. Surface mount via the two 3⁄16" diameter holes in the integral mounting bracket. The mounting holes are 3-7⁄8" apart.

(Fig. 1)



AIR SAMPLING CONNECTION (SEE FIGURE 2)

The **AFS-222** is designed to accept firm-wall sample lines of ¼" OD tubing by means of ferrule and nut compression connections. For sample lines of up to 10 feet, ¼" OD tubing is acceptable. For lines up to 20 feet, use ¼" ID tubing. For lines up to 60 feet, use ½" ID tubing. A ¼" OD adapter, suitable for slip-on flexible tubing is available: order part number 18311.

Locate the sampling probe a minimum of 1.5 duct diameters downstream from the air source. Install the sampling probe as close to the center of the airstream as possible. Refer to Figure 2 to identify the high pressure inlet (H) and the low pressure inlet (L). Select one of the following five application options, and connect the sample lines as recommended.

POSITIVE PRESSURE ONLY: Connect the sample line to inlet H; inlet L remains open to the atmosphere.

NEGATIVE PRESSURE ONLY: Connect the sample line to inlet L; inlet H remains open to the atmosphere.

TWO NEGATIVE SAMPLES: Connect the higher negative sample to inlet L. Connect the lower negative sample to inlet H.

TWO POSITIVE SAMPLES: Connect the higher positive sample to inlet H. Connect the lower positive sample to inlet L.

ONE POSITIVE AND ONE NEGATIVE SAMPLE: Connect the positive sample to inlet H. Connect the negative sample to inlet L.

Cleveland Controls
DIVISION OF UNICONTROL INC.
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Cleveland OH 44109

Tel: **216-398-0330**
Fax: **216-398-8558**
Email:**saleshvac@unicontrolinc.com**
Web page: **http://www.clevelandcontrols.com**

Are you reading a FAX or a COPY of this bulletin? DOWNLOAD the full-color PDF version of this and other literature at our website!

Bulletin LTAFS222-08

ELECTRICAL CONNECTIONS (SEE FIGURE 3)

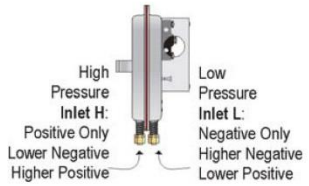
Before pressure is applied to the diaphragm, the switch contacts will be in the normally closed (NC) position. The snap switch has screw top terminals with cup washers. Wire alarm and control applications as shown in Figure 4.

FIELD ADJUSTMENT

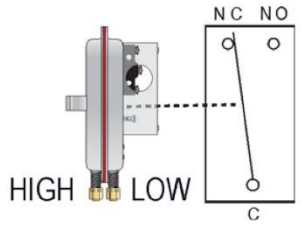
The adjustment range of an **AFS-222** Air Switch is 0.05±.02" w.c. to 12.0" w.c. To adjust the set point, turn the adjusting screw counterclockwise until motion has stopped. Next, turn the adjusting screw 4 complete turns in a clockwise direction to engage the spring. From this point, the next ten turns will be used for the actual calibration. **Each full turn represents approximately 1.2" w.c.**

Please note: To properly calibrate an air switch, a digital manometer or other measuring device should be used to confirm the actual set point.

(Figure 2)

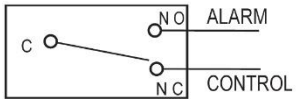


(Figure 3)

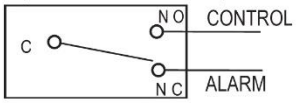


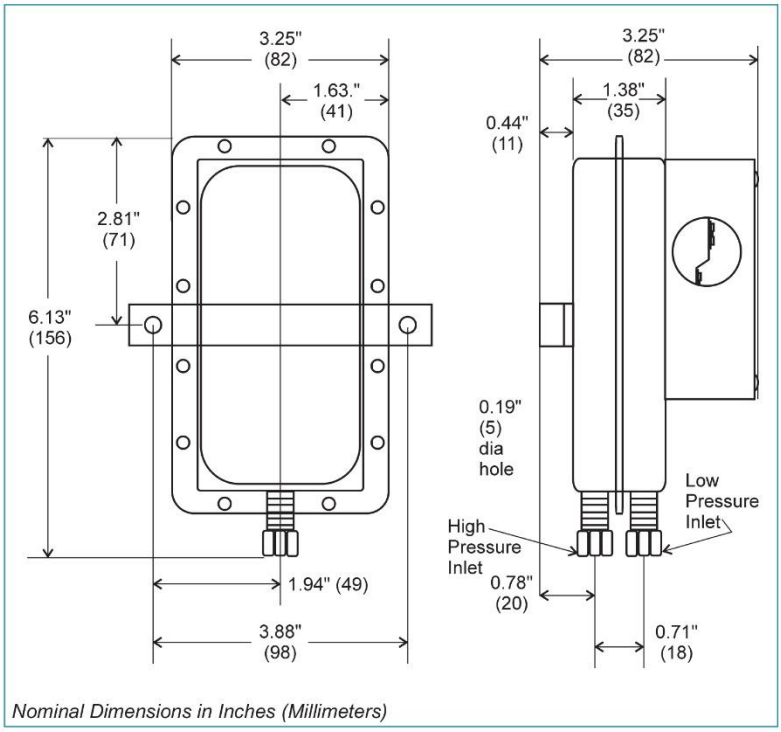
(Figure 4)

To prove excessive air flow or pressure:



To prove insufficient air flow or pressure:





Nominal Dimensions in Inches (Millimeters)

SPECIFICATIONS

MODEL AFS-222 AIR PRESSURE SENSING SWITCH WITH ADJUSTABLE SET POINT RANGE

Mounting Position:
Mount with the diaphragm in any vertical plane.

Set Point Range:
0.05 ± 0.02" w.c. to 12.0"w.c.

Field Adjustable "Operate Range":
0.07"w.c. to 12.0" w.c.

Field Adjustable "Release Range":
0.04"w.c. to 11.2" w.c.

Approximate Switching Differential:
Progressive, increasing from 0.02 ± 0.01"w.c. at minimum set point to approximately 0.8 " w.c. at maximum set point.

Measured Media:
Air, or combustion by-products that will not degrade silicone.

Maximum Pressure:
½ psi (0.03 bar).

Operating Temperature Range:
-40F to 180F (-40 to 82C).

Life:
100,000 cycles minimum at ½ psi maximum pressure each cycle and at maximum rated electrical load.

Electrical Rating:
300 VA pilot duty at 115 to 277 VAC, 15 amps noninductive to 277 VAC, 60Hz.

Contact Arrangement: SPDT.

Electrical Connections:
Screw-type terminals with cup washers.

Conduit Opening:
⅞" diameter opening accepts ½" conduit.

Sample Line Connectors:
Male, externally threaded 7/16" -24 UNS 2A thread, complete with nuts and self-aligning ferrules.

Sample Line Connections:
Connectors will accept ¼" OD rigid or semi-rigid tubing.

Approvals: UL, FM, CSA.

Shipping Weight: 1.2 lbs.

Accessories:

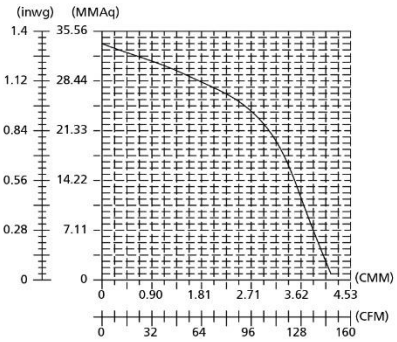
- P/N 18311 Slip-on ¼" OD Tubing Adapter, suitable for slipping on flexible plastic tubing.
- Sample line probes.
- Orifice plugs (pulsation dampers).

Dayton® PSC and Shaded Pole Blowers

Description

Dayton PSC and Shaded Pole blowers provide economical air delivery for general heating, cooling, ventilating, or component cooling. Typical applications include cooling greenhouses, blowers for wood and corn stoves, ventilating small buildings, cooling electrical enclosures and removing heat from machinery. The blowers are exact replacements for many OEM blowers with the same physical footprint. Forward curve wheels driven by Dayton motors are rated for continuous duty with all-position mount. These units incorporate balanced ball or sleeve-bearing motors with cast aluminum end shields. This provides greater heat dissipation and protection, reducing down time due to component failure and accidental damage. Direct drive blower wheels are dynamically balanced to reduce noise and vibration and to maintain CFM at higher static pressures.

60HZ



Specifications

Reference Number	CFM @0″	0.1″	0.2″	0.3″	0.4″	0.5″	0.6″	0.7″	0.8″	VOLTS	AMPS	HZ
1TDR6*	148	144	136	134	130	124	–	–	–	115	0.75	60

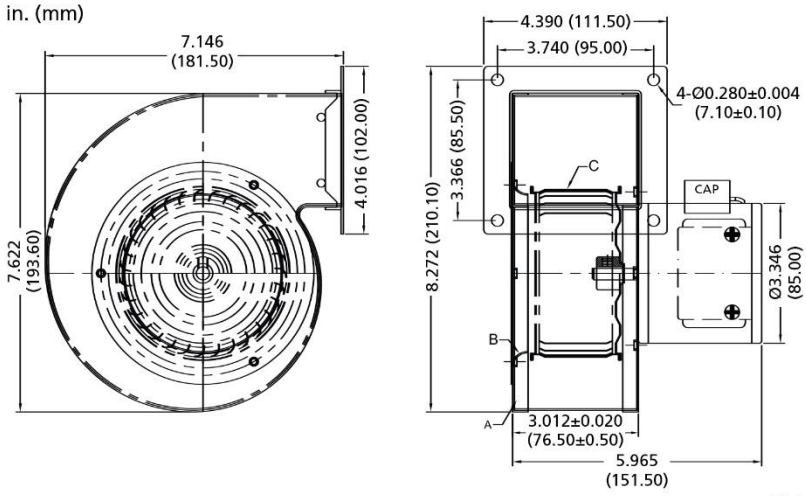
* Replaces 4C006

NOTE: Includes Conduit Box with 13″ Lead Length.

NOTE: Not suitable for use with speed-controllable devices.

Dimensions

in. (mm)



Features

- PSC motor
- Baked enamel Gray finish
- Heavy gauge steel housing
- All position Mounting
- Maximum Ambient Temperature 104°F
- Suitable for 50Hz operation

Additional Benefits

- Permanently Lubricated Ball-Bearings
- Extruded Aluminum Blower Frame for Increased Rigidity
- Auto-Thermal Protection

Motor Component Recognition cULus E47479

Dayton®

Protection Controls, Inc.

Electrical Flame Safety Equipment

Index

Products

Flash's Cool Control Panel

Contacts

About Us

Since its founding in 1953 by Robert Yates, Protection Controls, Inc. has provided combustion safeguards and burner management systems for the industrial heating industry. It was Mr. Yates who developed the rectifying principle for flame safety control in which the flame conducts the electrical current and rectifies the AC current to DC current. This principle is still in use today.

Protection Controls, Inc. is a highly specialized company with over 40 years of experience in flame safety control. Our product line includes many plug-in components and controls that are interchangeable with existing systems. The systems are designed with high signal strength to provide safe and secure operation while reducing the potential for system shutdown due to noise.

Protection Controls, Inc. has played an integral role in the drafting of combustion safety standards for the National Fire Protection Association. In addition to complying with NFPA codes, Proctection Controls' systems are approved by Underwriters Laboratory(UL), Factory Mutual(FM), and the Canadian Standards Association(CSA). Protection Controls, Inc. has been an IHEA member since 1953. Membership keeps us constantly aware of changes in the industry's requirements for safety and design. We work closely with other manufacturers to establish safe and reliable products for electrical and combustion equipment used in the industrial heating industry.

Protection Controls, Inc. continues to be owned and operated by the Yates family. Mr. James Yates (brother of Robert Yates and President for several years) passed away in 2008. Robert L.Yates (son of the founder) has retired. Douglas Yates and Bruce Yates are actively engaged in the day-to-day management of the company.

SERVICE MANUAL
PSM-1187-R6

Protectofier SERVICE MANUAL

FOR ALL PROTECTOFIER COMBUSTION SAFEGUARDS

SPECIFICATIONS

Ambient temperature: Minus 40° to plus 140°F
Flame response: 2 to 4 seconds (0.8 sec. available)
Voltage/Frequency: 120V AC +/- 10%, 50-60 Hz
Voltage at E teminal to ground: 390V AC
Voltage at UV terminal to ground: 590V AC
Rating: 125VA pilot duty
Power consumption: Single burner – 35VA or less
Multi-burner – 10VA for each additional burner

IMPORTANT
Terminals L1 and L2 must be powered by a single phase, neutral grounded 120V AC +/- 10% 50-60 Hz power supply. The PROTECTOFIER chassis must be earth grounded for proper operation.

FEATURES

- Flame failure response, 2 to 4 seconds
- Plug-in solid-state circuitry encapsulated, immediate response (FLAME-PAK)
- Enclosed, interchangeable plug-in relays
- Operates with flame rod and/or P-C II ultra-violet sensors
- Built-in flame response light(s).
- TELEFIER first-out flame indication
- Components and terminals on top of chassis
- All wiring under chassis

IMPORTANT
Read entire PROTECTOFIER service manual and refer to applicable wiring diagrams and operating sequence before attempting to install, operate or service control system.

APPLICATION

Single or multi-burner PROTECTOFIER monitors gas or oil burners. It responds to the presence or absence of flame to prevent build-up of combustible fuel mixtures in ovens, furnaces, boilers, and other heating equipment.

COMPONENTS

FLAME-PAK (SS100A) the plug-in electronic sensing unit provides immediate response via the flame rectification principle. Sensing is achieved either by (1) a flame rod which creates a DC signal to the FLAME-PAK, or by (2) the P-C II U-V Scanner in which a DC signal is developed by an ultra-violet sensitive tube. In either system, if the signal from the flame to FLAME-PAK is interrupted, the circuit to the fuel valves is broken, and can energize an alarm circuit if required.

Check Relay (ACF, plug-in type) makes certain that PROTECTOFIER is functioning properly. It is energized thru N.C. contacts of the Flame Relay. Failure of the Check Relay to prove safe-start check will prevent ignition and energizing of fuel valve.

Flame Relay (ACF, plug-in type) responds to FLAME-PAK operation energizing circuit to fuel valve.

Load Relay (ACF, plug-in type) is used on multi-burner units to energize fuel valves after all flames are proven. It is energized thru series circuit of N.O. contacts of all flame relays. Loss of flame signal from any one burner position de-energizes the load relay, which in turn de-energizes the fuel valves.

NR Relay (ACF, plug-in type) is used on all automatic NR units to provide non-return of ignition after flame failure. Contact of NR relay provides power to the thermal circuit breaker following a flame failure causing thermal circuit breaker to trip. Manual reset of thermal circuit breaker is required.

Thermal Circuit Breaker (lock-out switch) is required for automatic units to provide ignition trial timing. The thermal circuit breaker "latches-out" after failure to prove flame within ignition trial time and cannot re-start until breaker is manually reset.

TIMOFIER (U300M, plug-in type) is a non-adjustable motor driven timer used on manual units (VT, VLT) to provide purge time and ignition trial time. Purge timing should allow system to have a minimum of four fresh air changes.

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FAX: (847) 674-7009
e-mail@protectioncontrolsinc.com
www.protectioncontrolsinc.com

COMPONENTS (continued)

TIMOFIER (U300A, plug-in type) is a non-adjustable motor driven timer used on automatic units (VBT, VBLT, VBT-NR, VBLT-NR) to provide purge time and ignition trial time. Purge timing should allow system to have a minimum of four fresh air changes.

Purge Timer (SST, plug-in type) is a non-adjustable solid-state timer used on Form 7256BT-NR and Form 76057-BT to provide purge timing. Purge timing should allow system to have a minimum of four fresh air changes.

Transformer (SS3CP, plug-in type) provides low voltage for FLAME-PAK circuit and power source for E and UV terminals.

Test Jack provides convenient checking of flame signal by placing a DC microammeter in series with the flame rod or P-C II ultra-violet Scanner (see Servicing Sec. II E).

Flame Response Light(s): Neon indicator bulb(s) energized with flame(s) present.

TELEFIER: Flame-fault indicator lights for multi-burner systems instantly shows exact burner position causing shutdown.

Flame Rod or Ultra-violet Scanner: (either or both can operate in the same PROTECTOFIER system). The P-C II ultra-violet Scanner can be used with gas or oil flame. It is compact, containing only an ultra-violet sensing tube for direct 2-wire connection to PROTECTOFIER. See Bulletin UV-787.

CAUTION

Installation, operation and maintenance shall be performed by qualified personnel. Control may be returned to the factory for inspection, service and repair.

Disconnect power to the PROTECTOFIER when removing or inserting plug-in components **to prevent improper logic sequencing,** possible electrical shock or damage to components.

INSTALLATION

Mounting: PROTECTOFIER can be mounted in any position and in any type control panel. The distance from flame depends upon signal current from supervised burner.

A. Install only in an area of less than 140° F.

B. Flame rod should be mounted permanently in the path of the pilot flame where it can intersect the main burner flame.

C. U-V Scanner should be mounted to sight intersection of pilot and main burner and must be shielded from any source of ultra-violet except that of the flame position it is monitoring.

D. Adequate provisions should be made to the burner(s) (mechanically or electrically) to prevent the possibility of sensing the ignition spark by the ultra-violet scanner.

IMPORTANT

Wiring: Connections to the PROTECTOFIER must be made at terminals in accordance with wiring diagram furnished for a specific application. Wiring diagram and sequence of operation are available upon request.

CAUTION

Recommended operating temperatures and voltage must be followed.

The control system must be thoroughly checked monthly for proper operation by simulating flame failure at each flame position to verify proper response to loss of flame signal. Flame failure may be simulated by closing an upstream gas cock. The fuel shut-off valve should snap shut within a few seconds.

The above sequence should be performed on a weekly schedule if the sensor is a P-C II and burner is on continuously (over 24 hours).

Note: An alternative for continuous (over 24 hours) operation is to use the R-C 100 Redunda-Check U-V Scanner and Combustion Safeguard system (use with form 6642VL, -VBL,-VLT,-VBLT,-VBLNR, or -VBLTNR PROTECTOFIER with Group MR.)

Where pilots are used to ignite main burners, the flame sensor must be positioned to detect the flame at a point where the pilot flame at its minimum firing rate will reliably light the main burner. Flame sensor(s) must be checked frequently to ensure correct positioning as well as cleanliness and/or damage that could cause improper operation. Operating temperatures should not exceed 212° F (100° C) for the U-V sensor and 600° F (316° C) on the flame rod insulator.

CAUTION

Failure to observe safe procedures may result in electrical shock, fire or explosion.

SERVICING GUIDE

SEC. I VISUAL INSPECTION

Most operational failures can be remedied by following simple service procedures. However, before servicing is started on the PROTECTOFIER it is necessary that -

A. All wiring should be checked.

B. All terminal connections must be secure.

C. Plug-in relays and FLAME-PAKS must be properly and securely inserted.

SEC. II EXTERNAL ELECTRICAL INSPECTION

A. Voltage to the terminals on the PROTECTOFIER chassis L1 and L2 should be 120V AC +/- 10% 50-60 Hz.

B. External limit circuitry should be functioning and allowing uninterrupted voltage to proper PROTECTOFIER terminal.

C. Pilot Valve (if it fails to open)

1. Check voltage at pilot valve terminal on the PROTECTOFIER chassis. If there is no voltage see Sec. III Internal Service Guide.

2. If voltage is present, check valve coil for an open circuit.

SERVICING GUIDE (continued)

D. Ignition of Pilot (if pilot does not ignite with combustible mixture present).

1. Check voltage at ignition transformer.
2. Check if ignition transformer is providing spark at the spark-plug.

E. Pilot (if pilot ignites for brief moments).

1. Check input signal by placing a DC microammeter – dual scale (0-50 for flame rod) (0-200 for U-V Scanner) in series with the flame signal thru test jack on the chassis, or by removing wire on flame terminal (E or UV) and externally placing meter in series. CAUTION: Do not ground flame rod with the meter in series; damage to the meter may result. With flame rod operation, a 2-microampere signal is sufficient, but due to flame fluctuations 5 microamperes or more is recommended. With U-V Scanner operation a 10 microampere per second pulsing signal is required (signal may be lower if pulse rate increases).
2. If low signal occurs with flame rod operation
   a. Check position of flame rod in pilot: should be in the outer cone of the flame.
   b. Check for proper air-gas mixture.
   c. Check for leakage. Check for proper nominal voltage on PROTECTOFIER sensor terminals with sensitive VOM (E to ground terminal 390V AC, UV to ground terminal 590V AC). Measure terminal voltage with sensor wire connected and disconnected from terminal, voltage should be identical in both cases. Voltage drop of 10 volts AC or more indicates excessive leakage. Consult Flame Sensor Wire Installation Instructions.
3. With U-V Scanner operation
   a. Check position of U-V Scanner for maximum U-V signal.
   b. Check for proper air-gas mixture.
   c. U-V tube must be clean.

F. Main Valve (if it fails to open).

1. Check voltage on chassis. If there is voltage at the main valve terminal after proper sequence, check valve coil for an open circuit.
2. No voltage at terminal indicates:
   a. Flame relay is not energized.
   b. FLAME-PAK is not energized.
   c. Check for short circuit to main valve.

All of the above possibilities are given in Section III.

SEC. III PROTECTOFIER INTERNAL SERVICE GUIDE (use only after visual and external electrical inspections have been made).

A. Check Relay:

All controls have safe start/check, provided by a Check Relay. This relay is energized through a series circuit consisting of external safety limit switch(es) (SEC. II-B) as well as safe start position of flame and load relay contacts, TIMOFIER contact, and safety lockout switch contacts as applicable to the specific PROTECTOFIER used. Consult wiring diagram provided with control.

B. Flame Relay:

This relay responds to an amplified signal from the FLAME-PAK when flame is present. If flame relay does not pull in:

1. Remove wire from E or UV terminal and substitute with flame simulator between E or UV terminal and ground.
2. Interchange the FLAME-PAK: replace if needed. Interchange the Flame Relay; replace if needed. Check position of the flame rod for signal (see Sec. V).

SEC. IV OPERATIONAL CHECKS

A. If the pilot does not light, the cause may be in the safe-start circuit. The Check Relay will not energize if any one of the N.C. contacts in series with Check Relay is open.

1. Refer to wiring diagram and make continuity check.
2. Check pilot valve and ignition transformer.

B. If pilot lights but no flame response is obtained check for signal at E or UV terminal (see E Sec. II).

C. If Flame Relay will not drop out:

1. First remove wire from chassis E or UV terminal.
2. Interchange FLAME-PAK; replace if needed.
3. Interchange Flame Relay; replace if needed.
4. Interchange flame sensor; replace if needed.

SEC V TESTING FLAME RECTIFICATION

A. Flame rod signal can be tested by connecting a DC microammeter in series with flame rod. This measures the actual flame current flowing in microamperes – (millionths of an ampere).

B. Testing ultra-violet flame sensor:

Sensor signal can be tested by puttling a DC microammeter in series with the sensor wire connected to the UV terminal (see Sec. II E). The amount of current flowing through the U-V sensor depends upon several conditions.

1. Proper sighting of flame. Flame should be visible over the entire viewing port area.
2. Sensor should be mounted as close to the flame as possible. Cooling may be required to keep sensor temperature as low as possible. (Note! The sensor is rated at 100° C maximum).
3. U-V tube, lens in heat seal assembly (if used) and sighting tube must be kept clear. Smoke in the sighting tube or dirt on the lens or U-V tube absorb U-V thereby reducing signal.

SERVICING GUIDE (continued)

4. If all of the above mentioned have been checked and the U-V sensor shows a very low signal, or no signal on the microammeter, the U-V sensor should be replaced with a known working unit.

The microammeter should have a dual scale range (0-50 for flame rod) (0-200 for U-V scanner). A protective circuit is recommended because, among other things, accidental grounding of flame rod could burn out the microammeter. A protective circuit can be made with two 500 ma silicon rectifiers; one rectifier with its positive and negative leads connected to corresponding positive and negative terminals of the microammeter, and the other rectifier connected just the reverse of the first one.

C. The positive terminal of the meter connects to E terminal at the PROTECTOFIER, and negative terminal connects to the flame electrode.

D. The Flame Relay of the PROTECTOFIER will pull in at a flame current of 1.5 or 2.0 microamperes. However, for stable operation, flame current should be greater than this. Currents of 5 to 20 microamperes (and upward) are common.

E. The amount of current flowing through flame depends upon several conditions:

1. Position of flame rod relative to flame; best position is usually found in outer, rather than inner, cone of the flame.

2. Blow-off could also cause absence of flame current. This condition is often the result of excessive fuel and air velocity at the burner fuel outlet, and the flame does not have a chance to be grounded by establishing contact with grounded metal of the burner.

3. High resistance to ground can also cause insufficient current flow to PROTECTOFIER. This could result from carbon deposits on flame rod.

4. Poor insulation characteristics of flame rod or flame rod wire could permit grounding of signal current or leakage of signal current to ground. Grounding or leakage to ground by-passes the rectified current flow through the flame and the 50-60 Hz AC current flow cannot cause the amplifier to conduct.

5. Prolonged grounding of sensor or sensor wire can damage SS100A FLAME-PAK and/or SS3CP transformer. Excessively hot transformers or blistering of SS100A FLAME-PAK indicates a grounded wire or sensor.

FLAME SENSOR WIRE INSTALLATION INSTRUCTIONS

Both proper wire selection and routing are essential to the reliable operation of the combustion safeguard.

The wire must be rated for a minimum of 600V and for the maximum ambient temperature. Sensor wire may be either solid or stranded and should be plastic insulated such as TW, TH, THHN, or MTW. Number 14 AWG wire is normally used - minimum wire size is 18 AWG. Heavier wire may produce a slightly higher micro-ampere reading. Cloth, rubber, or asbestos insulated wire, microphone cable, twisted pairs, and multi-conductor cables should not be used due to their contaminent absorption and/or capacitance characteristics. The wire should not be spliced nor should pulling compound be used.

Flame sensor wire lengths less than 50 feet may be combined with nominal amperage 115V 60 Hz control wiring. Wire lengths over 50 feet should be run in a separate conduit. Wire lengths exceeding 150 feet are not recommended although lengths in excess of 250 feet have been used successfully. If lead lengths are over 150 feet, moving the combustion safeguard closer to the burner is recommended. If distances over 150 feet cannot be avoided, a low capacitance shielded cable such as RG62AU should be used. This cable is available - see Price Bulletin PAR. The maximum distance between the flame sensor and the combustion safeguard depends upon burner adjustment, sensor, routing, wire and external sources of interference.

RG62AU COAXIAL SHIELDED CABLE

Flame sensor wires acts like a capacitor to the conduit which reduces the sensor operating voltage and lowers the returned signal. The lower the capacitance of the wire, the better the signal that can be returned to the flame safeguard. **To achieve maximum distance,** the shield of the RG62AU cable should be floating (not grounded) at both ends. **To minimize external coupling interference,** the shield should be grounded at both ends although this will reduce the lead length that can be satisfactorily run.

External electromagnetic radiation will adversely affect operation of the flame sensor and combustion safeguard. Sensor wire must never be run with power wiring such as motor control, high voltage wiring such as ignition transformers or direct current wiring such as SCR motor control, proportional motors and thermocouple wires. Conduit should be routed away from high current devices such as motors, transformers or buss bars, especially if they have a direct current component. Sensor wire must be kept away from induction furnaces and powerful R.F. transmitters.

INSTALLATION, OPERATION AND MAINTENANCE SHALL CONFORM WITH NATIONAL FIRE PROTECTION ASSOCIATION STANDARDS, NATIONAL AND LOCAL CODES, AND AUTHORITIES HAVING JURISDICTION. ANY MODIFICATION VOIDES APPROVALS.

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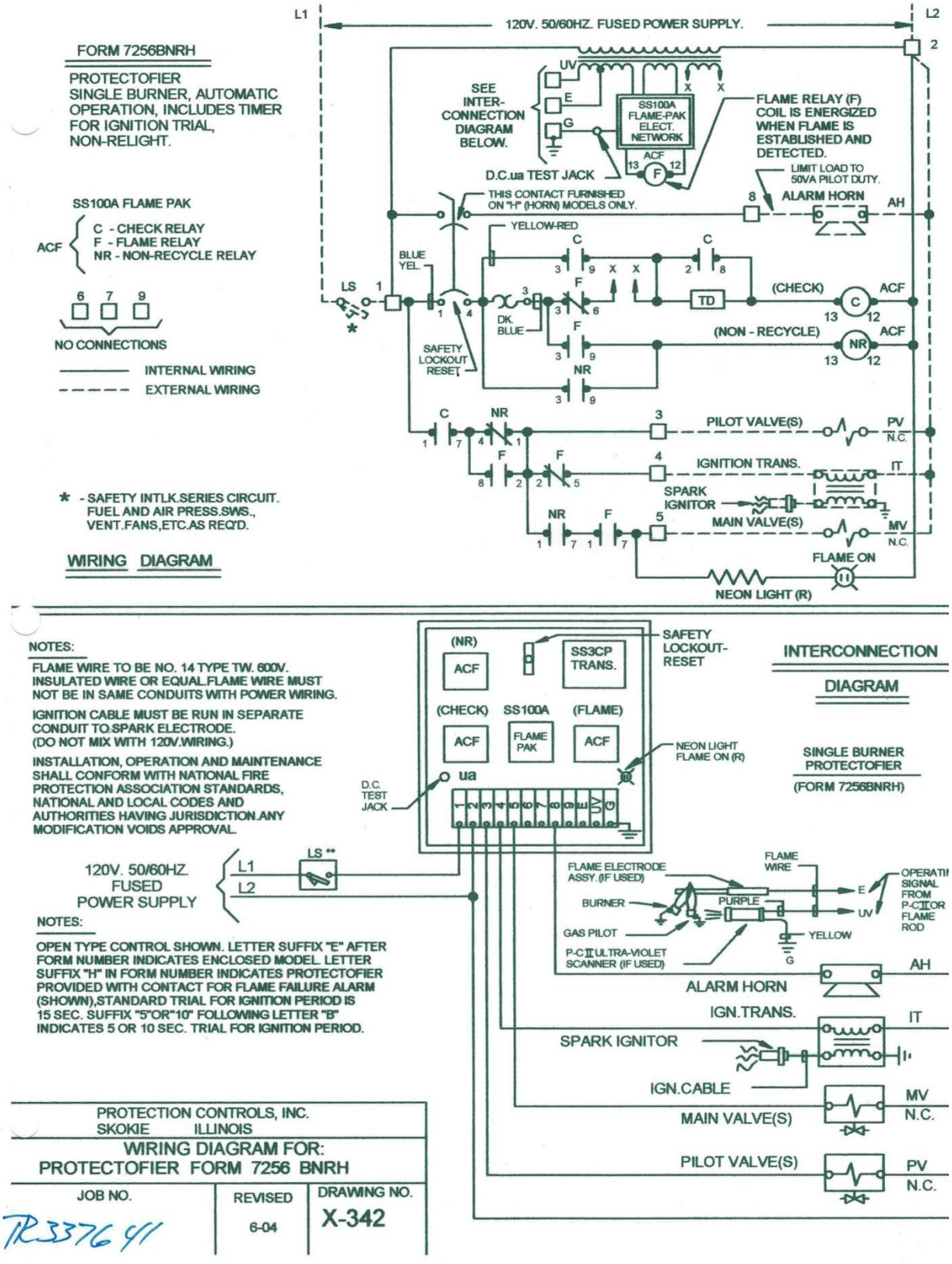
FORM 7256BNRH
PROTECTOFIER
SINGLE BURNER, AUTOMATIC OPERATION, INCLUDES TIMER FOR IGNITION TRIAL, NON-RELIGHT.
SS100A FLAME PAK
ACF
C - CHECK RELAY
F - FLAME RELAY
NR - NON-RECYCLE RELAY
6 7 9
NO CONNECTIONS
INTERNAL WIRING
EXTERNAL WIRING
* - SAFETY INTLK.SERIES CIRCUIT. FUEL AND AIR PRESS.SWS., VENT.FANS,ETC.AS REQ'D.
WIRING DIAGRAM
L1
120V. 50/60HZ. FUSED POWER SUPPLY.
L2
SEE INTER-CONNECTION DIAGRAM BELOW.
SS100A FLAME-PAK ELECT. NETWORK
FLAME RELAY (F) COIL IS ENERGIZED WHEN FLAME IS ESTABLISHED AND DETECTED.
D.C.ua TEST JACK
LIMIT LOAD TO 50VA PILOT DUTY.
THIS CONTACT FURNISHED ON "H" (HORN) MODELS ONLY.
ALARM HORN
AH
YELLOW-RED
BLUE YEL.
DK. BLUE
SAFETY LOCKOUT RESET
TD
(CHECK)
(NON - RECYCLE)
PILOT VALVE(S)
PV N.C.
IGNITION TRANS.
IT
SPARK IGNITOR
MAIN VALVE(S)
MV N.C.
FLAME ON
NEON LIGHT (R)
NOTES:
FLAME WIRE TO BE NO. 14 TYPE TW. 600V. INSULATED WIRE OR EQUAL.FLAME WIRE MUST NOT BE IN SAME CONDUITS WITH POWER WIRING.
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OPEN TYPE CONTROL SHOWN. LETTER SUFFIX "E" AFTER FORM NUMBER INDICATES ENCLOSED MODEL. LETTER SUFFIX "H" IN FORM NUMBER INDICATES PROTECTOFIER PROVIDED WITH CONTACT FOR FLAME FAILURE ALARM (SHOWN),STANDARD TRIAL FOR IGNITION PERIOD IS 15 SEC. SUFFIX "5"OR"10" FOLLOWING LETTER "B" INDICATES 5 OR 10 SEC. TRIAL FOR IGNITION PERIOD.
(NR)
ACF
SS3CP TRANS.
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ua
INTERCONNECTION DIAGRAM
SINGLE BURNER PROTECTOFIER
(FORM 7256BNRH)
120V. 50/60HZ. FUSED POWER SUPPLY
LS **
FLAME ELECTRODE ASSY.(IF USED)
FLAME WIRE
BURNER
PURPLE
GAS PILOT
P-C II ULTRA-VIOLET SCANNER (IF USED)
YELLOW
ALARM HORN
IGN.TRANS.
SPARK IGNITOR
IGN.CABLE
MAIN VALVE(S)
PILOT VALVE(S)
PROTECTION CONTROLS, INC.
SKOKIE ILLINOIS
WIRING DIAGRAM FOR:
PROTECTOFIER FORM 7256 BNRH
JOB NO.
TR3376 4/1
REVISED
6-04
DRAWING NO.
X-342

Protectofier

COMBUSTION SAFEGUARD

Form 7256 BNRH (Drawing X-342)

Single Burner Supervision, Automatic Ignition, Non-Relight, Plug-in Type SS1OOA FLAME PAK, Plug-in Type ACF Control Relays.

AUTOMATIC IGNITION

Power on PROTECTOFIER terminal 1 and 2 provide power to electronic network (thru safety and cycling limit switch circuits).

1. "ACF" CHECK relay "C" is energized thru N.C. contacts of "ACF" FLAME relay "F", SAFETY LOCKOUT switch circuit and component check "TD" circuit.

2. Ignition transformer is energized from terminal 4 (thru N.C. contact of FLAME relay "F") to provide electric spark ignition to the pilot. Pilot solenoid valve is energized from terminal 3.

3. With pilot flame established "ACF" FLAME relay "F" is energized.

   a. FLAME relay "F" contacts transfer.

      1) N.C. "F" contact in safe-start checking and SAFETY LOCKOUT circuit opens.

      2) N.C. "F" contact in ignition transformer circuit opens to de-energize the ignition transformer.

      3) N.O. "F" contact in main valve circuit closes.

      4) N.O. "F" contact in series to "ACF" NON-RECYCLE relay coil "NR" closes to energize "NR" relay.

      5) N.O. "NR" relay contact closes to electrically hold on "NR" coil.

      6) N.C. "NR" relay contact opens to prevent attempt to relight on flame failure condition.

      7) N.O. "NR" relay contact closes, permitting main valve circuit to be energized. "Flame On" indicator light on PROTECTOFIER chassis will glow to indicate flame is established.

Failure to establish pilot flame during limited ignition trial cycle will cause SAFETY LOCKOUT switch contacts to open. CHECK relay "C" is de-energized, pilot valve is de-energized and electric ignition is stopped. With no flame signal, main valve remains de-energized.

SAFETY LOCKOUT requires manual reset.

Flame failure during operation shuts off fuel supply by de-energizing fuel valves. NON-RECYCLE relay "NR" remains energized. N.C. "NR" relay contact remains open to prevent re-opening of pilot gas valve and re-ignition. SAFETY LOCKOUT switch contacts will open circuit to CHECK relay "C" coil at end of safety switch timing period.

SAFETY LOCKOUT requires manual reset.

Suffix letter "H" in Form number indicates Alarm circuit option is provided. Alarm circuit will be energized when SAFETY LOCKOUT switch trips on failure to light pilot or flame failure. Alarm load to be limited to 50VA maximum.

Power interruption to PROTECTOFIER terminal 1 de-energizes relays and fuel valves. Resumption of power will cause PROTECTOFIER to go thru another safe-start check and relight cycle.

Failure of CHECK relay "C" to prove safe-start check will prevent opening of fuel valves and also prevent ignition.

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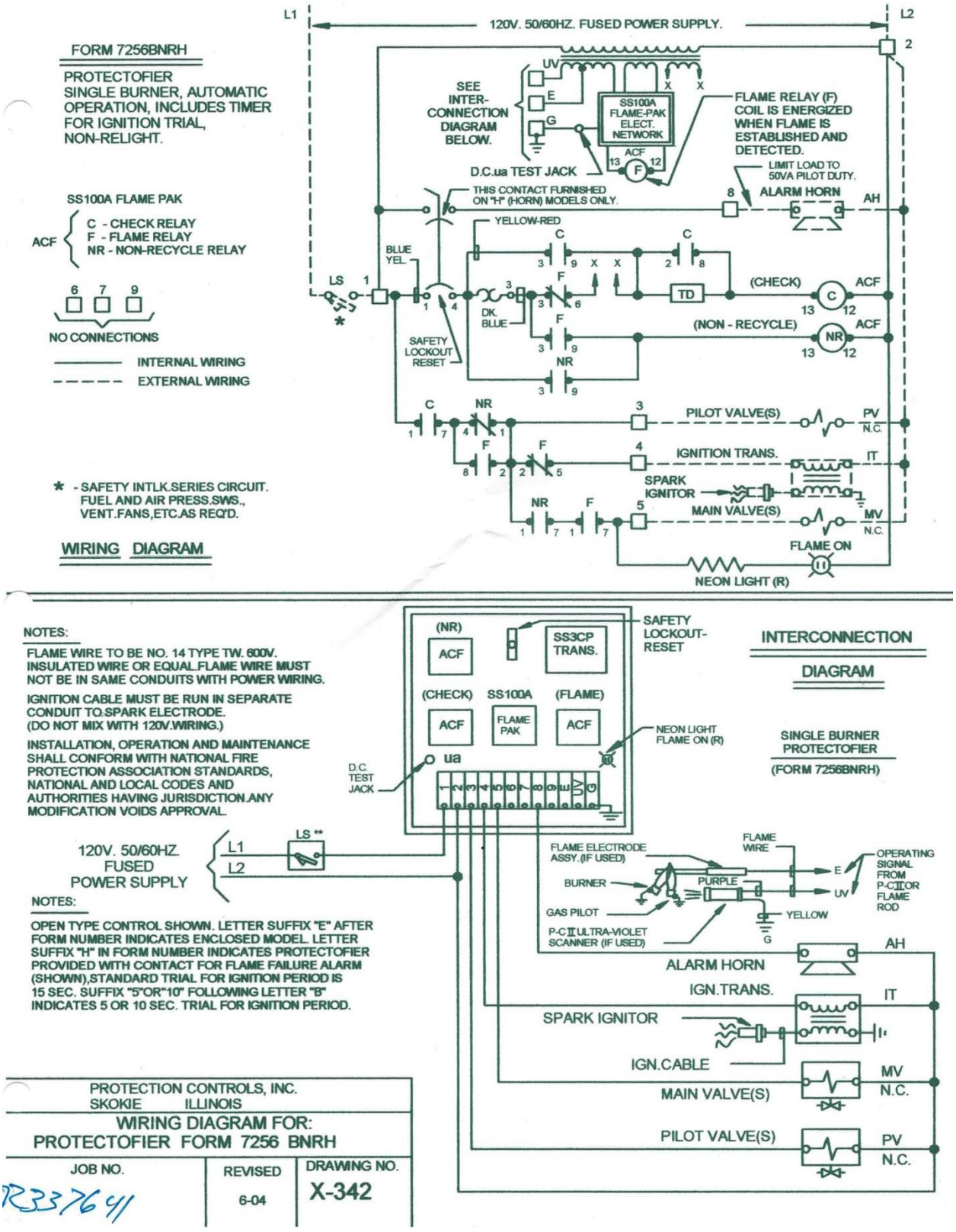
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FLAME PAK
NEON LIGHT FLAME ON (R)
D.C. TEST JACK
ua
INTERCONNECTION DIAGRAM
SINGLE BURNER PROTECTOFIER
(FORM 7256BNRH)
FLAME ELECTRODE ASSY.(IF USED)
FLAME WIRE
OPERATING SIGNAL FROM P-CII OR FLAME ROD
BURNER
PURPLE
GAS PILOT
P-CII ULTRA-VIOLET SCANNER (IF USED)
YELLOW
ALARM HORN
AH
IGN.TRANS.
IT
SPARK IGNITOR
IGN.CABLE
MV
N.C.
MAIN VALVE(S)
PILOT VALVE(S)
PV
N.C.
PROTECTION CONTROLS, INC.
SKOKIE ILLINOIS
WIRING DIAGRAM FOR:
PROTECTOFIER FORM 7256 BNRH
JOB NO.
R337641
REVISED
6-04
DRAWING NO.
X-342

BULLETIN UV-787-R8

P-C II

ULTRA-VIOLET SCANNER

- High flame signal
- Can be mounted in any position
- Encapsulated sensor tube permanently sealed in gas tight housing
- Operates with gas and/or oil flames

IRI ACCEPTED

P-C II ULTRA-VIOLET SCANNERS
Can be used with any flame which contains ultra-violet. Flame electrodes and P-C II SCANNERS can be used simultaneously in the same PROTECTOFIER system. Compact units contain an ultra-violet sensing tube for direct 2-wire connection to PROTECTOFIER.

P-C II—provided with an electrical connector for flexible metal conduit (⅜" max.)

P-C II W—provided with ½" straight liquid-tite electrical connector

P-C II WRA—provided with a ½" right angle liquid-tite electrical connector

MADE IN U.S.A.

SPECIFICATIONS

Ambient temperature:
Minus 20° to 212°F (100°C)

Nominal operating voltage:
590V 60Hz from PROTECTOFIER
UV terminal to ground

Peak spectral light response:
210 Nanometers (2100 Angstroms)

PROTECTION CONTROLS, INC.
ELECTRICAL SAFETY EQUIPMENT

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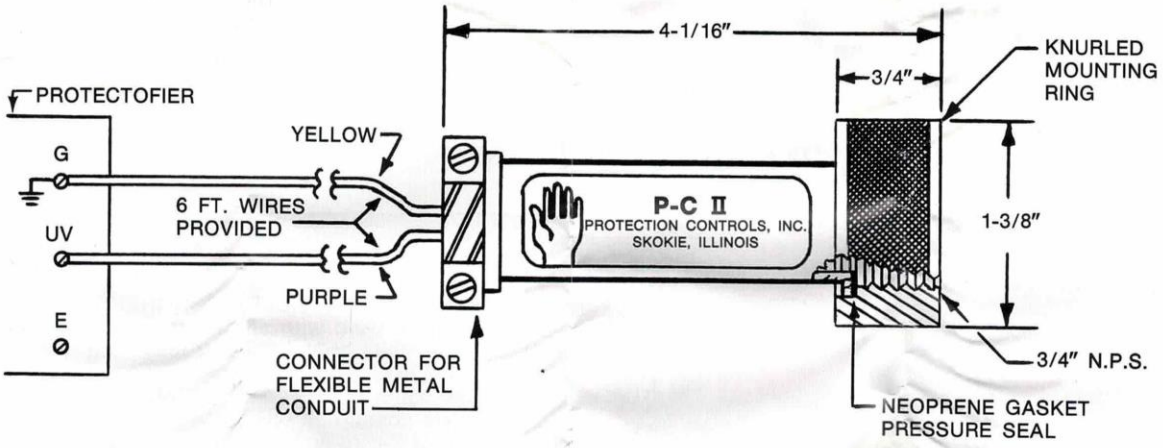
e-mail@protectioncontrolsinc.com
www.protectioncontrolsinc.com

P-C II U-V SCANNER



P-C II W — With ½" straight liquid-tite connector — add ½" to total length.

P-C II WRA — With ½" right angle liquid-tite connector — add 1½" to total length.

P-C II U-V SCANNER INSTALLATION INSTRUCTIONS

1. The **P-C II** U-V SCANNER shall be connected to the PROTECTOFIER Combustion Safeguard only.
   a. Purple lead wire connects to U-V terminal on PROTECTOFIER.
   b. Yellow lead wire connects to system ground. (Only one ground wire is required for any number of sensors.)

2. The **P-C II** U-V SCANNER must be positioned so it will sight at a point where the pilot flame at its minimum setting will reliably light the main burner flame.

3. The **P-C II** U-V SCANNER shall be shielded mechanically or electrically from spark excitation as well as from any other ultra-violet source.

4. Do not use a wrench on the housing or put strain on the housing when making flexible metal conduit connection as this can result in damage to the scanner. The flexible metal connection should be made prior to mounting the scanner on the burner. The electrical connector is not to be removed.

5. It is recommended that the **P-C II** U-V SCANNER be replaced at approximately 8000 hours of operation. Adverse operating conditions such as elevated temperatures and high operating voltages will require more frequent replacement.

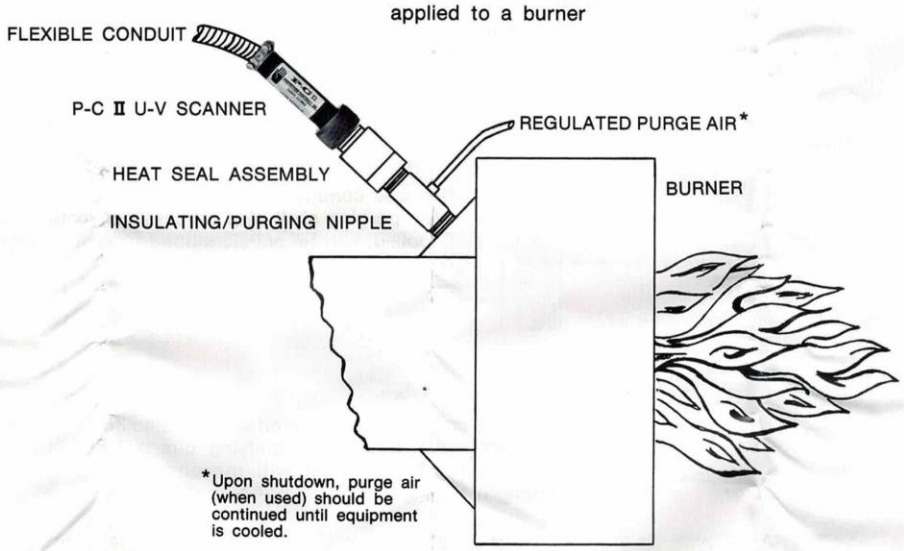
6. The control systems must be thoroughly checked monthly for proper operation by simulating flame failure at each flame position to verify proper response to loss of flame signal. Flame failure may be simulated by closing an upstream gas cock. The fuel shut-off valve should snap shut within a few seconds. The above sequence should be performed on a weekly schedule if the burner is on continuously (over 24 hours). Recommended for continuous (over 24 hours) operation is the Dual/Redundant Self Check R-C 100 Redunda-Check U-V Scanner and Combustion Safeguard System (use with form 6642VL, -VBL, -VLT, -VBLT, -VBLNR, or -VBLTNR PROTECTOFIER with Group MR.

7. Periodic cleaning of the **P-C II** U-V SCANNER tube is necessary to maintain highest signal strength.

*** INSTALLATION, OPERATION AND MAINTENANCE SHALL CONFORM WITH NATIONAL FIRE PROTECTION ASSOCIATION STANDARDS, NATIONAL AND LOCAL CODES, AND AUTHORITIES HAVING JURISDICTION. ANY MODIFICATION VOIDS APPROVALS.**

P-C II U-V SCANNER

with optional accessories
applied to a burner



FLAME SENSOR WIRE INSTALLATION INSTRUCTIONS

Both proper wire selection and routing are essential to the reliable operation of the combustion safeguard.

The wire must be rated for a minimum of 600V and for the maximum ambient temperature. Sensor wire may be either solid or stranded and should be plastic insulated such as TW, TH, THHN, or MTW. Number 14 AWG wire is normally used - minimum wire size is 18 AWG. Heavier wire may produce a slightly higher micro-ampere reading. Cloth, rubber, or asbestos insulated wire, microphone cable, twisted pairs, and multi-conductor cables should not be used due to their contaminent absorbtion and/or capacitance characteristics. The wire should not be spliced nor should pulling compound be used.

Flame sensor wire lengths less than 50 feet may be combined with nominal amperage 115V 60 Hz control wiring. Wire lengths over 50 feet should be run in a separate conduit. Wire lengths exceeding 150 feet are not recommended although lengths in excess of 250 feet have been used sucessfully. If lead lengths are over 150 feet, moving the combustion safeguard closer to the burner is recommended. If distances over 150 feet cannot be avoided, a low capacitance shielded cable such as RG62AU should be used. This cable is available – see Price Bulletin PAR. The maximum distance between the flame sensor and the combustion safeguard depends upon burner adjustment, sensor, routing, wire and external sources of interference.

RG62AU COAXIAL SHIELDED CABLE

Flame sensor wire acts like a capacitor to the conduit which reduces the sensor operating voltage and lowers the returned signal. The lower capacitance of the wire, the better the signal that can be returned to the flame safeguard. To achieve maximum distance, the shield of the RG62AU cable should be floating (not grounded) at both ends. To minimize external coupling interference, the shield should be grounded at both ends although this will reduce the lead length that can be satisfactorily run.

External electromagnetic radiation will adversely affect operation of the flame sensor and combustion safeguard. Sensor wire must never be run with power wiring such as motor control, high voltage wiring such as Ignition transformers or direct current wiring such as SCR motor control, porportional motors and thermocouple wires. Conduit should be routed away from high current devices such as motors, transformers or buss bars, especially if they have a direct current component. Sensor wire must be kept away from induction furnaces and powerful R.F. transmitters.

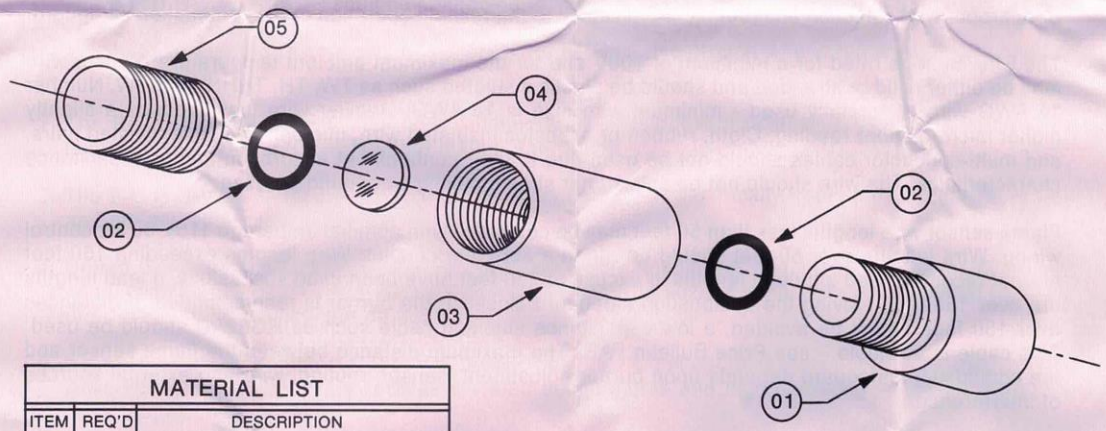
P-C II U-V SCANNER ACCESSORIES

FIBER INSULATOR (Phenolic)
Reduces conducted heat.

INSULATING/PURGING NIPPLE (Phenolic)
Reduces conducted heat. When used with regulated purging air it also reduces convected heat. Supplied with ⅛″ N.P.T. tapped hole and plug to receive purge air connection.

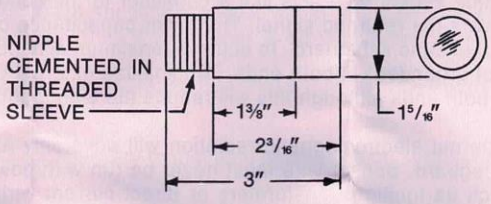
HEAT SEAL ASSEMBLY
Reduces conducted, convected and radiated heat. Available with plain or magnifying quartz lens. Magnifying quartz lens will increase signal strength.*

HEAT SEAL ASSEMBLY FOR P-C II U-V SCANNER



MATERIAL LIST		
ITEM	REQ'D	DESCRIPTION
01	1	FIBER INSULATOR - ¾″N.P.S.
02	2	NEOPRENE WASHER
03	1	HEAT SEAL THREADED SLEEVE 1⅜″LONG-¾″N.P.S.
04	1	QUARTZ LENS*
05	1	QUARTZ LENS RETAINING NIPPLE (¾″N.P.S. CLOSE NIPPLE)

* PLAIN OR MAGNIFYING LENS AVAILABLE. MAGNIFYING LENS NOT RECOMMENDED FOR INSTALLATION WHERE P-C II IS LESS THAN 10 INCHES FROM FLAME.



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