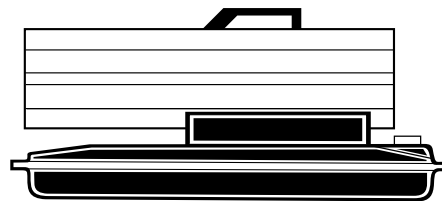
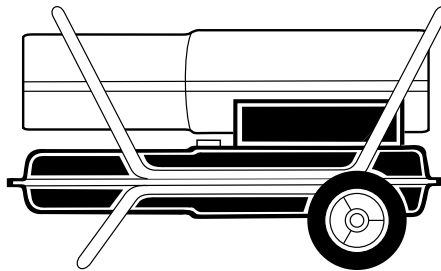


SECTION A

# SERVICE MANUAL

LOW PRESSURE  
PORTABLE FORCED AIR HEATER

HOT SURFACE IGNITION MODELS



# Hot Surface Ignition Models Service Manual

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## SAFETY INFORMATION

### WARNINGS

**IMPORTANT:** Read this owner's manual carefully and completely before trying to assemble, operate, or service this heater. Improper use of this heater can cause serious injury or death from burns, fire, explosion, electrical shock, and carbon monoxide poisoning.

** DANGER:** Carbon monoxide poisoning may lead to death!

**Carbon Monoxide Poisoning:** Early signs of carbon monoxide poisoning resemble the flu, with headaches, dizziness, and/or nausea. If you have these signs, the heater may not be working properly. **Get fresh air at once!** Have heater serviced. Some people are more affected by carbon monoxide than others. These include pregnant women, persons with heart or lung disease or anemia, those under the influence of alcohol, and those at high altitudes.

Make certain you read and understand all warnings. Keep this manual for reference. It is your guide to safe and proper operation of this heater.

- Use only kerosene or No. 1 fuel oil to avoid risk of fire or explosion. Never use gasoline, naphtha, paint thinners, alcohol, or other highly flammable fuels.
- Fueling
  - a) Personnel involved with fueling shall be qualified and thoroughly familiar with the manufacturer's instructions and applicable federal, state, and local regulations regarding the safe fueling of heating units.
  - b) Only the type of fuel specified on the heater's data plate shall be used.
  - c) All flame, including the pilot light, if any, shall be extinguished and the heater allowed to cool, prior to fueling.
  - d) During fueling, all fuel lines and fuel-line connections shall be inspected for leaks. Any leaks shall be repaired prior to returning the heater to service.
  - e) At no time shall more than one day's supply of heater fuel be stored inside a building in the vicinity of the heater. Bulk fuel storage shall be outside the structure.
  - f) All fuel storage shall be located a minimum of 25 feet from heaters, torches, welding equipment, and similar sources of ignition (exception: the fuel reservoir integral with the heater unit).
  - g) Whenever possible, fuel storage shall be confined to areas where floor penetrations do not permit fuel to drip onto or be ignited by a fire at lower elevation.
  - h) Fuel storage shall be in accordance with the federal, state, or local authority having jurisdiction.
- Never use heater where gasoline, paint thinner, or other highly flammable vapors are present.
- Follow all local ordinances and codes when using heater.
- Heaters used in the vicinity of tarpaulins, canvas, or similar enclosure materials shall be located a safe distance from such materials. The recommended minimum safe distance is 10 feet. It is further recommended that these enclosure materials be of a fire retardant nature. These enclosure materials shall be securely fastened to prevent them from igniting or from upsetting the heater due to wind action.
- Use only in well-vented areas. Before using heater, provide at least a three-square-foot opening of fresh, outside air for each 100,000 Btu/Hr of rating. This heater produces carbon monoxide, which is listed by the State of California as a reproductive toxin under Proposition 65.
- Use only in places free of flammable vapors or high dust content.
- Use only the electrical voltage and frequency specified on model plate.
- Use only a three-prong, grounded extension cord.
- Minimum heater clearances from combustibles:  
Outlet: 8 Ft. Sides: 4 Ft. Top: 4 Ft. Rear: 4 Ft.
- Locate heater on a stable and level surface if heater is hot or running or a fire may occur.
- When moving or storing heater, keep heater in a level position or fuel spillage may occur.
- Keep children and animals away from heater.
- Unplug heater when not in use.
- When used with thermostat, heater may start anytime.
- Never use heater in living or sleeping areas.
- Never block air inlet (rear) or air outlet (front) of heater.
- Never move, handle, refuel, or service a hot, operating, or plugged-in heater.
- Never attach duct work to front or rear of heater.
- Approved by the New York City Fire Department under certificate of approval #4803, #4860, #4908, or #4909. To be used only at construction sites in accordance with applicable New York City Codes, Regulations, Rules, Directives, Permits, etc.
- **Warning to New York City Residents** For Use Only At Construction Sites in accordance with applicable NYC codes under NYCFD certificate of approval #4803, #4899, #4908, #4909, or #4934.

# Hot Surface Ignition Models Service Manual

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## GENERAL INFORMATION

### I. ARRANGEMENT OF MANUAL

This manual contains information and service procedures to assist the service technician in understanding and correcting problems on DESA International oil-fired portable forced air heaters. The first section of the manual contains basic information concerning the operation of the different components in the heater. This information should be reviewed by service personnel to provide a basic understanding of how the components function in the working system. The *Troubleshooting* section of this manual is intended to provide a quick reference concerning conditions which result in customer complaints. These procedures will help the service technician quickly diagnose a malfunctioning heater. The illustrations in this manual may not necessarily depict the actual heater model, and are intended for reference ONLY.

### III. SERVICE PREPARATION

A clean work area at the start of each job is essential for efficient service work. Heaters which are extremely dirty should be cleaned prior to service. Cleaning will occasionally uncover the problem area. Tools needed for the job should be obtained before work is started. Delays resulting from locating tools result in lost time and wages.

Clean fuel should always be used when testing heaters. Many problems are often traced to the use of the wrong type of fuel or dirty fuel.

Use caution and common sense when working on a heater. Always remember that kerosene is flammable, and electrical parts can result in potential shock. Heater parts are hot during operation, which could result in burns.

# Hot Surface Ignition Models Service Manual

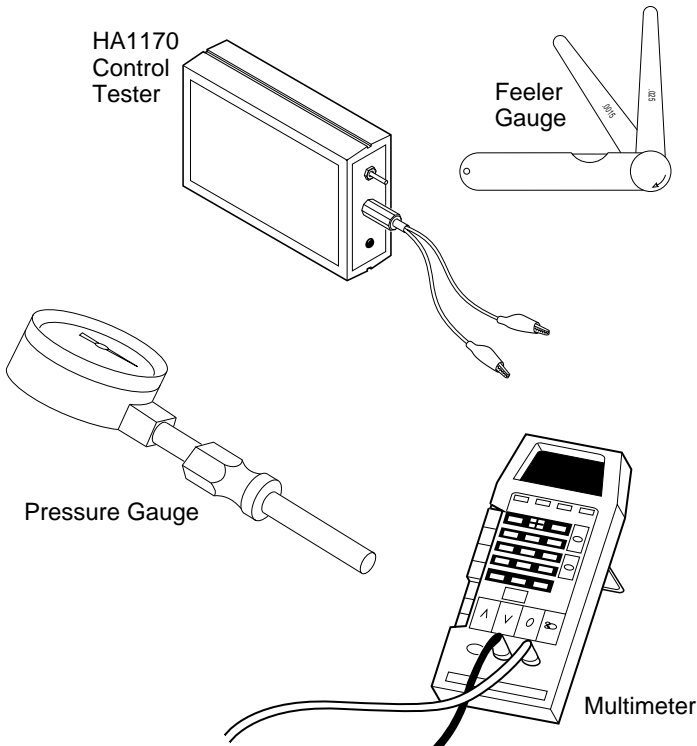
## IV. TOOLS REQUIRED

In addition to common hand tools, the service shop should have the following tools and instruments for proper repairing of the heaters. These instruments will be referred to throughout this manual.

| <u>INSTRUMENT</u>        | <u>RANGE</u>           | <u>PART NUMBER</u> |
|--------------------------|------------------------|--------------------|
| Control/Photocell Tester | N/A                    | HA1170             |
| Pressure Gauge           | 0-15 P. S. I.          | HA1180             |
| Feeler Gauge             | .001 to .1 inch        | None*              |
| Multimeter               | 0-250 VAC<br>0-200 Ohm | None**             |

\*Available at any auto parts store.

\*\*Available at most electronic stores.



## V. PARTS

In addition to the standard parts we now offer parts kits. Listed below are the item numbers and the accessory description

| <u>ITEM NUMBER</u>      | <u>ACCESSORY</u>  |
|-------------------------|---|
| HA1180                  | Air Gauge/All Models  |
| HA1210                  | Thermostat/Forced Air & LP Forced Air                             |
| HA1202                  | Heavy Duty Wheel Kit<br>Fits: 35, 40, 50, 55, 60, 70 Models       |
| HA1206                  | Wheel Kit<br>Fits: 35, 40, 50, 55, 60, 70 Models                  |
| HA2203                  | Rear Handle Fits: 110, 115 Models                                 |
| HA2204                  | Rear Handle<br>Fits: 150, 155, 165, 200 Models                    |
| HA2210                  | Filler Neck Screen  |
| <u>ITEM NUMBER</u>      | <u>REPLACEMENT PART</u>   |
| 104068-03               | Ignition control<br>Fits: 35, 40, 50, 55, 60 Models               |
| 104068-02               | Ignition control Fits: 70, 110, 115,<br>150, 155, 165, 200 Models |
| PP204                   | Rotor Kit 1/2"  |
| PP206                   | Nozzle (35, 40 Models)  |
| Refer to Owner's Manual | Nozzle (50/55 Models)   |
| PP219                   | Nozzle (60 Models)  |
| PP220                   | Nozzle (70 Models)  |
| PP221                   | Nozzle (110, 115 Models)  |
| PP222                   | Nozzle (150, 155 Models)  |
| PP223                   | Nozzle (165 Models)   |
| PP235                   | Nozzle (200 Models)   |
| PP200                   | Hot Surface Ignitor   |
| PP213                   | Air Filter Kit<br>(35, 40, 50, 55, 60, 70 Models)                 |
| PP214                   | Filter Kit<br>(110, 115, 150, 155, 165, 200 Models)               |
| PP205                   | Rotor Kit 5/8"  |
| M16656-24               | Photocell   |
| PP217                   | Pump Adjustment Kit   |

# Hot Surface Ignition Models Service Manual

## SPECIFICATIONS

### I. GENERAL SPECIFICATIONS

#### 1. Fuel Selection

One of the most critical specifications for trouble-free operation is the use of a clean, acceptable fuel. Listed below are guidelines and comments concerning operation of heaters with different fuels.

##### RECOMMENDED FUELS

Kerosene  
Fuel Oil No. 1  
Jet "A"

##### COMMENTS

Best overall results. Minimum odor and minimum maintenance. No additives necessary for cold weather operation.

##### ALTERNATE FUELS

Fuel Oil No. 2  
Diesel No. 1  
Diesel No. 2

##### COMMENTS

Noticeable increase in odor. Requires frequent maintenance of fuel filter and nozzle. Requires a winterizing additive at temperatures below 20°F

#### 2. Electrical

The heater must be connected to a standard electrical outlet (120V/60HZ). For safety, all heaters are equipped with a three prong power cord, which must be grounded. When selecting an extension cord for heater usage, the following chart should be used in determining wire size.

| <u>LENGTH OF CORD</u> | <u>WIRE SIZE (AWG)</u> |
|-----------------------|------------------------|
| 100 Ft.               | No. 14                 |
| 200 Ft.               | No. 12                 |
| 300 Ft.               | No. 10                 |
| 400 Ft.               | No. 8                  |
|                       | No. 6                  |

#### 3. Ventilation

The heater should be used only in well-ventilated areas. As a rule, the following minimum requirements should be followed.

| <u>HEATER SIZE (BTU)</u> | <u>SQUARE FOOT OPENING</u> |
|--------------------------|----------------------------|
| 35,000/40,000            | 1.0 Sq. Ft.                |
| 50,000/55,000/60,000     | 1.6 Sq. Ft.                |
| 70,000                   | 2.1 Sq. Ft.                |
| 110,000/115,000          | 3.2 Sq. Ft.                |
| 150,000/155,000          | 4.5 Sq. Ft.                |
| 165,000                  | 5.0 Sq. Ft.                |
| 200,000                  | 6.0 Sq. Ft.                |

The above is based on ventilation requirements of at least a 3 sq. ft. opening per 100,000 BTU. If possible, it is better to provide cross-ventilation to achieve better air movement.

#### 4. Heater Sizing

The user should be aware of the proper size heater needed for a particular application. It is easy to see that a 35,000 BTU heater would not heat a large warehouse, but the question is sometimes asked "What size heater should I use?" A simple formula that can be used to determine heater BTU requirements follows:

Cu. Ft. of Area X .133 X Desired Temp. Rise °F = BTU Size Needed.

##### **Example:**

Area: 50' X 25' X 10' = 12,500 Cu. Ft.  
Desired Temp. Rise: 30°F

12,500 (Cu. Ft.)

X .133 (Factor)

1662.5

X 30 (Temp. Rise)

49,875 (Proper Heater Size)

**ANSWER:** A 50,000 BTU heater should be selected for this application.

# Hot Surface Ignition Models Service Manual

## II. HEATER PERFORMANCE SPECIFICATIONS

### Technical Service Heater Performance Data

| Heater Model              | BTU Rating | Pump PSI<br>± .1 | Nozzle Part No.       | Nozzle GPH<br>± 5% | Motor Part No.           | Motor R.P.M. | Motor Horsepower | Ignitor Kit | Control Board | Fuel Tank Capacity (Gal) | Hot Air Output (C.F.M.) | AMPS (Running) |
|---------------------------|------------|------------------|-----------------------|--------------------|--------------------------|--------------|------------------|-------------|---------------|--------------------------|-------------------------|----------------|
| R35D<br>REM35C            | 35,000     | 3.0              | 100735-02<br>(HA3006) | 0.30               | 100088-01<br>(102001-01) | 1725         | 1/15             | 102548-03   | 104068-03     | 3.0                      | 165                     | 2.0            |
| R40<br>REM40              | 40,000     | 3.0              | 100735-02<br>(HA3006) | 0.30               | 100088-01<br>(102001-01) | 1725         | 1/15             | 102548-03   | 104068-03     | 3.0                      | 170                     | 2.0            |
| R55A<br>REM55A            | 55,000     | 3.6              | 100735-17<br>(HA3024) | 0.40               | 100088-01<br>(102001-01) | 1725         | 1/15             | 102548-03   | 104068-03     | 5.0                      | 175                     | 2.0            |
| R60<br>REM60<br>RM60      | 60,000     | 3.4              | 100735-17<br>(HA3024) | 0.40               | 100088-01<br>(102001-01) | 1725         | 1/15             | 102548-03   | 104068-03     | 5.0                      | 180                     | 2.0            |
| R70D<br>R70DT             | 70,000     | 4.7              | 100735-18<br>(HA3026) | 0.50               | 103609-01<br>(102001-20) | 3450         | 1/8              | 102548-03   | 104068-02     | 5.0                      | 250                     | 2.8            |
| R110B<br>R110BT           | 110,000    | 5.3              | 100735-19<br>(HA3027) | 0.80               | 103493-01<br>(102001-21) | 3450         | 1/5              | 102548-03   | 104068-02     | 9.0                      | 490                     | 3.6            |
| R115<br>REM115<br>RM115   | 115,000    | 5.3              | 100735-19<br>(HA3027) | 0.80               | 103493-01<br>(102001-21) | 3450         | 1/5              | 102548-03   | 104068-02     | 9.0                      | 490                     | 3.6            |
| REM150E                   | 150,000    | 5.4              | 100735-20<br>(HA3028) | 1.10               | 103493-01<br>(102001-21) | 3450         | 1/5              | 102548-03   | 104068-02     | 13.5                     | 550                     | 3.6            |
| R155B<br>REM155B<br>RM155 | 155,000    | 5.4              | 100735-20<br>(HA3028) | 1.10               | 103493-01<br>(102001-21) | 3450         | 1/5              | 102548-03   | 104068-02     | 13.5                     | 550                     | 3.6            |
| R165AT                    | 165,000    | 5.6              | 100735-21<br>(HA3029) | 1.20               | 103493-01<br>(102001-21) | 3450         | 1/5              | 102548-03   | 104068-02     | 13.5                     | 575                     | 3.6            |
| R200A                     | 200,000    | 6.2              | 100735-31             | 1.40               | 105183-01<br>(102001-27) | 3400         | 1/4              | 102548-03   | 104068-02     | 13.5                     | 600                     | 3.6            |

M16656-24 Photocell will apply to all models for service.

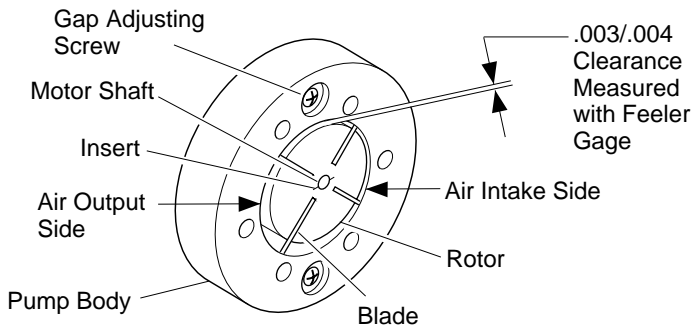
# Hot Surface Ignition Models Service Manual

## COMPONENT OPERATION

### I. AIR SYSTEM

#### 1. Air Pump

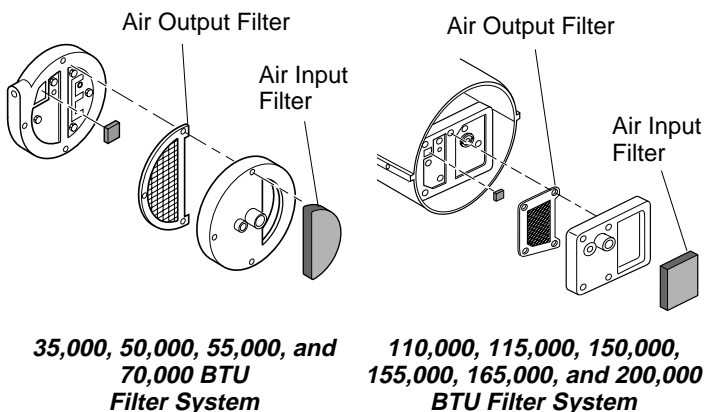
The heater's air pump consists of a rotor with four carbon blades rotating inside a pump body. The rotor is driven directly by the motor and is attached to the motor shaft by means of a plastic insert. As the motor rotates, the carbon blades travel outward rubbing against the inside surface of the steel pump body. The rotor's position inside the pump body is such that it is not concentric with the pump body and a .003/.004 of an inch gap is set at the uppermost quadrant. As the motor rotates, the air between the blades is compressed and routed to the nozzle through the air line.



*Direction of Rotation-Clockwise*

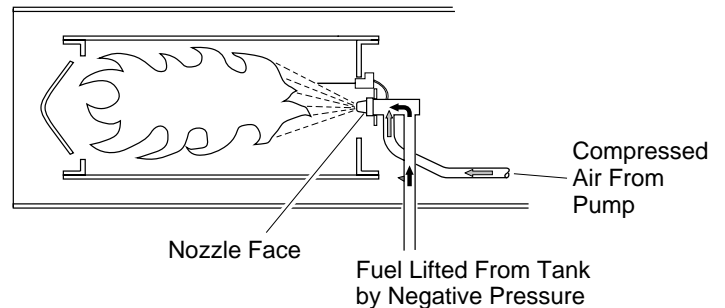
#### 2. Air Filters

The air filtering system consists of an air input filter and an air output filter. The air input filter is located at the right rear of the motor and its purpose is to filter all incoming air prior to entering the air pump. The filter design is such that it can be cleaned in a mild, soapy solution, thoroughly dried and used over again. The air output filter is located under the plastic end cover. This filter's purpose is to prevent any carbon dust (from rotor or blade wear) from entering the air passages in the nozzle. This filter is non-cleanable and should be replaced when considerable buildup of carbon dust is observed. (See drawings below).



#### 3. Nozzle

As mentioned previously, the purpose of the air pump is to compress air and deliver it to the nozzle. The compressed air, as it travels through the nozzle, creates a negative pressure that extends back through the center of the nozzle. This negative pressure lifts the fuel from the fuel tank. The fuel from the fuel tank and the compressed air are mixed at the nozzle which results in a very fine mist of fuel being sprayed into the combustion chamber. The air pump/nozzle combination eliminates the need for a conventional type fuel pump. It is important for the service technician to understand the nozzle operation. In many cases concerning improper operation of a heater, the problem is the result of a seal leak or a restriction (dust/dirt) being present within the nozzle. It should also be pointed out that each model heater requires different nozzles due to different fuel flow rates.

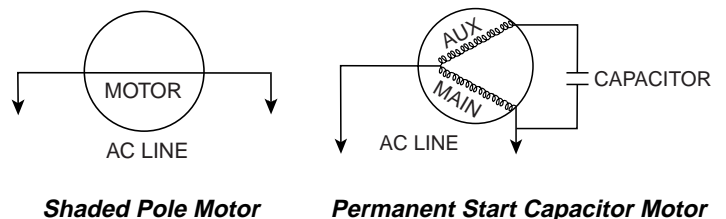


### II. ELECTRICAL SYSTEM

#### 1. Motors

The motors used on the low pressure heaters are fractional horsepower motors ranging from 1/15 HP on the smallest heater to 1/4 HP on the largest heaters. The motors used can be grouped into two categories. The first category is the shaded pole motor. The shaded pole motor contains a single winding and does not require an integral start/run capacitor for operation. This type of motor is used on 35, 40, 50, 55, and 60 model heaters.

The second category is the permanent start capacitor motor. This motor contains two separate windings. The first winding being the auxiliary or start winding and the second being the main or run winding. This motor utilizes an integral start/run capacitor which is wired internally and cannot be replaced. This type of motor is used on the 70, 110, 115, 150, 155, 165, and 200,000 Btu models.



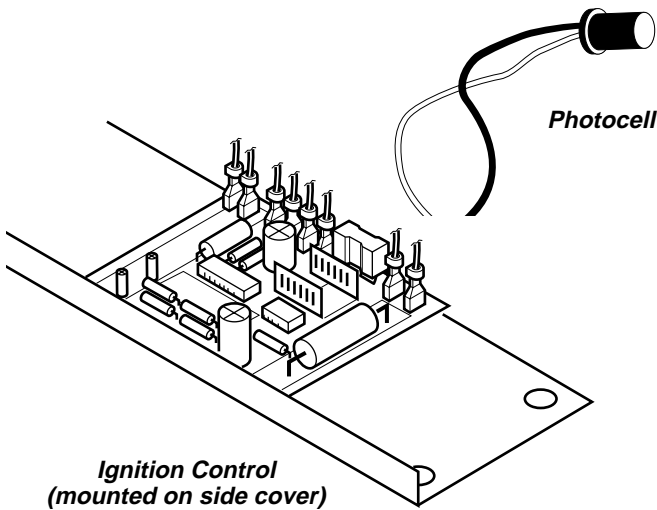
For replacement parts contact:

**www.PartsFor.com**

# Hot Surface Ignition Models Service Manual

## 2. Ignition Control/Photo Cell

The ignition control circuit consists of a photocell (light sensitive resistor) and an ignition control. The photocell is used to sense the presence of light inside the combustion chamber. The resistance of the photocell changes as the light level inside the combustion chamber changes. When the heater is operating properly, the flame pattern inside the combustion chamber is very turbulent which results in the resistance of the photocell increasing and decreasing very rapidly. This dynamic change in resistance is required by the ignition control to allow the heater to continue to operate. If the signal from the photocell becomes "lazy" or steady state indicating a lack of turbulence, then the heater will be turned off. Some examples of this condition are a loss of fan and a blocked inlet. Because the photocell also responds to the color of the flame, the control will also shut off the heater if the fuel/air mixture is too lean. With a fuel lean mixture the flame becomes blue in color and the photocell does not respond to that end of the light spectrum as well as it responds to orange light which is present during proper operation. As a service technician, it is important to understand the operation of the ignition control. In the past, it has been the single most misdiagnosed part of the heater. It is suggested that all controls be checked per instructions listed in the *Troubleshooting* section, prior to replacement.

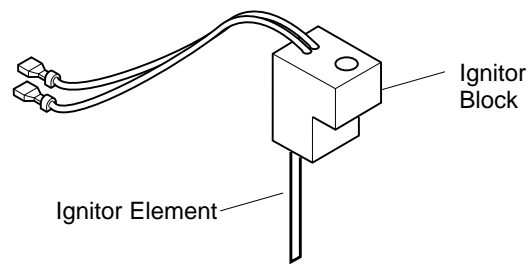


## 3. Hot Surface Ignitor

All models will use 102548-03 Ignitor Kit.

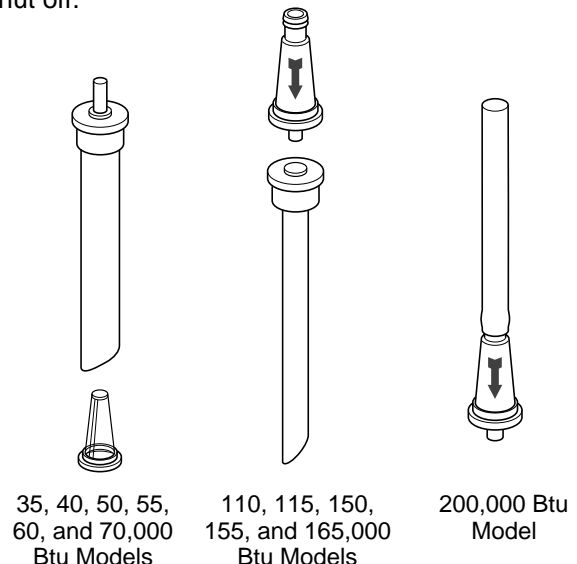
The hot surface ignitor is rated for 120 volts. With the rated voltage applied, the ignitor element heats up to 1400° Celsius (2550° Fahrenheit) within 5 seconds. When the atomized fuel is sprayed by the nozzle it is ignited by this extremely hot surface.

*Note:* It is important for the service technician to be cautious when working with the hot surface ignitor due to its extremely high operating temperature. Care should also be taken not to bend or strike the ignitor element.



## III. FUEL SYSTEM (FUEL FILTERS)

There are several types of fuel filters used on different model heaters. The filters are always located in line with the fuel pickup tube. The purpose of the filter is to eliminate the possibility of dirt, dust, etc. from entering the nozzle and restricting the flow. The filters should be inspected and cleaned whenever a heater is brought in for service. It is also important that the bottom of the tank be inspected for sedimentation or dirt buildup. The filter's design is such that a possible restriction in the filter screen can be present during operation and be dislodged back into the tank when the heater is shut off.

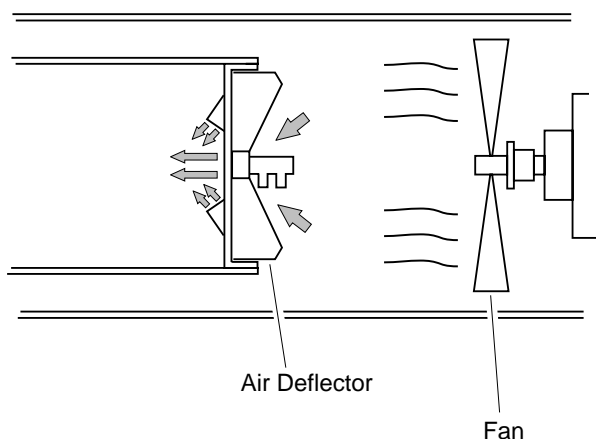




# Hot Surface Ignition Models Service Manual

## IV. COMBUSTION SYSTEM

Air being blown by the fan is directed by the air deflectors into the combustion chamber through the two louvers and center opening in the rear head which is riveted to the back of the combustion chamber. The nozzle and nozzle adapter are mounted in the burner strap which is fastened to the rear head. As the atomized fuel exits the nozzle and is ignited it mixes with the air entering through the rear head. The combustion process is completed inside the combustion chamber and the hot air exits the outlet end of the chamber.



## V. ALL SYSTEMS WORKING TOGETHER

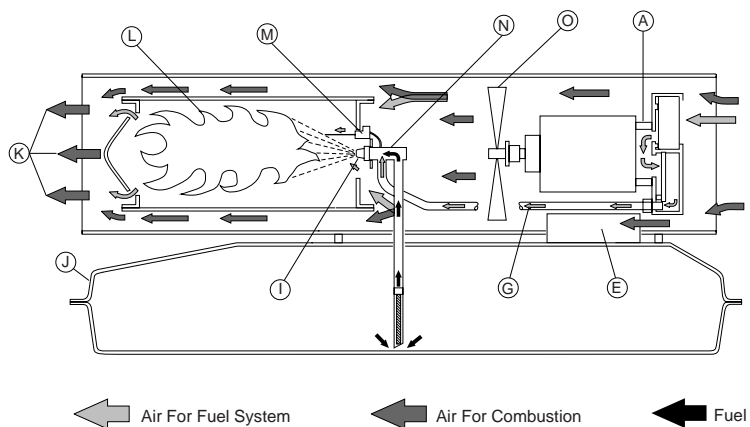
There are four basic systems within the heater: the fuel system, the air system, the electrical system, and the combustion system.

An air pump (A) on one end of the motor shaft forces air through the air line (G) and out the nozzle (I). The moving air creates a pressure differential in the nozzle adapter (N) causing fuel to be drawn from the tank (J). The fuel-air mixture is sprayed into the combustion chamber (L) in a fine mist.

Additional air is supplied to the combustion chamber by a fan (O) to enter the combustion chamber where it mixes with the air and fuel from the nozzle. The remaining air is directed around and over the combustion chamber. This air mixes with the heated air from the combustion chamber and is ejected as a jet of clean, heated air (K).

The ignition system consists of an ignition control assembly (E) and hot surface ignitor (M). The ignition control assembly applies 120 volt power to the hot surface ignitor for 10 seconds which consists of a 5 second preheat period and a 3 to 4 second ignition trial period. The extremely high temperature of the ignitor element ignites the fuel and air mixture within the combustion chamber. After the trial period the power is removed from the ignitor.

In the safety circuit, the photocell monitors the amount of flame turbulence inside the combustion chamber.



# Hot Surface Ignition Models Service Manual

## TROUBLESHOOTING

### I. SAFETY REQUIREMENTS

This service manual is intended for use by individuals with an adequate knowledge of electrical and mechanical skills. Attempts to repair this heater by individuals without those skills can result in personal injury, as well as property damage.

### II. CAUTIONS

1. Before servicing, disconnect the heater from the electrical power source by removing the electrical plug from the wall receptacle.

*Note:* When certain tests require electrical power to be applied, connect electrical power only for the time necessary to complete the test.

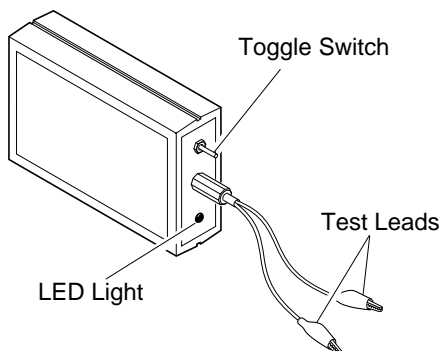
2. Do not bypass safety devices except when instructed to do so during troubleshooting procedures.
3. If replacement parts are necessary, do not substitute with non-factory parts (use only factory authorized replacement parts).
4. Make sure all electrical connections are secure and correct prior to connecting heater to a grounded electrical power source.

### III. USING THE HA1170 TESTER

The HA1170 control/photocell tester provides a means of troubleshooting the forced air kerosene heater by verifying the operation of the ignition control and photocell.

#### Operation

The tester's toggle switch has three positions. The middle position puts the tester in the OFF mode. The switch should be kept here when the tester is not in use to conserve battery power. With the switch in the ON position, the red LED is on continuous. This 2 foot-candle light source can be used to test the static resistance of the photocell. With the switch in the PULSE position, the red LED flashes off and on at a rate of 10 times per second (10 hertz). This position is used to verify the proper operation of the ignition control.

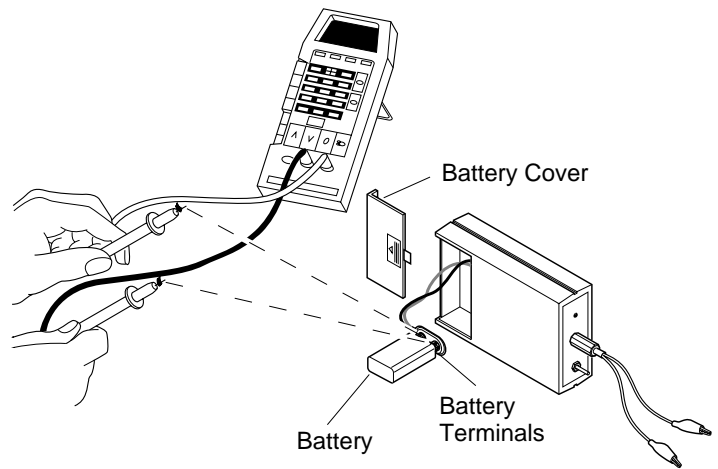


**HA1170 Tester**

### Calibration

**IMPORTANT:** This tester will not function properly without adequate battery power. Prior to using the tester, the full load battery voltage must be verified as follows.

Remove the battery cover to expose the battery and terminals. With the battery connected and the switch in the ON position (LED on continuous), measure the D.C. voltage across the battery terminals. If this voltage reads 7.5 volts or higher, proceed with testing. If the voltage reads lower than 7.5 volts, replace the battery and confirm the full load voltage.



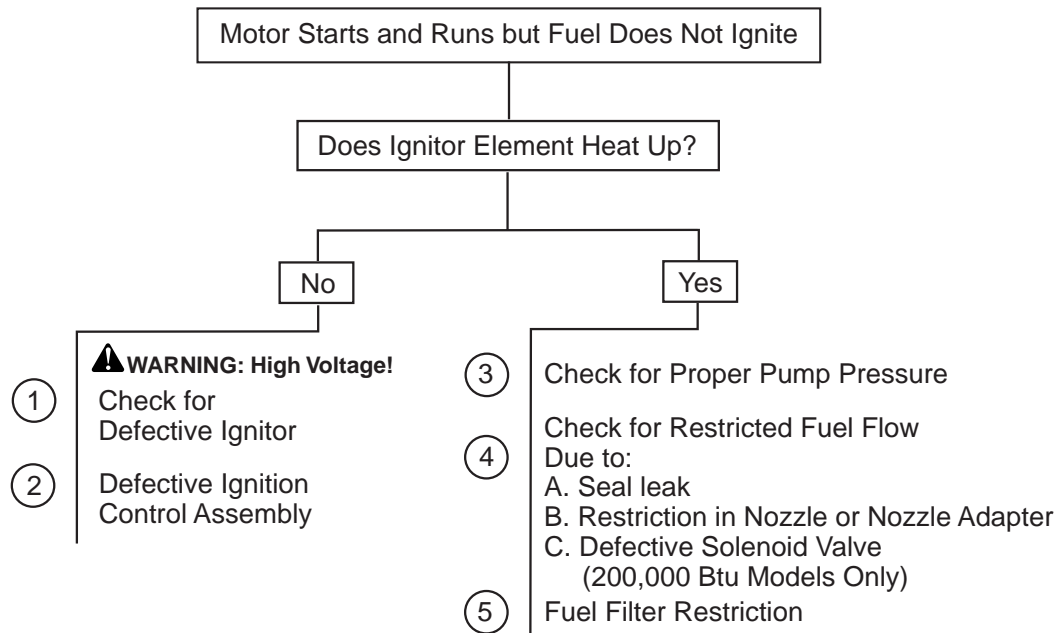
### IV. DIAGNOSTIC CHARTS

The following pages contain various diagnostic charts. To use the charts, find the "Observed Fault" that exists and follow test procedure.

#### Observed Fault Index

|  |    |
|--|----|
| Motor starts and runs but fuel does not ignite .....   | 11 |
| Ignitor element heats up but motor does not start within five seconds .....  | 14 |
| Ignitor does not heat up and motor does not start within five seconds .....  | 17 |
| Ignitor heats up, motor starts and runs, and fuel ignites, but heater shuts off after a short period of time ..... | 18 |
| Delayed Ignition .....   | 22 |

## OBSERVED FAULT



## TEST PROCEDURE

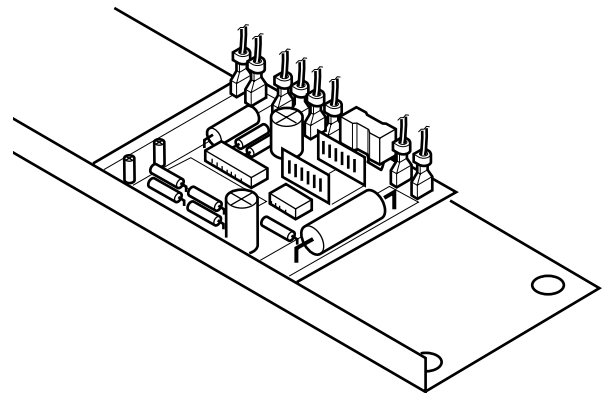
### ① Check Ignitor

Disconnect ignitor wires from ignition control assembly. Measure the resistance of the ignitor at the terminals with an ohmmeter (use 0-200 OHM scale). Ignitor resistance should measure 30 to 175 OHMS. If resistance measures outside of this range, then ignitor is defective and should be replaced.

### ② Check Ignition Control Assembly

Remove fuse cover and check fuse (70,000 to 200,000 Btu models only). If fuse is blown replace it with a GMA-10 fuse. Disconnect motor red and white wires from control. With Ignitor wires disconnected, attach voltmeter leads to the ignitor terminals (labeled IGNITOR). Use the 0 to 200 V.A.C. scale. Plug power cord into a grounded 120V/60 Hz outlet. Meter should read 120V(rms) for approximately 10 seconds. If voltage reads 0 or stays at 120 for more than 10 seconds, the control is defective and should be replaced.

⚠ **WARNING: High Voltage!**



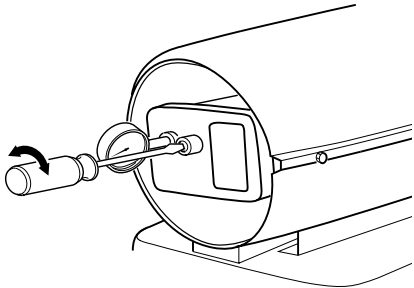
*Ignition Control*

# Hot Surface Ignition Models Service Manual

## ③ Check for Proper Pump Pressure

Install HA1180 Pressure Gauge or equivalent to rear of air filter housing. Start heater and adjust air pressure to specified pressure. Turn adjustment screw clockwise ↻ to increase pressure and counterclockwise ↻ to decrease pump pressure. The screwdriver must be removed from the slot after any adjustment before taking a reading on the gauge. (See *Heater Performance Specification* on page 6 for specified pressures).

*Note:* Pressure gauge must be scaled in 1/4 pound increments for accurate measurement.



## ④ Check for Restricted Fuel Flow

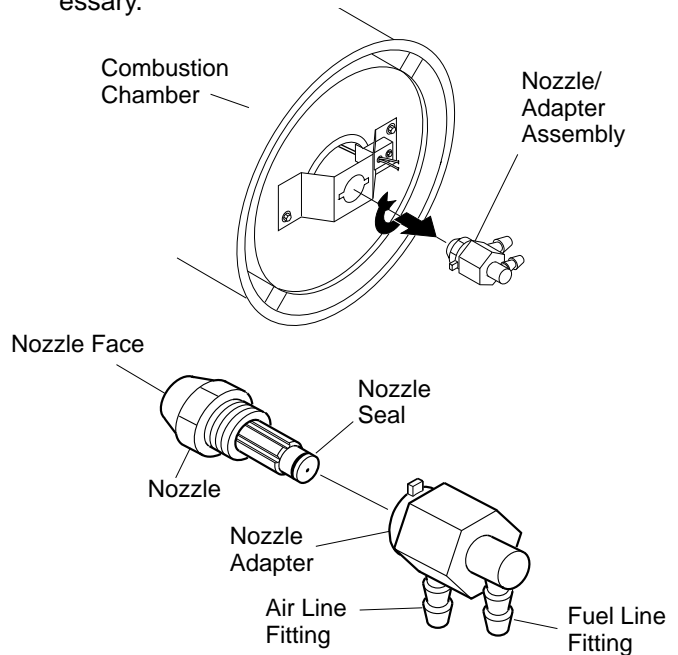
35,000 to 165,000 Btu Models Remove air and fuel lines from nozzle adapter. Remove nozzle adapter/nozzle from bracket.

200,000 Btu Model Remove ignitor (do not strike or bend element) from bracket. Place in a safe location. Remove air and fuel lines from nozzle adapter. Remove two bracket screws and remove bracket, nozzle adapter, and nozzle assembly from combustion chamber.

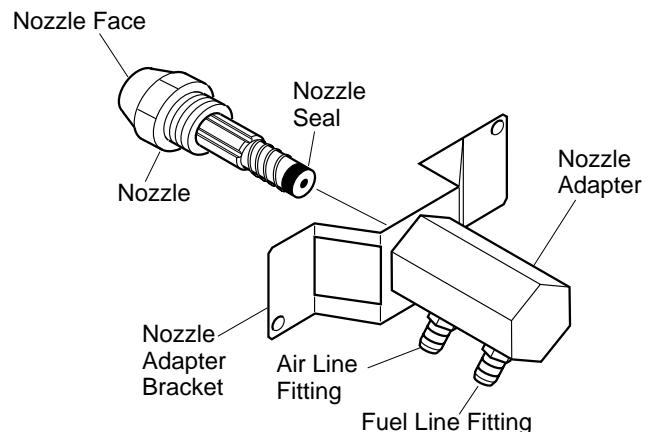
Using a 5/8" socket wrench, carefully remove the nozzle from nozzle adapter. (Be extremely careful not to scratch or score the face of the nozzle).

### A. Seal Leak

Inspect nozzle seal or o-ring for damage. Replace if necessary.



**35,000 - 165,000 Btu Models**



**200,000 Btu Models**

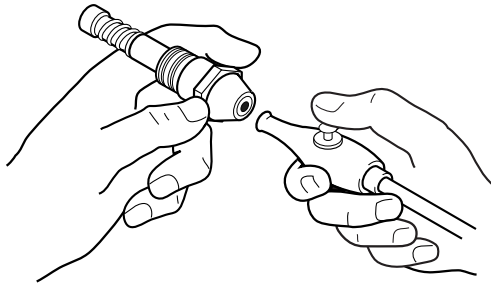
# Hot Surface Ignition Models Service Manual

## B. Restriction in Nozzle or Nozzle Adapter

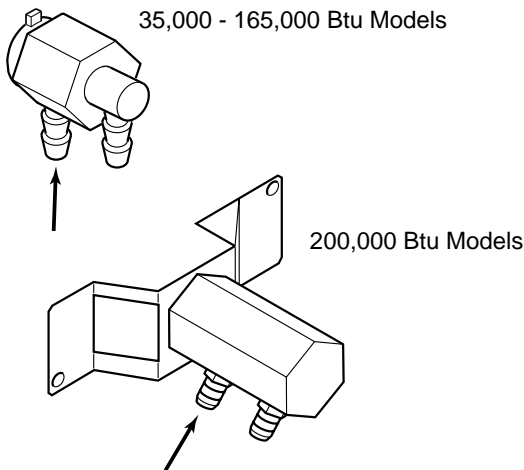
Using a compressed air source, blow the compressed air through the outlet end of nozzle to dislodge any foreign debris.

**CAUTION: NEVER DRILL OUT OR TRY TO INCREASE NOZZLE SIZE.**

Also, blow compressed air through the nozzle adapter in the direction shown to dislodge any foreign debris.



**Blowing Compressed Air Through Nozzle**



**Blowing Compressed Air Through Nozzle Adapter**

## C. Defective Solenoid Valve (200,000 Btu model only)

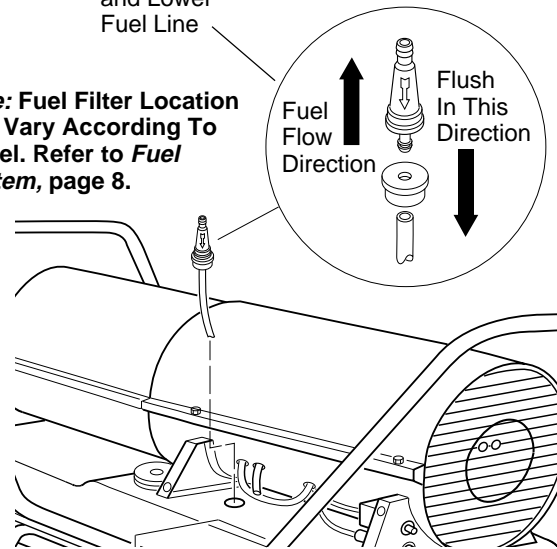
Remove upper and lower fuel lines from fittings on solenoid valve. Apply 120V/60 Hz power to valve. Shine a flashlight at one side of valve. Light should be visible from the other side when the solenoid is energized. If not, the valve is obstructed or defective. Clean or replace as necessary.

## 5 Fuel Filter Restriction

The fuel filter should be inspected and cleaned (see section III, *Fuel System (Fuel Filters)*, page 8. After removing filter, flush with clean kerosene in the reverse direction of the fuel flow.

Fuel Filter,  
Bushing,  
and Lower  
Fuel Line

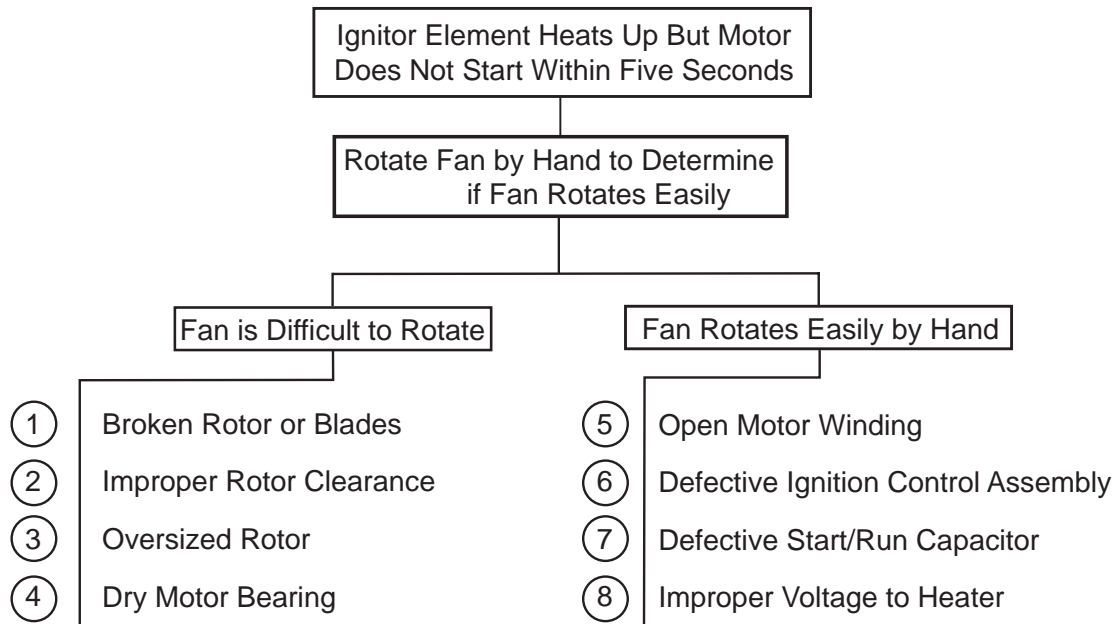
**Note: Fuel Filter Location May Vary According To Model. Refer to Fuel System, page 8.**



**100,000 - 165,000 Btu Models Shown**

# Hot Surface Ignition Models Service Manual

## OBSERVED FAULT



## TEST PROCEDURE

### ① Broken Rotor or Blades

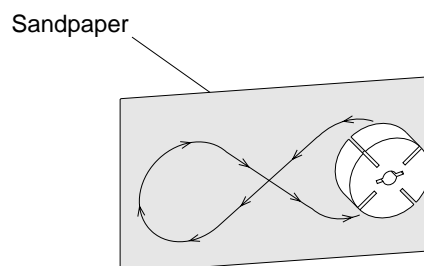
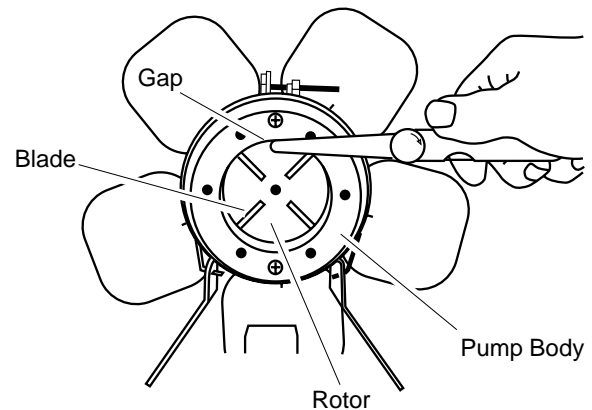
Disassemble the end cover filter and end pump cover from rear of motor. Visually inspect the rotor and blades for breakage. Make sure that the rotor and blades are free of any type of lubricant. Rotor and blades must be clean and dry for proper operation.

### ② Improper Rotor Clearance

Check rotor with feeler gauge for proper clearance (.003"-.004") between rotor and pump body. Rotate rotor and make sure all four quadrants of rotor have adequate clearance.

### ③ Oversized Rotor

If the fan is hard to turn when the motor end cover is installed, but easy to turn when loosened, the rotor should be removed and lightly sanded. Remove the rotor and lightly sand by placing rotor in the palm of hand and sanding on a flat surface making figure eight rotations. (Use the finest grade of sandpaper available).



## ④ Dry Motor Bearing

If the fan is difficult to turn with air pump parts removed, then motor bearings are defective. Bearings are permanently lubricated, therefore motor should be replaced.

## ⑤ Open Motor Windings

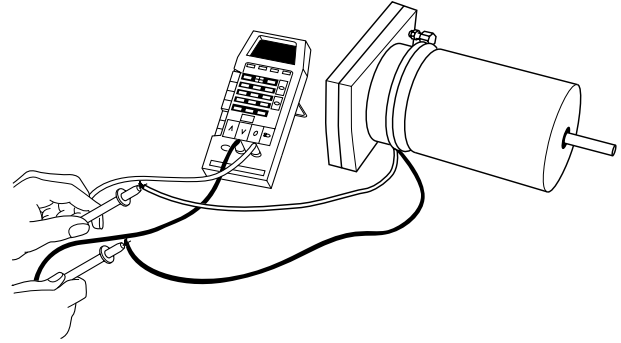
Disconnect motor wires (red and white) from ignition control assembly. Attach the ohmmeter leads to the motor wire terminals. Using the 0 to 200 OHM scale, measure the resistance of the motor windings. Refer to the chart below for resistances for each model. If the resistance is not within the specified range motor is defective and should be replaced.

**NOTE:** Resistances may vary due to motor temperature.

| MOTOR WINDING RESISTANCE                      |                         |
|---|-------------------------|
| MODEL   | RESISTANCE RANGE (OHMS) |
| 35,000, 50,000, 55,000, 60,000                | 5.57-6.81               |
| 70,000  | 6.03-7.37               |
| 100,000, 110,000, 150,000<br>155,000, 165,000 | 4.14-5.06               |
| 200,000                                       | 3.96-4.84               |

**Note:** In some cases it is possible for the resistance to read correctly without power applied and the motor still not work with power applied. If the ignition control assembly is tested and found to be good, then the motor is defective and should be replaced.

*Note:* Motor may vary according to model



# Hot Surface Ignition Models Service Manual

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## ⑥ Defective Ignition Control Assembly

Disconnect motor wires from control. Attach voltmeter leads to motor terminals on control. Use 0 to 200 V.A.C. scale on meter. Plug power cord into a 120V/60 Hz grounded outlet. Meter should read 0 volts for five seconds, 120 volts for 3 to 4 seconds, then drop to 0 volts. If the meter remains at 0 volts, the control is defective and should be replaced.

## ⑦ Defective Start/Run Capacitors

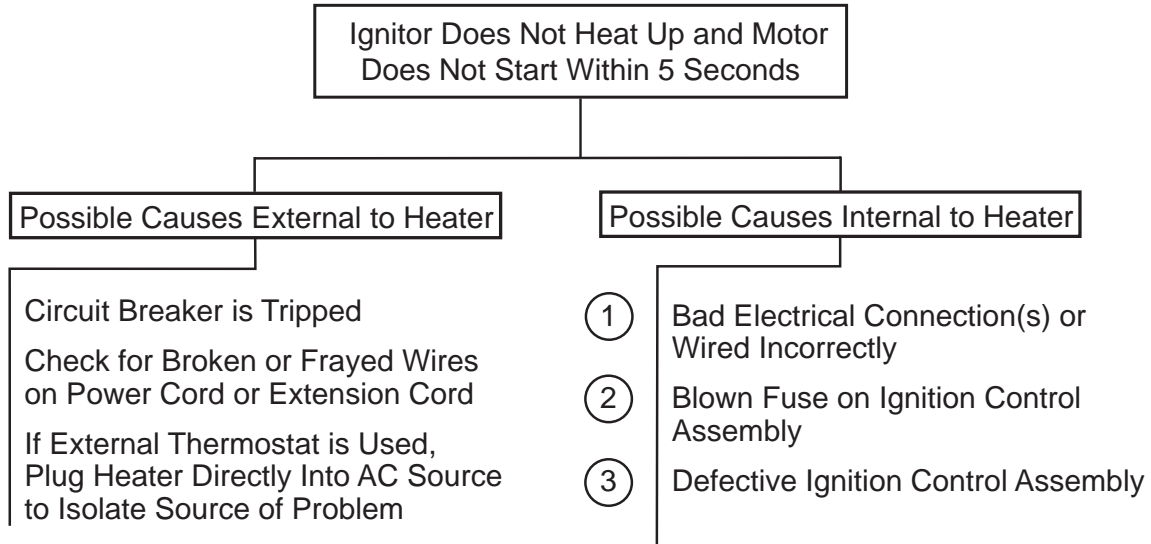
Motors used in 70,000 to 200,000 Btu model heaters are the Permanent Start Capacitor (PSC) type and are equipped with an integral start/run capacitor. If the resistance of the motor windings read correctly and the ignition control assembly is found to be working properly, the capacitor may be "open" circuit. The capacitor is wired internally and cannot be replaced. No service parts are available and entire motor assembly should be replaced.

## ⑧ Improper Voltage Input to Heater

The specified voltage operating range for this product is 108 to 132 volts (rms) 60 hertz. Verify that the voltage applied to the heater while the motor is running is at least 108 volts and does not exceed 132 volts. Refer to the *Electrical* section of this manual (page 5) for proper extension cord sizing.



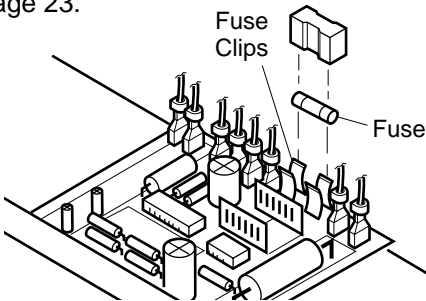
## OBSERVED FAULT



## TEST PROCEDURE

### ① Bad Electrical Connection(s) or Wired Incorrectly

Verify that all connections to the ignition control assembly are secure and wired according to the wiring diagram on page 23.



Checking Fuse

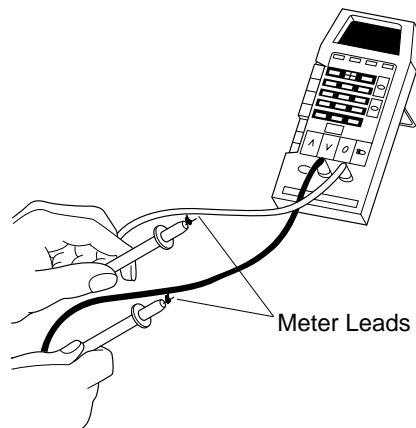
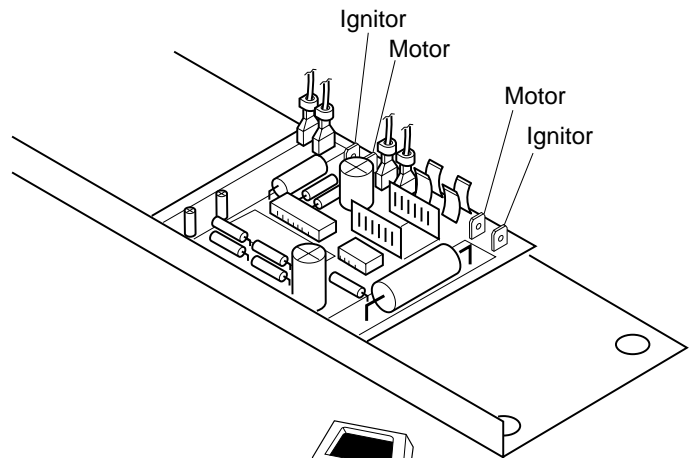
### ② Blown Fuse on Ignition Control Assembly

Remove fuse cover and inspect fuse. Check for continuity with an ohmmeter. If fuse is open, replace with a fuse of the same type and rating (GMA-10).

### ③ Defective Ignition Control Assembly

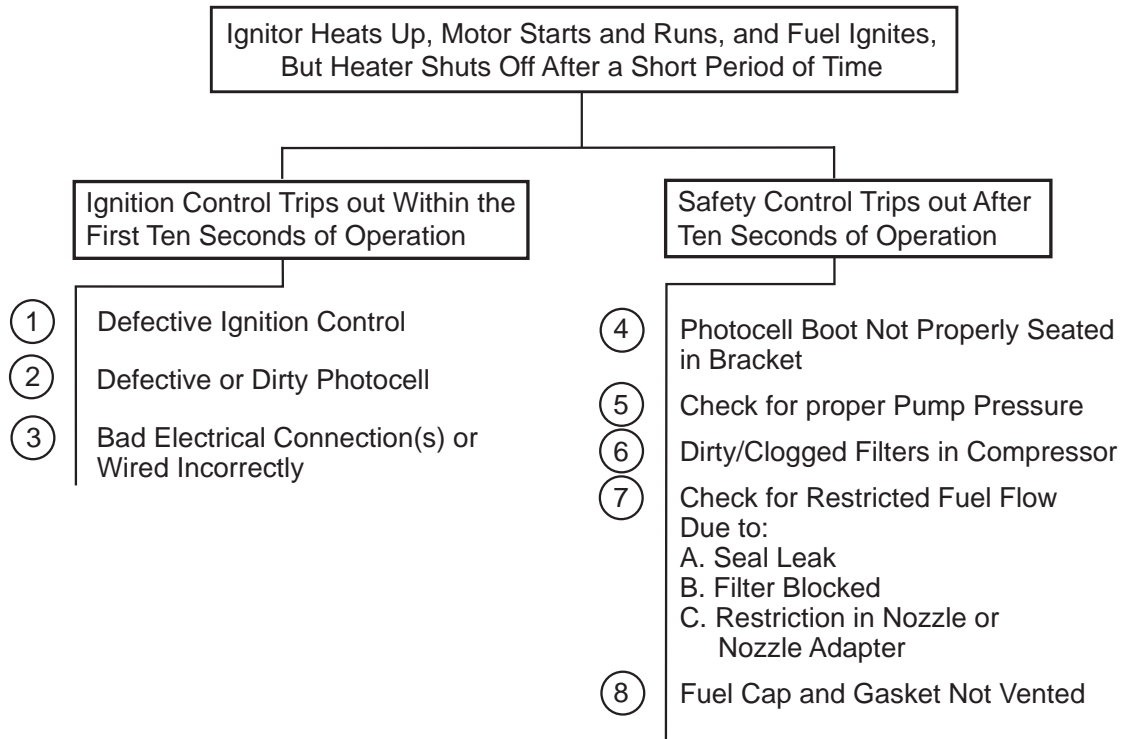
With motor and ignitor wires disconnected, connect voltmeter leads to the ignitor terminals. Use the 0 to 200 V.A.C. scale on the voltmeter. Apply power (120V/60Hz) to the control. The meter should read 120 volts for ten seconds and then drop to 0 volts. Remove power to control. Connect meter leads to the motor terminals. Apply

power to control. Meter should read 0 volts for five seconds, 120 volts for 3 to 4 seconds, then drop to 0 volts. If measurements differ from those described, control is defective and should be replaced.



# Hot Surface Ignition Models Service Manual

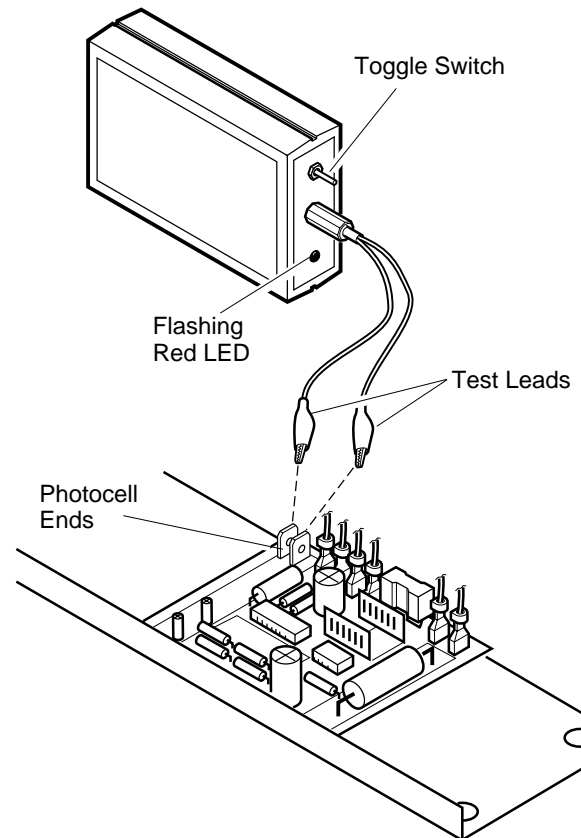
## OBSERVED FAULT



## TEST PROCEDURE

### ① Defective Ignition control

Remove pressure gauge plug from filter end cover. Remove 4 side cover screws that attach the side cover to the heater. Allow side cover (with ignition control attached) to rest on fuel tank flange. Disconnect only the photocell wires from ignition control. Attach the HA1170 leads to the photocell terminals on the ignition control. Plug the power cord into a grounded 120V/60 Hz outlet. When the motor starts turn the HA1170 toggle switch to the "flashing" red LED position (see page 10 for HA1170 calibration procedures). If the motor shuts off after 3 or 4 seconds, the control is defective and should be replaced. If the motor continues to run in step 1, the photocell may be dirty or defective.



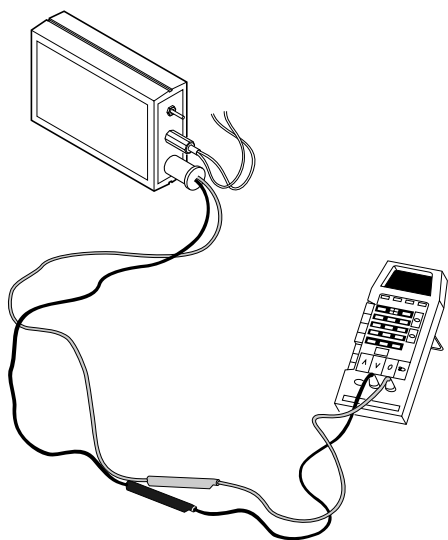
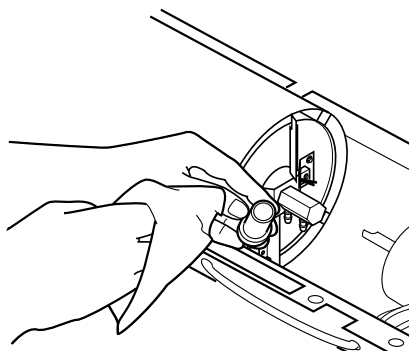
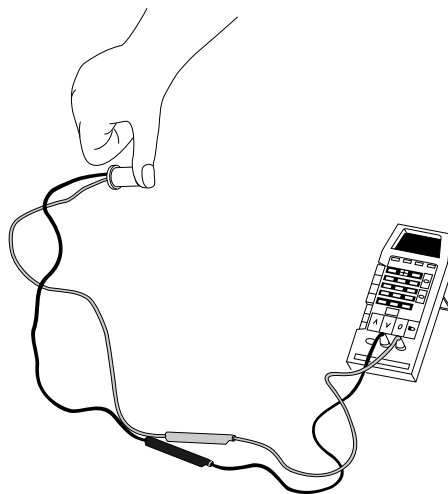
## ② Defective or Dirty Photocell Assembly

Inspect the lens of the photocell for soot/dirt, etc... If dirty, wipe off with a clean, damp cloth.

Remove photocell assembly from heater. Turn the toggle switch on the HA1170 tester to the "solid" red LED position. Place the photocell boot over the red LED on the tester. Connect the leads of an ohmmeter to the terminals on the photocell assembly. Use the 0 to 20,000 OHM scale on the meter. The resistance should measure 11,000 OHMS or less. If not the photocell is defective and should be replaced.

Block off the light source by putting thumb over opening of photocell. Replace the photocell if a change in resistance is not observed.

The resistance should measure greater than 50,000 OHMS (use the 1 megohm scale on the meter).

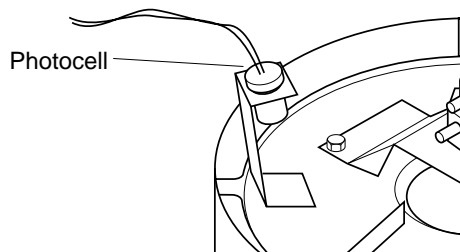


## ③ Bad Electrical Connection(s) or Wired Incorrectly

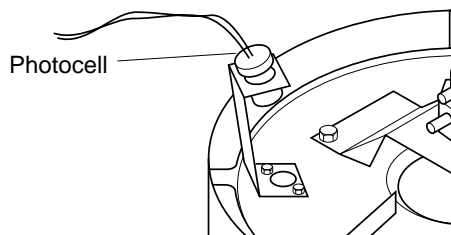
Verify that all electrical connections are secure and making electrical contact. Verify that wiring is per the wiring diagram (see diagram, page 23).

## ④ Photocell Boot Not Properly Seated in Bracket

Make sure photocell boot is seated in bracket securely. See illustration that follows.



**Correct Photocell Placement**



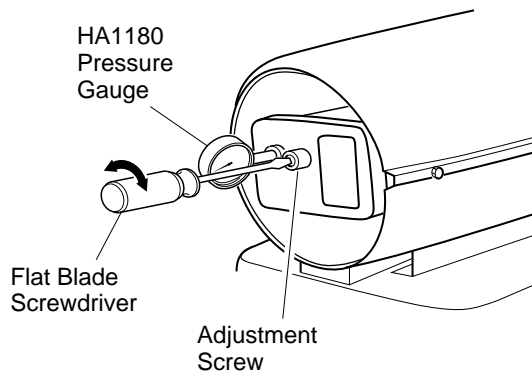
**Incorrect Photocell Placement**

# Hot Surface Ignition Models Service Manual

## ⑤ Check for Proper Pump Pressure

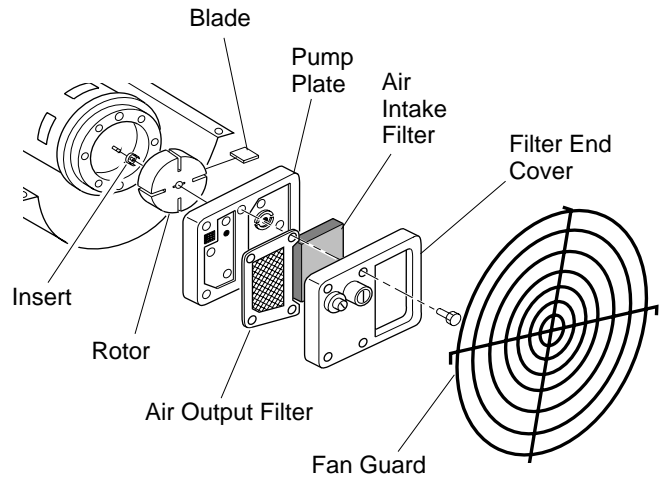
Install HA1180 Pressure Gauge or equivalent to rear of air filter housing. Start heater and adjust air pressure to specified pressure. Turning adjustment screw clockwise increases pressure, counterclockwise decreases pressure. The screwdriver must be removed from the slot after any adjustment before taking a reading on the gauge. (See *Heater Performance Specification*, on page 6 for specified pressures). It may be necessary to connect the HA1170 tester in place of the photocell while adjusting the pressure due to the fast shutdown response of the control.

*Note:* Pressure gauge must be scaled in 1/4 pound increments for accurate measurement.



## ⑥ Dirty/Clogged Air Filters in Compressor

Inspect and replace air intake, air output, and lint filter if necessary. Filters should be replaced after 500 hours of operation.



# Hot Surface Ignition Models Service Manual

## 7 Check for Restricted Fuel Flow

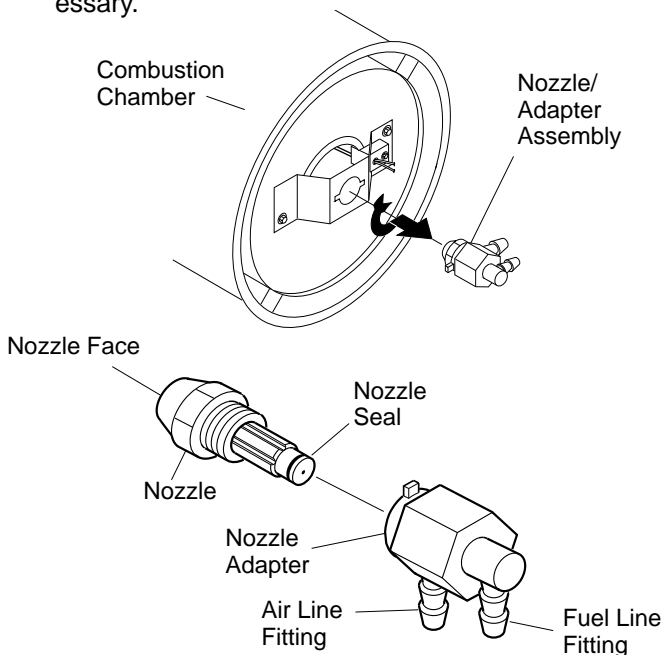
35,000 to 165,000 Btu Models Remove air and fuel lines from nozzle adapter. Remove nozzle adapter/nozzle from bracket.

200,000 Btu Model Remove ignitor (do not strike or bend element) from bracket. Place in a safe location. Remove air and fuel lines from nozzle adapter. Remove two bracket screws and remove bracket, nozzle adapter and nozzle assembly from combustion chamber.

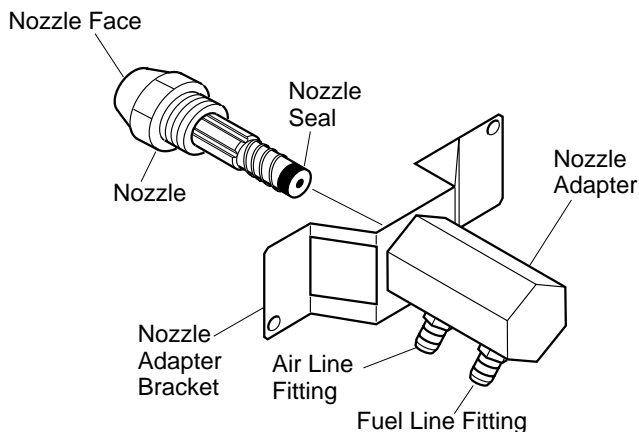
Using a 5/8" socket wrench, carefully remove the nozzle from nozzle adapter. (Be extremely careful not to scratch or score the face of the nozzle).

### A. Seal Leak

Inspect nozzle seal or o-ring for damage. Replace if necessary.



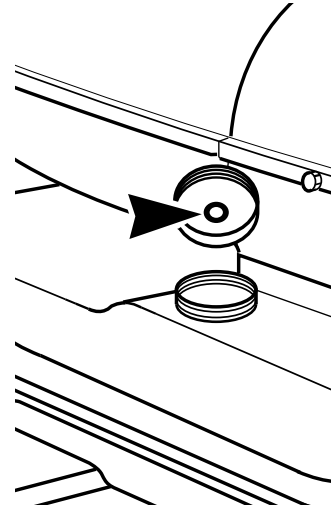
**35,000 - 165,000 Btu Models**



**200,000 Btu Models**

## 8 Fuel Cap and Gasket Not Vented

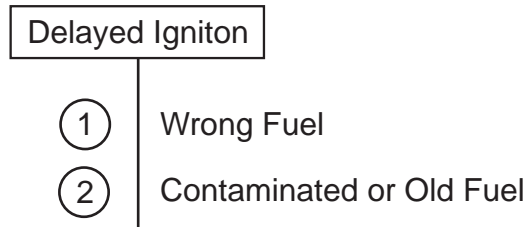
Remove fuel cap and inspect the vent hole and gasket to make sure the passage is open. Verify that only one gasket has been installed. The fuel tank must be vented properly for the fuel delivery system to operate correctly.



# Hot Surface Ignition Models Service Manual

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## OBSERVED FAULT



## TEST PROCEDURE

### ① Wrong Fuel

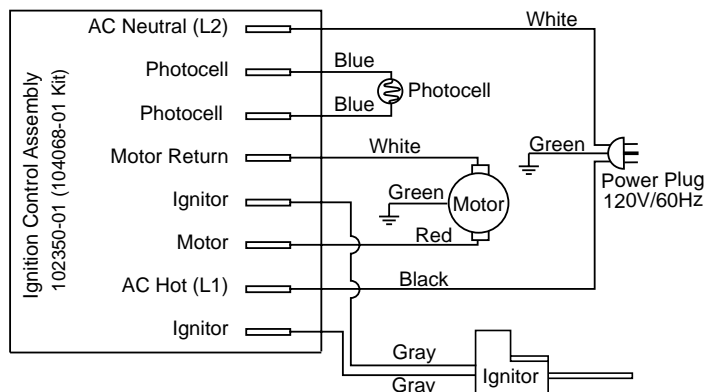
Refer to *Fuel Selection* on page 5 of this manual.

### ② Contaminated or Old Fuel

Fuel may not be fresh or may be contaminated with water or other foreign liquids. Drain fuel tank and rinse with clean, fresh kerosene or No. 1 fuel oil. Refer to local city or county ordinances for proper disposal of fuel oil.

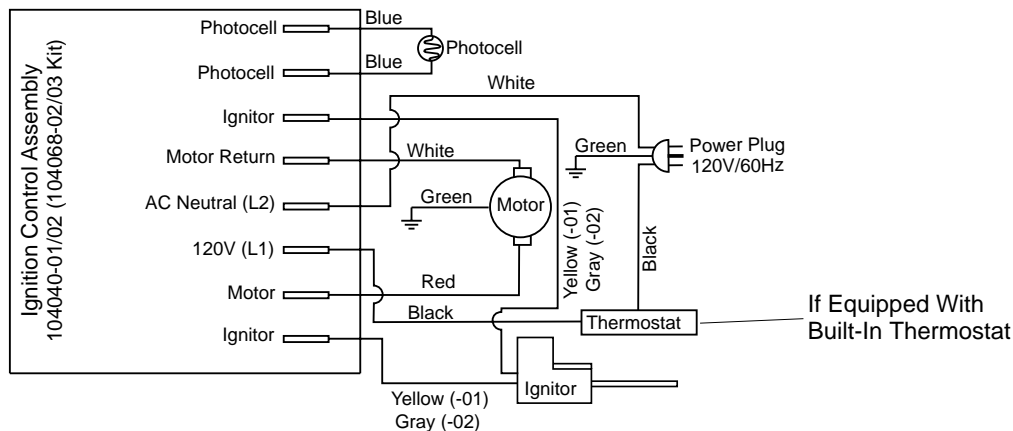
# Hot Surface Ignition Models Service Manual

## WIRING DIAGRAMS



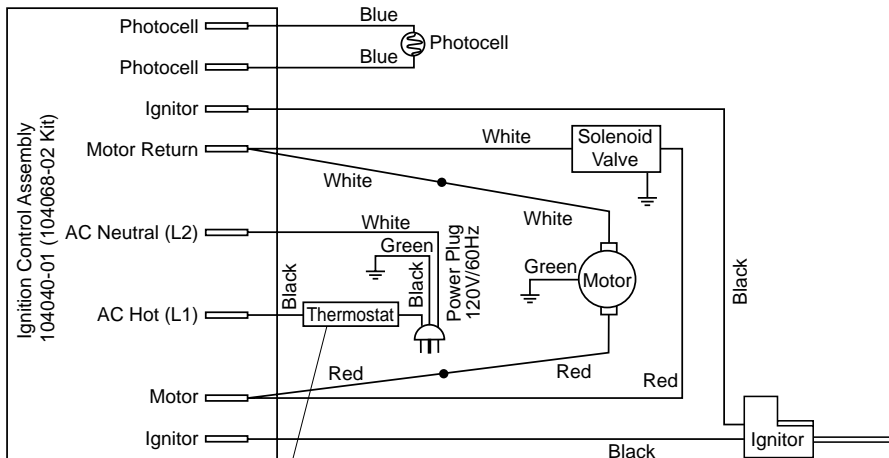
**ATTENTION: Earth ground must be connected to ensure operator safety!**

**55,000 BTU Model (R55A Model Only)**



If Equipped With Built-In Thermostat

**35,000, 40,000, 50,000, 55,000, 60,000, 70,000, 110,000, 115,000, 150,000, 155,000, 165,000 BTU Models**



If Equipped With Built-In Thermostat **200,000 BTU Model**

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