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Propane Heaters

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Introduction to Propane Heaters

By reading this manual, we sincerely hope that you will find this to be a good investment of your time. This manual is designed to offer knowledge of propane heaters to the person just starting out in the field of propane heater repair as well as to the seasoned veterans of the trade. If you happen to be one of the people just starting out, we do have a few pieces of advice for you about using this manual. First, start by reading the next three sections of the manual. By doing this first, it will give you a good starting point when it comes to understanding the theory of propane heaters. Second, pay close attention to the section titled "PARTS IDENTIFICATION and DEFINITION." This section not only will tell you what a part does in your heater, but it will also show you a picture of that component part as well as how to troubleshoot that component. This section will be of major importance until you get comfortable with the theory and the applications of propane heaters.

As you will notice, this manual has few part numbers located in the front portion of this manual. This is done for a reason. The front portion of this manual is for educating people about all of the different aspects involved with propane and propane heating. Once the first part of the manual is read and understood, then the rest of the manual will be much easier to comprehend, and then the part numbers may need to come into play. In order to gain access to more specific part numbers, you can do that in one of three ways. First, you can get a copy of PORTABLE HEATER PARTS latest TECHNICAL SERVICE MANUAL. This manual usually is updated on a bi-annual basis and is regarded as the best source for part numbers and accessories in the business. Second, you can visit our web site @ www.portableheaterparts.com and browse through our on-line Sales and Technical Service catalogs. Last, and by far the most important, are the great customer service people at PORTABLE HEATER PARTS @ (800) 362-6951 Ext. 1. Their knowledge and commitment to their customer (you) is second to none!

And now, we get to the real reasons for writing this manual. The first reason (and most important) reason is YOU, our customer. For without you, we would not be here. The second reason is that this industry has not had a simple, in depth manual written about the theories of how propane heaters work, and what to do with them when they don't. We hope that this manual fills that void. We hope to fill that void by providing a simple, easy way of looking at the basics of propane heating, along with a simple way of helping you discover what could be wrong with your heater. If this manual accomplishes that, then it was well worth writing. The last reason for writing this manual is that many people are apprehensive about working with propane heaters. This is only natural. By reading this manual, we hope to alleviate some of that apprehension, and hopefully you will get to know a little bit more about propane heaters.

Propane Heater Safety

Propane heaters can be an extremely safe way of providing heat as long as certain safety precautions are followed:

1. Never check for gas leaks with an open flame. Use a one part soap to three parts water solution to spray the gas connections. Propane vapor in a gas hose or in a heater is under POSITIVE pressure, meaning that any leaks will be outgoing. Also, propane vapor is HEAVIER than air, so if you have a vapor leak, the vapor will stay low and accumulate, thereby creating a very dangerous situation.

2. Never try to convert propane vapor heaters to ANY other type of fuel source (natural gas, butane, or liquid propane without an external vaporizer). Any attempt to do so violates any manufacturers warranties as well as any manufacturers liabilities. Make sure to use vapor withdrawal cylinders only.

3. Never point a vapor propane heater or any other kind of heater at a propane cylinder. Locate the heater at least seven feet away from any propane cylinder. It is true that air moving around a propane vapor withdrawal cylinder will help propane "boil" from a liquid to a vapor, but air movement around a vapor withdrawal cylinder should be accomplished by using fans only, if at all. If you find that you need to use a fan to help the "boiling" process, then go to a larger vapor withdrawal cylinder.

4. Never operate a vapor propane heater or any other heater with any factory installed safety controls removed. The safety controls are there for a reason, let them do their job. If you find that an original factory installed safety control is defective, then replace it immediately with a factory-authorized replacement only. You may need to remove or bypass a safety control for troubleshooting purposes only, but never let that unit leave your workbench without reinstalling the proper safety controls.

5. Never replace a regulator unless it is a factory authorized replacement. Just because some regulators look alike does not mean that they perform alike. If you remove or change any part and replace it with a non-factory authorized replacement, then the liability is yours alone. Doing this will also void the factory warranty.

6. Never put duct on a vapor propane heater unless it is explicitly authorized by the original equipment manufacturer. If your heater was not designed for ducting (the vast majority of them are not), then do not attempt to use ducting. The repercussions of using ducting may cause a fire and also cause failure of heating components. Using ducting not only will void your manufactures warranty, most insurance companies will not honor a policy resulting from any damage from operating a heater that was not used under original factory specifications.

7. Always allow for proper ventilation when operating any propane heater. The recognized industry guideline for this is usually three square feet for every 100,000 BTU'S of heat. For optimum ventilation, either try to split the ventilation openings evenly between the floor and ceiling, or try to utilize cross ventilation.

8. Always secure propane cylinders with the shut off valve up to prevent toppling over or falling.

9. Do not attempt to move, service, or handle a heater that is in operation or still warm from operation.

10. Follow the owners manual to determine safe operating distances from combustibles.

11. Use a properly grounded outlet and extension cord for propane forced air heaters.

12. Always adhere to any and all safety instructions that are listed in your owner's manual.

None of the above safety rules are to supercede manufacturers safety standards; these rules should always be viewed as an addition to your factory specified safety instructions.

The Characteristics of Propane

The purpose of this manual is to help you understand the basic principles of propane, as well as the basics of propane heaters and their components. We will explain how propane turns from a liquid to a vapor; we will cover the propane as it leaves the cylinder until combustion; we will also cover the parts along the way so you may have a full understanding of how these things come together to produce a properly working heating system. This manual will also discuss the pros and cons of the three types of heating (convection, radiant, and forced air). This manual is to be used as a guide, not your whole source of knowledge. You may run across problems and symptoms not covered here, but at least this manual should give you a place to begin your problem solving. And as always, PHP is just a phone call away!

There are two different types of propane cylinders. The first type, (which we will be dealing with) is the vapor withdrawal cylinder. The second type is the liquid withdrawal cylinder. The vapor withdrawal cylinder is easy to recognize because the withdrawal valve is on top of the cylinder. These cylinders come in various sizes ranging from 1 pound up to 1,000 gallons or more. To appreciate the size of the cylinders that are described in gallons, let's state some propane facts. A gallon of propane weighs in at 4.24 pounds, so the 1,000 gallon propane cylinder has 4,240 pounds of propane when the cylinder is full. Therefore, if there are 4,240 pounds of propane in a 1,000 gallon cylinder, and if a pound of propane has 21,548 BTU'S (approx.), than there are 91,363,520 potential BTU'S in a 1,000 gallon cylinder. A chart listing the approximate BTU'S per cylinder is below:

As you can see, having the correct size cylinder is important. However, getting the propane out of the cylinder is another matter. As discussed earlier, the propane in the cylinder is a liquid, but the vast majority of propane heaters burn vapor that is produced from the liquid propane in the tank. The process of creating vapor from liquid propane is called "boiling."

BOTTLE SIZE:	TOTAL BTU'S (APPROX.)
1 lb	21,548
5 lb	107,740
10 lb	215,480
20 lb	430,960
40 lb	861,920
50 lb	1,077,400
60 lb	1,292,880
100 lb	2,154,800
250gal	22,840,880
500gal	45,681,760
1,000gal	91,363,520

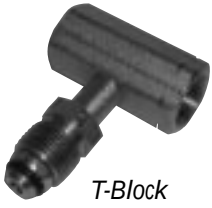
The Boiling Process

When a propane cylinder is full, the tank's contents are approximately 85% liquid and 15% vapor. Once the cylinder is opened, and vapor is used from the tank, the liquid inside the tank "boils" into vapor. The "boiling" action is caused by the outside temperature on the "wetted" (liquid filled portion) of the cylinder. As the outside temperature drops, the "boiling" action slows down, the pressure drops, and less propane vapor is available for fuel. Almost the same thing happens as the cylinder starts to empty. As you use up the fuel, you have less of a "wetted" surface area to boil the liquid into a vapor. Simply stated, as the temperature drops the pressure drops. As the pressure drops, the vaporization of BTU'S drops. See chart below:

Available BTU's in a 100 lb. Bottle

		DEGREES FARENHEIGHT							
		-15	-10	-5	0	20	40	60	70
POUNDS	100	28,000	57,000	85,000	113,000	167,000	214,000	277,000	300,000
OF	90	26,000	52,000	78,000	104,000	152,000	200,000	247,000	277,000
PROPANE	80	23,500	47,000	71,000	94,000	137,000	180,000	214,000	236,000
IN	70	21,000	42,000	62,000	83,000	122,000	160,000	199,000	214,000
CYLINDER	60	19,000	38,000	56,000	75,000	109,000	140,000	176,000	192,000
	50	16,000	32,000	48,000	64,000	94,000	125,000	154,000	167,000
	40	14,000	28,000	41,000	55,000	79,000	105,000	131,000	141,000
	30	11,000	23,000	34,000	45,000	66,000	85,000	107,000	118,000
	20	9,000	18,000	27,000	36,000	51,000	68,000	83,000	92,000
	10	7,000	14,000	21,000	28,000	38,000	49,000	60,000	66,000

Heater selection should be based on appropriate tank sizing, the outside temperature, as well as the area to be heated. However, what happens when you need to use a 400,000 BTU heater and it is 20 degrees outside?



T-Block

There are two possible answers. The first answer is to use multiple cylinders. This process is called manifolding. For each tank you add you need one T-block and one pigtail. Be sure to check local codes to see how many cylinders can be legally manifolded together in your area. The second answer is to use a larger bulk cylinder (refer to the chart on page 6).

Various Types of Pigtails

As you can figure out by looking at the chart on the next page, if you want to use 100 lb. cylinders, you would have to manifold three of them together.

MAXIMUM CONTINUOUS DRAW IN BTU'S PER HOUR
AT VARIOUS TEMPERATURES IN DEGREES

		0 DEGREES 1 CYLINDER	20 DEGREES 1 CYLINDER	0 DEGREES 2 CYLINDERS	20 DEGREES 2 CYLINDERS	0 DEGREES 3 CYLINDERS	20 DEGREES 3 CYLINDERS
POUNDS	100	113,000	167,000	248,000	367,000	545,000	807,000
OF	90	104,000	152,000	228,000	334,000	501,000	734,000
PROPANE	80	94,000	137,000	206,000	301,000	400,000	662,000
IN	70	83,000	122,000	182,000	168,000	363,000	589,000
CYLINDER	60	75,000	109,000	165,000	239,000	310,000	453,000
	50	64,000	94,000	141,000	206,000	260,000	382,000
	40	55,000	79,000	121,000	174,000	217,000	319,000
	30	45,000	66,000	99,000	145,000	195,000	282,000
	20	36,000	51,000	79,000	112,000	174,000	246,000
	10	28,000	38,000	62,000	84,000	136,000	184,000

The Supply Issues with Propane Heaters

There are a few supply issues associated with propane heaters that need to be addressed here. Quite often, technical issues associated with the performance of propane heaters do not always involve the heater itself, but with the various components before they even reach the heater. In order to have a properly working heater, we need to be able to guarantee the delivery of the appropriate amount of each of three components, fuel supply, electric supply (if applicable), and air supply.

Fuel Supply

As we touched on earlier, guaranteeing an adequate fuel supply is one of the biggest problems associated with the proper performance of propane fired heaters. In order to have the correct fuel supply we need to guarantee two things. First, we need to be able to get the proper operating pressure (operating pressure is the propane pressure required by your heater for safe and proper operation). In other words, supply pressure is the amount of force behind the propane vapor. Second, we need to be able to maintain our proper fuel volume (volume is the amount of inlet fuel required to insure proper operation). Your heater requires that BOTH of these needs be satisfied to insure proper operation. As you may have already figured out from the above statement, there is a big difference between the required operating pressure in a fuel supply and the required volume in a fuel supply. If the information listed above makes sense to you, then you may have come to the correct conclusion that your heater can have the proper operating pressure, but your heater will not work properly (or at all) without having the proper volume of fuel. For help in selecting the proper propane supply cylinder(s) for your application, please refer to the previous section titled " THE CHARECTERISTICS OF PROPANE".

Gas Hose Sizing

Maximum delivered propane capacity at 11" wc inlet pressure with a .5" wc pressure drop in btu's per hour times 1,000

	Hose length in feet						
	10	25	50	75	100	150	200
hose inside diameter							
1/4"	27	16	11	9	8	6	5
3/8"	78	47	32	26	22	18	16
1/2"	165	100	70	55	47	38	32
3/4"	478	290	200	162	137	109	96
1"	1,018	616	425	351	291	233	204
1 1/4"	1,829	1,107	762	616	523	418	365

Maximum delivered propane capacity at 1 psi inlet pressure with a .5" wc pressure drop in btu's per hour times 1,000

	Hose length in feet						
	10	25	50	75	100	150	200
hose inside diameter							
1/4"	28	17	12	9	8	6	6
3/8"	80	49	33	27	23	18	16
1/2"	170	103	72	57	49	39	33
3/4"	492	299	206	166	141	113	98
1"	1,049	635	438	362	300	240	210
1 1/4"	1,883	1,140	785	635	539	430	376

Maximum delivered propane capacity at 5 psi inlet pressure with a .5" wc pressure drop in btu's per hour times 1,000

	Hose length in feet						
	10	25	50	75	100	150	200
hose inside diameter							
1/4"	35	21	15	12	10	8	7
3/8"	101	61	42	34	29	23	20
1/2"	215	130	91	72	62	49	42
3/4"	621	377	260	210	178	142	124
1"	1,324	801	553	456	378	302	265
1 1/4"	2,377	1,439	991	800	680	543	474

Gas Hose Sizing

Maximum delivered propane capacity at 10 psi inlet pressure with a .5" wc pressure drop in btu's per hour times 1,000

	Hose length in feet						
	10	25	50	75	100	150	200
hose inside diameter							
1/4"	44	27	18	15	12	10	9
3/8"	126	76	53	43	36	29	25
1/2"	269	163	114	90	77	61	53
3/4"	777	471	325	261	222	178	155
1"	1,655	1,002	691	570	473	378	331
1 1/4"	2,971	1,799	1,239	1,002	850	679	593

Maximum delivered propane capacity at 20 psi inlet pressure with a .5" wc pressure drop in btu's per hour times 1,000

	Hose length in feet						
	10	25	50	75	100	150	200
hose inside diameter							
1/4"	62	37	26	21	18	14	12
3/8"	179	108	75	65	51	41	36
1/2"	380	230	161	127	109	87	75
3/4"	1099	667	459	372	315	252	220
1"	2,342	1,417	978	807	670	535	468
1 1/4"	4,206	2,546	1,753	1,418	1,204	961	839

How to Estimate Your BTU Needs

To determine the BTU needs for any job, you can use a simple formula. You will need to have the following information to estimate the optimal number of BTU:

* Cubic Feet of Heating Job
* Heating Variable (always is .133)
* The Desired Temperature Rise

Cubic feet can be determined by computing the length x width x height. The desired temperature rise is how warm your needs are inside the jobsite compared to how cold it might get outside. For a chart indicating the design temperatures in your area, please refer to page 43. The variable of .133 is a multiplier indicating heat loss.

You can now gather an estimate for BTU needs in the following example. You have a building with measurements of 80 x 60 x 20. You want to have the temperature on the inside to be maintained at 50 degrees. So far, you know that the cubic footage is 96,000. You see on the chart that the coldest it could get in your area is -10 degrees. Your desired temperature rise is now 60 degrees. Take the information in this paragraph and plug the numbers into the formula to estimate BTU needed.

Formula:
Cubic Feet x Variable x Temperature Rise
96,000 x .133 x 60 = 766,080 BTU needed for this example.

Having the knowledge of BTU need will get you half way to the solution. You now must decide the fuel preference, power supply available, and your inventory. We would recommend that your customer rents or purchases two or more heaters for the job. If you have two heaters on the jobsite and one of the heaters malfunctions, you still have one heater to keep things warm until a technician can repair the broken heater.

The Three Types of Propane Heaters

There are three basic types of propane heaters: forced air, radiant, and convection. This section defines each type of heater and discuss the advantages and disadvantages of each.

Forced Air

These heaters use an internal motor and fan to distribute heat. These are the ones commonly called "torpedo" heaters. Forced air propane heaters are available in sizes ranging from 30,000 BTU'S to 750,000 BTU'S through PHP. The advantages of the forced air heater are as follows. The whole unit does not have to be in the area to be heated (only the discharge end of the unit has to be in the area to be heated). This allows clean air exchanges with outside air. In addition, the forced air heater is also a "directional " heater. This means heat can be focused on a certain item or place (but never at a propane cylinder). The forced air heater usually has multiple safety features. These usually consist of high limit switches, sail switches, air proving switches, tip switches (usually found on older L.P. units), spark plugs, igniter electrodes, ignition control boards, valves, and even thermocouples. In addition, some of the forced air heaters can use a thermostat for temperature control. Moreover, a few models may even be ducted. As with all heating systems, there are a few disadvantages associated with forced air units. The first disadvantage is the fact that electricity is required for operation. Another disadvantage is that forced air is more of a complex unit to troubleshoot and repair. Lastly, forced air units rely on three components to work properly. Those components are the timed delivery of air, spark, and fuel (in that order).

Radiant

These heaters work on the principle of transferring heat from one object to another without heating the space in between. For instance, the roof of a black car that has been sitting in the sun on a cool 60 degree day is much warmer than the surrounding air. Therefore, the radiant heat from the sun heated the roof of the car without heating the space in between. That is the concept of radiant heat. As with all heating systems, there are advantages as well as disadvantages. The first advantage is that most radiant heaters require no external electricity. The second advantage of radiant heat is that the ground level is heated first, this way you do not waste as many BTU's as in other heating sources. The third advantage is that the most popular radiant heaters are in the 100,000 BTU range, making them ideal for using the standard 100 pound propane cylinder. The disadvantages are few. First, very few

models have a thermostatic gas valve (meaning not thermostat capable). Second, there are relatively few BTU sizes available, mainly 100,000 BTU and 250,000 BTU units

Convection

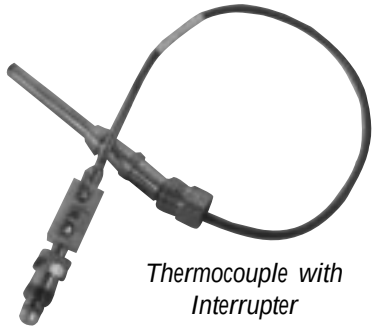
These heaters work on the principle of heat stratification. Heat stratification means heating the topmost areas first, then forcing the heat down in layers until it reaches the comfort zone (usually from ground level to 6' off the ground). The main advantage of convection heaters is that they are the least expensive heaters to purchase (in other words, the most BTU'S for the buck!). The disadvantages of convection heaters are twofold. First, since convection heaters work on the theory of heat stratification, most of your fuel dollars quickly rise with the heat to the ceiling and away from the comfort zone. Second, with very little difference in price between the 80,000 BTU models and the 200,000 BTU models, people usually buy the most BTU's for the buck. What people do not realize is the fact that the 200,000 BTU model needs two or three 100 pound cylinders manifolded together to attain full fire in most heating applications. In general, people who buy these heaters plan to use their 20-pound barbeque cylinders as their fuel source. For an explanation on why the 20 pound cylinder will not work properly, please see the "BOILING PROCESS" listed on page 6. A good majority of the technical issues related to these heaters is fuel supply related.

Propane Pressures

Propane pressure is divided into two categories, high pressure (rated in pounds of pressure) and low pressure (rated in inches of water column). In most cases, high-pressure propane heaters are usually over 150,000 BTU'S, while low-pressure heaters are usually 150,000 BTU'S or less.

Parts Identification and Definition

Thermocouple



Thermocouple with Interrupter

The thermocouple is a safety feature that works with a thermoelectric gas valve to allow or interrupt the flow of fuel. The thermocouple works on a principle of two dissimilar metals, that generates D.C. electricity, when heated. Because of this technology, it is important that the thermocouple's sensing bulb is in the hottest portion of the flame pattern to work properly. The D.C. electricity is rated in millivolts. The D.C. electricity passes down the thermocouple until it reaches the power coil located inside of the thermoelectric gas valve. The thermocouple needs to generate and send at least 17 millivolts of D.C. electricity to the thermoelectric gas valve to keep the power coil compressed or energized, and let allows gas to pass through. A thermocouple may also have an electrical interrupter connection. An electrical interrupter connection is an electrical interrupter located between the tip of the thermocouple and the nut that threads into the gas valve. The purpose of this interrupter is that it allows the manufacturer to install a safety feature on the thermocouple to break the D.C. circuit in case of a unit malfunction. The most common use of the interrupter connection is to install a high limit switch. For example, if your heater has a high limit switch attached to the interrupter, and the switch gets too hot, the limit switch will open up contacts and break the polarity between the thermocouple and power coil, thereby shutting down the flow of fuel.

Troubleshooting the Thermocouple

Tools Required — In order to troubleshoot a thermocouple, you will need one of each of the following: a multimeter, a one pound propane torch, a short jumper wire with 1/4" female spades or alligator clips on both ends if the thermocouple has an electrical interupter.

Thermocouple Test

The thermocouple may be tested by using an electrical multimeter set to read DC milliamps or DC millivolts. Unplug the power and disconnect the gas supply to the heater. The thermocouple may be removed or left in the heater for testing. Separate the connection between the gas valve and the thermocouple. If the thermocouple has two wires connected to it, remove the two wires and place a short "jumper" wire across the two male terminals on the thermocouple. Set the electrical multimeter to read a low range of DC milliamps or DC millivolts. Place the negative meter probe at the center of the small lump found on the end of the thermocouple where it connected into the gas valve. Place the pos-

itive meter probe anywhere on the outside of casing of the thermocouple. Using a lighter or torch, heat the end of the thermocouple that is normally in the heater's flame. The heated thermocouple must produce a minimum of 30 DC milliamps or 17 DC millivolts to pass the test.

Conclusion

What you should conclude is that since the thermocouple sensing tip is comprised of two dissimilar metals and the D.C. electricity is a by product of the heating of those, the dissimilar metals will weaken and fail. This is why it is desirable to keep the most popular thermocouples in your parts inventory.

D.S.I. Control

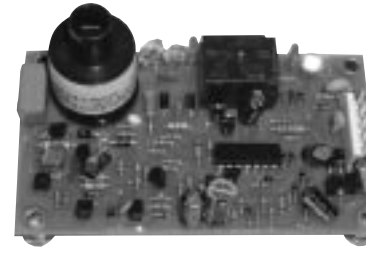
Some people call this part the "brain box" of the heater. Actually, D.S.I. stands for Direct Spark Igniter. However, this part controls a lot more than ignition. It controls the following circuits.

Ignition - The board produces the secondary voltage during the ignition process.
Flame sensing - The board monitors the flame through a spark plug, electrode, or flame rod.
Electronic delay timer (pre-ignition purge cycle).
Supplies the solenoid circuit with power.

The most common brand names for D.S.I. controls are:

Ram controls - Ram controls have come in three different colors, blue, white, or gray.
Gaslighter controls - Gaslighter boards have usually been black in color.
Fenwall controls - Fenwall controls are usually gray in color.

The last point to mention about D.S.I. controls is that if you have one in your heater, two things are true. 1) your heater can use a thermostat, and 2) your heater will not have a thermocouple.



Troubleshooting the D.S.I. Control

To troubleshoot the DSI control you need a special testing device that can be purchased from PHP. The device has wires that hook up to the various styles of DSI boards you may wish to test. Instructions are included. The tester will check the DSI board for three functions. The tester will check for high voltage to the spark plug or electrode. It will test for

voltage to the solenoid valve. Also the tester will check the DSI board to see if it is sensing flame. All these tests can be accomplished in about five minutes. Having the tester can save enough troubleshooting time to pay for the tester itself.

Conclusion

If possible, it is usually best to test the components that rely on the D.S.I. first before looking to the D.S.I. for troubleshooting. As with the thermocouples listed above, it may be desirable to keep one of each of the most popular D.S.I. controls in stock. P.H.P. keeps D.S.I. boards in stock for usual same day shipping.

Gas Valves

Gas Valves are used for two main purposes. The first is to shut off the flow of fuel in case of malfunction, the second is to determine manifold gas pressure.

There are two different types of gas valves (thermoelectric & solenoid) used in portable heaters.

Thermoelectric - Thermoelectric gas valves work on the principle of D.C. voltage being generated by a thermocouple. Thermoelectric valves are sometimes known as the "push button" valves. The thermoelectric valve receives the D.C. voltage generated by the heated thermocouple and then energizes (magnetizes) the power coil located inside of the valve body. The power coil needs this voltage to stay compressed (magnetized) to allow gas to flow through to the burner. The minimum voltage required to keep the power coil energized is 17 millivolts of D.C. electricity.

Thermoelectric Valve with Power Coil

Troubleshooting Thermoelectric Gas Valves

Tools Required - (Thermoelectric Valve, Test Outside of Unit)

In order to troubleshoot a thermoelectric gas valve, you will need the following service items: a tested and proven good thermocouple (see page 14 for the thermocouple test), a one lb. propane torch or a cigarette lighter and a jumper wire if your thermocouple has an electrical interrupter.

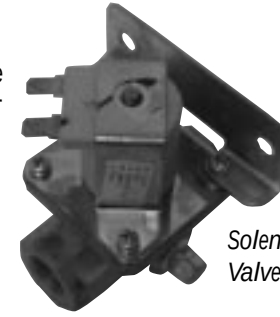
How to Troubleshoot (Thermoelectric Valve)

The first thing to do when troubleshooting a thermoelectric gas valve is to perform a thermocouple troubleshooting test as explained on page 14 to guarantee a good working thermocouple. The next thing is to thread the properly tested thermocouple into the valve at the appropriate place making sure that both aluminum contacts are free of dirt and debris. Make sure that the electrical interrupter connections are jumpered out (if so equipped). Pre-heat the sensing tip of the thermocouple for 30 seconds. With the thermocouple tip hot from the pre-heating, depress the push button on the valve. If the button pops back out, the valve is bad. If the button stays in, the valve has accepted the D.C. voltage and the problem is elsewhere.

Conclusion (Thermoelectric Valve)

Because this test requires another part to verify the valve's performance, this test should only be done after testing the other components involved with the flow of propane that directly affect the operation of the thermoelectric gas valve. In addition, most thermoelectric gas valves have a replaceable power coil located inside of the valve. Replacing the power coil may save from having to replace the entire valve if it fails the above test. This is another example of an item you may want to keep in your parts inventory.

Solenoid valves - require a.c. voltage (usually 120 volts) to open. When power to the solenoid valve is removed the valve closes, stopping the flow of gas to the burner. Power for the solenoid valve comes from the DSI control board. This allows the DSI board to shut off the gas flow if ignition is not achieved or sensed.



Solenoid Valve

Troubleshooting Solenoid Valves

Tools Required - (120 Volt Solenoid Valve, Test Outside of Unit)

There are only a handful of tools required to test the 120-volt solenoid valve. You need a good set of INSULATED 120-volt test leads with either alligator clips, or 1/4" female spade connections and a source of compressed air that comes close to matching the valve's rated inlet pressure. If you cannot match the solenoid's rated inlet pressure, than go under the rated pressure, never over.

How to Troubleshoot (120-Volt Solenoid Valve)

Remove the solenoid valve from the unit and attach the 120-volt test leads to the solenoid spade. Next, plug the test leads into a grounded 120-volt outlet. Listen for the solenoid electronically close. Release the compressed air into the INLET of the solenoid. If the valve electronically closes and physically opens, then the solenoid valve is good. If it fails

any portion of this test, the solenoid is defective with no user serviceable parts.

Conclusion (120-Volt Solenoid Valve)

The conclusion drawn from this test is to realize that your solenoid valve needs to be electronically closed and physically open when the proper voltage is supplied. The solenoid valve is usually one of the most reliable components in your portable heater, and therefore, its performance should be viewed accordingly.

High Limit Switch

High limit switches are switches that are normally electronically closed, but will open electrical contacts at a certain temperature. It accomplishes this with a bi-metal sensing element. A bi-metal is a temperature sensitive metal that expands with heat. Therefore, as the heater runs, and as the bi-metal gets warm, it begins to warp. When it reaches a certain temperature it will open up the electrical contacts. The temperature varies from switch to switch, and is listed on each switch. For example, if the markings on a limit switch read L240, than the limit switch opens up electronically at 240 degrees and will lead to an open circuit shutdown.

Various High Limit Switch Examples

Troubleshooting the High Limit Switch

Tools Required - The only tool needed to test most limit switches is a jumper wire. The jumper wire usually will need 1/4" female spades (or alligator clips) on both ends.

How to Troubleshoot (Test Inside of Heater)

The secret to troubleshooting the high limit switch is to bypass the switch all together. Since the high limit switch is normally closed, a simple bypass will close the circuit and eliminate the high limit switch from the circuit.

Conclusion

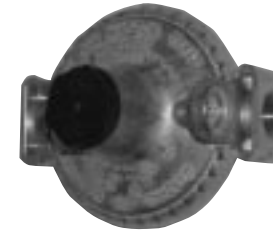
The bypass of the high limit switch should always be used as a TEST ONLY, never as a permanent solution to a problem heater. In other words, NEVER let a heater leave your workbench with the high limit switch bypassed. There is one other conclusion you need to draw from the high limit switch. That conclusion is that the limit switch is made-up of a bimetal, which means that the high limit switch is going to fail through constant usage. Always replace the high limit switch with the exact same high limit switch. Never use one with a different temperature rating, with a different bracket, or place it in a different location within the heater.

Regulator

A regulator, by definition, is a means to adjust to a standard rate and / or to adjust to make your work accurate. A regulator takes tank pressure and breaks that down to give you a known and consistent lower pressure out of the regulator's outlet. Every propane heater, regardless of how big or small, has to have at least one pressure regulator. Each propane heater should indicate the inlet pressure ratings on the specification plate to assist in selecting the appropriate regulator(s) for your application. For the purposes of this manual, there are three basic types of regulators: the first stage regulator, the second stage regulator, and the appliance regulator. Your heater may need to use any or all three of these regulators, depending on your heater and your application. Again, if you have any questions about regulators, please call your local propane dealer or you can contact PHP anytime.

First stage regulator: The first stage regulator is the regulator actually mounted to the propane cylinder by the tank connector. It can handle tank pressure and will deliver either high pressure or low pressure out depending on the regulator and the application. This regulator has an external vent and should only be used outdoors. Every propane heater is required to have a first stage regulator at the fuel supply.

Second stage regulator: The second stage regulator accepts the output pressure from the first stage regulator and delivers what is called input pressure to the heater. Not all propane heaters make use of this regulator because most first stage regulators that come with the smaller heaters can handle tank pressure and give you your proper inlet pressure. This regulator has an external vent and should only be used outdoors.



Regulator

Appliance regulator: This regulator is not common in portable propane heaters. It is used mostly in vented and unvented heating systems as well as any appliance that uses gas in your home and is usually located inside of the heater or appliance. This regulator has an internal vent. If the pressure to this regulator surges or spikes, the displaced air will vent out of the regulator outlet and not vent to the outside of the unit. Since this regulator has an internal vent, it cannot handle a great deal of pressure and will always have a first stage regulator associated with it. This regulator is designed to be used indoors.

Troubleshooting the Regulator

Tools Required - The tools required to test the regulator are going to vary depending on a few different factors. Those factors include; minimum and maximum inlet pressures, desired outlet pressures, and pipe sizing. A good testing kit will contain the following: various pipe nipples; various pipe tees, and various reducing bushings. All of these fittings should range from 1/8" to 1/2". A low-pressure propane gauge (0" W.C. to 30" W.C., part # G24503) and a high-pressure propane gauge (0 lb to 30 lb, part # HV1027P) are recommended as well. You will also need access to regulated compressed air.

How to Troubleshoot (Test Outside of the Heater)

Connect the regulator to the regulated compressed air that is set to 40 lbs. Attach the appropriate size pipe nipple into the regulator outlet. Attach the appropriate size pipe tee. Attach the male hose connection to the pipe tee outlet. The last remaining connection is to the appropriate gas pressure gauge. Then turn on your regulated air. This will give you your output pressure on your forced air heater (if the heater has a solenoid valve). If the heater has a thermoelectric gas valve, you will also need to depress the push button on the thermoelectric valve. If the pressure gauge reading matches your regulator outlet pressure, then the regulator is fine. If the pressure reading is too high or to low, remove the top cap of the regulator (if so equipped) to adjust to the desired outlet pressure. Turn the regulator control clock wise to increase the outlet pressure and counter clock wise to decrease the outlet pressure. If you have no outlet pressure, or you do not have a regulator adjustment, then replace the regulator.

DO NOT try this test on an appliance regulator without dropping the inlet air pressure down to a minimum of 11" W.C. Check the regulator's output pressure inside of the heater if the solenoid valve has a pressure tap located on the base of the solenoid.

Conclusion

Most new propane heaters come with a sealed regulator, meaning that there are no user serviceable adjustments that can be made to the outlet pressure. This is a good thing for the rental market because it makes it difficult for an end user to alter a regulator's factory preset outlet pressure.

Tank Connectors

Tank connectors are the devices used to connect the first stage regulator to the vapor withdraw propane cylinder. While all tank connectors serve the same function, the current industry standard is to use certain connectors with certain applications only (certain applications meaning capable BTU output, whether or not there is an excess flow valve, and whether it has left hand or right hand pipe threads). While there are many types of tank connectors on the market, we are going to discuss just a few of the more popular ones only. The most popular tank connector is the soft nose P.O.L., followed by the Acme tank connector.

Soft nose P.O.L. - The soft nose P.O.L. fitting is the fitting that most service people are familiar with and is still in use today on all vapor withdraw cylinders over 40 pounds. The soft nose P.O.L. consists of the following component parts: The right hand thread P.O.L. nipple which actually goes into the L.P. vapor withdraw valve on the top of the cylinder, the 7/8" hex nut (G1643) which tightens the nipple into the withdraw valve, the o-ring (G1653-3) to help maintain a tight seal inside the valve, and lastly, the excess flow valve which will shut off the flow of fuel to the unit if there is a cut or rupture of the gas supply hose. The excess flow valve is the only non-replaceable part in the P.O.L. assembly. Soft nose P.O.L. fittings vary by BTU output as well as thread type, so it is important to use the correct part number listed on the heater's breakdown.

Soft Nose P.O.L. Connector

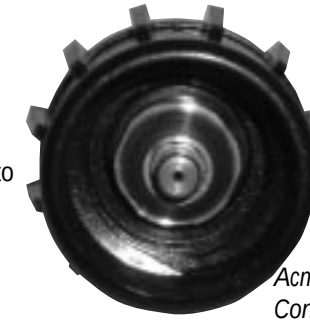
Troubleshooting the Soft Nose P.O.L. Fitting

Tools Required - There is no good way to test a P.O.L. to justify spending any time or energy on a suspected defective fitting.

Conclusion

The easiest way to eliminate a potential problem with the P.O.L. fitting is to change the fitting.

Acme Tank Connector - The Acme tank connector has become more popular because of the new code requiring the O.P.D. (overflow protection device) withdraw valve on cylinders of 40 pounds and under. The Acme tank connector has a spring assembly mounted on the inside of the fitting itself to measure backpressure. The Acme tank connector will allow only a limited amount of propane to pass through it until the gas hose is pressurized. Once the hose is pressurized, the backpressure on the spring assembly will compress and allow the proper amount of propane needed for the burn to pass through. In order to get this tank connector to compress the spring assembly and allow the proper amount of fuel through, you need to close all the gas connections past the supply hose. Then turn the propane cylinder on, and let the unit set until the fuel supply hose pressurizes. This pressurization can take anywhere from 15 seconds to an hour. The Acme tank connector is actually available as a whole unit only, with no user serviceable components. If any part of the Acme tank connector ever breaks or fails, then the fitting needs to be replaced. This fitting also has an excess flow valve that will shut down the flow of fuel to the unit if there is a cut or rupture of the gas supply line. Acme tank connectors come in two different varieties. The black handled Acme is rated for outputs of 71,000 BTU's or less, while the green handled Acme is rated from 71,000 BTU's to 200,000 BTU's.



Acme Tank Connector

Troubleshooting the Acme Tank Connector

Tools Required - There is no good way to test an Acme tank connector to justify spending any time or energy on a suspected defective connector.

Conclusion

The easiest way to eliminate a potential problem with the Acme tank connector is to change the connector itself.

Spark Igniter

Spark igniters are small, self-contained controls whose sole purpose is to provide secondary voltage to the spark plug/electrode. You can look at spark igniters as the spark generators. These controls are found on propane forced air heaters that use thermoelectric gas valves but do not have push button (Piezo) ignition. If the unit has a thermoelectric gas valve, then the heater will automatically have a thermocouple. Spark igniters are continuous ignition, generating a constant spark at up to 25,000 volts. If the heater has a spark igniter and a thermoelectric gas valve, then the heater cannot use a thermostat. There are two different spark igniters being used in the industry today. The first one is the Eaton spark igniter, and the second one is the Hi-LO 801. Both of these igniters have no user serviceable parts.

Eaton Spark Igniter - Both Desa (Master, Reddy, Remington, etc) and Scheu Products (National Riverside, All Pro, and Universal) use the Eaton spark igniter. They are blue in color and have four wire connections consisting of an ignition lead, a hot wire, a common wire, and a ground wire. The Eaton is an enclosed spark igniter with only the 1/4" electrical connections exposed.

Eaton Spark Igniter

Troubleshooting the Spark Igniter

Tools Required - In order to troubleshoot both spark igniters (the HI-LO 801 and the Eaton), you will need a few common shop items. The first thing you need (and the most important) is a GOOD set of insulated pliers. The second thing you need is a set of jumper leads with 1/4" female spade connections. Next, you need an insulated ignition lead with a 1/4" female spade connection. Finally, you need to make a ground wire with a 1/4" female spade connection on one end (only if your spark igniter has a post to attach a ground wire).

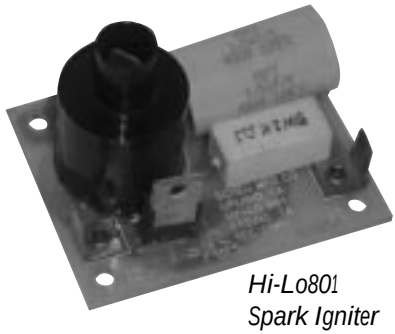
How to Troubleshoot Eaton (Test Outside the Heater)

To troubleshoot the Eaton spark igniter, remove the Eaton from the heater. Then, remove the ignition lead. Attach the hot (black) wire from the jumper leads to the "L" post. Attach the common (white) wire from your jumper leads to the "N" post. Attach the high voltage ignition lead that you removed from the heater to the number "1" post. Attach a ground wire to the number "2". This ground wire needs to be attached on the other end to where you are going to test your spark (which in the case of the Eaton, needs to be an external ground, away from the igniter itself). Like in the test above, after the unit is plugged in, touch the ignition lead to the source of metal where the ground wire is attached and pull the lead away slowly. You should be able to pull the lead away at least a 1/2" away and maintain multicolor spark. If the test performs as stated, then the Eaton igniter is working. The spark igniter can be tested while it is inside the heater if you don't have jumper leads by disconnecting the gas supply and removing the fan blade. Once that is done, just follow the above instructions about beginning with the insulated pliers.

Conclusion

The conclusion to be drawn from the tests on the spark igniter is that these two spark igniters look totally different, and they wire-up different, but they both serve the same function. Spark igniters produce secondary voltage anywhere from 15,000 volts to 25,000 volts and they are constantly sparking, so EXTREME caution should be used in testing these units.

Hi-Lo 801 spark igniter is used by Scheu Products exclusively. The Hi-Lo 801 is an open spark igniter with the resistors and diodes visible. The Hi-LO 801 is also a four-wire spark igniter. The Hi-LO 801 has one exception to the application rule listed earlier. The exception is that the HI-LO 801 was actually used on National Riverside forced air heaters made from 1978 to 1991 that could use a thermostat. At different times during that period those heater model numbers included the 80FA, the 150FA, and the 3500FA.



Hi-Lo801 Spark Igniter

Troubleshooting the Spark Igniter

Tools Required - In order to troubleshoot the HI-LO 801, you will need a few common shop items. The first thing you need (and the most important) is a GOOD set of insulated pliers. The second thing you need is a set of jumper leads with 1/4" female spade connections. Next, you need an insulated ignition lead with a 1/4" female spade connection. Finally, you need to make a ground wire with a 1/4" female spade connection on one end.

How to Troubleshoot HI-LO 801 (Test Outside the Heater)

Remove the spark igniter from the heater. On the HI-LO 801 spark igniter, attach the black wire from your jumper leads to the I1 terminal. Attach the white wire from the jumper leads to the I2 terminal. Plug the insulated ignition lead into the top of the ignition coil on the HI-LO 801, leaving the end of the ignition lead that attaches to the spark plug as the only remaining free wire. Hold the ignition lead with the insulated pliers at about two inches above the ignition boot, making sure that the ignition wire is not touching metal. Connect the jumper leads to a 120 volt source. With the leads plugged in, touch the ignition lead to the metal mounting plate on the bottom of the HI-LO mounting bracket and then to pull the lead away slowly. If you can maintain a 1/2" of spark, then the HI-LO 801 is working properly.

Conclusion

The conclusion to be drawn from the tests on the spark igniter is that these two spark igniters look totally different, and they wire-up differently, but they both serve the same function. Spark igniters can always be tested inside the heaters if you don't have jumper leads by disconnecting the gas supply and removing the fan blade. Once that is done, follow the above instructions beginning with the insulated pliers, and ground the ignition lead to clean, grounded metal. Spark igniters produce constant secondary voltage anywhere from 15,000 volts to 25,000 volts; therefore, EXTREME caution should be used in testing these units.

Piezo Igniter with Nut

Piezo Igniter - The Piezo igniter is what is commonly referred to as the "push button" igniter. Piezo igniters are found on both Desa and Scheu heaters. The Piezo is also found on all three types of propane heaters: radiant, convection, and forced air models. The Piezo igniter generates a spark when an internal spring-mounted piece of metal is pushed across a crystal when the "push button" is depressed. There are no user serviceable parts inside a Piezo igniter. There is one rule of thumb when it comes to Piezo igniters; if the heater has a Piezo igniter, then it also has a thermoelectric gas valve, a thermocouple. If a heater has these components, it cannot use a thermostat.

Troubleshooting the Piezo Igniter

Tools Required - In order to troubleshoot a Piezo igniter, you will need a good pair of insulated pliers, and whatever tools required to remove the igniter electrode and ignition lead from the pilot/burner area.

How to Troubleshoot (Test Inside the Heater)

Shut off and disconnect the gas supply. Remove the igniter electrode and the ignition lead from the heater. Examine the igniter electrode and ignition lead for any cracks or breaks. If there are no visible breaks or cracks, then proceed with the rest of the test. Re-attach the ignition lead to the Piezo and the igniter electrode. With the ignition lead held by the insulated pliers mid-way between the Piezo and the igniter electrode, keep the igniter electrode 1/4" to 1/2" away from the shell of the heater, and push the Piezo igniter push button. If you see a spark every time you depress the Piezo, then your Piezo is fine. If you do not see a spark jump to ground, then replace the Piezo igniter.

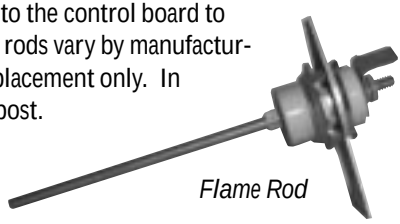
Conclusion

The Piezo igniter has no user serviceable parts. A good rule of thumb when troubleshooting a Piezo igniter is that if the pushbutton has little or no resistance, then the Piezo is bad.

Flame Rods/Sensors

Flame rods and flame sensors are parts that work to prove the existence of flame. Although they both try to prove the existence of flame, flame rods and flame sensors go about accomplishing this in different ways. It is important to note that there are no user serviceable parts on either of these parts.

Flame Rod - The flame rod is a metal probe that protrudes into the area of combustion. The flame rod conducts the current from the ions that are naturally occurring. Ions are the static electricity that is in the air. The explosions from the combustion process straighten out the ions and the burner becomes negatively charged, and the flame rod becomes positively charged. It delivers the charge to the control board to prove the existence of combustion. Because flame rods vary by manufacturer, it is important to use the factory authorized replacement only. In addition, flame rods usually have only one wiring post.



Flame Rod

Troubleshooting the Flame Rod

Tools Required - You will need a multimeter with a set of jumper leads (with alligator clips). You will also need to have your heater properly connected to the appropriate propane supply.

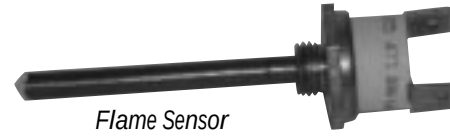
How to Troubleshoot (Test Inside the Heater)

Unplug the heater from the power source. Disconnect the wire from the flame rod. Connect the negative (black) lead from the multimeter. Remove the flame sensor wire from the control board and connect the positive (red) lead on the multimeter to the wire. Set the multimeter to the D.C. millivolt scale. Plug the heater in and turn on the gas supply and turn the heater on. With the heater running, there should be a reading of between 5 to 20 millivolts D.C. If the multimeter cannot get this reading with the heater burning, then flame rod is faulty. If you have any questions please call.

Conclusion

The are a few conclusions to be drawn from this test. First, it is rare to see flame rods in heaters today. Flame rods have been replaced by the spark plug or igniter electrode to send the signal back to the control board. The second conclusion (even though it is not stated above) is that flame rods come in different lengths and they can be bent at different angles. This is extremely important because they are engineered for that specific flame proving application. Therefore, only factory-authorized replacements should be used according to the specific model number.

Flame Sensors - Like the flame rod, the flame switch is also a probe that protrudes into the combustion chamber. However, that is where the similarity ends. The flame switch is not usually all metal, for there is a sensing element located inside of the metal probe. The flame switch is a normally electronically open, but when the unit is exposed to heat, the sensing element expands to close the circuit. Unlike the flame rod, the flame switch has two wiring posts attached to them. Since flame switches vary by manufacturer, by temperature, by length, and by application, it is important to use the factory authorized replacement only.



Flame Sensor

Troubleshooting the Flame Sensor

Tools Required - The only tool required for testing the flame sensor is a jumper wire made up with two 1/4" female spades.

How to Troubleshoot (Test Inside the Heater)

To troubleshoot the flame switch, unplug the heater and gain access to the flame sensor. Trace the wires from the flame switch sensor to their source of origin. Remove the wires and jumper around the flame sensor. Re-assemble the heater and make the appropriate electrical and gas connections.

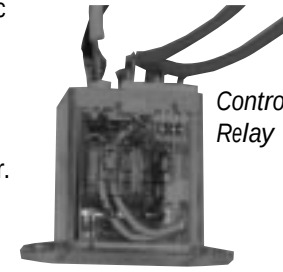
Start the heater up and let the unit run. If the heater continues to run, then replace the flame sensor.

Conclusion

The conclusion to be drawn from this test is that this is ONLY a test, not a solution. Once again, a heater must NEVER leave your workbench or shop with ANY safety feature removed or bypassed. In addition, some flame sensors may look the same, but they expand at different temperature levels. Therefore, only factory authorized replacement parts should ever be used.

Control Relay

The control relay is a safety feature added to some of the newer forced air propane heaters that use a thermocouple and a thermoelectric valve. Two of the major propane heater manufactures mentioned in this manual use control relays. What the control relay's purpose is to allow the D.C. electric circuit (the thermocouple, the high limit switch, and the thermoelectric gas valve) and the A.C. electric circuit to interface with each other. In other words, if the high limit switch opens contacts, then the whole unit will shut down.



Control Relay

Troubleshooting the Control Relay

Tools Required - The main tools required to test the control relay are the always-popular jumper wires. The jumper wires needed are the same ones used in most component part bypassing applications: the 1/4" female spade by 1/4" female spade.

How to Troubleshoot (Test Inside the Heater)

In order to troubleshoot the control relay, bypass the unit altogether. By bypassing the control relay, the heater will have a stand-alone A.C. circuit and a stand-alone D.C. circuit. For the first step in the bypass, remove the relay wires from the terminal board and the interrupter on the thermocouple.Remove the relay wire from the high limit switch. Attach the jumper wires from the high limit switch to the interrupter on the thermocouple and fire the heater. If the heater runs fine, then replace the control relay.

Conclusion

The conclusion to be drawn from this test is that this is ONLY a test, NOT a solution to the problem. A heater should NEVER leave your workbench or workshop with ANY feature not in factory original (and working) condition!

Fan Blade

(Forced Air Heaters Only) The fan blade in the propane forced air heater plays an extremely important role in the operation of the entire heating system. It has many purposes. First, its job is to pull air in through the back of the unit to cool the internal components. Next, (and most importantly) the fan blade circulates air around and thru the combustion chamber. Not only is the fan blade responsible for producing the hot, forced air, but also it is extremely important in determining WHERE the burn takes place in the combustion chamber. Since a propane forced air heater has no nose cone, the air movement delivered by the fan blade is of extreme importance in determining where the combustion takes place. All of your safety components in your forced air heater rely on the burn occurring at a particular place in the combustion chamber for proper monitoring and proving.

Troubleshooting the Fan Blade (Test Outside of Heater)

Tools Required - You will need a 1/8" hex Allen wrench, a tape measure or ruler, and a fine tip marker.

How to Troubleshoot

Remove the fan blade from the heater and lay the fan blade on a LEVEL surface with the hub (set screw) side up. Use a ruler and measure from the level surface to the highest point of each blade. Place a mark on each blade at its highest point with the fine tip marker. This will give you what is known as "inches of pitch". All of the measurements should be

the same. In addition, all of the marks made on your fan blade should be at the same place on the fan blade. If all of the measurements are not the same on every fan blade, or if the marks on the blade are not in the same place, replace the fan blade. The next step is to measure from the hub of the fan blade to where the mark is on the fan blade and record those measurements. If those measurements are not the same, then there is a problem with the inches of pitch, and the fan blade should be replaced.

Conclusion

The conclusions from troubleshooting your fan blade are many. First, the importance of a properly balanced fan blade in a propane heater is extremely important. If you will notice, your propane heater does not have a nose cone. This means that a propane heater counts heavily on the components in the heater that determine where the burn takes place. The consistency of the inches of pitch on a propane heater fan blade are just as important if not more important than inches of pitch on a kerosene heater fan blade. Secondly, now that you know how important the propane heater fan blade is, you will realize why we do not recommend bending your fan blade back into pitch by hand. This is why we always recommend that you replace your propane fan blade instead.

Pilot Orifice

(Radiant and Convection Models Only) The pilot orifice is used on radiant and convection heaters that utilize a thermoelectric (push button) gas valve. There are two main purposes of the pilot orifice. The first (and most important) reason is to heat the thermocouple for safety monitoring. The second reason is so that every time you want heat, you do not have to go through the ignition process. Since the pilot orifice requires the least amount of propane, and has the smallest diameter, it is usually the first place to become restricted or obstructed during normal operation.

Troubleshooting the Pilot Orifice (Test Outside of Heater)

Tools Required - The only tools required to troubleshoot any propane orifice is regulated, compressed air.

How to Troubleshoot

Blow regulated compressed air (regulated down to the factory setting of manifold pressure) through the orifice itself in the opposite way of the normal fuel supply. By blowing through in the opposite direction of the fuel flow, you have more of a chance to remove any obstructions without damaging the orifice.

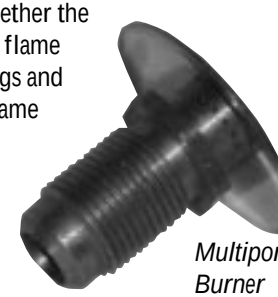
Conclusion

The most important conclusion to be drawn from this is to NEVER use anything other than regulated, compressed air to clean any orifice. Any other tool (drill bit, etc) can cause an

alteration of the desired fuel flow, thereby changing where the pilot and burn take place. Any orifice (pilot or burner) is under positive pressure can become defective from consistent use and constant wear.

Burner Orifice

All propane heaters have a burner orifice. Whether the burner orifice is a single-port (having one gas opening and a flame deflector) or a multi-port (having six or more smaller openings and may or may not have a flame deflector), they both serve the same purpose. That purpose is to deliver propane into the area of combustion in a way to allow for safe, even, and proper combustion. All burner orifices have a certain outlet size that is determined by the manufacturer and should NEVER be altered.



Multiport Burner Orifice

Troubleshooting the Burner Orifice (Test Outside of Heater)

Tools Required - The only tools required to troubleshoot any propane orifice is regulated, compressed air.

How to Troubleshoot

Blow regulated compressed air (regulated down to the factory setting of manifold pressure) through the orifice in the opposite way of the normal fuel flow. By blowing through in the opposite direction of the fuel flow, you have more of a chance to remove any obstructions without damaging the orifice.

Conclusion

The most important conclusion to be drawn from this is to NEVER use anything other than regulated, compressed air to clean any orifice. Any other tool (drill bit, etc) can cause an alteration of the desired fuel flow, thereby changing where the pilot and burn take place. Any orifice (pilot or burner) is under positive pressure can become defective from consistent use and constant wear.

Motor

The motor in a forced air propane heater has a multitude of functions. One of the motor's responsibilities is to bring fresh air around and through the combustion chamber for combustion and equal distribution of heat. The motor also cools down the heater's internal components with that same inlet air. By turning the fan blade, the motor has as much to do with where the burn takes place in the combustion chamber as any other component in the heater.

Troubleshooting the Motor

Tools Required - There is quite a large variety of electric motors being utilized on propane forced air heaters. If you suspect that you have a problem or service issue with a motor, we would recommend that you call P.H.P. for service information.

Conclusion

If the motor is suspected to be a problem, check the voltage going to the motor to guarantee that the motor has the opportunity to function properly. If the voltage going to the motor falls within the motor tolerances and the motor does not perform properly, then the motor should be a service issue.

Diagnosing Propane Radiant & Convection Heaters

This section of the manual involves the diagnosing of various issues and problems that will come up when dealing with propane radiant and convection heaters. You may have dealt with these questions before, but this section may give you a few more options when it comes to troubleshooting. The purpose of this section is not to cover every question and answer possible, but it will hopefully give you a good basic background on how many different things can cause a certain symptom. What is extremely important about this section is that the possible solutions to a heater's problem will be listed in order of most common to the least common. If you do not know how to test a component part, or if you do not know what the component part does, than please refer to the " PARTS IDENTIFICATION & DEFINITION" section listed earlier in this manual. The first section covers radiant and convection style heaters, with the forced air section to follow.

Convection and Radiant Symptom

Symptom *My convection heater will run, but it will shut off when I take my finger off the gas valve.*

Question Is the thermocouple in the hottest portion of the pilot flame?

Yes, then check for adequate fuel supply to the unit. Next, hold in the gas valve button for 30 to 60 seconds. If that does not work, then test the thermocouple, then the gas valve, and lastly, check and clean the connection between the valve and the thermocouple. If the gas valve fails the test, then you may be able to change the power coil by itself instead of the whole gas valve.

NO, then check for an adequate fuel supply for the BTU output. If there is an adequate fuel supply, then check the pilot orifice for obstructions, then perform a tank connector test and a regulator test. In addition, check to make sure that the fuel valve completely open. Convection heaters can run up to 250,000 BTU'S and the number one technical issue with these heaters is inadequate fuel supply. (Note: red regulator is high pressure, silver is low pressure). The section of the manual titled "THE CHARACTERISTICS OF PROPANE" will let you know what the appropriate propane cylinder(s) will be for your application.

Symptom *My pilot light will not light.*

Question Is there gas coming out of the pilot orifice?

Yes, just because we have gas coming out of the pilot orifice does not mean that it is coming out properly or even with the proper pressure behind it. Check to make sure that you have the proper regulator for your model of heater, and then blow compressed air through the pilot orifice in the opposite direction of the fuel flow. Then test your fuel supply system backwards until you get to the P.O.L. fitting (check excess flow valve) and the propane cylinder. Check to make sure it is the proper size cylinder(s) for the unit and check the fuel content of it. If your heater has a Piezo igniter and an igniter electrode, test both of them.

No, then start from the propane cylinder and proceed forward. Check the fuel level in the cylinder(s), and then check the propane tank valve(s) to make sure it (they) is open. Then proceed to use regulated compressed air to check and test the rest of the components of the fuel supply all of the way to the pilot and burner orifice. Pay special attention to the excess flow valve.

Symptom *My heater gives off an odor and doesn't give off much heat.*

Question Is the propane bottle and fuel level the right size for the heater?

Yes, if the fuel cylinder and fuel level are adequate for your heater, then your problem lies in a few other areas. The most common problem is the restriction of fuel flow from the orifices, followed by the excess flow valve the regulator, and lastly the push button gas valve. Use regulated compressed air to blow through these components in the opposite direction of the normal fuel flow.

No, then you may need to get the correct fuel supply for your heater and your heating application. Use a full 100 pound propane bottle for every 70,000 to 100,000 BTU's of heat that you require. For help in selecting propane bottles for your heating application please refer back to the sections titled " THE CHARACTERISTICS OF PROPANE" and "THE SUPPLY ISSUES WITH PROPANE HEATERS". Also, find out the overall length and the inside diameter of the gas hose. Quite often, improper firing of a heater may be caused by the propane's vapor's volume drop in longer and smaller diameter fuel supply hoses. For help in this area, refer to the section titled the "SUPPLY ISSUES WITH PROPANE HEATERS". If you

have the correct propane cylinder(s), then you will want to test the burner orifice. The condition of sheet metal plays a major role in determining where the burn takes place.

Symptom *My heater makes a "whistling" sound when it runs.*

Question Does it do this when you put use a new, full propane cylinder?

Yes, then your problem is usually going to be a restriction along your fuel supply. Start the component testing with the burner orifice and work your way back along the fuel supply until you get to the P.O.L. fitting.

No, if the "whistling" stops when you change propane cylinders, then your problem was with a low fuel supply level or an improperly sized propane cylinder.

Symptom *My heater burns, but it has a mostly yellow flame*

Question Does your heater give off an odor?

Yes, then you have a problem getting the correct components of combus tion together at the same time with the correct quantity. You will want to guarantee the correct fuel flow. This could mean that you have to check for the possibility of an incorrect regulator, a partially restricted burner orifice, a low or improper fuel level, or a problem with an improper fuel supply hose.

No, then this is most likely a low fuel related issue. The low fuel related issue could mean low fuel supply in your propane tank(s), improper tank sizing, or the wrong regulator. For help in selecting the proper propane cylinder(s) for your heater and your application please refer to the section titled " THE CHARACTERISTICS OF PROPANE".

Diagnosing Propane Forced Air Heaters (Thermoelectric)

This section of the manual deals with the troubleshooting of forced air propane heaters. In this section, the propane forced air heaters are divided into two categories. The first section consists of forced air heaters that use a thermoelectric (push button) gas valve (the forced air heaters that CANNOT use a thermostat). The second section will deal with the forced air heaters that use an A/C voltage solenoid valve (which can use a thermostat). You will notice quite a few similarities with the symptoms of the heaters, but the causes can be completely different. One of the biggest problems with any propane heater is improper sizing of the fuel supply. Improper sizing of the fuel supply can be from using smaller than designed propane cylinders for the heater, using too small of a fuel supply line , or using too long of a fuel supply hose for the heater. This has to be considered when diagnosing EVERY type of propane heater. If you have any questions, please refer back to the earlier sections labeled "THE SUPPLY ISSUES WITH PROPANE HEATERS" and "PARTS IDENTIFICATION and DESCRIPTION"

Thermoelectric Forced Air Symptom

Symptom *My heater shuts off when I take my hand off the push button valve.*

Question Is the thermocouple in the hottest portion of the burner flame?

Yes, then check for adequate fuel supply to the heater. Next, try to hold the gas valve in for 30 to 60 seconds. If those two things do not work, then test these components in the following order: the thermocouple, the high limit switch, the relay (if so equipped), and the thermoelectric gas valve. Test these components one at a time, making sure to put the working component back in the heater before moving on to the next test.

No, check for an adequate fuel supply for the BTU output. If the supply is appropriate, then check the fuel supply line from the propane cylinder all the way to the burner orifice for obstructions or failures. If those tests do not solve the problem, then remove your fan blade and do a fan blade test. The burner orifice may have a deflector on the front of it. Check the deflector for any kind of bending or warping. In addition, double check to make sure that the correct regulator for that heater has been properly installed.

Symptom *My heater runs fine from five to thirty minutes and then shuts off.*

Question Is there frost on your propane cylinder?

Yes, then your problem is that you cannot boil enough propane to fire your heater properly. One or more of the following things need to be corrected. First, check on what size propane tank that is being used with your heater The rule of thumb is to use a 100 pound propane cylinder for every 70,000 to 100,000 BTU's of heat. Second, check the level of fuel in your cylinder. Keep in mind that a 100 pound propane cylinder with only 20 pounds of propane is no better than a full 20 pound propane cylinder. Next, check the inside diameter and and the length of the supply hose. For help on this, please refer to the manual section titled "THE SUPPLY ISSUES WITH PROPANE HEATERS". Finally, consider manifolding propane cylinders together using t-blocks and pigtails to provide more wetted surface area of the propane tanks. Refer to the section titled "THE CHARACTER-ISTICS OF PROPANE" for specific information about manifolding cylinders.

No, then you need to do the following series of tests in the stated order. First, observe the burn of the heater to see if the thermocouple stays in the hottest portion of the burn. If it does, then perform a high limit switch test. Next, test the control relay. Next, you will want to test your thermocouple. Finally, you will want to do the thermoelectric gas valve test. These tests should tell you where the problem lies.

Symptom *My heater has an odor when it runs.*

Question Does it have an odor when you change propane cylinders?

Yes, if your forced air heater has an odor when you change propane cylinders then you need to try a few things. First, make sure you have the appropriate size propane cylinder for the heater and the environment that the heater is located. You may need to manifold two or more propane cylinders together to achieve proper vaporization. Examine the deflector, looking for bends or warping of the metal. The deflector is located in the combustion chamber. Next, test the fan blade. Then, you need to test the burner orifice, blowing regulated com pressed air in the opposite direction of the fuel flow. If this does not solve the problem, then you need to test the rest of the fuel supply components from the burner backwards. Make sure you have the correct regulator and that the fuel supply hose is the proper diameter and length for the job. Refer to the section

titled "THE SUPPLY ISSUES WITH PROPANE HEATERS" for help with hose sizing.

No, The problem can be either with a low fuel supply or an undersized propane cylinder. You may also want to check that you have the correct regulator installed with the heater.

Symptom *I smell gas when I start my heater, but it does not ignite.*

Question Does your heater have proper propane gas pressure?

Piezo Ignition

Yes, since your heater has proper fuel, then you need to do a Piezo igniter test. If the Piezo test fine, then do an electrode test and an ignition lead test. If they test fine then clean the burner orifice \ and also examine the deflector for any bending or warping. Do a fan blade test to insure proper fan blade pitch and balance, as this can also have a hand in whether the heater ignites or not.

Spark Igniters

Yes, since your heater has proper fuel, then test the spark igniter, making sure that you have 120 volts coming into the spark igniter itself. The spark igniter has an extremely high secondary voltage output, so use EXTREME caution when testing. Next, test the spark plug and ignition lead. If those components test fine, then you will need to start with examining the burner orifice and burner deflector. Double-check the fan blade for proper installation as well as proper inches and degrees of pitch.

No, (for both) then make sure that you not only have the correct size tank and quantity of fuel in the tank for your application, but also the correct length and diameter hose. Next, make sure that you have the correct regulator for the heating application. If the regulator is correct, then test the regulator and tank con nector. These tests should reveal the problem.

Symptom *My heater does not get any propane to come out.*

Question Is there fuel in the propane cylinder?

Yes, if there is frost on the cylinder, then you are either low on propane, or you are using an undersized propane cylinder for your heater's requirements. Next, make sure that your tank connector fitting's excess flow valve is not closed. Clean the burner orifice. If these tests do not solve the

issue, then check and test the regulator.

No, then fill or replace your propane cylinder making sure that it is the correct size cylinder to fill your heater's requirements.

Symptom *When I start my heater up, my fan comes on and I smell fuel, but I have no fire.*

Question Does your heater have spark?

Yes, test to see if you have the appropriate amount of spark by testing your source of ignition (the Piezo or ignition control). You also need to check and test the electrode/sparkplug and the ignition lead. If those test fine, then perform a fan blade test. Check to see that you have the proper hose and regulator for your heating application. These tests should reveal the problem.

No, then start by testing your source of ignition (the Piezo or ignition control). In addition, check to see that the wiring to our ignition control (if applicable) is wired correctly. Then you also want to check and test the spark plug/electrode and ignition lead. This should reveal the problem.

Symptom *My motor drags when I plug in my heater.*

Question Is your extension cord the correct gauge and length for your heater?

Yes, then start by removing the motor from of the heater to do a bench test. If the motor has a hot wire, a neutral wire, and a ground wire, test the motor by applying direct voltage to the proper wires. If the motor reaches full RPM, the motor is fine. If the motor has two hot wires, a neutral wire, and a ground wire, the motor is a split phase motor and needs to be tested using a split phase motor test. Using a test cord with alligator clips, connect the black wire on the test cord to the red wire on the motor. Connect the white wire from the test cord to the white wire on the motor. Connect the two ground wires together. Use a good pair of insulated wires and hold the black wire coming from the motor. Connect the test cord to a 120 VAC source. The motor should hum and move at a slow speed. Touch the black wire from the motor momentarily to the black/red combination. The motor should reach full RPM within one second. If the motor tests fine, then double-check the voltage at the wall receptacle or generator for 120 volts.

It may be helpful to remove any other electrical draw off of that circuit. Lastly, make sure that the fan blade has no obstructions. These tests should reveal the problem.

No, then you need to go with either a heavier gauge cord, or a shorter length of cord. There is a wire resistance chart and formula in the section titled "THE SUPPLY ISSUES WITH PROPANE HEATERS"

Symptom *When my heater runs, I have mostly yellow flames in my combustion chamber.*

Question Do I have adequate fuel supply to my heater?

Yes, then most likely there is a problem with the air/fuel mixture. Many things could cause this. Check and clean the burner orifice. Perform a blade test to see if there is a problem with the inches or degrees of pitch.

No, then start off by making sure that you have the proper regulator installed for the heater. Check to make sure that you have the correct size propane tank and fuel level for the heater to function properly. These tests should help alleviate this issue.

Diagnosing Propane Forced Air Heaters
(SOLENOID)

This section of the manual deals with the troubleshooting of forced air propane heaters that use solenoid valves and direct spark ignition (D.S.I.). These heaters are capable of using a thermostat because of the solenoid valve and direct spark igniter. The units addressed in this manual will range from 45,000 BTU's up to 700,000 BTU's. Remember, improper fuel supply is one of the most common problems associated with the proper operation of forced air propane heaters. For help with proper propane tank and hose sizing, please refer to the earlier sections titled " THE CHARACTERISTICS of PROPANE" (page 6) and THE SUPPLY ISSUES WITH PROPANE" (page 8). In addition, the section titled "PARTS IDENTIFICATION and DEFINITION" (page 14) section will let you know how to troubleshoot individual component parts.

Symptom *My heater shuts off after 8 to 12 seconds*

Question Is there frost on the propane cylinder?

YES, then your problem is could be too small of a propane cylinder to fill your heaters needs, too low of a fuel level in the cylinder or a bad or incor rect regulator. Remember, under ideal circumstances, we would like to have one full 100 LB cylinder for every 70,000 BTU's of heat.

NO, then you have a problem in one or more crucial areas. Your problem could be with any of your safety features, or even with flame proving itself. You should start by testing your safety features first. For help in trou bleshooting these components, please refer to the section titled "PARTS IDENTIFICATION and DEFINITION" (page 14). If your safety features test out good, then consider that everything that helps where the burn takes place can be suspect. You can have a problem with either incorrect inches of pitch or degrees of pitch on a fan blade. You may have dirt in our burner orifice, or a cracked ceramic burner (if so equipped). Some heater manufac turers have ceramic burners that may have hairline cracks in them. You may have a problem with either a bad, incorrect, or improperly positioned igniter electrode (or spark plug). On, even low motor R.P.M.. Any one (or more) of these most likely will be your problem.

Symptom *My heater turns on, but does not fire.*

Question Do you smell propane?

YES, then the first thing we need to check is if our ignition control is pro ducing spark (make sure that your propane is shut-off AND disconnected from the heater before you check for spark). If we have spark, then we need to do a fan blade test as well as clean the burner orifice. Also, make sure that you have the correct regulator for your heater.

NO, then we know that our problem will most likely be electrical. The best way to start proving voltage is to start by making sure that we have 120 volts at our heater. If we do not have 115-120 volts, then check our outlet for the proper voltage, then make sure our power cord is properly sized for our heater's needs. For help with extension cord sizing, please refer to the sec tion titled " THE CHARACTERISTICS WITH PROPANE" (page 6). If our inlet voltage is correct, then we need to start by checking our D.S.I. control for 120 volts across the A/C to the A/CR terminals (on some controls, the terminals will be labeled 120 volts hot and 120 volts return). Then check for 120 volts across the M/V to the V/R terminals (on some controls, these posts will be labeled V/1 and V/2). If we do not have 120 volts across these connections, then our board is bad. If we do have the 120 volts across those terminals, then bypass our high limit control (if so equipped). If this does not address the problem, then put the PROPER voltage to our solenoid valve. If the valve does not electronically open and physically close, then our solenoid is bad. The last thing to check is the centrifical switch on the motor (if so equipped). The centrifical switch works closes contacts when the motor reaches a certain R.P.M. and then sends 120 volts to the solenoid valve. If your motor does not send 120 volts to your centrifical switch, then the motor is bad.

Symptom *When my heater runs, I have mostly yellow flames in my com bustion chamber.*

Question Do I have adequate fuel supply to my heater?

YES, then most likely we have a problem with our air/fuel mixture. Many things could cause this. Firstly, we need to check and clean our burner ori fice. Second, we need to do a fan blade test to see if we have a problem with our inches or degrees of pitch. One thing is for certain, if we have adequate fuel to our heater, then we have a problem of how and/or where these sys tems come together.

NO, then start by making sure that we have the proper regulator for our heater (having the incorrect regulator happens more often than you think). We also need to check to make sure that we have the correct size propane tank (and fuel level) for our heater to function properly. These tests should help alleviate this issue.

Symptom My heater runs, but I have flames coming out of the combustion chamber.

Question Do we have the proper fuel supply?

YES, then we have a problem with our air-fuel mixture (one is overpowering the other). We first need to check our fuel delivery system. The fuel deliv ery system would include the following: the excess flow valve, the regulator, the fuel supply hose, the solenoid valve (and filter insert if so equipped), and the burner orifice (and ceramic burner or flame spreader if so equipped). Then, we need to check our air delivery system. This system would include our motor, fan blade, and even the sheet metal. We can even include the combustion chamber and heater body in the air system. Remember, when checking sheet metal, you check for equal spacing as well as for any warping or dents.

NO, then we need to be able to deliver the proper fuel supply. Remember, we would like to see a 100-pound propane cylinder for every 70,000 Btu's of heat. We also need to refer to the section titled "THE CHARACTERIS TICS OF PROPANE" (page 6) for our proper supply hose needs.

Design Temperatures of Various Cities by State

State	City	Design Temp	State	City	Design Temp
Alabama	Birmingham	17	**Alaska**	Anchorage	-23
	Huntsville	11		Fairbanks	-51
	Montgomery	22			
Arizona	Flagstaff	-2	**Arkansas**	Eldorado	18
	Tucson	28		Fort Smith	12
				Little Rock	15
California	Bakersfield	30	**Colorado**	Denver	
	Fresno	28		Pueblo	-7
	Los Angeles	37			
	Sacramento	30			
	San Francisco	35			
Connecticut	Bridgeport	6	**Delaware**	Wilmington	10
	Hartford	3			
Florida	Jacksonville	29	**Georgia**	Atlanta	17
	Pensacola	25		Macon	21
	Tallahassee	27		Savannah	24
	Tampa	36			
Idaho	Boise	3	**Illinois**	Chicago	-8
	Pocatello	-8		Moline	-9
				Peoria	-8
				Rockford	-9
				Springfield	-3
Indiana	Evansville	4	**Iowa**	Des Moines	-10
	Fort Wayne	-4		Dubuque	-12
	Indianapolis	-2		Sioux City	-11
	Terre Haute	-2		Waterloo	-15
Kansas	Dodge City	0	**Kentucky**	Lexington	3
	Topeka	0		Louisville	5
	Wichita	3			
Louisiana	New Orleans	29	**Maine**	Caribou	-18
	Shreveport	20		Portland	-6

Design Temperatures of Various Cities by State

State	City	Design Temp	State	City	Design Temp
Maryland	Baltimore	10	**Massachusettes**	Boston	6
				Worchester	0
Michigan	Alpena	-11	**Minnesota**	Duluth	-21
	Detroit	3		Minneapolis	-16
	Grand Rapids	1		Rochester	-17
	Lansing	-3			
	Marquette	-12			
	Sault Ste Marie	-12			
Mississippi	Jackson	21	**Missouri**	Columbia	-1
	Meridian	19		Kansas City	2
				St Louis	2
				Springfield	3
Montana	Billings	-15	**Nebraska**	Lincoln	-5
	Cut Bank	-25		Omaha	-8
	Glasgow	-22		Scottsbluff	5
	Great Falls	-21			
	Helena	-21			
Nevada	Elko	-8	**New Hampshire**	Concorde	-8
	Las Vegas	25		Manchester	-8
	Reno	5			
New Jersey	Newark	10	**New Mexico**	Albuquerque	12
	Trenton	11		Roswell	13
New York	Albany	-6	**North Carolina**	Asheville	10
	Binghampton	-2		Charlotte	18
	Buffalo	2		Greensboro	14
	New York	11		Raleigh/Durham	16
	Rochester	1			
	Syracuse	-3			
North Dakota	Bismarck	-23	**Ohio**	Akron/Canton	1
	Fargo	-22		Cincinnati	1
	Minot	-24		Cleveland	1
				Columbus	0
				Dayton	-1
				Toledo	-3
				Youngstown	-1

Design Temperatures of Various Cities by State

State	City	Design Temp	State	City	Design Temp
Oklahoma	Oklahoma City	9	**Oregon**	Eugene	17
	Tulsa	8		Medford	19
				Pendleton	-2
				Portland	17
Pennsylvania	Allentown	4	**Rhode Island**	Providence	5
	Erie	4			
	Harrisburg	7			
	Philadelphia	10			
	Pittsburgh	1			
South Carolina	Charleston	25	**South Dakota**	Huron	-18
	Spartanburg	18		Rapid City	-11
				Sioux Falls	-15
Tennessee	Chattanooga	13	**Texas**	Abilene	15
	Knoxville	13		Amarillo	6
	Memphis	13		Austin	24
	Nashville	9		Dallas	18
				El Paso	26
				Fort Worth	17
				Galveston	31
				Houston	27
				Lubbock	10
				San Antonio	25
				Waco	20
Utah	Salt Lake City	3	**Vermont**	Burlington	-12
Virginia	Lynchburg	12	**Washington**	Seattle/Tacoma	21
	Norfolk	20		Spokane	-6
	Richmond	14		Walla Walla	0
	Roanoke	12		Yakima	-2
West Virginia	Charleston	7	**Wisconsin**	Green Bay	-13
	Elkins	1		LaCrosse	-13
	Huntington	5		Madison	-11
	Parkersburg	7		Milwaukee	-8
Wyoming	Casper	-11			
	Cheyenne	-9			
	Lander	-16			
	Sheridan	-14			

Desa Forced Air Propane - Reddy

Model#	Motor	Thermocouple/Flame Sensor	Ignition Control/D.S.I.	Valve: Safety/ Auto Control	Fan Blade	Safety Switches	Igniter/Electrode	Regulator	Orifice: Pilot/Burner	Hose	Hose/Reg Assy	Spark Generator
RLP30	104156-01	104146-01 Thermocouple		104144-01	101478-02	101732-05 Limit	104784-01	LPA2170	See Valve	LPA1020 (10ft)	LPA3120	102445-01 Piezo
				7111NR Power Coil						2525 (25ft)		
RLP35	099521-01	099538-01 Thermocouple		099728-01	099537-01	101732-05 Limit	099539-01	LPA2110	See Valve	LPA1020 (10ft)	LPA3090	102445-01 Piezo
				7111NR Power Coil						2525 (25ft)		
RLP45	079054-01	M51580-01 Flame Sensor	M51605-01	079473-02	M50893-01	079147-02 Sail	HA3013	LPA2070	078980-03	LPA1000 (10ft)	LPA3010	
										3825 (25ft)		
RLP50	100589-01	099538-01 Thermocouple		100591-01	099537-01	101732-01 Limit	100588-01	LPA2140	See Valve	LPA1020 (10ft)	LPA3055	102445-01 Piezo
				7111NR Power Coil						2525 (25ft)		
RLP50A	103864-01	099538-01 Thermocouple		100591-01	103865-01	101732-01 Limit	100588-01	LPA2140	See Valve	LPA1020 (10ft)	LPA3055	102445-01 Piezo
				7111NR Power Coil						2525 (25ft)		
RLP50V	103864-01	099538-01 Thermocouple		100591-01	099537-03	101481-05 Limit	100588-01	LPA2140	103862-01	LPA1020 (10ft)	LPA3055	102445-01 Piezo
				7111NR Power Coil						2525 (25ft)		
RLP50VA	105332-01	104146-01 Thermocouple		103921-01	101478-03	101481-01 Limit	099539-01	LPA2140	See Valve	LPA1020 (10ft)	LPA3055	102445-01 Piezo
				7111NR Power Coil						2525 (25ft)		
RLP80	079054-01	M51580-01 Flame Sensor	M51605-01	079473-02	M51107-01	079147-01 Sail	HA3013	LPA2080	078980-02	LPA1000 (10ft)	LPA3080	
										3825 (25ft)		
RLP100	102366-01	099538-01 Thermocouple		102601-01	M51153-01	101732-01 Limit	102487-01	LPA2150	099138-02	LPA1000 (10ft)	LPA3100	102601-01 Eaton
				7111NR Power Coil		103847-01 Relay Kit				3825 (25ft)		
RLP150	105336-01	M51580-01 Flame Sensor	M51605-01	079473-01	M23147	079147-01 Sail	HA3013	LPA2090	078980-01	LPA1000 (10ft)	LPA3020	
										3825 (25ft)		
RLP155	105336-01		M51605-02	099132-01	M51153-01	097952-03 Limit	099133-01	LPA2100	099138-01	LPA1010(10ft)	LPA3070	
										382550(25ft)		
RLP155A	105336-01		M51605-02	099132-01	M51153-01	101732-01 Limit	099133-01	LPA2100	099138-01	LPA1010(10ft)	LPA3070	
										382550(25ft)		
RLP155AT	105336-01		110287-01	103015-01	M51153-01	101487-01 Limit	099133-01	LPA2100	099138-01	LPA1010(10ft)	LPA3070	
(2003)			110267-01 Wire Harness							382550(25ft)		
RLP375A	097802-01		M51605-02	098201-01	097811-01	101732-03 Limit	097805-01	LPA2020	099679-01	LPA1020 (10ft)	LPA3030	
RLP375AT										2525 (25ft)		
RLP375AT	097802-01		110287-01	098201-01	097811-01	101732-03 Limit	097805-01	LPA2020	099679-01	LPA1020(10ft)	LPA3030	
(2003)			110267-01 Wire Harness							2525 (25ft)		

Desa Forced Air Propane -Master

Model#	Motor	Thermocouple/Flame Sensor	Ignition Control/D.S.I.	Valve: Safety/ Auto Control	Fan Blade	Safety Switches	Igniter/ Electrode	Regulator	Orifice: Pilot/Burner	Hose	Hose/Reg Assy	Spark Generator
BLP30	104156-01	104146-01 Thermocouple		104144-01	101478-02	101732-05 Limit	104784-01	LPA2170	See Valve	LPA1020 (10ft)	LPA3120	102445-01 Piezo
				7111NR Power Coil						2525 (25ft)		
BLP35	099521-01	099538-01 Thermocouple		099728-01	099537-01	101723-02 Limit	099539-01	LPA2110	See Valve	LPA1020 (10ft)	LPA3090	102445-01 Piezo
				7111NR Power Coil						2525 (25ft)		
BLP45	079054-01	M51580-01 Flame Sensor	M51605-01	079473-02	M50893-01	079147-02 Sail	HA3013	LPA2070	078980-03	LPA1000 (10ft)	LPA3010	
										3825 (25ft)		
BLP50	100589-01	099538-01 Thermocouple		100591-01	099537-03	101732-01 Limit	100588-01	LPA2140	See Valve	LPA1020 (10ft)	LPA3055	102445-01 Piezo
				7111NR Power Coil						3825 (25ft)		
BLP50A	103684-01	099538-01 Thermocouple		100591-01	103865-01	101732-01 Limit	100588-01	LPA2140	See Valve	LPA1020 (10ft)	LPA3055	102445-01 Piezo
				7111NR Power Coil						3825 (25ft)		
BLP50V	103684-01	099538-01 Thermocouple		103861-01	099537-03	101481-01 Limit	100588-01	LPA2140	103862-01	LPA1020 (10ft)	LPA3055	102445-01 Piezo
				7111NR Power Coil						3825 (25ft)		
BLP50VA	105332-01	104146-01 Thermocouple		103921-01	101478-01	101481-04	099539-01	LPA2140	See Valve	LPA1020 (10ft)	LPA3055	102445-01 Piezo
				7111NR Power Coil						3825 (25ft)		
BLP80	079054-01	M51580-01 Flame Sensor	M51605-01	079473-02	M51107-01	079147-01 Sail	HA3013	LPA2080	078980-02	LPA1000 (10ft)	LPA3010	
										3825 (25ft)		
BLP100	102366-01	099538-01 Thermocouple		102601-01	M51153-01	101732-01 Limit	102487-01	LPA2150	099138-02	LPA1000 (10ft)	LPA3100	102601-01 Eaton
				7111NR Power Coil		103847-01 Relay Kit				3825 (25ft)		
BLP150	105336-01	M51580-01 Flame Sensor	M51605-01	079473-01	M23147	079147-01 Sail	HA3013	LPA2090	078980-01	LPA1000 (10ft)	LPA3020	
										3825 (25ft)		
BLP155	105336-01		M51605-02	099132-01	M51153-01	079752-03 Limit	099133-01	LPA2100	099138-01	LPA1010(10ft)	LPA3070	
										382550(25ft)		
BLP155A	105336-01		M51605-02	099132-01	M51153-01	101732-01 Limit	099133-01	LPA2100	099138-01	LPA1010(10ft)	LPA3070	
										382550(25ft)		
BLP155AT	105336-01		M51605-02	103015-01	M51153-01	101732-01 Limit	099133-01	LPA2100	099138-01	LPA1010(10ft)	LPA3070	
										382550(25ft)		
BLP155AT	105336-01		110287-01	103015-01	M51153-01	101487-01 Limit	099138-01	LPA2100	099138-01	LPA1020 (10ft)	LPA3030	
(2003)			110267-01 Wire Harness							2525 (25ft)		
BLP375	097802-01		098884-01	098201-01	097811-01	097952-01 Limit	097805-01	LPA2020	097810-01	LPA1020 (10ft)	LPA3030	
										2525 (25ft)		
BLP375A	097802-01		M51605-02	098201-01	097811-01	097952-01 Limit	097805-01	LPA2020	097810-01	LPA1020 (10ft)	LPA3030	
BLP375AT										2525 (25ft)		
BLP375AT	097802-01		110287-01	098201-01	097811-01	101732-03 Limit	097805-01	LPA2020	099679-01	LPA1020 (10ft)	LPA3030	
(2003)			110267-01 Wire Harness							2525 (25ft)		

Desa Forced Air Propane - Remington

Model#	Motor	Thermocouple/Flame Sensor	Ignition Control/D.S.I.	Valve: Safety/ Auto Control	Fan Blade	Safety Switches	Igniter/ Electrode	Regulator	Orifice: Pilot/Burner	Hose	Hose/Reg Assy	Spark Generator
REM30LP	104156-01	104146-01 Thermocouple		104144-01	101478-02	101732-05 Limit	104784-01	LPA2170	See Valve	LPA1020 (10ft)	LPA3120	102445-01 Piezo
				7111NR Power Coil						2525 (25ft)		
REM35LP	099521-01	099538-01 Thermocouple		099728-01	099537-01	101732-02 Limit	099539-01	LPA2110	See Valve	LPA1020 (10ft)	LPA3090	102445-01 Piezo
				7111NR Power Coil						2525 (25ft)		
REM50LP	100589-01	099538-01		099537-03	099537-03	101732-01 Limit	100588-01	LPA2140	See Valve	LPA1020 (10ft)	LPA3055	102445-01 Piezo
				7111NR Power Coil						2525 (25ft)		
REM50LPA	103684-01	099538-01		100591-01	103865-01	101732-01 Limit	100588-01	LPA2140	See Valve	LPA1020 (10ft)	LPA3055	102445-01 Piezo
				7111NR Power Coil						2525 (25ft)		
REM50PV	103684-01	099538-01		100591-01	099537-03	101732-01 Limit	100588-01	LPA2140	103862-01	LPA1020 (10ft)	LPA3055	102445-01 Piezo
				7111NR Power Coil						2525 (25ft)		
REM50PVA	105332-01	104146-01		103921-01	101478-03	101481-04 Limit	099539-01	LPA2140	See Valve	LPA1020 (10ft)	LPA3055	102445-01 Piezo
				7111NR Power Coil						2525 (25ft)		
REM100LP	102366-01	099538-01		102601-01	M51153-01	102601-01 Relay	102487-01	LPA2150	099138-01	LPA1000 (10ft)	LPA3100	
				7111NR Power Coil		101732-04 Limit				3825 (25ft)		
REM150LP	105336-01	M51580-01	M51605-01	079473-01	M23147	079147-01 Sail	HA3013	LPA2090	078980-01	LPA1000 (10ft)	LPA3020	
										3825 (25ft)		

Desa Forced Air Propane -Vanguard

Model#	Motor	Thermocouple/Flame Sensor	Ignition Control/D.S.I.	Valve: Safety/ Auto Control	Fan Blade	Safety Switches	Igniter/Elec trode	Regulator	Orifice: Pilot/Burner	Hose	Hose/Reg Assy	Spark Generator
VLP35	099521-01	099538-01		099728-01	099537-01	101732-02 Limit	099539-01	LPA2110	See Valve	LPA1020 (10ft)	LPA3090	102445-01
				7111NR Power Coil						2525 (25ft)		
VLP45	079054-01	M51580-01	M51605-01	079473-02	M50893-01	079147-02 Sail	HA3013	LPA2070	078980-03	LPA1000 (10ft)	LPA3010	
										3825 (25ft)		
VLP80	079054-01	M51580-01	M51605-01	079473-02	M51107-01	079147-01 Sail	HA3013	LPA2080	078980-02	LPA1000 (10ft)	LPA3010	
										3825 (25ft)		
VLP150	105336-01	M51580-01	M51605-01	079473-01	M23147	079147-01 Sail	HA3013	LPA2090	078980-01	LPA1000 (10ft)	LPA3020	
										3825 (25ft)		
VLP155	105336-01	M51580-01	M51605-02	099132-01	M51153-01	097952-03 Limit	099133-01	LPA2100	099138-01	LPA1010 (10ft)	LPA3070	
										382550 (25ft)		
VLP375	097802-01		098884-01	098201-01	097811-01	097952-01 Limit	097805-01	LPA2020	097810-01	LPA1020 (10ft)	LPA3030	
										2525 (25ft)		
VLP375A	097802-01		M51605-02	098201-01	097811-01	097952-01 Limit	097805-01	LPA2020	097810-01	LPA1020 (10ft)	LPA3030	
										2525 (25ft)		

Desa Forced Air Propane -Desa

Model#	Motor	Thermocouple/Flame Sensor	Ignition Control/D.S.I.	Valve: Safety/ Auto Control	Fan Blade	Safety Switches	Igniter/Elec trode	Regulator	Orifice: Pilot/Burner	Hose	Hose/Reg Assy	Spark Generator
C35LP	099521-01	099538-01		099728-01	099537-01	101732-02 Limit	099539-01	LPA2110	See Valve	LPA1020 (10ft)	LPA3090	102445-01 Piezo
				7111NR Power Coil						2525 (25ft)		
C155LP	105336-01		M51605-02	099132-01	M51153-01	097952-03 Limit	099133-01	LPA2100	099138-01	LPA1010 (10ft)	LPA3070	
										382550 (25ft)		
C375LP	097802-01		098884-01	098201-01	097811-01	097952-01 Limit	097805-01	LPA2020	097810-01	LPA1020 (10ft)	LPA3030	
										2525 (25ft)		

Desa Propane Convection & Radiant Heaters - Reddy

Model#	Thermocouple	T.E. Safety Valve	Igniter/Electrode	Regulator	Orifice: Pilot/Burner	Hose	Other
RCP25	099236-01	101864-01	LPA4000 Piezo	LPA2025	097161-01 Pilot	LPA1025 (10ft)	LPA3025 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	101878-01 Electrode		097162-01 Burner		101864-01 Complete Burner Assy
RCP80	099236-01	097155-01	LPA4000 Piezo	LPA2130	097163-03 Pilot Assy	LPA1000 (10ft)	LPA3035 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	099539-02 Electrode		099679-01 Burner	3825 (25ft)	
RCP80V	099236-01	103030-01	102445-01 Piezo	LPA2160	103032-01 Burner	LPA1000 (10ft)	LPA3110 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	103904-01 Electrode			3825 (25ft)	103036-01 Stealth Knob
RCP200	099236-01	097155-01	LPA4000 Piezo	LPA2050	097161-01 Pilot	LPA1020 (10ft)	LPA3060 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	097150-01 Electrode		097162-01 Burner	2525 (25ft)	097152-01 Manual Control Valve
RCP2000	099236-01	097155-01	LPA4000 Piezo	LPA2005	097161-01 Pilot	LPA1020 (10ft)	LPA3005 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	101278-01 Electrode		097162-02 Burner	2525 (25ft)	097152-01 Manual Control Valve
RCP200V	099236-01	103926-01	102445-01 Piezo	LPA2005	097162-01 Burner	LPA1010 (10ft)	LPA3005 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	103398-01 Electrode			2525 (25ft)	103924-01 Knob
RCP250,	099236-01	097155-01	LPA4000 Piezo	LPA2010	097163-03 Pilot Assy	LPA1020 (10ft)	LPA3000 Hose & Reg Assy
RCP275	099237-01 Nut	7111NR Powr Coil	097150-01 Electrode		097162-01 Burner	2525 (25ft)	097152-01 Manual Control Valve

Desa Propane Convection & Radiant Heaters - Master

Model#	Thermocouple	T.E. Safety Valve	Igniter/Electrode	Regulator	Orifice: Pilot/Burner	Hose	Other
TC25	099236-01	101864-01	102445-01 Piezo	LPA2025	097161-01 Pilot	LPA1025 (10ft)	LPA3025 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	101878-01 Electrode		097162-01 Burner		101864-01 Complete Burner Assy
TC80	099236-01	097155-01	102445-01 Piezo	LPA2130	097163-03 Pilot Assy	LPA1000 (10ft)	LPA3035 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	099539-02 Electrode		099682-01 Burner	3825 (25ft)	097152-01 Manual Control Valve
TC80V	099236-01	103030-01	102445-01 Piezo	LPA2160	103032-01 Burner	LPA1000 (10ft)	LPA3110 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	103904-01 Electrode			3825 (25ft)	103036-01 Stealth Knob
TC100R	099236-01	097155-01	102445-01 Piezo	LPA2150	097161-03 Pilot Assy	LPA1000 (10ft)	LPA3100 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	104118-01 Electrode		099138-03 Burner	3825 (25ft)	097152-01 Manual Control Valve
TC100VR	107374-01	109930-02	102445-01 Piezo	LPA2160	103032-02 Burner	LPA1000 (10ft)	LPA3110 Hose & Reg Assy
		7111NR Power Coil	106174-01 Electrode			3825 (25ft)	099393-03 Control Knob
TC200	099236-01	097155-01	LPA4000 Piezo	LPA2050	097161-03 Pilot Assy	LPA1020 (10ft)	LPA3060 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	097150-01 Electrode		097162-01 Burner	2525 (25ft)	097152-01 Manual Control Valve
TC200V	099236-01	103926-01	102445-01 Piezo	LPA2005	097161-01 Pilot	LPA1020 (10ft)	LPA3005 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	103398-01 Electrode		097162-01 Burner	2525 (25ft)	103924-01 Knob
TC250	099236-01	097155-01	LPA4000 Piezo	LPA2010	097163-03 Pilot Assy	LPA1020 (10ft)	LPA3000 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	097150-01 Electrode		097162-01 Burner	2525 (25ft)	097152-01 Manual Control Valve
TC250A	099236-01	097155-01	LPA4000 Piezo	LPA2010	097161-01 Pilot	LPA1020 (10ft)	LPA3000 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	097150-01 Electrode		097162-01 Burner	2525 (25ft)	097152-01 Manual Control Valve
TC275	099236-01	097155-01	102445-01 Piezo	LPA2010	097161-01 Pilot	LPA1020 (10ft)	LPA3000 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	097150-01 Electrode		097162-01 Burner	2525 (25ft)	097152-01 Manual Control Valve
TC275J	099236-01	097155-01	102445-01 Piezo	LPA2005	097161-01 Pilot	LPA1020 (10ft)	LPA3005 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	101278-01 Electrode		097162-02 Burner	2525 (25ft)	097152-01 Manual Control Valve

Desa Propane Convection & Radiant Heaters - Remington

Model#	Thermocouple	T.E. Safety Valve	Igniter/Electrode	Regulator	Orifice: Pilot/Burner	Hose	Other
REM25LP	099236-01	101864-01	102445-01 Piezo	LPA2025	097161-01 Pilot	LPA1025 (10ft)	LPA3025 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	101878-01 Electrode		097162-01 Burner		101864-01 Complete Burner Assy
REM200LP	099236-01	097155-01	LPA4000 Piezo	LPA2010	097161-01 Pilot	LPA1020 (10ft)	LPA3005 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	097150-01 Electrode		097162-02 Burner	2525 (25ft)	097152-01 Manual Control Valve
REM2000	099236-01	097155-01	102445-01 Piezo	LPA2005	097161-01 Pilot	LPA1020 (10ft)	LPA3060 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	101278-01 Electrode		097162-02 Burner	2525 (25ft)	097152-01 Manual Control Valve
REM275	099236-01	097155-01	102445-01 Piezo	LPA2010	097161-01 Pilot	LPA1020 (10ft)	LPA3000 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	097150-01 Electrode		097162-02 Burner	2525 (25ft)	097152-01 Manual Control Valve

Desa Propane Convection & Radiant Heaters - Desa

Model#	Thermocouple	T.E. Safety Valve	Igniter/Electrode	Regulator	Orifice: Pilot/Burner	Hose	Other
CP200	099236-01	097155-01	LPA4000 Piezo	LPA2050	097163-01 Pilot	LPA1020 (10ft)	LPA3060 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	097150-01 Electrode		097162-01 Burner	2525 (25ft)	097152-01 Manual Control Valve
CP250	099236-01	097155-01	LPA4000 Piezo	LPA2010	097161-01 Pilot	LPA1020 (10ft)	LPA3060 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	097150-01 Electrode		097162-01 Burner	2525 (25ft)	097152-01 Manual Control Valve
DESA250	099236-01	097155-01	LPA4000 Piezo	LPA2010	097161-01 Pilot	LPA1020 (10ft)	LPA3060 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	097150-01 Electrode		097162-01 Burner	2525 (25ft)	097152-01 Manual Control Valve
CP275	099236-01	097155-01	LPA4000 Piezo	LPA2010	097161-01 Pilot	LPA1020 (10ft)	LPA3060 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	097150-01 Electrode		097162-01 Burner	2525 (25ft)	097152-01 Manual Control Valve

Desa Propane Convection & Radiant Heaters - Vanguard

Model#	Thermocouple	T.E. Safety Valve	Igniter/Electrode	Regulator	Orifice: Pilot/Burner	Hose	Other
VCP250	099236-01	097155-01	102445-01 Piezo	LPA2010	097163-03 Pilot Assy	LPA1020 (10ft)	LPA3000 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	097150-01 Electrode		097162-01 Burner	2525 (25ft)	097152-01 Manual Control Valve
VCP250A	099236-01	097155-01	LPA4000 Piezo	LPA2010	097161-01 Pilot	LPA1020 (10ft)	LPA3000 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	097150-01 Electrode		097162-01 Burner	2525 (25ft)	097152-01 Manual Control Valve
VCP275	099236-01	097155-01	LPA4000 Piezo	LPA2010	097161-01 Pilot	LPA1020 (10ft)	LPA3000 Hose & Reg Assy
	099237-01 Nut	7111NR Power Coil	097150-01 Electrode		097162-01 Burner	2525 (25ft)	097152-01 Manual Control Valve

Desa Tank Top Heaters

Model#	Thermocouple	Orifice	Gas Valve	Hose	Regulator
HD12	100886-01		NLA		LPA2025
HD12A	E73117		NLA		E73410
HD12B	100886-01	100889-01	NLA		LPA2025
HD12C	100886-01		NLA		LPA2025
HD12C-A	E73117		NLA	P4122	
HD12C-B	100886-01		NLA		LPA2025
HD15	100886-01	100889-03	NLA		LPA2025
HD24A	E73117		NLA		E73410
			7111NR Power Coil (Qty. 2)		
HD24B	100886-01	108889-01	NLA	100921-01 (Qty 2)	LPA2025
			7111NR Power Coil (Qty. 2)		
TT15	100886-01	100889-03	NLA		
TT24B	100886-01	108889-01	NLA	100921-01 (Qty 2)	LPA2025
			7111NR Power Coil (Qty. 2)		

Scheu Forced Air Propane

Model#	Motor	Thermocouple	Ignition Control/ D.S.I.	Valve: Safety/Auto Control	Fan/Squirrel Cage	Safety Switches	Igniter/Electrode	Regulator	Orifice: Pilot/Burner	Hose	Spark Generator	Other
30FAS/SPC30	0751NR	6803NR		1641NR Valve	6732NR	6168NR Limit	1377NR Electrode	6255NR	1640NR	7152NR (10ft)	6473NR Peizo	0966NR Relay Replacement
1986				7111NR Power Coil								6171NR Push Button
												Cannot Use Thermostat
30FAS/SPC30	0751NR	6803NR		1641NR Valve	6732NR	6168NR Limit	1377NR Electrode	6255NR	1640NR	7152NR (10ft)	6250NR Eaton or	0966NR Relay Replacement
1987				7111NR Power Coil							3275NR HY-LO 801	6171NR Push Button
												Cannot Use Thermostat
30FAS/SPC30	1368NR	6803NR		1641NR Valve	6732NR	1440NR Limit	1377NR Electrode	6255NR	1640NR	7152NR (10ft)	6250NR Eaton or	1811 Relay
(1988-1992)				7111NR Power Coil							3275NR HY-LO 801	6171NR Push Button
												6641NR Terminal Board
30FAS/SPC30	1368NR	6803NR		7285NR Valve	6732NR	1440NR Limit	1377NR Electrode	6255NR	1640NR	7152NR (10ft)	6250NR Eaton or	1811NR Relay
(1993-2002)				7111NR Power Coil							3275NR HY-LO 801	6171NR Push Button
												6641NR Terminal Board
30DFAS	1429NR		1446NR (Call)	6974NR	6732NR	1440NR Limit	6172NR Flame Rod	6255NR	1456NR	6251NR (10ft)		Can Use A Thermostat
1988										2525 (25ft)		
30DFAS	1429NR		1446NR (Call)	6100NR	6732NR	1440NR Limit	6172NR Flame Rod	6255NR	1456NR	6251NR (10ft)		Can Use A Thermostat
(1988-1991)										2525 (25ft)		
30DFAS	1429NR		M51605-02 (Call)	6100NR	6732NR	6168NR Limit	1565NR Electrode	6255NR	3618NR	6251NR (10ft)		Can Use A Thermostat
(1992-1995)										2525 (25ft)		
35FAC/SPC35	8076NR	See Valve		8079NR	8077NR	6168NR Limit	8080NR Electrode	6256NR	See Valve	1591NR (10ft)	6473NR Peizo	Cannot Use Thermostat
(1997-2002)				7111NR Power Coil								1007NR Hose and Regulator Assy
40FA	1037NR	6542NR		6105NR	6086NR	6168NR Limit	1083NR Spark Plug	6255NR	1259NR	6152NR (10ft)	0671NR (Call)	0540NR Relay
(1978-1982)				7111NR Power Coil						3825 (25ft)		6171NR Push Button
												Cannot Use A Thermostat
40FAS	1037NR	6654NR		1641NR	6086NR	6168NR Limit	1082NR Spark Plug	6255NR	1032NR	7152NR (10ft)	3275NR HY-LO 801	0540NR Relay
(1981-1983)				7111NR Power Coil								6171NR Push Button
												Cannot Use A Thermostat
40FAS	1037NR	6654NR		1641NR	6086NR	6168NR Limit	1082NR Spark Plug	6255NR	1032NR	7152NR (10ft)	6250NR Eaton	1068NR Relay
(1983-1988)				7111NR Power Coil								6171NR Push Button
												Cannot Use Thermostat
40FAS	1652NR	6654NR		6516NR	6086NR	6168NR Limit	1082NR Spark Plug	6255NR	1032NR	7152NR (10ft)	6250NR Eaton	1811NR Relay
(1988-1994)				7111NR Power Coil								6171NR Push Button
												6641NR Terminal Board
40FAC/SPC40	1652NR	6654NR		7285NR	6086NR	6168NR Limit	1082NR Spark Plug	6255NR	1032NR	7152NR (10ft)	3275NR HY-LO 801	1811NR Relay
(1995-2002)				7111NR Power Coil								Cannot Use Thermostat
45FAC/SPC45	1652NR	6654NR		7285NR	6086NR	1751NR Limit	1082NR Spark Plug	6257NR	1930NR	6152NR (10ft)	3275NR HY-LO 801	1811NR Relay
(1997-2002)				7111NR Power Coil						3825 (25ft)		7431NR Ball Control Valve
												Cannot Use Thermostat
55F/SPC55	1652NR	6654NR		7285NR	6086NR	1751NR Limit	1082NR Spark Plug	6257NR	2236NR	6152NR (10ft)	3275NR HY-LO 801	1811NR Relay
2003				7111NR Power Coil						3825 (25ft)		7431NR Ball Control Valve
												Cannot Use Thermostat
60FA-BE	1315NR	6238NR		6106NR	6084NR	6175NR Limit	1057NR (Manual)	6255NR	6107NR Pilot	6152NR (10ft)		Can Use Thermostat
1984									6111NR Burner	3825 (25ft)		Limit Switch Is 350 Degrees

Scheu Forced Air Propane Continued

Model#	Motor	Thermocouple	Ignition Control/ D.S.I.	Valve: Safety/Auto Control	Fan/Squirrel Cage	Safety Switches	Igniter/Electrode	Regulator	Orifice: Pilot/Burner	Hose	Spark Generator	Other
60FAS	1315NR	6540NR		1047NR Combo Valve	6085NR	6535NR Limit	6657NR Electrode	6255NR	6108NR Pilot	6152NR (10ft)	6473NR Peizo	Can Use Thermostat
(1978-1989)									1301NR Burner Tube	3825 (25ft)		Limit Swich Is 250 Degrees
60DFAS	1315NR		1475NR (Call)	6100NR	6084NR	1316NR Limit	1083NR Spark Plug	6255NR	1310NR Burner Tube	6152NR (10ft)		Can Use Thermostat
(1985-1991)										3825 (25ft)		
75FAS	1431NR		1303NR	6100NR	6953NR	6168NR Limit	6172NR Flame Rod	6255NR	1433NR Burner Tube	6152NR (10ft)		Can Use Thermostat
(1990-1991)						1436NR Sail				3825 (25ft)		6961NR Capacitor
75DFAS	1431NR		1303NR	6100NR	6953NR	6168NR Limit	6172NR Flame Rod	6255NR	1433NR Burner Tube	6152NR (10ft)		Can Use Thermostat
(1988-1991)										3825 (25ft)		6961NR Capacitor
75DSFAS	1065NR		M51605-02	6101NR	6953NR	6168NR Limit	1565NR Electrode	6255NR	3617NR	6152NR (10ft)		Can Use Thermostat
(1992-1995)										3825 (25ft)		6961NR Capacitor
80FA	0751NR		10741NR Conversion	6100NR	6086NR	6168NR Limit	1083NR Spark Plug	6255NR	1257NR	6152NR (10ft)	0761NR (Call)	1245NR 24 Volt Transformer (Call)
(1979-1981)						1165NR Flame Rod				3825 (25ft)		6170NR Toggle Switch
												6180NR Time Delay Relay (Call)
VX80	0751NR		10741NR Conversion	6100NR	6086NR	6168NR Limit	1082NR Spark Plug	6557NR	1063NR	6152NR (10ft)	0761NR (Call)	1145NR 24Volt Transformer (Call)
(1981-1982)						1165NR Flame Rod				3825 (25ft)		6170NR Toggle Switch
												1243NR Amber Light Assembly
80FAS	0751NR		10741NR Conversion	6100NR	6086NR	6168NR Limit	1082NR Spark Plug	6255NR	1063NR	6152NR (10ft)	0761NR (Call)	1145NR 24 Volt Transformer (Call)
(1981-1984)						6172NR Flame Rod				3825 (25ft)		6170NR Toggle Switch
												Can Use Thermostat
80FAS	0751NR		1303NR Call	6100NR	6086NR	3207NR Air Switch	1082NR Spark Plug	6255NR	1063NR	6152NR (10ft)		6170NR Toggle Switch
1885						6172NR Flame Rod				3825 (25ft)		Can Use Thermostat
80FAS	0751NR		1303NR Call	6100NR	6086NR	6168NR Limit	1082NR Spark Plug	6255NR	1063NR	6152NR (10ft)		6170NR Toggle Switch
(1986-1987)						3207NR Air Switch				3825 (25ft)		Can Use Thermostat
80FAS	1361NR		1303NR Call	6100NR	6086NR	6168NR Limit	1082NR Spark Plug	6255NR	1063NR	6152NR (10ft)		6170NR Toggle Switch
(1988-1990)										3825 (25ft)		Can Use Thermostat
80FAS	1551NR		M51605-02	6100NR	6086NR	1550NR Limit	1082NR Spark Plug	6255NR	1063NR	6152NR (10ft)		6170NR Toggle Switch
(1991-1993)										3825 (25ft)		Can Use Thermostat
80FAC	1551NR		M51605-02 / 7499NR (Call)	6100NR	6086NR	1550NR Limit	1083NR Spark Plug	6255NR	1755NR	6152NR (10ft)		6170NR Toggle Switch
(1994-1999)										3825 (25ft)		1671NR Motor Mounting Grill
												Can Use Thermostat
80FAC	1551NR		7808NR	6100NR	6086NR	1550NR Limit	1083NR Spark Plug	6255NR	1755NR	6152NR (10ft)		6170NR Toggle Switch
(2000-2002)										3825 (25ft)		1959NR Wiring Harness
												Can Use Thermostat

Scheu Forced Air Propane Continued

Model#	Motor	Thermocouple	Ignition Control/ D.S.I.	Valve: Safety/Auto Control	Fan/Squirrel Cage	Safety Switches	Igniter/Electrode	Regulator	Orifice: Pilot/Burner	Hose	Spark Generator	Other
85FAC/SPC85	1551NR	6654NR		7285NR	6086NR	1751NR Limit	1083NR Spark Plug	6257NR	1673NR	6152NR (10ft)	6250NR Eaton	1811NR Relay
1992				7111NR Power Coil						3825 (25ft)		7404NR Variable Ball Valve
												6171NR Push Button Switch
85FAC/SPC85	1551NR	6654NR		7285NR	6086NR	1751NR Limit	1083NR Spark Plug	6257NR	1673NR	6152NR (10ft)	3275NR HI-LO 801	1811NR Relay
(1993-2002)				7111NR Power Coil						3825 (25ft)		7404NR Variable Ball Valve
												Cannot Use Thermostat
125FAC/SPC125	1551NR	6654NR		7285NR	7898NR	2003NR Limit	1083NR Spark Plug	6257NR	2002NR	6152NR (10ft)	3275NR HI-LO 801	1811NR Relay
(1997-2002)				7111NR Power Coil						3825 (25ft)		7897NR Variable Control Valve
												Cannot Use Thermostat
150FA	1166NR		10742NR Conversion	6100NR	6074NR	6168NR Limit	1083NR Spark Plug	6255NR	3122NR	6152NR (10ft)	0761NR (Call)	6170NR Toggle Switch
(1975-1983)						6169NR Flame Sensor				3825 (25ft)		1090NR Resistor Assy
												Can Use Thermostat
150FAS	1166NR		10741NR Conversion	6100NR	6074NR	6168NR Limit	1082NR Spark Plug	6255NR	1168NR	6152NR (10ft)		1145NR 24Volt Transformer
(1988-1991)						6172NR Flame Rod				3825 (25ft)		6170NR Toggle Switch
												6269NR Ball Control Valve
150FAS/SPC150FA	1561NR		M51605-02 / 7499NR (Call)	6100NR	6074NR	1550NR Limit	1083NR Spark Plug	6255NR	1168NR	6152NR (10ft)		6170NR Toggle Switch
(1992-1996)										3825 (25ft)		Can Use Thermostat
150FAST/SPC150T	1561NR		M51605-02 / 7499NR (Call)	6100NR	6074NR	1550NR Limit	1083NR Spark Plug	6255NR	1168NR	6152NR (10ft)		1734NR Thermostat
(1997-1998)										3825 (25ft)		1942NR Thermostat Knob
												3087NR Inlet Grill
150FAST/SPC150T	1561NR		7801NR / 7808NR	6100NR	6074NR	1550NR Limit	1083NR Spark Plug	6255NR	1168NR	6152NR (10ft)		1959NR Wiring Harness
(1999-2002)										3825 (25ft)		1734NR Thermostat
												1924NR Thermostat Knob
170S/SPC170	2251NR		7808NR	6101NR	6074NR	6168NR Limit	8774NR	6257NR	2250NR	6152NR (10ft)		2254NR Thermostat
2003										3825 (25ft)		8777NR Burn Rate Adjustment Valve
												8773NR Burn Rate Adjustment Knob
3500FA	1174NR		10741NR Conversion	1125NR	6073NR	1118NR Limit	1083NR Spark Plug	6254NR Interior 5-20psi	3191NR	6151NR (10ft)	3275NR HI-LO 801	1122NR Thermostat
						6169NR Flame Sensor		6253NR Exterior 40psi		2525 (25ft)		6119NR J S Filter
						0945NR Tip Switch						1127NR 1000 Ohm Resistor
3500FAS	1174NR		1303NR (Call)	1125NR	6073NR	1176NR Limit	1083NR Spark Plug	6258NR	3191NR	6151NR (10ft)		1122NR Thermostat
						0945NR Tip Switch				2525 (25ft)		6118NR Filter, Pipe Insert 1/4"
												1507NR Thermostat Knob
3500FAC	1174NR		Call	1125NR	6073NR	1316NR Limit	7118NR Electrode	6258NR	3652NR	6151NR (10ft)		1663NR Ceramic Burner Grid Assy
										2525 (25ft)		1122NR Thermostat
												6118NR Filter, Pipe Insert 1/4"
3500FACV	1174NR		Call	1125NR	6073NR	6168NR Limit	7118NR Electrode	7406NR	3652NR	6151NR (10ft)		1663NR Ceramic Burner Grid Assy
										2525 (25ft)		7431NR Ball Adjustment Valve
												1734NR Thermostat
7000FACV	7618NR		7499NR	7721NR (qty 2)	7619NR	7661NR Limit	7118NR	7723NR	3913NR	7659NR (10ft)		1856NR Ceramic Burner Grid Assy
(1996-1998)						7722NR Air Switch						6689NR Wheel (qty 2)
												1734NR Thermostat
7000FACV	7618NR		7499NR (1999)	7970NR (qty 2)	7619NR	7661NR Limit	7118NR	7723NR	3913NR	7659NR (10ft)		7660NR P.O.L Fitting
(1999-2002)			7801NR (2000-2002)			7722NR Air Switch						7663NR Ball Adjustment Valve
												1734NR Thermostat

Scheu Propane Convection Heaters

Model	Thermocouple	T.E. Safety Valve	Igniter/Electrode	Regulator	Orifice: Pilot/Burner	Hose	Other
SPC25VC	6233NR	6104NR	6473NR Piezo	7919NR	4034NR Pilot	7918NR (10ft)	7161NR Piezo Nut
	6045NR Clip	7111NR Power Coil	7916NR Electrode		4035NR Burner		
SPC80C	8643NR	6104NR	6473NR Piezo	6255NR	8644NR Pilot	6152NR (10ft)	8654NR Ball Valve
80C	6045NR Clip	7111NR Power Coil	7652NR Electrode		8641NR Burner	3825 (25ft)	8651NR Ball Valve Nut
(2003)							8655NR Ball Valve Insert
80VC	6233NR	6104NR	6473NR Piezo	6255NR	7157NR Pilot	6152NR (10ft)	6655NR Ball Valve
(Pre 1999)	6045NR Clip	7111NR Power Coil	7160NR Electrode		3557NR Burner	3825 (25ft)	7161NR Piezo Nut
80VCA	6233NR	6104NR	6473NR Piezo	6255NR	7157NR Pilot	6152NR (10ft)	6269NR Ball Valve
	6045NR Clip	7111NR Power Coil	7652NR Electrode		3557NR Burner	3825 (25ft)	7161NR Piezo Nut
80VCB	8643NR	6104NR	6473NR Piezo	6255NR	8644NR Pilot	6152NR (10ft)	8654NR Ball Valve
	6045NR Clip	7111NR Power Coil	7652NR Electrode		8641NR Burner	3825 (25ft)	8651NR Ball Valve Nut
							8655NR Ball Valve Insert
101	6235NR	6103NR (Brushed Aluminum)		6255NR	6108NR Pilot	6152NR (10ft)	6433NR P.O.L. Fitting
		6515NR Knob			6112NR Burner	3825 (25ft)	
SPC200C	8643NR	6104NR	6473NR Piezo	6256NR	8647NR Pilot	1591NR (10ft)	8654NR Ball Valve
200C	6045NR Clip	7111NR Power Coil	7652NR Electrode		8646NR Burner		8651NR Ball Valve Nut
(2003)							6252NR P.O.L. Fitting
SPC200VC	6234NR	6104NR	6473NR Piezo	6256NR	7708NR Pilot	6151NR (10ft)	6269NR Ball Valve
	6045NR Clip	7111NR Power Coil	7652NR Electrode		3988NR Burner	2525 (25ft)	7161NR Piezo Nut
							6252NR P.O.L. Fitting
SPC225VC	6233NR	6104NR	6473NR Piezo	6256NR	7708NR Pilot	1591NR (10ft)	6252NR Ball Valve
	6045NR Clip	7111NR Power Coil	7652NR Electrode		3988NR Burner		7161NR Piezo Nut
							6252NR P.O.L. Fitting

Scheu Propane Convection Heaters Continued

Model	Thermocouple	T.E. Safety Valve	Igniter/Electrode	Regulator	Orifice: Pilot/Burner	Hose	Other
SPC225VCA	6233NR	6104NR	6473NR Piezo	6256NR	7708NR Pilot	1591NR (10ft)	6269NR Ball Valve
	6045NR Clip	7111NR Power Coil	7652NR Electrode		3988NR Burner		7161NR Piezo Nut
							6252NR P.O.L. Fitting
SPC225VCB	8643NR	6104NR	6473NR Piezo	6256NR	8647NR Pilot	1591NR (10ft)	8654NR Ball Valve
	6045NR Clip	7111NR Power Coil	7652NR Electrode		8646NR Burner		8651NR Ball Valve Knob
							8655NR Ball Valve Insert
250	6233NR	6104NR		6256NR	3140NR Pilot	6151NR (10ft)	6269NR Ball Valve
(1985-1988)	6045NR Clip	7111NR Power Coil			3145NR Burner	2525 (25ft)	6252NR P.O.L. Fitting
250	6233NR	6104NR		6256NR	6716NR Pilot	1591NR (10ft)	6655NR Ball Valve
(1994-On)	6045NR Clip	7111NR Power Coil			3145NR Burner		6252NR P.O.L. Fitting
250A	6233NR	6104NR		6256NR	6716NR Pilot	6151NR (10ft)	6269NR Ball Valve
1986	6045NR Clip	7111NR Power Coil			3145NR Burner	2525 (25ft)	6252NR P.O.L. Fitting
250A	6233NR	6104NR	6473NR Piezo	6256NR	6716NR Pilot	1591NR (10ft)	6655NR Ball Valve
(1994-2000)	6045NR Clip	7111NR Power Coil	7160NR Electrode		3145NR Burner		7161NR Piezo Nut
							6252NR P.O.L. Fitting
250H	6234NR	6104NR		6256NR	3140NR Pilot	6151NR (10ft)	6655NR Ball Valve
(1977-1994)	6045NR Clip	7111NR Power Coil			3159NR Burner	2525 (25ft)	6252NR P.O.L. Fitting
250P	6233NR	6104NR Valve	6473NR Piezo	6256NR	6716NR Pilot	6151NR (10ft)	6655NR Ball Valve
1991	6045NR Clip	7111NR Power Coil	7160NR Electrode		3145NR Burner	2525 (25ft)	7161NR Piezo Nut
							6252NR P.O.L. Fitting
SPC250VC	6243NR	6104NR Valve	6473NR Piezo	6256NR	6716NR Pilot	6151NR (10ft)	6269NR Ball Valve
	6045NR Clip	7111NR Power Coil	7652NR Electrode		3145NR Burner	2525 (25ft)	7161NR Piezo Nut
							6252NR P.O.L. Fitting

Scheu Propane Radiant Heaters

Model#	Thermocouple	T.E. Safety Valve	Switch: Safety	HEATERS Ignitor/Electrode	Regulator	Orifice: Pilot/Burner	Hose	Other
11PHTT	8390NR	8401NR	8361NR Tilt Switch	8386NR Electrode	8360NR	8392NR		8397NR Knob
								8403NR Ignition Wire
								F273702 12" Ext Hose
SPC12IR	6233NR	7285NR			6257NR	3008NR	1016NR	0566NR Ceramic Grid
	6045NR Nut	7111NR Power Coil						3017NR Grid Keeper (Qty 2)
								1010NR Complete Burner Assy
SPC15R	8661NR	8660NR Burner Head Assy			8663NR	8660NR Burner Head Assy		8664NR Grill
	8662NR Nut (Qty 2)	7111NR Power Coil						
SPC21PHTTS	8551NR	8533NR	8555NR Tilt Switch	8550NR Electrode	8552NR	8539NR		8554NR Knob
	8541NR Nut							8557NR Door Knob
								8558NR Door Latch
SPC24IR (P)	6233NR	7285NR		6473NR Piezo (24P Only)	6257NR	3008NR (Qty 2)	1016NR	0566NR Ceramic Grid (Qty 2)
	6045NR Nut	7111NR Power Coil		7395NR Electrode (24P Only)				3017NR Grid Keeper (Qty 3)
								1010NR Complete Burner Assy (Qty 2)
SPC30R	8661NR (Qty 2)	8660NR Burner Head ASSY (Qty 2)		8672NR Piezo	8663NR	8660NR Burner Head Assy (Qty 2)	8665NR (Qty 2)	8664NR Grill (Qty 2)
	8662NR Nut (Qty 2)	7111NR Power Coil		8666NR Electrode (Qty 2)				8673NR Piezo Nut
SPC36AP	6233NR	7285NR		6473NR Piezo	6257NR	3008NR (Qty 3)	7309NR	0566NR Ceramic Grid (Qty 3)
	6045NR Nut	7111NR Power Coil		7395NR Electrode				3017NR Grid Keeper (Qty 2)
				8129NR Flat Tip Electrode				1010NR Complete Burner Assy (Qty 3)
SPC36IR	6233NR	7285NR			6257NR	3008NR (Qty 3)	1016NR	0566NR Ceramic Grid (Qty 3)
	6045NR Nut	7111NR Power Coil						3017NR Grid Keeper (Qty 2)
								1010NR Complete Burner Assy (Qty 3)

Scheu Propane Radiant Heaters Continued

Model#	Thermocouple	T.E. Safety Valve	Switch: Safety	Ignitor/Electrode	Regulator	Orifice: Pilot/Burner	Hose	Other
SPC42PH	8001NR	7999NR		6473NR Piezo	2075NR Assy	8063NR Pilot	2075NR Assy	8004NR Patio Knob
				2085NR Electrode		4176NR Burner		G1851 Acme Withdrawal Valve
SPC44PHW	8301NR	8304NR		8251NR Piezo	2075NR Assy	8306NR Pilot	8248NR	8004NR Knob
				8302NR Electrode		8303NR Burner		G1851 Acme Withdrawal Valve
SPC45PHS	8301NR	8304NR		8251NR Piezo	2075NR Assy	8306NR Pilot	8248NR	8004NR Knob
				8302NR Electrode		8303NR Burner		G1851 Acme Withdrawal Valve
SPC48IR	6233NR	7285NR		6473NR Piezo	6257NR	3008NR (QTY 4)	1016NR	0566NR Ceramic Grid (Qty 4)
	6045NR Nut	7111NR Power Coil		7395NR Electrode				3017NR Grid Keeper (Qty 3)
				8129NR Flat Tip Electrode				1010NR Complete Burner Assy (Qty 4)
SPC54PHW	8576NR (O.D.S.)	8603NR	8605NR Tip Switch	6473NR Piezo	2242NR Assy	8576NR Pilot (O.D.S.)	2242NR Assy	8692NR Wheel Assy
SPC54PHB				Electrode Part Of 8576NR (O.D.S.)		8611NR Burner		8579NR Knob
								8617NR Reflector (Dome)
SPC55PHS	8576NR (O.D.S.)	8603NR	8605NR Tip Switch	8577NR Pulse Igniter	2243NR Assy	8576NR Pilot (O.D.S.)	2243NR Assy	8579NR Knob
SPC55PHT				Electrode Part Of 8576NR (O.D.S.)		8611NR Burner		8693NR Wheel Assy
								8617NR Reflector (Dome)
SPC100RA	6235NR	6103NR (Brushed Aluminum)			6255NR	6108NR Pilot	6152NR (10ft)	6433NR P.O.L. Fitting
(Pre 1991)		6515NR Knob				6112NR Burner	3825 (25ft)	
SPC100RA	6234NR	6104NR		6473NR Piezo	6255NR	7157NR Pilot	6152NR (10ft)	6654NR Ball Control Valve
(Post 1991)	6045NR Clip	7111NR Power Coil		3451NR Electrode		6112NR Burner	3825 (25ft)	6433NR P.O.L. Fitting
SPC250RA	6234NR							
	6045NR Clip	6104NR			6256NR	7481NR Pilot	1591NR (10ft)	1007NR Hose & Reg Assy
		7111NR Power Coil				7480NR Burner		6433NR P.O.L. Fitting

LB White Forced Air Propane

Model#	Motor	Thermocouple	Ignition Control/DSI	Valve:Safety/ Auto Control	Fan/Squirrel Cage	Safety Switches	Igniter/ Electrode	Regulator	Orifice: Pilot/Burner	Hose	Transformer	Other
286	20290		098884-01	05547	02808	05550 Air Proving	06479	06772	05560	20704 (10ft)		05548 Manual Shut-Off Valve
286A						05559 Flapper						05568 Thermostat With Bracket
						07264 Limit(286A)(350˚)						07027 Wiring Hamess
286B	20290		098884-01	05547	02808	05550 Air Proving	06479	06772	05560	20704 (10ft)		05548 Manual Shut-Off Valve
						05559 Flapper						05568 Thermostat With Bracket
						05566 Limit (350˚)						07027 Wiring Hamess
290	20554		098884-01	05547	02684	07264 Limit (350˚)	06479	09911	02691	20704 (10ft)		05548 Manual Shut-Off Valve
290A						02680 Air Proving						05568 Thermostat With Bracket
						02441 Flapper						09160 Wheel (Qty 2)
290B	20554		098884-01	05547	02684	05566 Limit (350˚)	06479	09911	02691	20704 (10ft)		05548 Manual Shut-Off Valve
						02680 Air Proving						05568 Thermostat With Bracket
						02441 Flapper						07027 Wiring Hamess
292A	03830		05145 (Call)	05144	03831	03933 Limit (275˚)	03849	04655	05303	04784 (10ft)	06979	03834 On-Off Switch
						04605 Air Flow						05148 Wiring Hamess
						03948 Flame Rod						04724 Valve Cock Assy
292E	03830		098884-01	05309	21575	06739 Air Proving	07160	06772	05851	20704 (10ft)		03834 On-Off Switch
						06687 Backflash						07027 Wiring Hamess
296	03830		03327	03837	03831	03933 Limit (275˚)	03849	03836	03860	03535 (10ft)	06979	03834 On-Off Switch
296A						04605 Air Flow						
						03948 Flame Rod						
296B	03830		05145 (Call)	05144	03831	03933 Limit (275˚)	03849	04655	03860	04784 (10ft)	06979	03834 On-Off Switch
						04605 Air Flow						05148 Wiring Hamess
						03948 Flame Rod						
296D	03830		05549	05144	21575	05688 Flame Rod	05687	06772	05849	20704 (10ft)		03834 On-Off Switch
						07161 Sail Switch						05845 Valve Cock Assy
												05854 Fuse, Thermal Assy
296E	03830		098884-01	05309	21575	06739 Air Proving	07160	06772	06685	20704 (10ft)		03834 On-Off Switch
						06687 Backflash						07027 Wiring Hamess
301A	03830		03327	03986	03831	03933 Limit (275˚)	03849	03936	03860	03535 (10ft)	06979	03834 On-Off Switch
						04605 Air Flow						
						03843 Flame Rod						
304B	04785		05145 (Call)	05867	04794	03933 Limit (275˚)	03849	04791	04665	20704 (10ft)	06979	03834 On-Off Switch
						03326 Air Flow						04977 Valve Cock Assy
						03843 Flame Rod						05829 Thermostat
						09224 Tilt						05149 Wiring Hamess

LB White Forced Air Propane Continued

Model#	Motor	Thermocouple	Ignition Control/DSI	Valve:Safety/ Auto Control	Fan/Squirrel Cage	Safety Switches	Igniter/ Electrode	Regulator	Orifice: Pilot/Burner	Hose	Transformer	Other
304D	04719		098884-01	08022	06697	06664 Backflash	06873 Plug OR	08997	06571	20704 (10ft)		03834 On-Off Switch
						07161 Sail	20312 Electrode					05829 Thermostat
						09224 Tilt						04720 Capacitor
												06871 Throttling Valve
324	07181	01090		02990 Solenoid AND	01227			21788	01230 Pilot	01229 (10ft)		06537 Thermostat
				20356 Thermo Electric					01591 Burner	2525LH (25ft)		01099 Wheel
				7111NR Power Coil								20598 Manual Shut Off Valve
324E	07181	01090		20356	01227			01106	01230 Pilot	01229 (10ft)		20598 Manual Shut Off Valve
324F				7111NR Power Coil					01591 Burner	2525LH (25ft)		01098 Hose Adapter
												01099 Wheel
324G	07181	01020		02812 Solenoid AND	01227			01106	01230 Pilot	01229 (10ft)		20598 Manual Shut Off Valve
				20356 Thermo Electric					01591 Burner	2525LH (25ft)		01098 Hose Adapter
				7111NR Power Coil								01099 Wheel
324H	07181	01090		07966 Thermoelectric	01227			01106	01230 Pilot	01229 (10ft)		20229 Manual Shut Off Valve
				7111NR Power Coil					01591 Burner	2525LH (25ft)		01098 Hose Adapter
												01099 Wheel
326	07181	01020		02990 Solenoid AND	01227			21788	01230 Pilot	01229 (10ft)		06537 Thermostat
				20356 Thermo Electric					01591 Burner	2525LH (25ft)		20598 Manual Shut Off Valve
				7111NR Power Coil								
326H	07181	01020		02812 Solenoid AND	01227			01106	01230 Pilot	01229 (10ft)		06537 Thermostat
				20356 Thermo Electric					01591 Burner	2525LH (25ft)		01098 Hose Adapter
				7111NR Power Coil								01099 Wheel
326J	07181	01020		02990 Solenoid AND	01227			01106	01230 Pilot	01229 (10ft)		07339 Thermostat
				07966 Thermo Electric					01591 Burner	2525LH (25ft)		01098 Hose Adapter
												01099 Wheel

LB White Forced Air Propane Continued

Model#	Motor	Thermocouple	Ignition Control/DSI	Valve:Safety/ Auto Control	Fan/Squirrel Cage	Safety Switches	Igniter/ Electrode	Regulator	Orifice: Pilot/Burner	Hose	Transformer	Other
328	07181	01090		02990 Solenoid AND	01227			21788	01230 Pilot	01229 (10ft)		06537 Thermostat
				20356 Thermo Electric					03415 Burner	2525LH (25ft)		20598 Manual Shut Off
				7111NR Power Coil								01098 Hose Adapter
328F	07181	01090		02990 Solenoid AND	01227			01106	01230 Pilot	01229 (10ft)		06537 Thermostat
				20356 Thermo Electric					03415 Burner	2525LH (25ft)		20598 Manual Shut Off Valve
				7111NR Power Coil								01099 Wheel
330	07181	01020		02990 Solenoid AND	01227			21788	01230 Pilot	01229 (10ft)		06537 Thermostat
330G				20356 Thermo Electric					03415 Burner	2525LH (25ft)		01098 Hose Adapter
				7111NR Power Coil								01099 Wheel
334	07181	01020		20356	01342			21788	01230 Pilot	01229 (10ft)		01098 Hose Adapter
334G				7111NR Power Coil					03416 Burner	2525LH (25ft)		20229 Manual Shut Off Valve
												01099 Wheel (Qty 2)
334H	07181	01020		20356	01342			01106	01230 Pilot	01229 (10ft)		01098 Hose Adapter
				7111NR Power Coil					03416 Burner	2525lh (25ft)		20229 Manual Shut Off Valve
												01099 Wheel (Qty 2)
343G	20290	03497		02309	02808	05566 Limit (350˚)		01225	02689 Pilot	01229 (10ft)		05568 Thermostat
									03411 Burner	2525LH (25 ft)		05548 Manual Shut Off Valve
346A	01174	01036		01196	02808	02662 Limit		01225	02729 Pilot	01229 (10ft)		01208 Thermostat
									02805 Burner	2525LH (25 ft)		
346G	20290	03497		02309	02808	05566 Limit (350˚)		01225	02689 Pilot	01229 (10ft)		05568 Thermostat
									03418 Burner	2525LH (25ft)		05548 Manual Shut Off Valve
350	01174	01036		02309	01190	02662 Limit		06772	02689 Pilot	5010 (10ft)		3850FTG Hose to Regulator Fitting
									01296 Burner	5025 (25ft)		01208 Thermostat
												01420 Manual Shut Off Valve

LB White Forced Air Propane Continued

Model#	Motor	Thermocouple	Ignition Control/DSI	Valve:Safety/ Auto Control	Fan/Squirrel Cage	Safety Switches	Igniter/ Electrode	Regulator	Orifice: Pilot/Burner	Hose	Transformer	Other
377J	20554	03497		02309	03531	05566 Limit (350˚)		06772	02689 Pilot	20704 (10ft)		06537 Thermostat
377J-3						02680 Sail Switch			03518 Burner			05548 Manual Shut Off Valve
377J-4												03535 Hose to Regulator Fitting
408J	20554	01090		02309	02684	05566 Limit (350˚)		09911	02689 Pilot	20704 (10ft)		06537 Thermostat
408J-3						02680 Sail Switch			02691 Burner			05548 Manual Shut Off Valve
408J-4												
CP100A	03830		08810	22039	21575	06739 Air Proving	07160	06772	05851	20704 (10ft)	08260	08240 On-Off Switch
CP100B						06687 Back Flash						08811 L.E.D. With Leads
												03536 Hose to Regulator Fitting
CP100BSP	03830		08810	22039	21575	07161 Sail Switch	07160	06772	05851	20704 (10ft)	08260	08240 On-Off Switch
						06687 Back Flash						08811 L.E.D. With Leads
												03536 Hose to Regulator Adapter
CP155A	03830		08810	22039	21575	06739 Air Proving	07160	06772	06685	20704 (10ft)	08260	08240 On-Off Switch
CP155B						06687 Back Flash						08811 L.E.D. With Leads
												03536 Hose to Regulator Adapter
CP155BSP	03830		08810	22039	21575	07161 Sail Switch	07160	06772	06685	20704 (10ft)	08260	08240 On-Off Switch
						06687 Back Flash						08811 L.E.D. With Leads
												03536 Hose to Regulator Adapter
CP155C	03830		22301 (24 Volt)	22400 (24 Volt)	21575	06687 Back Flash	07160	06772	06685	21841 (10ft)	06979	22213 Thermostat
						06739 Air Proving						03834 On-Off Switch
												07027 Wire Harness
CP155C	03830		07637 (120 Volt)	05144 (120 Volt)	21575	06687 Back Flash	07160	06772	06685	21841 (10ft)		07027 Wire Harness
						06739 Air Proving						03834 On-Off Switch
												22213 Thermostat
CP155C	03830		22301 (24 Volt)	22400 (24 Volt)	09347	06687 Back Flash	07160	06772	06685	21841 (10ft)	06979	22299 L.E.D. Lens
(Diagnostic)						06739 Air Proving						05549 Manual Valve
												22213 Thermostat

LB White Forced Air Propane Continued

Model#	Motor	Thermocouple	Ignition Control/DSI	Valve:Safety/ Auto Control	Fan/Squirrel Cage	Safety Switches	Igniter/ Electrode	Regulator	Orifice: Pilot/Burner	Hose	Transformer	Other
CP380A	04719		08810	08813 (Qty 2) or	06697	06664 Back Flash	20312	08997	20410	20719 (10ft)	08958	04720 Capacitor
CP380B				08814 Kit		06739 Air Proving						08811 L.E.D. With Leads
												08240 On/Off Switch
CP380BSF	04719		08810	08813 (Qty 2) or	06697	06664 Back Flash	07160 Plug OR	08997	06751	20704 (10ft)	08958	06871 Throttle Valve
				08814 Kit		07161 Air Flow	20312 Electrode					04720 Capacitor
						20076 Tilt Switch						08811 L.E.D. With Leads
CP400A	04719		098884-01	08022	06697	06739 Air Proving	20312	08997	20410	20704 (10ft)		04720 Capacitor
						06664 Back Flash						06871 Throttle Valve
												05829 Thermostat
CP400B	04719		07637	08022	22302	22526 Air Proving	20312	22315	20410	21841 (10ft)		06971 Throttle Valve
						22294 Back Flash						04720 Capacitor
												03834 On/Off Switch
CP400B	04719		22301	22313	22302	22526 Air Proving	20312	22315	20410	21841 (10ft)	06979	22213 Thermostat
Diagnostic)						22294 Back Flash						04720 Capacitor
												22299 L.E.D.
CP400T	04719		07637	08802	06697	06739 Sail	20312	08997	20410	20704 (10ft)		03834 On/Off Switch
						20411 Back Flash						05829 Thermostat
												04720 Capacitor
CP400T	04719		08810	08813 (Qty 2) or	06697	06739 Sail	20312	08997	20410	20704 (10ft)	08958	05829 Thermostat
Diagnostic)				08814 Kit		20411 Back Flash						04720 Capacitor
												08811 L.E.D.
CS060	20290	03497		02309	02808	05566 Limit (350˚)		06772	02689 Pilot	01517 (10ft)		05548 Manual Valve
									03418 Burner			06537 Thermostat
CS080C	08920		08810	22076	03531	03933 Limit (275)	06479	08990	09753	20531 (10ft)	08922	09454 Thermostat
CS080D						09821 Limit (250)						
CS080E	08920		08810	22076	03531	03933 Limit (275)	06479	08990	09753	20531 (10ft)	08922	09454 Thermostat
						09821 Limit (250)						
						21186 Air Proving						

LB White Forced Air Propane Continued

Model#	Motor	Thermocouple	Ignition Control/DSI	Valve:Safety/ Auto Control	Fan/Squirrel Cage	Safety Switches	Igniter/ Electrode	Regulator	Orifice: Pilot/Burner	Hose	Transformer	Other
CS170D	20169		08810	22076	09050	03933 Limit (275)	06479	09911	09786	20704 (10ft)	08922	09160 Wheel (Qty 2)
CS170E						03784 Limit (190)						06421 Axle
						09925 Air Proving						09454 Thermostat
CT080A	08920		08810	22039	03531	03933 Limit (275)	06479	08990	08918	20531 (10ft)	08922	09454 Thermostat
CT080B												08872 L.E.D. With Leads
CT170A	22112		08810	22039	09050	03933 Limit (275)	06479	09911	09130	20704 (10ft)	08922	09160 Wheel (Qty 2)
CT170B												09454 Thermostat
												08872 L.E.D. With Leads
TS080C	08920		08810	22076	03531	03933 Limit(275)	06479	08990	09753	20531 (10ft)	08922	09454 Thermostat
TS080D						09821 Limit (250)						09915 Heat/Vent Toggle Switch
												08811 L.E.D. With Leads
TS080E	20292		08810	22076	03531	03933 Limit (275)	06479	08990	09753	20531 (10ft)	08922	09454 Thermostat
						09821 Limit (250)						22017 Heat/Vent Rocker Switch
						21186 Air Proving						08811 L.E.D With Leads
TS170C	20169		08810	22076	09050	03933 Limit (275)	06479	09911	09786	20704 (10ft)	08922	09160 Wheel (Qty 2)
						09784 Limit (190)						09915 Heat/Vent Toggle
						09925 Air Proving						09454 Thermostat
TS170D	20169		08810	22076	09050	03933 Limit (275)	06479	09911	09786	20704 (10ft)	08922	22017 Heat/Vent Toggle Switch
						09784 Limit(190)						09454 Thermostat
						09925 Air Proving						09160 Wheel (Qty 2)
TS350	22908		08810	22897	22868	81108 Limit (325)	06479	22919	22898	23079 (10ft)	09615	08685 Relay
						09784 Limit (190)				23078 (15ft)		22017 Selector Switch (With L.E.D.)
						22946 Air Proving						22914 Wheel (Qty 2)
												23130 Caster (Qty 2)
												23129 Belt
												22920 Thermostat

LB White Propane Convection Heaters

Model#	Thermocouple	T.E. Safety Valve	Igniter/ Electrode	Regulator	Orifice: Pilot/Burner	Hose	Other
320	01090	20356		06228	01230 Pilot	01229 (10ft)	20598 Manual Shut-Off Valve
					01329 Burner	2525LH (25ft)	01098 Hose Adapter
							01722 Pilot Screen
320B	01090	07966		21788	01230 Pilot	01229 (10ft)	20229Burner Shut-Off Valve
		7111NR Power Coil			22353 Burner	2525LH (25ft)	01098 Hose Adapter
							01722 Pilot Screen
322	01090	20356		21788	01230 Pilot	01229 (10ft)	20598 Burner Shut-Off Valve
		7111NR Power Coil			01591 Burner	2525LH (25ft)	01098 Hose Adapter
							01722 Pilot Screen
322F	01090	20356		01106	01230 Pilot	01229 (10ft)	20598 Burner Shut-Off Valve
					01591 Burner	2525LH (25ft)	01098 Hose Adapter
							01722 Pilot Screen
322G	01090	07966		01106	01230 Pilot	01229 (10ft)	20229 Burner Shut-Off Valve
		7111NR Power Coil			01591 Burner	2525LH (25ft)	01098 Hose Adapter
							01722 Pilot Screen
340	03497	07966		07960	01230 Pilot	01223 (10ft)	07969 Burner Shut-Off Valve
		7111NR Power Coil			07942 Burner	2525LH (25ft)	01098 Hose Adapter
							01722 Pilot Screen

LB White Propane Convection Heaters Continued

Model#	Thermocouple	T.E. Safety Valve	Igniter/ Electrode	Regulator	Orifice: Pilot/Burner	Hose	Other
340A	03497	07966	06434 Piezo	07960	01230 Pilot	01223 (10ft)	07969 Burner Shut-Off Valve
		7111NR Power Coil	07975 Electrode		07942 Burner	2525LH (25ft)	01098 Hose Adapter
							01722 Pilot Screen
341	01090	20356		21788	01230 Pilot	01229 (10ft)	20598 Manual Shut-Off Valve
		7111NR Power Coil			01329 Burner	2525LH (25ft)	01098 Hose Adapter
							01722 Pilot Screen
341G	01090	20356		01106	01230 Pilot	01229 (10ft)	20598 Manual Shut-Off Valve
					01329 Burner	2525LH (25ft)	01098 Hose Adapter
							01722 Pilot Screen
341H	01090	20356		21788	01230 Pilot	01229 (10ft)	20598 Manual Shut-Off Valve
342G		7111NR Power Coil			01329 Burner	2525LH (25ft)	01098 Hose Adapter
							01722 Pilot Screen
380	03497	01540		06772	02689 Pilot	20704 (10ft)	03536 Hose Adapter
380J					06237 Burner		
CV100	03555	07966	20280 Piezo	21722	20213 Pilot	20496 (10ft)	20229 Burner Shut-Off Valve
		7111NR Power Coil	20184 Electrode		20187 Burner		01098 Hose Adapter
							20391 Inlet Screen
CV200	03497	07966	20280 Piezo	21722	01230 Pilot	20703 (10ft)	07969 Burner Shut-Off Valve
		7111NR Power Coil	07975 Electrode		07942 Burner		01098 Hose Adapter
							01722 Inlet Screen
CV250	03555	07966	20280 Piezo	21722	20212 Pilot	20496 (10ft)	20229 Burner Shut-Off Valve
		7111NR Power Coil	20184 Electrode		20189 Burner		01098 Hose Adapter

COMMON GAS FITTING PART NUMBERS

Pipe Thread X Pipe Thread

6133NR	1/4"FPT x 1/4"FPT Coupler
3825CPL	1/4"FPT x 3/8"FPT Coupler
2538BELL	1/4"FPT X 3/8"FPT Bell Reducer
01544	1/4"FPT x 3/8"FPT Reducing Bushing
6435NR	1/4"FPT x 3/8"MPT Reducing Bushing
01519	1/4"FPT x 1/2"FPT Union
6267NR	1/4"FPT x 1/2"MPT Bushing
28199	1/4"FPT x 1/2"FPT Reducing Bushing
01195	3/8"FPT x 1/2"FPT Reducing Bushing
3850BELL	3/8"FPT x 1/2"FPT Bell Reducer
3850CPL	3/8"FPT x 1/2"FPT Coupler
3850FTG	3/8"FPT x 1/2"FPT Bushing
5038FTG	3/8"FPT x 1/2"MPT Reducing Bushing
54	1/2"FPT x 1/2"FPT Swivel Union
7500P	3/4"FPT x 3/4"FPT Swivel Union
12500P	11/2"FPT x 11/2"FPT Swivel Union

Flare X Flare

2538FLR	1/4"FFLR x 3/8"MFLR
2550FTG	1/4"MFLR x 3/8"MFLR
381050FTG	3/8"MFLR x 1/2"FFLR

Pipe Thread X Flare

097157-01	1/4"FPT x 1/4"MFLR
097157-02	1/4"FPT x 3/8"MFLR
097157-03	1/4"FPT x 1/2"MFLR
097809-01	1/4"MPT x 1/4"MFLR
6127NR	1/4"MPT x 3/8"MFLR
3810FTG	3/8"FPT x 3/8"MFLR
M51572-01	3/8MPT x 3/8"MFLR
M51572-02	3/8"MPT x 1/2"MFLR
8017NR	1/2"FPT x 3/8"MFLR
6126NR	1/2"MPT x 3/8"MFLR
10444	1/2"MPT x 1/2"FFLR
103401-01	1/2"MPT x 1/2"MFLR

Special Fittings

07970*	1/4"LHMPT x 1/4"FPT
01098*	1/4"LHMPT x 1/4"MPT
2510LHFTG*	1/4"LHMPT x 1/4"LHMPT
03395*	1/4"LHMPT x 1/2"MPT
06771**	1/4"MPT x 1/2"MPT(INV. FLARE)
03536**	3/8"MPT x 1/2"MPT(INV. FLARE)
02894**	1/2"MPT x 1/2"MPT(INV. FLARE)

COMMON GAS HOSES

2510	1/4" x 10ft with 1/4"MPT x 1/4"FFLR Swivel
2525	1/4" x 25ft with 1/4" MPT x 1/4"FFLR Swivel
3810	3/8" x 10ft with 3/8"MPT x 3/8"FFLR Swivel
381050	3/8" x 10ft with 3/8"MPT x 1/2"FFLR Swivel
3825	3/8" x 25ft with 3/8"MPT x 3/8"FFLR Swivel
382550	3/8" x 25ft with 3/8"MPT x 1/2"FFLR Swivel
5010	1/2" x 10ft with 1/2"MPT x 1/2"MPT
5025	1/2" x 25ft with 1/2"MPT x 1/2"MPT
5050	1/2" x 50ft with 1/2"MPT x 1/2"MPT
7510P	3/4" x 10ft with 3/4"MPT x 3/4"MPT
7525P	3/4" x 25ft with 3/4"MPT x 3/4"MPT
7550P	3/4" x 50ft with 3/4"MPT x 3/4"MPT
12510P	11/4" x 10ft with 11/4"MPT x 11/4"MPT
12525P	11/4" x 25ft with 1/14"MPT x 11/4"MPT
2510LH	1/4" x 10ft with 1/4"LHFPT x 1/4"LHFPT*
2525LH	1/4" x 25ft with 1/4"LHFPT x 1/4"LHFPT*

COMMON GAS ACCESSORIES

G1629	Soft nosed withdrawal fitting with excess flow valve
G1690	Hard nosed withdrawal fitting with excess flow valve
G6252	Soft nosed withdrawal fitting with handwheel and excess flow valve
30SO7P*	Soft nosed withdrawal fitting with all left hand pipe threads
G1851	Black acme withdrawal fitting for 71,000 BTU's or less
G1852	Green acme withdrawal fitting for 71,000-200,000 BTU's
P400	48" copper pigtail with hard nosed withdrawal fittings
1630RU	30" rubber pigtail with soft nosed withdrawal fittings
1648RU	48" rubber pigtail with soft nosed withdrawal fittings
G1851	Black acme withdrawal fitting (0-70,000 BTU's)
G1852	Green acme withdrawal fitting (71-200,000 BTU's)

MPT=Male Pipe Threads
FPT=Female Pipe Threads
MFLR=Male Flare
FFLR=Female Flare
*Left Hand Pipe Threads

Introduction to Natural Gas Heaters

In this section of the manual, we will be dealing with natural gas heaters as well as the principals of natural gas heating. Natural gas heaters will have distinct advantages and disadvantages when compared to the propane heaters mentioned earlier. The main advantage of using natural gas heaters is the availability of fuel supply. Natural gas is available in most communities, as well as in most industrial situations. With the fuel supply already on site and always available, natural gas may be the best alternative. As the availability for natural gas increases, so will the natural gas heater's share of the portable heater market. However, natural gas does have some disadvantages. First, natural gas is not available in all areas. Second, the portability of natural gas heaters is limited by the gas pressure, as well as by the length and diameter of the fuel supply hose. Next, it is important to maintain the proper volume of natural gas. For help with natural gas volume issues, please refer to the section titled "THE SUPPLY ISSUES WITH NATURAL GAS HEATERS". The last two disadvantages of natural gas heat are that there are not many heating applications where high pressure (pounds of pressure) natural gas is available, and that there are not as many different model numbers available for natural gas as there are for propane. However, there will be situation where the best heater option is to use natural gas.

Technical Issues with Natural Gas Heaters

The number one technical issue with natural gas heaters is the ability to get the proper natural gas volume. Most natural gas heaters usually do not come with a fuel supply hose because the inside diameter (I.D.) of the hose size will vary depending on the available gas supply pressure. That happens to be the number one technical issue with natural gas heaters: having the correct natural gas volume. For more information about natural gas volumes, or for help in natural gas supply hose selection, please refer to the section titled "THE SUPPLY ISSUES WITH NATURAL GAS HEATERS". For technical issue involving the troubleshooting of individual components, please refer to the earlier section titled "PARTS IDENTIFICATION & DEFINITION".

Natural Gas Heater Safety

Natural gas heaters can be an extremely safe way of providing heat as long as certain safety precautions are followed:

1. Never check for gas leaks with an open flame. Use a water solution of one part soap to three parts water to spray the gas connections. Natural gas in a supply hose or in a heater is under POSITIVE pressure, meaning that any leaks will be outgoing. Never try to convert natural gas heaters to ANY other type of fuel source (propane vapor, butane, or liquid propane.) The procedure can create potentially dangerous situations and it can void manufacturer's warranties.

2. Never operate a natural gas heater or any other heater with any factory installed safety controls removed. The safety controls are there for a reason, let them do their job. If you find that an original factory installed safety control is defective, then replace it immediately with a factory-authorized replacement only. It may be necessary to remove or bypass a safety control for troubleshooting purposes only, but never let that unit leave your workbench without reinstalling the proper safety controls.

3. Never replace a regulator unless it is a factory authorized replacement. Some regulators look alike, but that does not mean that they perform alike. If a part is replaced with anything other than original equipment manufacturer (OEM) parts, the product liability falls on the person replacing the parts. Using non-OEM parts may void factory warranties.

4. Never put ductwork on a natural gas heater unless it is explicitly authorized by the OEM. If the heater was not designed for ducting (the vast majority of them are not), then do not attempt to use ducting. Use of ducting on heaters not meant to be ducted can cause a fire or component damage and failure. Using ducting not only will void the manufacture's warranty, but most insurance companies will not honor a policy resulting from damage from operating a heater that was not used under original factory guidelines.

5. Always allow for proper ventilation when operating any natural gas heater. The recognized industry guideline for this is usually three square feet for every 100,000 BTU'S of heat. For optimum ventilation, either try to split the ventilation openings evenly between the floor and ceiling, or try to utilize cross ventilation.

6. Do not attempt to move, service, or handle a heater that is in operation or still warm from operation.

7. Always adhere to the owner's manual for manufacturer's recommendations in spacing your heater away from combustibles.

8. Use a properly grounded outlet and extension cord for natural gas forced air heaters.

None of the above safety rules are to supercede manufacturer's safety standards; these rules are always to be viewed as an addition to your factory specified safety instructions.

The Supply Issues With Natural Gas Heaters

Quite often, technical issues associated with the performance of natural gas heaters do not always involve the heater itself, rather with the various components before they even reach the heater. In order to have a properly working heater, there needs to be an appropriate amount of each of three component: fuel supply, electric supply (if applicable), and air supply.

Fuel Supply

Guaranteeing an adequate fuel supply is one of the biggest problems associated with the proper performance of natural gas heaters. In order to have the correct fuel supply two things are needed: 1) proper operating pressure, and 2) proper fuel volume.

Operating pressure is the natural gas pressure required by the heater for safe and proper operation. In other words, supply pressure is the amount of force behind the natural gas. This pressure can be either low pressure (rated in inches of water column), or high pressure (rated in pounds of pressure). Proper fuel volume is the amount of inlet fuel required to insure proper operation. All natural gas heaters require BOTH of these needs be satisfied to insure proper operation. There is a big difference between the required operating pressure in a fuel supply and the required operating volume in a fuel supply. It is possible for a heater to have the proper operating pressure; it will not work properly (or at all) without having the proper volume of fuel. For various hose sizing charts, please see the following.

Natural Gas hose capacity table at .5" w.c. pressure drop and inlet pressure of 11" w.c.

BTU's	Hose Length in Feet									
per Hour	5	10	15	20	25	50	75	100	150	200
5,000	1/4"	1/4"	1/4"	1/4"	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"
10,000	1/4"	1/4"	1/4"	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"	1/2"
15,000	1/4"	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"	1/2"	1/2"	1/2"
20,000	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"	1/2"	1/2"	1/2"	1/2"
25,000	3/8"	3/8"	3/8"	3/8"	3/8"	1/2"	1/2"	3/4"	3/4"	3/4"
50,000	3/8"	1/2"	1/2"	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"	3/4"
75,000	1/2"	1/2"	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"	1"	1"
100,000	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"
150,000	1/2"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1.25"	1.25"
200,000	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1.25"	1.25"	1.25"
250,000	3/4"	3/4"	1"	1"	1"	1"	1.25"	1.25"	1.25"	
300,000	3/4"	3/4"	1"	1"	1"	1.25"	1.25"	1.25"		
350,000	3/4"	1"	1"	1"	1"	1.25"	1.25"	1.25"		
400,000	3/4"	1"	1"	1"	1.25"	1.25"	1.25"			
450,000	1"	1"	1"	1"	1.25"	1.25"				
500,000	1"	1"	1"	1.25"	1.25"					
550,000	1"	1"	1.25"	1.25"	1.25"					
600,000	1"	1"	1.25"	1.25"	1.25"					
650,000	1"	1.25"	1.25"	1.25"	1.25"					
700,000	1"	1.25"	1.25"	1.25"	1.25"					
750,000	1"	1.25"	1.25"	1.25"						

NOTE:

(1) Capacity of hose assembly will vary depending on end fitting flow diameter and adapters.

(2) BTU's per hour based on Nat. Gas with .63 Sp. Gr. And BTU per C.F. at 60 degrees F.

Natural Gas hose capacity at .5" w.c. pressure drop and inlet pressure of 1 P.S.I. (28.6" w.c.)

BTU's	Hose Length in Feet									
Per Hour	5	10	15	20	25	50	75	100	150	200
5,000	1/4"	1/4"	1/4"	1/4"	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"
10,000	1/4"	1/4"	1/4"	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"	3/8"
15,000	1/4"	1/4"	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"	1/2"	1/2"
20,000	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"	1/2"	1/2"	1/2"	1/2"
25,000	1/4"	3/8"	3/8"	3/8"	3/8"	1/2"	1/2"	1/2"	1/2"	3/4"
50,000	3/8"	3/8"	1/2"	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"	3/4"
75,000	3/8"	1/2"	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"	1"	1"
100,000	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"
150,000	1/2"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1"	1.25"
200,000	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1.25"	1.25"	1.25"
250,000	3/4"	3/4"	3/4"	1"	1"	1"	1.25"	1.25"	1.25"	
300,000	3/4"	3/4"	1"	1"	1"	1.25"	1.25"	1.25"		
350,000	3/4"	1"	1"	1"	1"	1.25"	1.25"	1.25"		
400,000	3/4"	1"	1"	1"	1"	1.25"	1.25"			
450,000	3/4"	1"	1"	1"	1.25"	1.25"				
500,000	1"	1"	1"	1.25"	1.25"	1.25"				
550,000	1"	1"	1.25"	1.25"	1.25"					
600,000	1"	1"	1.25"	1.25"	1.25"					
650,000	1"	1"	1.25"	1.25"	1.25"					
700,000	1"	1.25"	1.25"	1.25"	1.25"					
750,000	1"	1.25"	1.25"	1.25"						

NOTE:

(1) Capacity of hose assembly will vary depending on end fitting flow diameter and adapters.

(2) BTU's per hour based on Nat. Gas with .63 Sp. Gr. And BTU per C.F. at 60 degrees F.

Natural Gas hose capacity at .5" w.c. pressure drop at inlet pressure of 5 P.S.I.

BTU's	Hose Length in Feet									
Per Hour	5	10	15	20	25	50	75	100	150	200
5,000	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	3/8"
10,000	1/4"	1/4"	1/4"	1/4"	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"
15,000	1/4"	1/4"	1/4"	1/4"	3/8"	3/8"	3/8"	3/8"	1/2"	1/2"
20,000	1/4"	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"	1/2"	1/2"	1/2"
25,000	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"	1/2"	1/2"	1/2"	1/2"
50,000	3/8"	3/8"	3/8"	1/2"	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"
75,000	3/8"	1/2"	1/2"	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"	3/4"
100,000	1/2"	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"
150,000	1/2"	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1"
200,000	1/2"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1.25"	1.25"
250,000	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1.25"	1.25"	1.25"
300,000	3/4"	3/4"	3/4"	1"	1"	1"	1.25"	1.25"	1.25"	1.25"
350,000	3/4"	3/4"	1"	1"	1"	1"	1.25"	1.25"	1.25"	
400,000	3/4"	1"	1"	1"	1"	1.25"	1.25"	1.25"		
450,000	3/4"	1"	1"	1"	1"	1.25"	1.25"			
500,000	3/4"	1"	1"	1"	1"	1.25"	1.25"			
550,000	1"	1"	1"	1"	1.25"	1.25"				
600,000	1"	1"	1"	1.25"	1.25"	1.25"				
650,000	1"	1"	1"	1.25"	1.25"					
700,000	1"	1"	1.25"	1.25"	1.25"					
750,000	1"	1"	1.25"	1.25"	1.25"					

NOTE:

(1) Capacity of hose assembly will vary depending on end fitting flow diameter and adapters.

(2) BTU's per hour based on Nat. Gas with .63 Sp. Gr. And BTU per C.F. at 60 degrees F.

Natural Gas hose capacity at .5" w.c. pressure drop at inlet pressure of 10 P.S.I.

BTU's	Hose Length in Feet									
Per Hour	5	10	15	20	25	50	75	100	150	200
5,000	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"
10,000	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	3/8"	3/8"	3/8"
15,000	1/4"	1/4"	1/4"	1/4"	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"
20,000	1/4"	1/4"	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"	1/2"	1/2"
25,000	1/4"	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"	1/2"	1/2"	1/2"
50,000	3/8"	3/8"	3/8"	3/8"	3/8"	1/2"	1/2"	3/4"	3/4"	3/4"
75,000	3/8"	3/8"	1/2"	1/2"	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"
100,000	3/8"	1/2"	1/2"	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"	3/4"
150,000	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"
200,000	1/2"	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1"
250,000	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1.25"	1.25"
300,000	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1"	1.25"	1.25"
350,000	3/4"	3/4"	3/4"	1"	1"	1"	1"	1.25"	1.25"	1.25"
400,000	3/4"	3/4"	1"	1"	1"	1"	1.25"	1.25"	1.25"	
450,000	3/4"	3/4"	1"	1"	1"	1.25"	1.25"	1.25"		
500,000	3/4"	1"	1"	1"	1"	1.25"	1.25"	1.25"		
550,000	3/4"	1"	1"	1"	1"	1.25"	1.25"			
600,000	3/4"	1"	1"	1"	1"	1.25"	1.25"			
650,000	3/4"	1"	1"	1"	1.25"	1.25"				
700,000	3/4"	1"	1"	1"	1.25"	1.25"				
750,000	1"	1"	1"	1.25"	1.25"	1.25"				

NOTE:

(1) Capacity of hose assembly will vary depending on end fitting flow diameter and adapters.

(2) BTU's per hour based on Nat. Gas with .63 Sp. Gr. And BTU per C.F. at 60 degrees **F.**

Natural Gas hose capacity at .5" w.c. pressure drop at inlet pressure of 20 P.S.I.

BTU's	Hose Length in Feet								
Per Hour	5	10	15	20	25	50	75	100	150	200
5,000	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"
10,000	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	3/8"	3/8"
15,000	1/4"	1/4"	1/4"	1/4"	1/4"	1/4"	3/8"	3/8"	3/8"	3/8"
20,000	1/4"	1/4"	1/4"	1/4"	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"
25,000	1/4"	1/4"	1/4"	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"	1/2"
50,000	1/4"	3/8"	3/8"	3/8"	3/8"	3/8"	1/2"	1/2"	1/2"	3/4"
75,000	3/8"	3/8"	3/8"	3/8"	1/2"	1/2"	1/2"	3/4"	3/4"	3/4"
100,000	3/8"	3/8"	1/2"	1/2"	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"
150,000	3/8"	1/2"	1/2"	1/2"	1/2"	3/4"	3/4"	3/4"	1"	1"
200,000	1/2"	1/2"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1"
250,000	1/2"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1"	1"
300,000	1/2"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1"	1"
350,000	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1.25"	1.25"
400,000	3/4"	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1.25"	1.25"
450,000	3/4"	3/4"	3/4"	3/4"	1"	1"	1"	1.25"	1.25"	1.25"
500,000	3/4"	3/4"	3/4"	1"	1"	1"	1"	1.25"	1.25"	1.25"
550,000	3/4"	3/4"	3/4"	1"	1"	1"	1.25"	1.25"	1.25"	
600,000	3/4"	3/4"	3/4"	1"	1"	1"	1.25"	1.25"	1.25"	
650,000	3/4"	3/4"	1"	1"	1.25"	1.25"	1.25"	1.25"		
700,000	3/4"	1"	1"	1"	1.25"	1.25"	1.25"	1.25"		
750,000	3/4"	1"	1"	1.25"	1.25"	1.25"	1.25"	1.25"		

NOTE:

(1) Capacity of hose assembly will vary depending on end fitting flow diameter and adapters.

(2) BTU's per hour based on Nat. Gas with .63 Sp. Gr. And BTU per C.F. at 60 degrees F.

Electrical Supply (If applicable)

It is important to have ample voltage supply at the heater. It is not uncommon for a 120 volt receptacle to have something less than 120 volts. When a receptacle has less than 120 volts, a voltage drop exists. This is caused from a number of circumstances.

Use a multi-meter to test for 120 volts (AC) at the receptacle. It is also important to make sure that the length and gauge of the extension cord are both appropriate for the proper supply voltage needs. The longer the extension cord and the higher the gauge wires in the cord, the more resistance there will be in the cord. A voltage drop may also exist in extremely cold weather conditions. For a helpful reference on wire resistance, see the following chart.

Wire Resistance in Common Gauge Cords

WIRE GAUGE SIZE	RESISTANCE PER FOOT
#6 Wire	.000403
#8 Wire	.000641
#10 Wire	.00102
#12 Wire	.00162
#14 Wire	.00258
#16 Wire	.00409
#18 Wire	.00651

How To Figure Voltage Drop

Every natural gas heater that uses electricity will have a voltage drop. The voltage drop can be calculated using a simple formula. There are four things needed to determine the voltage drop:

1. The amp draw of the heater.
2. The gauge of the power cord or extension cord.
3. The length of the power cord or extension cord to be used.
4. The resistance per foot for the power cord or extension cord.

The amp draw of the motor can be found on the spec plate of the heater. The gauge of the extension cord indicates the size of the copper wire that is inside the extension cord and is usually found on the outside insulation of the cord. The extension cord's resistance can be found by reviewing the "wire resistance chart." Locate the gauge of the extension cord and match it up with the resistance per foot in the chart. The formula is as follows:

length of cord x resistance per foot of cord x amp draw = voltage drop

The following example can be worked out using the given inputs:
amp draw for our heater = 5 amps
gauge of cord = 16 gauge
length of cord = 200 ft
resistance of 16 gauge cord = .00409 per ft (see resistance chart)

200 x .00409 x 5 = 4.09

The voltage drop determined in the example is 4.09 volts. Subtract 4.09 from the starting voltage of 120 to get 115.91. Most 120-volt heaters can operate safely down to 107 volts, so the desired extension cord in the example will be sufficient for the application. However, if it gets extremely cold, or if anything else is going to be run off of the same circuit, then it is advisable to use a 14 gauge or 12 gauge cord. This is why PHP does not stock any extension cords over 12 gauge. To decrease the odds of this becoming a technical (and performance) issue, try to keep 12 gauge (the best seller at PHP) or 10 gauge cords in stock. If you have further questions about voltage drop, please contact PHP.

Air Supply

Air supply can be broken down into two fields. The first field that requires a certain amount of air supply is air for the combustion process. Without a certain percentage of clean air, the efficiency of the burn will diminish or go out altogether. This volume of needed air supply will vary per heater and will be listed in each heaters owner's manual. The second field that requires a certain amount of air supply is the interior area that the heater is operating. Most propane heaters discharge the contaminants of the burn into the area to be heated. Normal room oxygen levels are in the 20% range, plus or minus a few percent due to varied factors. Most natural gas heaters require 20% of oxygen for a high efficient burn. If the oxygen levels start to fall below 20%, efficiency starts to suffer. When efficiency starts to suffer, O2 levels will buildup in the space being heated. Dangerous oxygen levels start at approximately the 17% level. At the 17% level, headaches and other related health issues are encountered. This is why the industry standard on ventilation is three SQ FT per 100,000 BTU's of heat. This level should always be adhered to.

The Three Types Of Natural Gas Heaters

There are three basic types of natural gas heaters: forced air, radiant, and convection. In this section, each heater is defined along with its particular advantages and disadvantages.

FORCED AIR

These heaters are heaters that use an internal motor and fan to distribute heat. Forced air heaters are commonly called "torpedo" heaters. Forced air natural gas heaters range in size from 150,000 BTU'S to 750,000 BTU'S through PHP. The advantages of the forced air heater are many. The whole unit does not have to be in the area to be heated; only the discharge end of the unit has to be in the area to be heated. This allows clean air exchanges with outside air. In addition, the forced air heater is also a "directional" heater. This means heat can be focused on a certain item or place. The forced air heater usually has multiple safety features. These usually consist of high limit switches, sail switches, air proving switches, tip switches (normally found on older units), spark plugs, igniter electrodes, ignition control boards, valves, and even thermocouples.

As with all heating systems, there are a few disadvantages associated with forced air units. The first disadvantage is the fact that electricity is required for operation. Another disadvantage is that forced air is more of a complex unit to troubleshoot and repair. Lastly, forced air units rely on three components to work properly: the timed delivery of air, spark, and fuel (in that order).

RADIANT

These heaters work on the principle of transferring heat from one object to another without heating the space in between. For instance, the roof of a black car that has been sitting in the sun on a cool 60 degree day is much warmer than the surrounding air. Therefore, the radiant heat from the sun heated the roof of the car without heating the space in between. That is the concept of radiant heat. As with all heating systems, there are advantages as well as disadvantages.

The first advantage is that most radiant heaters require no external electricity. The second advantage of radiant heat is that the ground level is heated first, maximizing the BTU efficiency more so than other heating sources. The third advantage is that the most popular radiant heaters are in the 100,000 BTU range, making them ideal for using standard residential natural gas pressure. The disadvantages are few. First, very few models have a thermostatic gas valve which means you cannot use a thermostat. Second, there are relatively few BTU sizes available, mainly low pressure 100,000 BTU models and high pressure 250,000 BTU models.

CONVECTION

These heaters work on the principle of heat stratification. Heat stratification means heating the topmost areas first, then forcing the heat down in layers until it reaches the comfort zone (usually from ground level to 6' off the ground). The main advantage of convection heaters is that they are the most inexpensive heaters to purchase, providing the most BTU'S for the buck! The disadvantages of convection heaters are twofold. First, since convection heaters work on the theory of heat stratification, most of the fuel dollars quickly rise with the heat to the ceiling and away from the comfort zone. Second, with very few convection models available for natural gas, large heating applications are not usually practical.

Diagnosing Natural Gas Radiant and Convection Heaters

This section of the manual involves the diagnosing of various issues and problems that will come up when dealing with natural gas radiant and convection heaters. You may have dealt with these questions previously, but this section may give you a few more options when it comes to troubleshooting. The purpose of this section is not to have every single question and answer possible. What it will hopefully give you is a good basic background on how many different things can cause a certain symptom. What is extremely important about this section is that the possible solutions to a heater's problem will be listed in order of most common to the least common. If you do not know how to test a component part, or if you do not know what the component part does, then please refer to the " PARTS IDENTIFICATION & DEFINITION" section listed earlier in this manual. In this first section, we will be dealing with the radiant and convection (salamander) heaters only. The forced air section immediately follows the radiant and convection section.

Convection and Radiant Symptom

Symptom *My convection heater will run, but it will shut off when I take my finger off the gas valve.*

Question Is the thermocouple in the hottest portion of the pilot flame?

Yes, then check for the proper fuel supply to the unit. Next, light the pilot light and hold in the gas valve button for 30 to 60 seconds. If that does not work, then test the thermocouple, then the gas valve, and lastly, check and clean the connection between the valve and the thermocouple. If the gas valve fails the test, then you may be able to change the power coil by itself instead of the whole gas valve.

No, then check for an adequate fuel supply for the BTU output. If there is an adequate fuel supply, then check the pilot orifice for obstructions. In addition, check to make sure that the fuel valve is all the way open. Convection heaters can run up to 250,000 BTU'S and the number one technical issue with these heaters is inadequate fuel supply.

Symptom *My pilot light will not light.*

Question Is there gas coming out of the pilot orifice?

Yes, just because there is gas coming out of the pilot orifice does not mean that it is coming out properly or even with the proper pressure behind it. Check to make sure that you have the proper regulator for your model of heater. If you have the proper gas pressure, then shut off your gas to the unit, and purge the gas from the fuel supply hose. Then disconnect your fuel supply hose from the heater. Then, press in the button on the gas valve and blow compressed air through the pilot orifice in the opposite direction of the fuel flow. By doing this, any contaminants inside your heater will be blown free of the unit. If your heater has a Piezo igniter and an igniter electrode, perform a test on both of them.

No, then start by checking to see if you have gas to the unit. If you have gas to the unit, then disconnect the unit from the fuel supply hose after properly purging the system of gas. Then proceed to blow regulated, compressed air from the pilot and burner orifice backwards until all contaminants are removed from the unit.

Symptom *My heater gives off an odor and does not give off much heat.*

Question Is the supply hose the right size for the heater?

Yes, if the fuel supply hose is adequate for your heater, then your problem lies in a few other areas. The most common problem is the restriction of fuel flow from the orifices, then the regulator, and lastly the push button gas valve. Use regulated compressed air to blow thru these components in the opposite direction of the normal fuel flow. The condition of the sheet metal also plays a part in where and how our burn takes place.

No. Make sure you have the correct supply hose for your heater and heating application. Please see the previous section titled "THE SUPPLY ISSUES WITH NATURAL GAS HEATERS" for help in selecting the proper fuel supply hose for your heater.

Symptom *My heater burns, but it has a mostly yellow flame.*

Question Does your heater give off an odor?

Yes, then there may be a problem getting the correct components to function at the right time. Make sure that you have 3 square feet of ventilation for every 100,000 BTU's. Make sure you have correct fuel flow. Check for the possibility of an incorrect regulator, a partially restricted burner orifice, a low or improper fuel level, or a problem with a too long of a hose or too small of an inside diameter of the hose.

No, then this is most likely a low fuel related issue. Check to make sure that you have the correct regulator as well as the correct fuel supply hose.

Remember, if you have any other questions, please call P.H.P. @ (800) 362-6951

Diagnosing Natural Gas Forced Air Heaters

This section of the manual deals with the troubleshooting of natural gas forced air heaters. Gas pressures and volumes are the two biggest troubleshooting issues when working with natural gas forced air heaters. For assistance with natural gas pressures and volumes, please refer to the section titled "THE SUPPLY ISSUES WITH NATURAL GAS HEATERS" listed earlier in this manual.

Symptom *My heater will fire, but it will only run for about 15 seconds.*

Question Is your heater low pressure ?

Yes, if your heater is low pressure, then most likely there is a problem with either the unit's ability to prove the existence of flame, or there is a problem with the high limit switch. Bypass the high limit switch. If the heater runs correctly, replace the switch. If the unit does not work correctly, then make sure that the sensing element (electrode, spark plug, flame rod, or flame sensor) is in a position to properly sense the existence of the flame. If these components are in the proper position to sense the flame, then you need to test them one at a time. Please refer to the section labeled "PARTS IDENTIFICATION & DEFINITION" for help with troubleshooting. If these components test fine, then you most likely have a bad ignition control board. In addition, you still may have a problem supplying the proper amount or volume of fuel to the unit. Please refer to the section titled "THE SUPPLY ISSUES WITH NATURAL GAS HEATERS" (page 72).

No, if your heater is high pressure (rated in pounds), then you need to find out what the gas line pressure is. High pressure natural gas is usually found in larger industrial applications only, therefore the applications for using high pressure natural gas heaters is limited. If the natural gas supply pressure is low pressure (rated in inches of water column), then you need to use low pressure heaters. Usually, the largest low pressure forced air natural gas heaters are in the 150,000 BTU range.

Symptom *My heater will run from 15 to 30 minutes, and then shut down.*

Question Does the heater run for shorter lengths of time each time it cycles?

Yes, then the most common problem will be with the high limit switch. To prove this, bypass the limit switch (for testing only), and let the unit run for an hour. If this does not solve the problem, then bypass the thermostat (if applicable). This should solve the problem.

No, there be a problem with the fuel hose being either too long, or too small in diameter. For help in this area, please refer to the section titled "THE SUPPLY ISSUES WITH NATURAL GAS HEATERS" (page 72).

Symptom *My motor runs, I smell gas, but my heater will not light.*

Question Do you hear the electrode (or spark plug) clicking?

Yes, then there is a problem with how the air, fuel and spark systems come together for proper operation. Usually this means that the natural gas is too far in front of the spark for ignition. If this is the case, you first need to blow compressed air through the burner orifice. Then, perform a fan blade test. If the problem persists, then you need to check the diffuser, burner, and / or the filter (depending on the heater's manufacturer).

No, then you may have a bad ignition control module. In order to prove that you have a bad ignition control module, test the component parts that function off the module itself. In other words, if the components around the ignition control module work, then by process of elimination, the ignition control module is faulty.

Symptom *My motor runs, my electrode sparks, but my heater will not ignite.*

Question Do you smell gas?

Yes, then once again, there is a problem with how the air, fuel and spark systems come together for proper operation. Usually this means that the natural gas is too far in front of the spark for ignition. If this is the case, blow compressed air thru the burner orifice. Then, perform a fan blade test. If the problem persists, then check the diffuser, burner, and / or the filter (depending on the heater's manufacturer).

No, then you most likely will have a problem with the high limit switch, the solenoid valve, or the ignition control module. You can find out which one of the three is bad by bypassing the high limit switch. If the heater fires, then replace the high limit switch. If that does not solve the problem, apply the proper inlet voltage to the board (usually 120 volts), and check the leads that run to the solenoid valve for the same voltage with a voltmeter. If proper voltage is feeding the solenoid, and the solenoid will still not open, then the solenoid needs to be replaced. If there is not proper voltage coming off the ignition control module when the proper inlet voltage is applied, then the module itself is faulty and needs to be replaced.

Desa Natural Gas

Model#	Motor	Thermocouple	Ignition Control/D.S.I.	Valve:Solenoid/Thermoelectric	Safety Switches	FAN	Igniter/Electrode	Regulator	Orifice: Pilot/Burner
BNG150T	105336 01	NA	51605 02	103403 01 olenoid	101481 05 igh Limit	51153 01	103934 01	103406 01	103891 01 Nozzle
BNG150T 003	105336 01	NA	110287 01 110267 01 amess	103403 01 olenoid	101481 05 igh Limit	51153 01	103934 01	103406 01	103891 01 Nozzle
TC100RNG	NA	099237 01 099236 01 Clip	NA	104119 01 hermoelectric	NA	NA	102445 01 Piezo 104118 01 Electrode	103936 01	097161 04 Pilot 099138 03 Burner
TC100VRNG	NA	107374 01	NA	103920 03 hermoelectric 7111NR Power Coil	NA	NA	102445 01 Piezo 106174 02 Electrode	103406 02	106184 02 Burner Kit
TC 50RNG	NA	097151 01	NA	097155 01 hermoelectric 7111NR Power Coil	NA	NA	102445 01 Piezo 104118 01 Electrode	104141 01	097161 01 Pilot 099138 05 Burner

Scheu Natural Gas Radiant & Convection

Model#	Thermocouple	T.E. Safety Valve	Igniter/Electrode	Regulator	Orifice: Pilot/Burner	Hose Optional	Other
80VCNG	6233NR 6045NR Clip	6104NR 7111NR Power Coil	6473NR Piezo 7160NR Electrode	6259NR	7253NR Pilot 3621NR Burner	5010 (10ft)	6655NR Ad uster Valve Low Pressure
101NG	6235NR	6103NR Brushed Aluminum 6515NR Knob	NA	6259NR	6109NR Pilot 6112NR Burner	5010 (10ft)	anual Ignition Low Pressure
100RNG Pre 1	6235NR	6103NR Brushed Aluminum 6515NR Knob	NA	6259NR	6109NR Pilot 6113NR Burner	5010 (10ft)	anual Ignition Low Pressure
100RANG 1 1 8	6234NR 6045NR Nut	6103NR Brushed Aluminum 6515NR Knob	NA	6259NR	7253NR Pilot 6113NR Bumer	5010 (10ft)	anual Ignition Low Pressure
100RANG 1 00	6234NR 6045NR Nut	7616NR Brushed Aluminum 6515NR Knob	6473NR Piezo 3451NR Electrode	6259NR	7253NR Pilot 6113NR Bumer	5010 (10ft)	7161NR Piezo Nut Low Pressure
1 5RN	09352	00332	CR835 Piezo CR805 Igniter	11666	05374 Pilot	Call	CR810 heel (t 2) CR820 A le CR815 A le Brac ets
50RANG	6234NR 6045NR Nut	6104NR 7111NR Power Coil	NA	7531NR	7479NR Pilot 3743NR Bumer	5010 (10ft)	6655NR Burner Valve 7496NR Burner Valve andle

ou ma need to use part s 54 and 10444 to adapt hoses for propper application

Scheu Natural Gas Forced Air

Model#	Motor	Thermocouple	Ignition control/D.S.I.	Valve: Safety/Auto Control	Fan/S uirrel Cage	Safety Switches	Igniter/Electrode	Regulator	Orifice: Pilot/Burner	Hose Optional	Spark Generator	Other
30DFASNG 1 1 5	1429NR	NA	51605 02 (Call)	1657NR Valve Ass 6101NR Valve Onl	6732NR	6168NR Limit	1565NR Electrode	6259NR	3611NR	5010 10ft	NA	Can se thermostat
75DFASNG 1 88 1 5	1431NR	NA	51605 02 (Call)	1657NR Valve Ass 6101NR Valve Onl	6953NR	6168NR Limit	1565NR Electrode	6259NR	3616NR	5010 10ft	NA	Can se hermostat 6961NR Capacitor 6444NR erminal Board
80FASNG 1 87	0751NR	NA	1303NR (Call)	6100NR	6086NR	6168NR Limit 3207NR Air witch	1082NR par Plug	6259NR	1227NR	5010 10ft	NA	Can se hermostat 6170NR oggle witch 6444NR erminal Board
80FASNG 1 88 1 0	1361NR	NA	1303NR (Call)	6100NR	6086NR	6168NR Limit	1083NR par Plug	6259NR	1227NR	5010 10ft	NA	Can se hermosta 6170NR oggle witch 6444NR erminal Board
80FASNG 1 1 1 5	1551NR	NA	51605 02 (Call)	6100NR	6086NR	1550NR Limit	1083NR par Plug	6259NR	1227NR	5010 10ft	NA	Can se hermostat 6170NR oggle witch 6444NR erminal Board
80FASNG 1 1	1551NR	NA	7499NR	6100NR	6086NR	1550NR Limit	1083NR par Plug	6259NR	1227NR	5010 10ft	NA	Can se hermostat 6170NR oggle witch 6444NR erminal Board
80FASNG 000 00	1551NR	NA	7808NR	6100NR	6086NR	1550NR Limit	1083NR par Plug	6259NR	1227NR	5010 10ft	NA	Can se hermostat 1959NR iring arness 6170NR oggle witch
150FANG	1166NR	NA	10742NR Conversion	6100NR	6074NR	6168NR Limit 6169NR Flame ensor	1083NR par Plug	6259NR	3122NR	5010 10ft	3275NR I LO 801	Can se hermostat 1243NR Amber Light 1251NR Resistor
150FASNG 1 78 1 0	1166NR	NA	10741NR	6100NR	6074NR	6168NR Limit 6172NR Flame Rod	1083NR par Plug	6259NR	1216NR	5010 10ft	3275NR I LO 801	Can se hermostat 6170NR oggle witch
150FASNG 1 1 1 8	1561NR	NA	51605 02 (Call)	6100NR	6074NR	1550NR Limit	1083NR par Plug	6259NR	1216NR	5010 10ft	NA	Can se hermostat 6170NR oggle witch
150FASNG 1 00	1561NR	NA	7808NR	6100NR	6074NR	1550NR Limit	1083NR par Plug	6259NR	1216NR	5010 10ft	NA	Can se hermostat 6170NR oggle witch 1959NR iring arness
3500FA	1174NR	NA	10741NR (Call)	1125NR	6073NR	1118NR Limit 6169NR Flame witch 0945NR ip witch	1083NR par Plug	6254NR	3104NR	CALL	3275NR I LO 801	1122NR hermostat 6119NR Filter 6271NR 30lb uage
3500FACNG	1174NR	NA	CALL	1125NR	6073NR	6168NR Limit	7118NR Electrode	6258NR	3841NR	CALL	NA	1122NR hermostat 1663NR Ceramic Burner 6118NR 1 2 Pipe Filter Insert

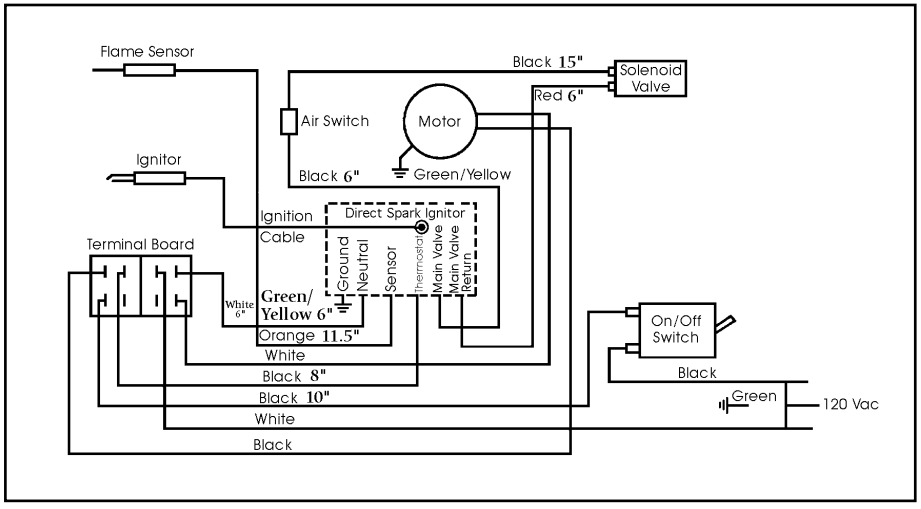
ou ma need to use part s 54 and 10444 to adapt hoses for use

LB White Natural Gas

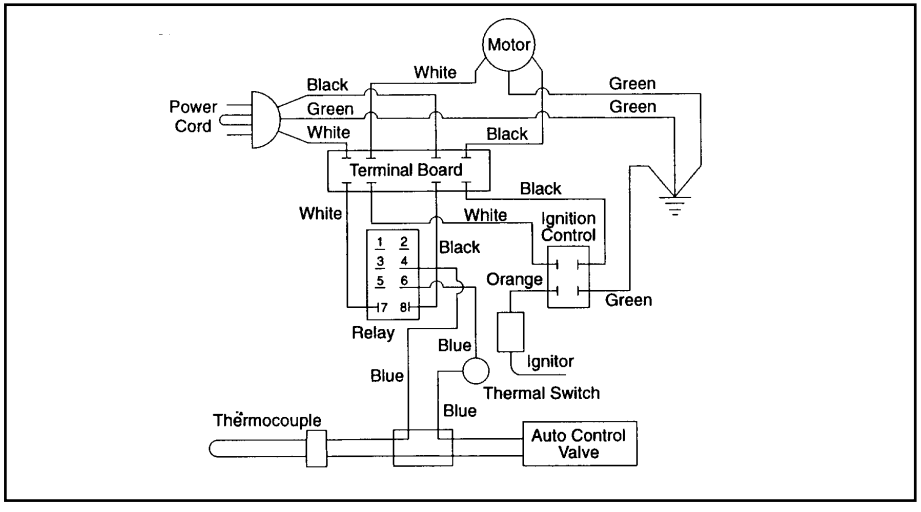
Model#	Motor	Thermocouple	Ignition Control/DSI	Valve: Safety/Auto Control	Fan/S uirrel Cage	Safety Switches	Igniter/Electrode	Regulator	Oriface: Pilot/Burner	Hose	Transformer	Other
8E	03830	NA	098884 01	05309	21575	06739 Air Flow 06687 Bac Flash	07160	06713	06686	20704	NA	03834 On Off witch 07028 iring arness
303A	04785 (ith Capacitor)	NA	6183NR (Call)	05335	05336	03933 Limit 03326 Air Flow 03843 Flame Rod 04803 ip witch	03849	04799	05323	NA	06979	03934 On Off witch 05829 hermostat 04805 hermostat Knob
33 **33 F** **33 G**	07181	03066	NA	20356 hermo Electric 7111NR Power Coil	01342	NA	NA	01104	01520 Pilot 01081 Burner	20704	NA	09698 anual Control Valve 01099 heel (t 2)
345G	20290	03497	NA	02309	02808	05566 Limit	NA	01326	02740 Pilot 03412 Burner	05301	NA	05568 hermostat 05548 Valve Coc
348A	01174	01036	NA	01196	02808	02662 Limit	NA	01326	02740 Pilot 01514 Burner	20704	NA	01208 hermostat 02741 Pilot i er
348G	20290	03497	NA	02309	02808	05566 Limit	NA	01326	02740 Pilot 01297 Burner	05301	NA	05568 hermostat 05548 Valve Coc
35	01174	01036	NA	02309	01190	02326 Limit	NA	01326	02740 Pilot 01297 Burner	NA	NA	01208 hermostat 01420 Valve Coc 02741 Pilot i er
37 **37 3** **37 4**	20554	03497	NA	02309	03531	05566 Limit 02680 ail witch	NA	02736	02740 Pilot 03519 Burner	20704	NA	05548 anual Valve 06537 hermostat
410 **410 3** **410 4**	02683	01090	NA	02309	02684	05566 Limit 02680 ail witch	NA	02736	06978 Pilot 02735 Burner	20704	NA	05548 anual Valve 06537 hermostat
CP155BSN	03830	NA	08810	06623	21575	06687 Bac Flash 05689 ail witch	07160	06713	06683	20704	08260	08240 On Off witch 08810 L.E. . ith Leads
CP155C	03830	NA	22301 (24 Volt)	22400 (24 Volt)	21575	06687 Bac Flash 06739 Air Proving	07160	06713	06686	20504	06979	05548 anual Control Valve 22213 hermostat 03834 On Off witch
CP155C	03830	NA	07637 (120 Volt)	05144 (120 Volt)	21575	06687 Bac Flash 06739 Air Proving	07160	06713	06686	20504	NA	05548 anual Control Valve 22213 hermostat 03834 On Off witch
CP155C Diagnostic	03830	NA	22301	22400	09347	06887 Bac Flash 06739 Air Proving	07160	06713	06686	20504	06979	22299 L.E. . Lens 05548 anual as Valve 08240 On Off witch
CS0 0	20290	03497	NA	02309	02808	05566 Limit	NA	01326	02740 Pilot 01297 Burner	20704	NA	06537 hermostat 05548 anual Valve
CS080C **CS080D**	08920	NA	08810	09368	03531	03933 Limit (275) 09821 Limit (250)	06479	21999	09754	20531	08922	09454 hermostat
CS080E	20292	NA	08810	09368	03531	03933 Limit 21186 Air Proving	06479	21999	09754	20531	08922	09454 hermostat

Desa Heater Wiring Diagrams

BLP45/BLP80/RLP45/RLP80

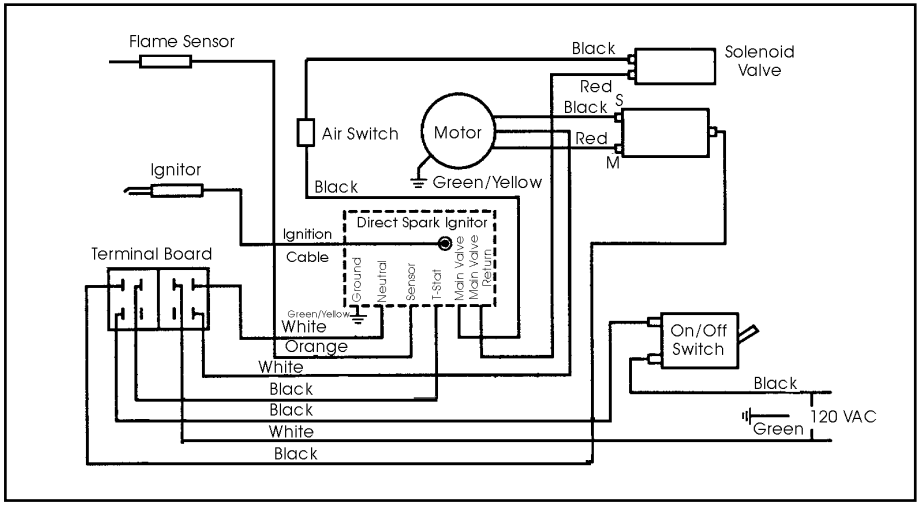


BLP100/RLP100/REM100LP

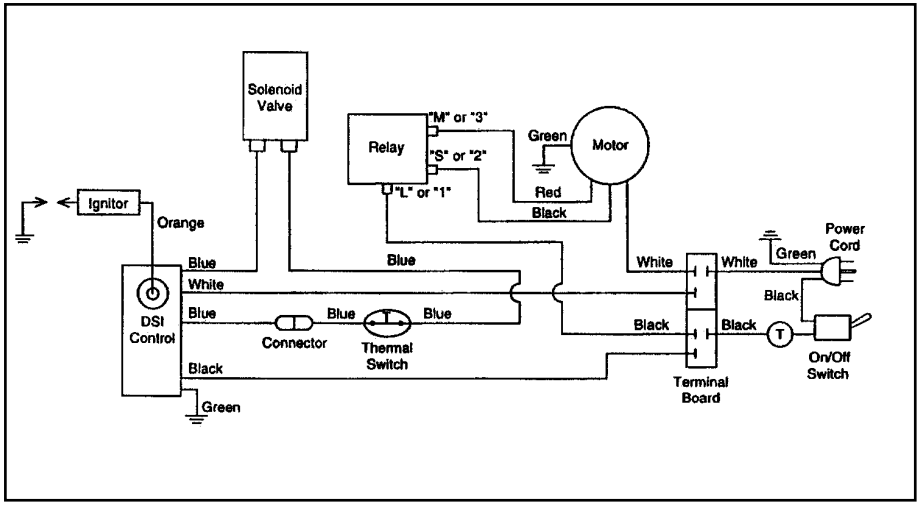


Desa Heater Wiring Diagrams

BLP150 (with relay)/RLP150/VLP150



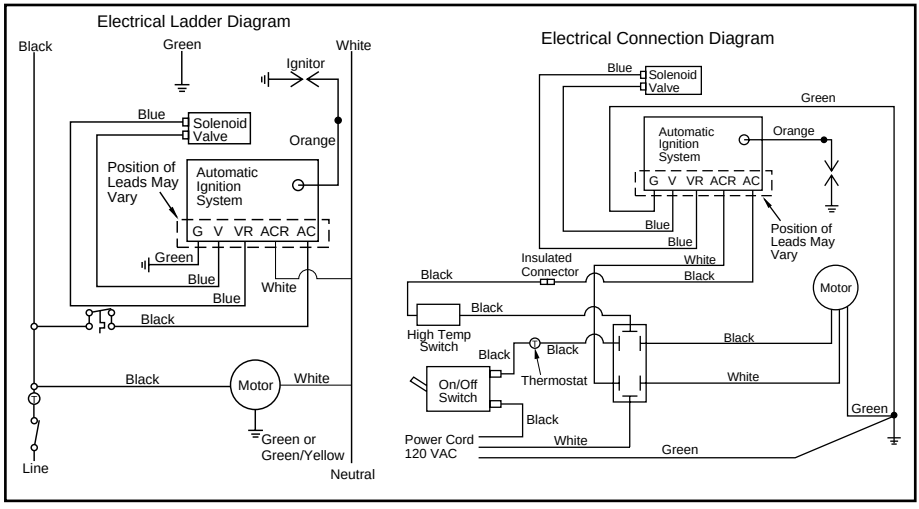
BLP155/BLP155A/BLP155AT /RLP155/RLP155A/RLP155AT with Relay



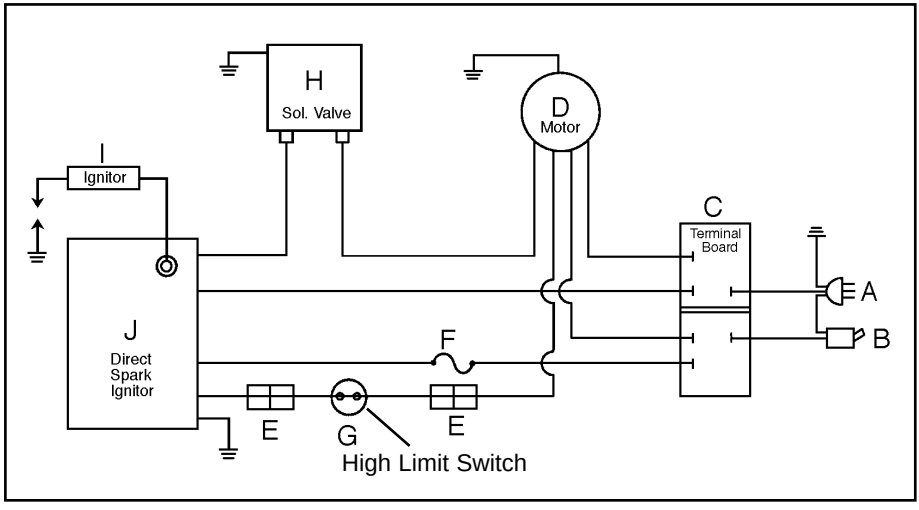
Desa Heater Wiring Diagrams

(new style w / capacitor)

BLP155/BLP155A/BLP155AT/RLP155/RLP155A/RLP155AT/BNG150T

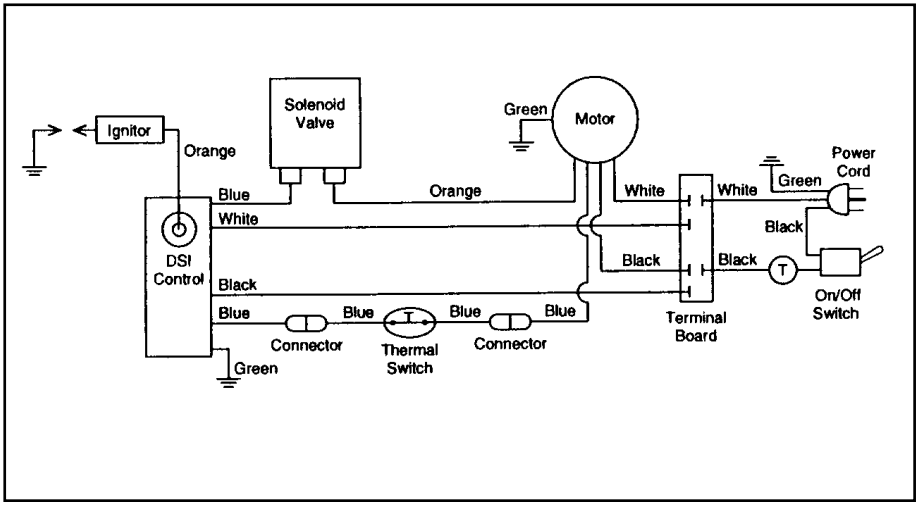


BLP375/VLP375



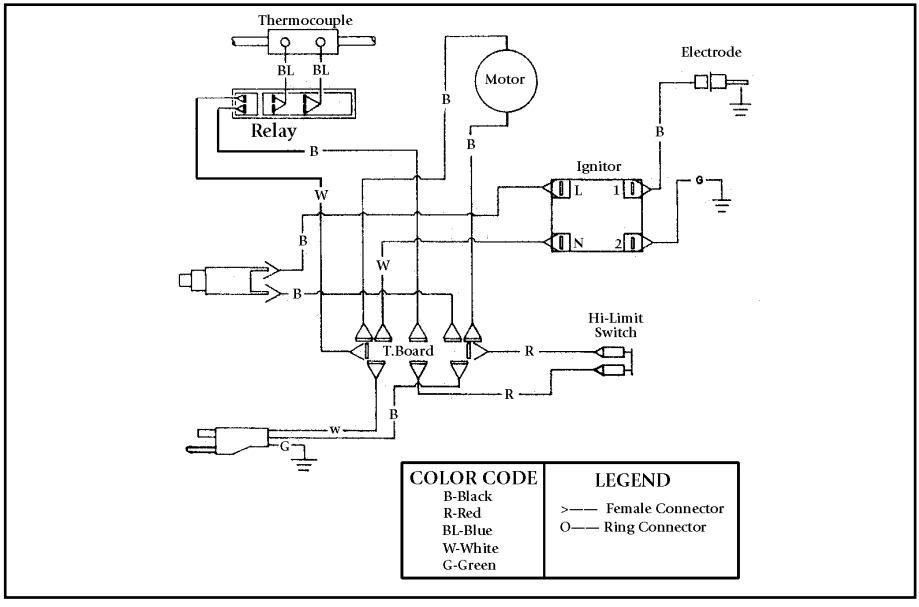
Desa Heater Wiring Diagrams

BLP375AT/RLP35AT/RLP375AT



Scheu Heater Wiring Diagrams

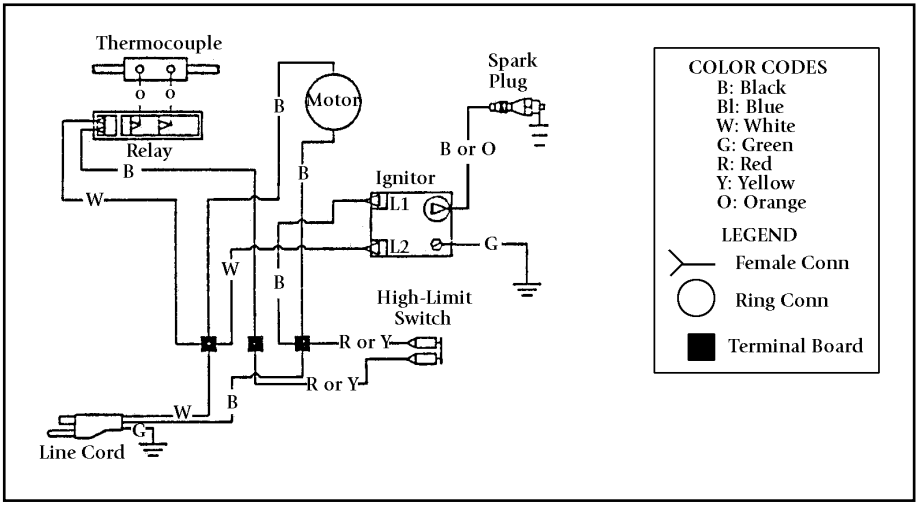
30FAS/SPC30



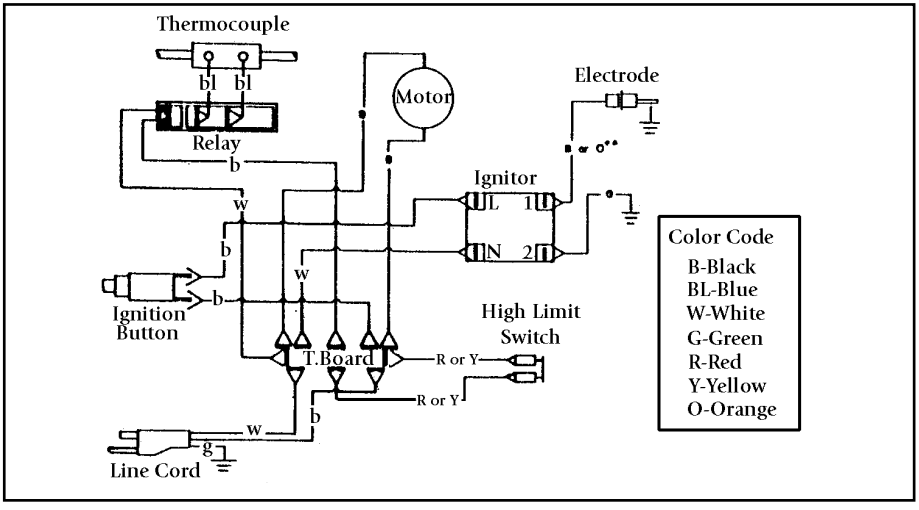
Scheu Heater Wiring Diagrams

40FAC/SPC40/45FAC/SPC45/55FAC/SPC55/85FAC/SPC85/125FAC/SPC125

With Hi-Low Ignition

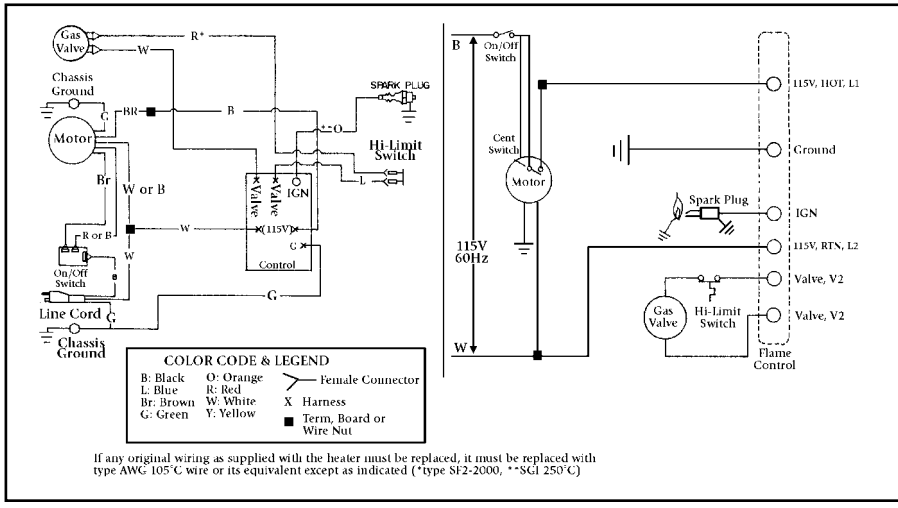


With Eaton

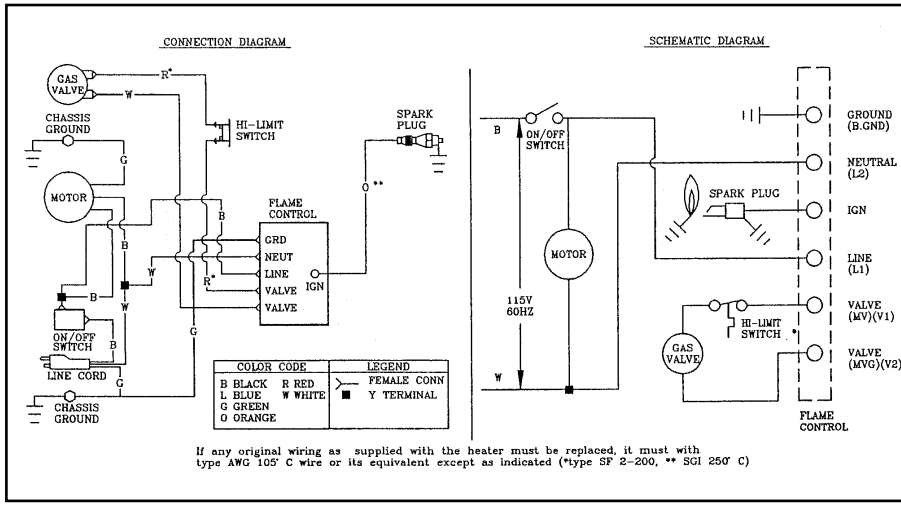


Scheu Heater Wiring Diagrams

80FAS/80FAC

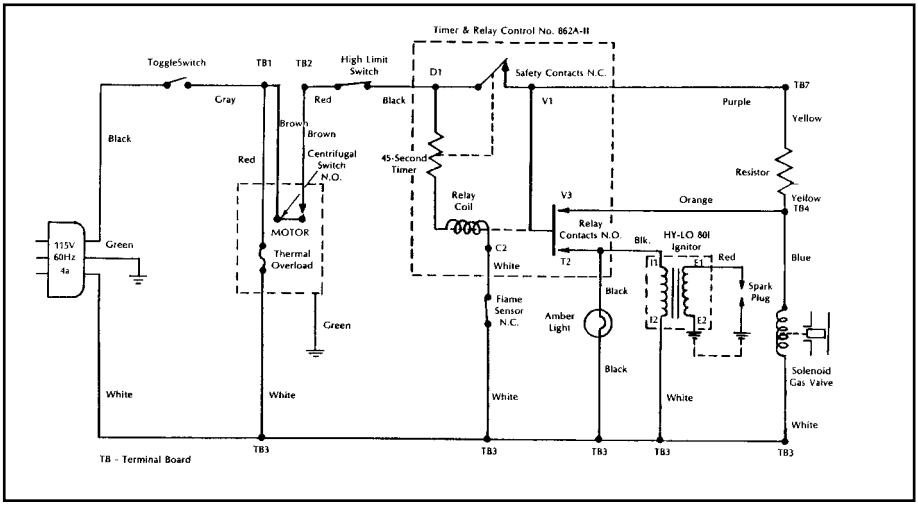


80FAS

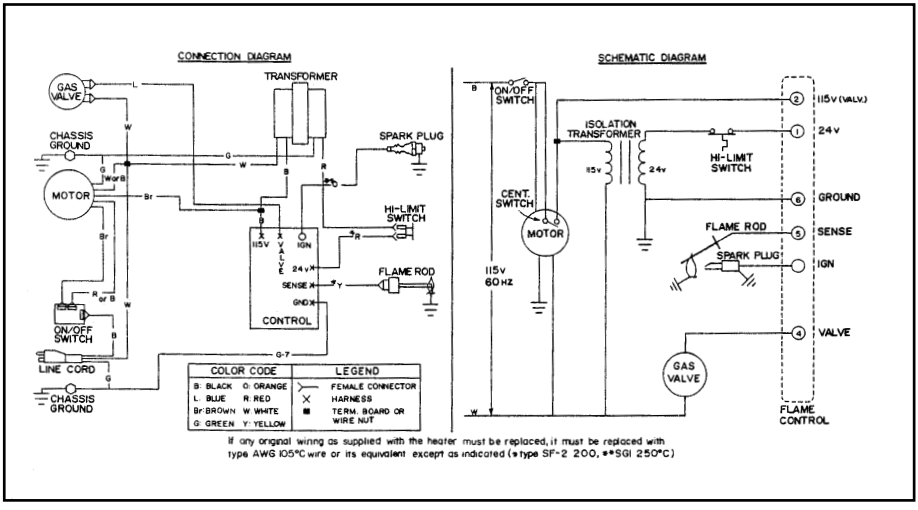


Scheu Heater Wiring Diagrams

150FA/150FANG

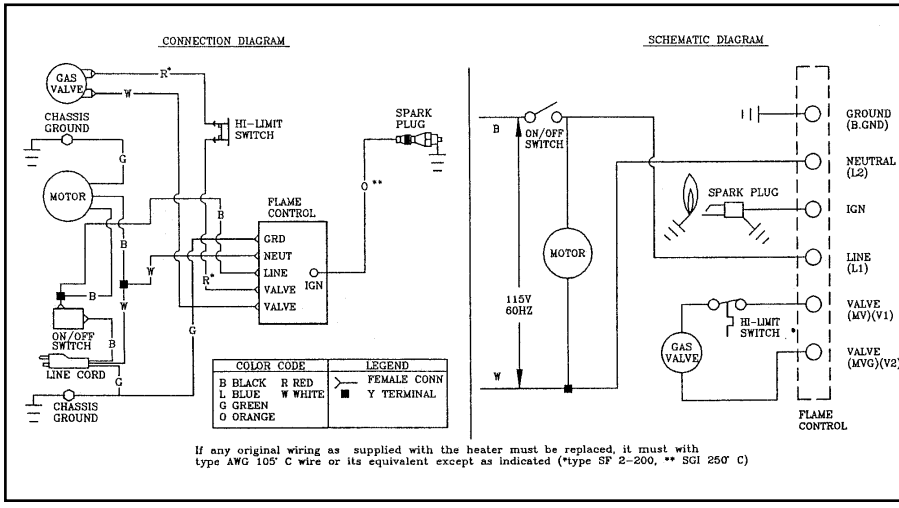


150FAS with FENWAL

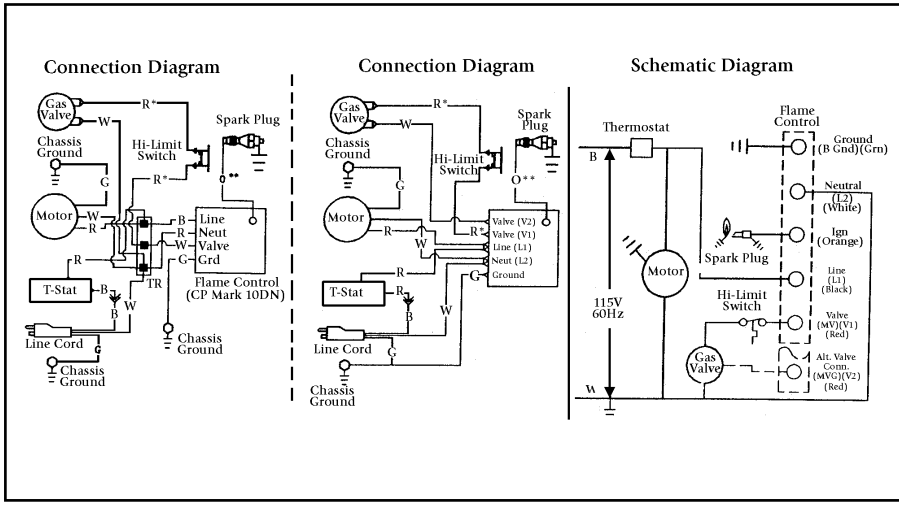


Scheu Heater Wiring Diagrams

150FAS/150FASNG

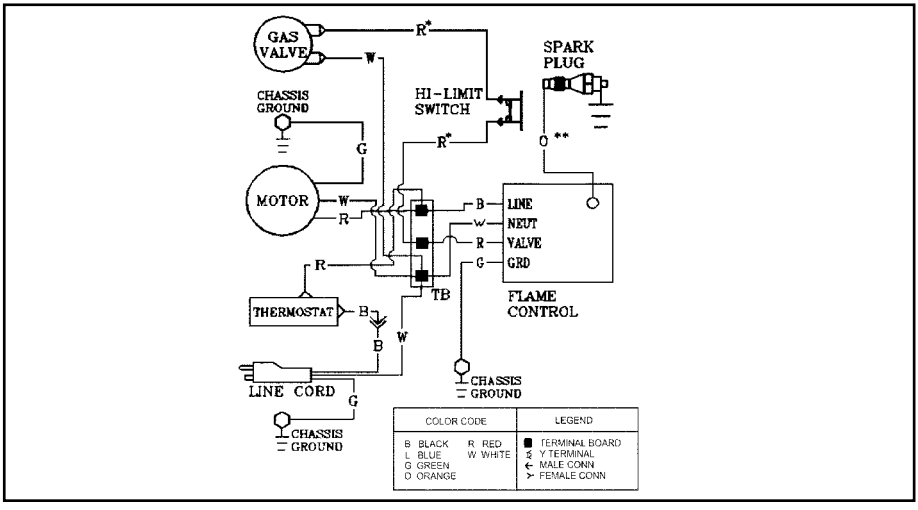


150FAST/SPC150FAST

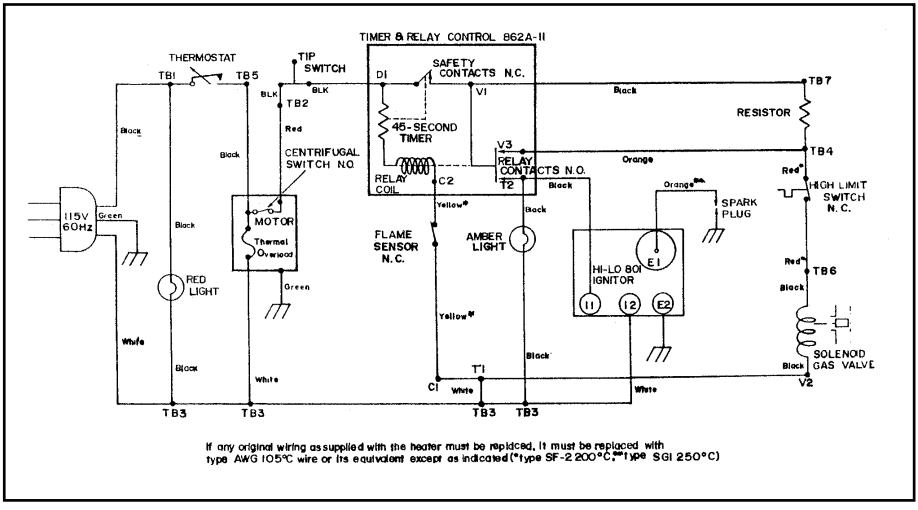


Scheu Heater Wiring Diagrams

170FAST/SCP170

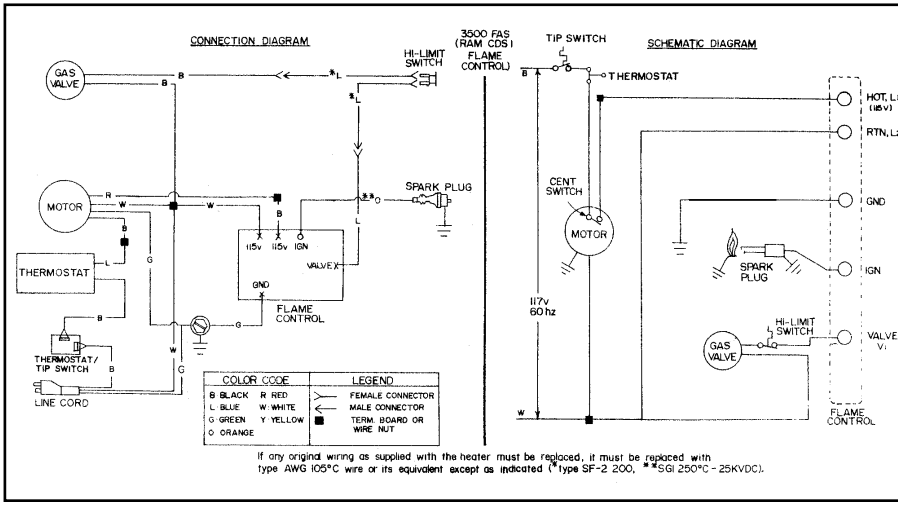


3500FA/3500FANG

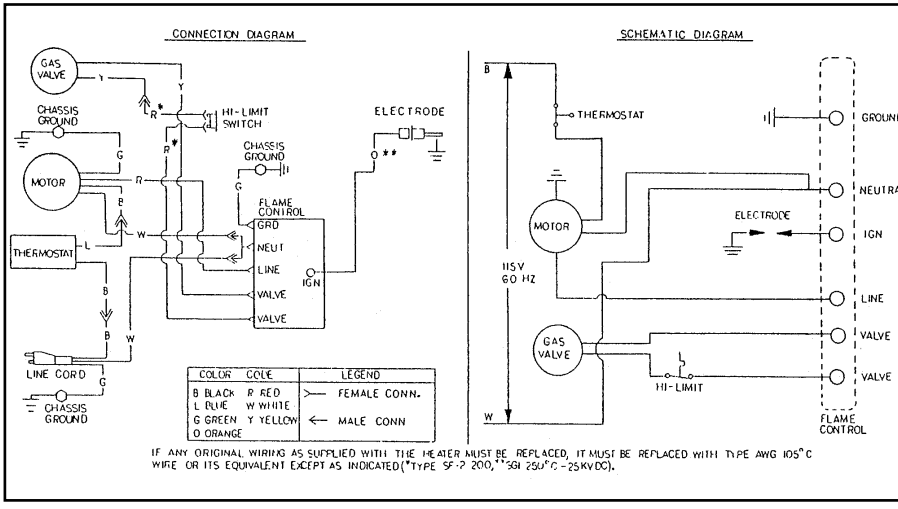


Scheu Heater Wiring Diagrams

3500FAS/3500FASNG

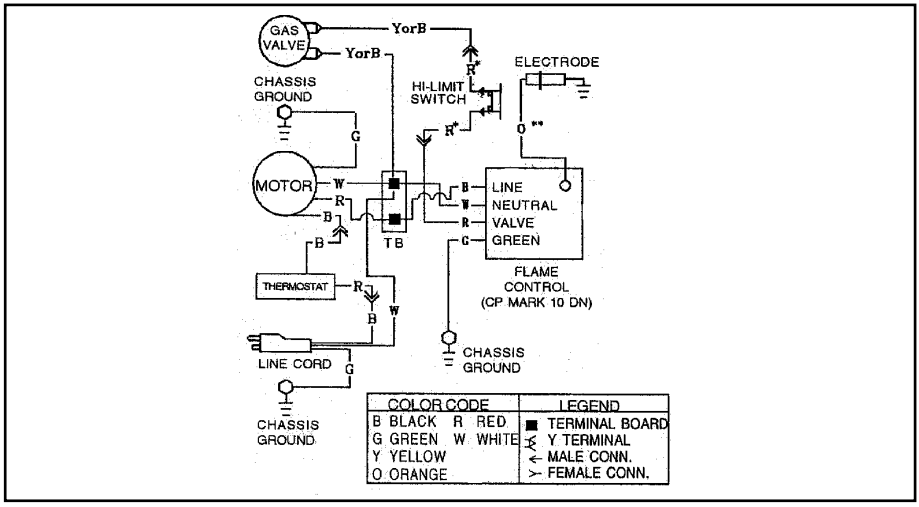


3500FACV/3500FACNG with 5 wire D.S.I.

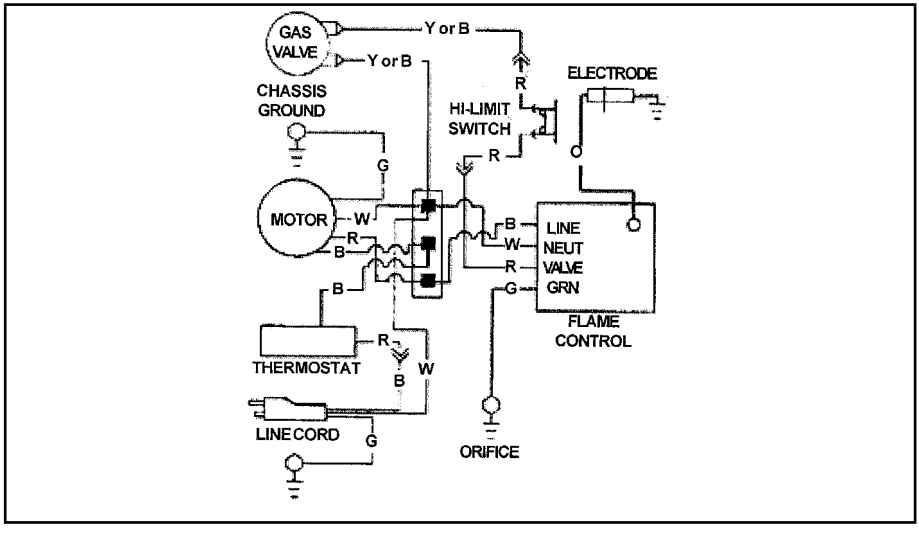


Scheu Heater Wiring Diagrams

3500FACV with potted D.S.I.

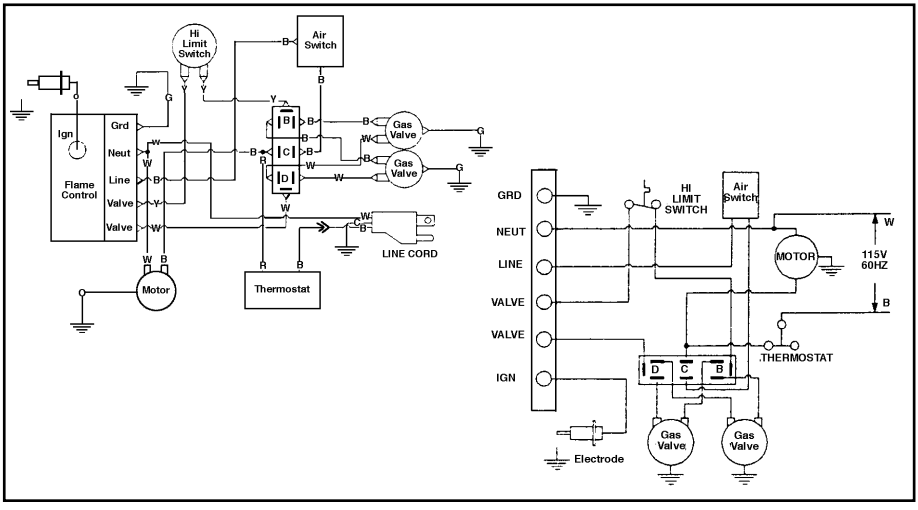


3500FACNG with potted D.S.I.

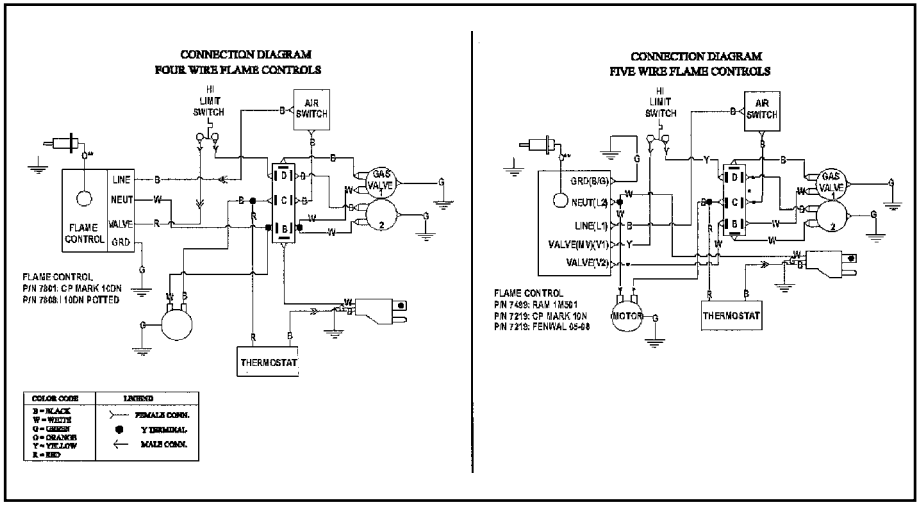


Scheu Heater Wiring Diagrams

7000FACV

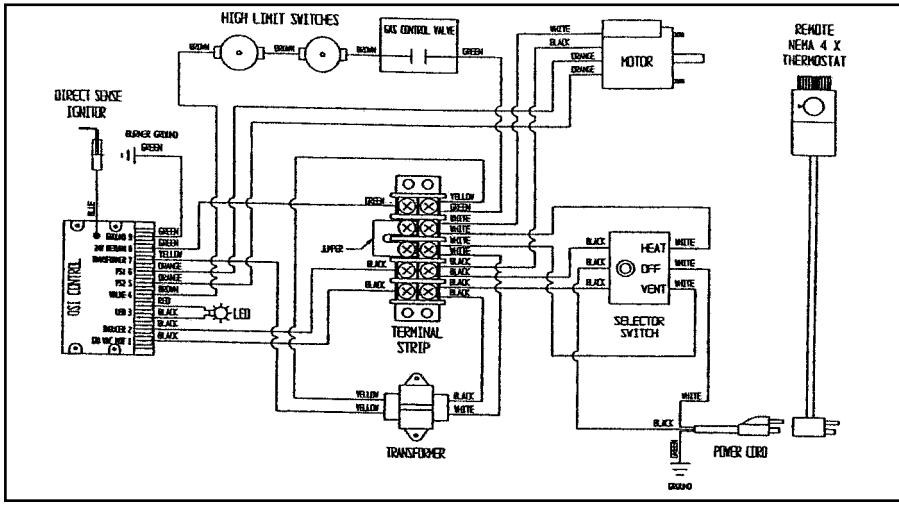


7000FACV with potted D.S.I.

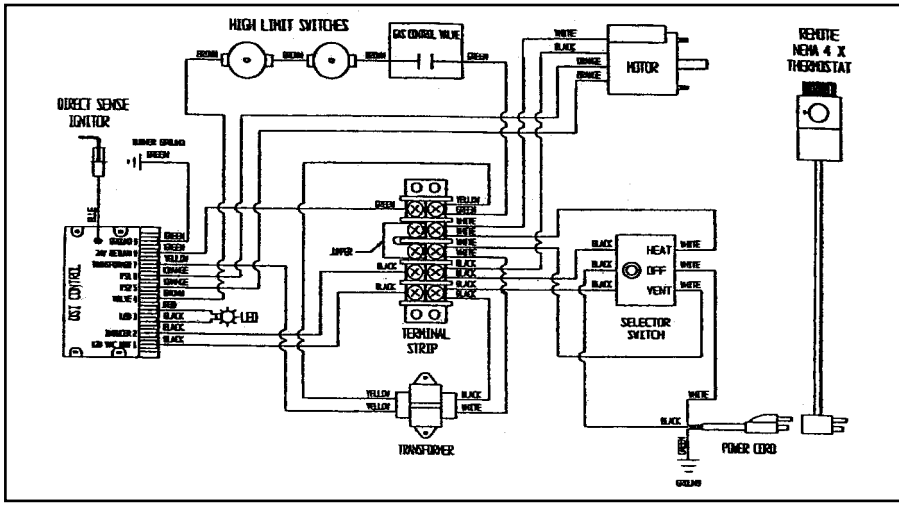


LB White Heater Wiring Diagrams

TS080

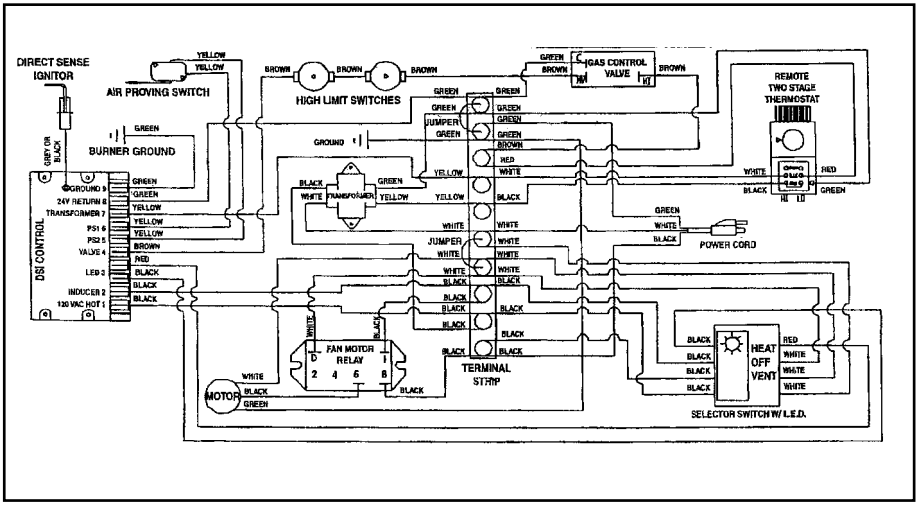


TS170



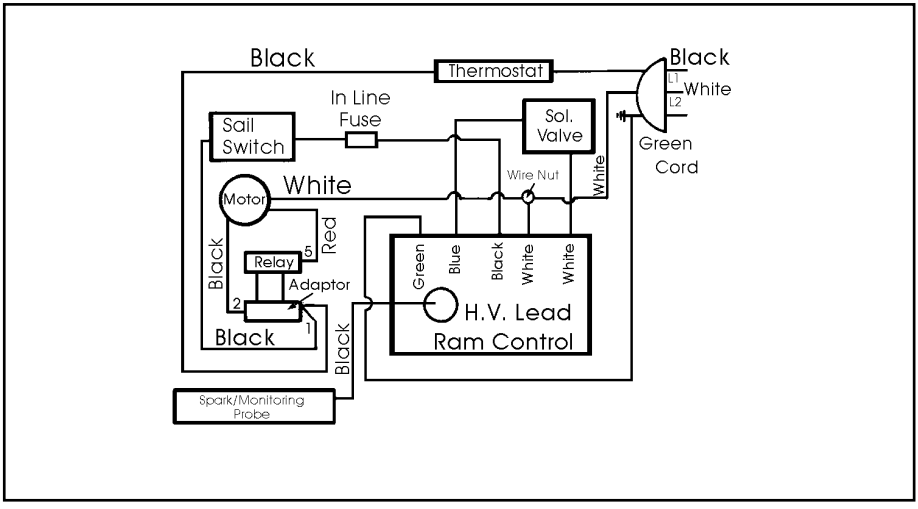
LB White Heater Wiring Diagrams

TS350



Toro Heater Wiring Diagrams

PH90/PH150



Notes:

Let Us Give You A Hand Fixing That Heater!

Technical Service Manual

- Heater & equipment breakdowns
- Technical tips & troubleshooting
- Part references

Part No. 21T

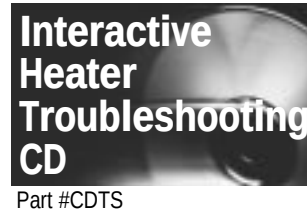
Low Pressure Oil Fired Service Manual

We have developed our own 160 page service manual that covers all three manufacturers of low pressure oil fired heaters; Desa, Toro, Scheu.

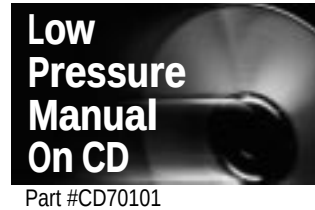
Part No. SM70106

Heater Service CD Roms

Part #CDTECH



Part #CDTS



Part #CD70101

Part #CDGF