

# **Paragon HT & KM Series Instruction and Service Manual**

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## INTRODUCTION

Your new furnace should give you many years of trouble-free service, provided you read and follow these instructions. There are many ways to damage a furnace. If you read and follow this manual, however, you will avoid those pitfalls and will be delighted with your furnace's ease of operation.

We suggest you read the manual twice. The first time read it straight through before you plug your furnace in. The second time use it as a guide to set up and fire the furnace. In addition, read the separate digital controller instructions.

Tremendous stresses are generated within the furnace. The insulating firebricks expand and contract with each firing. This is absolutely necessary for the long life of your furnace. Hairline cracks will appear in the brick while the furnace is cold. Do not be concerned with these; they close tightly when the heated brick expands.

Firing in a reduced oxygen atmosphere will shorten the life of the heating elements. Element failure from reduction firing is not covered by warranty. However, we will show you how to do contained reduction firing using inconel foil.

Thank you for purchasing a Paragon furnace. May it give you many years of faithful service!

### **Repair Under Warranty**

In the unlikely event that you need a warranty repair, you can replace parts yourself—this manual shows how. Or you can ship the furnace back to the factory, and we will fix it for you. Please call us before shipping the furnace to us. If you decide to replace the part yourself, call or write us first, ship the defective part to us, and we will ship you a replacement. (Please note that transportation costs to and from the factory for parts or furnace are paid by the owner.)

When you call or write about your furnace, it is important that we have the complete model number. This number will insure that you receive the correct replacement parts. The model number is on the data plate near the bottom of the switch box.

### **Important Safety Rules**

- Unplug furnace when not in use.
- Do not touch hot sides.
- Keep unsupervised children away.
- Place furnace on a non-combustible surface.
- Do not install closer than 12" from any wall or combustible surface.
- Fire only in a well ventilated, covered and protected area.
- **DANGEROUS VOLTAGE!** Do not touch heating elements with anything.
- Disconnect furnace before servicing.
- Do not leave furnace unattended while firing.
- Wear protective glove and firing safety glasses when opening the door of a hot furnace.
- Never burn salts or cyanide compounds in your furnace. The gases emitted are toxic.
- Keep a fire extinguisher nearby when using quenching oil.
- Keep food away from your work area.

1 Wear firing safety glasses during unloading.

# FURNACE SET-UP

## Unpacking the Furnace

Carefully inspect your furnace as soon as it arrives. If the furnace is damaged, call Paragon Industries, Inc. at 214/288-7557. (We're open Monday through Thursday, 7 a.m. to 5:30 p.m. Central time.) Save all packing materials for inspection by the freight claims adjuster. Refer to your packing list for more information.

## Where to Locate Your Furnace

- 1** Place your furnace in a well ventilated, covered and protected area such as the garage, basement, or workshop. Do NOT store gasoline, paint or other inflammable liquids in that room.
- 2** Never allow the room temperature to exceed 100 -110° F. (Measure room temperature three or more feet from the furnace.) If necessary, use fans to lower room temperature.
- 3** If you use two or more furnaces side by side, keep them at least four feet apart. Otherwise the room temperature can build up around the furnaces and overheat the electronic controllers.
- 4** Provide a minimum of 12 inches clearance between furnace and the closest wall.
- 5** Keep the furnace away from curtains or other combustible materials.
- 6** Position furnace on a level, fire-proof surface. We recommend a metal table.
- 7** Keep unsupervised children away from the firing area.
- 8** Keep the power supply cord away from the side of the furnace. Your furnace case is hot during firing and touching could damage the cord set.

## Seating the Elements

Shipping may dislodge the elements of your furnace. Please perform the kitchen knife test to make sure the elements are seated in their grooves.

### Kitchen Knife Test

*CAUTION: Always unplug furnace before touching an element with anything. Read this manual completely before plugging in your furnace.*

*Touch only a cold element—never a hot one—with a plastic object such as a comb. Plastic will melt on and ruin a hot element.*

Press the elements into their grooves by running a blunt kitchen knife or plastic comb completely around each groove. Do this before you fire the furnace even if the



element appears to be seated in its groove. The element must fit all the way back into each corner and must not bulge outside the groove.

*The element will not be seated in the curved portions of the groove. This is alright as long as the element is seated in the straight grooves and corners.*

Before the furnace is fired, there is no danger of breaking the elements by bending or moving them. After firing, however, the elements must be reheated if they bulge out of the groove. (See page 7.)

## Cleaning the Furnace

Clean the furnace before firing. Use a soft brush nozzle on a vacuum cleaner to remove brick dust from inside the furnace, especially from the grooves. A damp cloth or damp sponge can also be used to gently wipe dust from the firebricks.

## Electrical Installation

Your furnace must be plugged into a correctly wired circuit. The circuit must not be used by other appliances while the furnace is firing. Turn off the circuit breaker of the circuit your furnace will use. Check to see if other appliances shut off too. If that circuit powers appliances that must remain on while the furnace is firing, plug your furnace into a different circuit.

*If your furnace is 240 volts, never use an extension cord. Avoid extension cords on 120 volt models if possible. If you must use one on a 120 volt furnace, never use one smaller than 12 gauge or longer than 20 feet. Never plug it into a ceiling outlet!*

The receptacle must have a separate safety grounding wire. This protects you from serious electrical shock. If you have the least doubt that your circuit is properly wired, have an electrician check it for you.

## Electrical Specifications

Specifications on the furnace electrical data plate supersede specifications on this chart.

This chart is for United States and Canadian 120 and 240 volt, single phase models with a factory-installed cord set only. For foreign countries, refer to the kiln's electrical data plate. Your electric circuit should be installed only by a licensed electrician and in accordance with local codes. *Changing the cord plug will void your warranty!*

MODEL NO.	Electrical Power Rating			Circuit Size*		NEMA Config.
	Volts	Amps	Watts	Wire	Fuse Size	
PKM-9D	120	15	1800	12	20	5-15R
KM-14D	120	16	1920	12	20	5-20R
KM-24D	240	15	3600	12	20	6-20R
KM-36D	240	15	3600	12	20	6-20R
HT-10D	120	14.1	1692	12	20	5-15R
HT-14D	240	13	3120	12	20	6-20R
HT-22D	240	30	7200	6	50	6-50R

\*These are recommended copper wire and circuit breaker sizes only. Refer to and comply with local electrical codes if they differ from our recommendations.

## HEAT TREATING

# HEAT TREATING

We will tell you how to heat treat D2, 440C, ATS 34, 0-1 and A-2 tool steels. Though written for the knifemaker, these instructions can also be used for making tools and parts.

To heat treat steels not covered here, ask your steel supplier for the heat treating specifications. Steel manufacturers publish this information.

Your own favorite heat treating "recipes" may differ from ours. This is alright, because there are many ways to successfully heat treat steel. Enjoy experimenting.

## GUIDELINES

- Whatever you place inside the furnace must be clean and dry.
- Keep all items to be heat treated at least 1" away from heating elements.
- Never heat salts or cyanide compounds in an electric furnace. The gases emitted are toxic and will shorten not only the life of the element but your life as well.
- Always use knifeholders to support your knives inside the furnace. Laying a knife flat against the furnace bottom could warp your knife.
- Stay near the furnace during heat treating. It's easy to forget a knife and leave it in too long.
- Do not place room-temperature blades into a furnace heated to hardening temperature. Instead, place them inside a cold furnace and let them heat up with the furnace.
- Keep organic materials out of the furnace unless they are wrapped in inconel foil. Burning organic materials in the furnace could lead to carbon buildup on the firebrick walls. This could cause electrical arcing across the element grooves, since carbon conducts electricity. This would not be covered by warranty.
- Keep your furnace clean. Use the soft brush nozzle of a vacuum cleaner to clean it after every few firings.
- Be careful not to disturb the thermocouple when loading and unloading your furnace.

## The Rockwell Hardness Rating

The Rockwell hardness tester is the most common method of testing steel hardness. The machine pounds a small impression into the metal. It then reads the depth of the impression to determine hardness. Knives are rated in hardness on the "C" scale of the Rockwell hardness tester. The higher the number, the harder the steel.

How hard should your knives be after heat treating? It all depends on the purpose of the knife. The harder the blade, the longer it will stay sharp. Very hard blades are difficult to sharpen and are brittle. Some knife makers test completed blades by dropping them onto a concrete floor. If the blade tip breaks off, the steel needs to be heat treated to a lower Rockwell number.

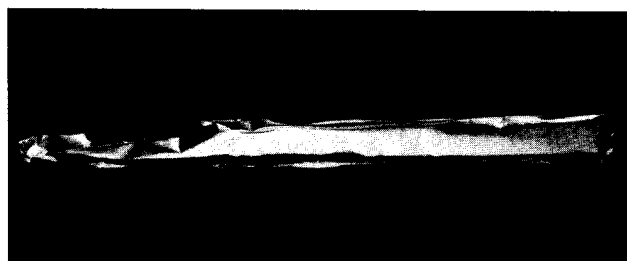
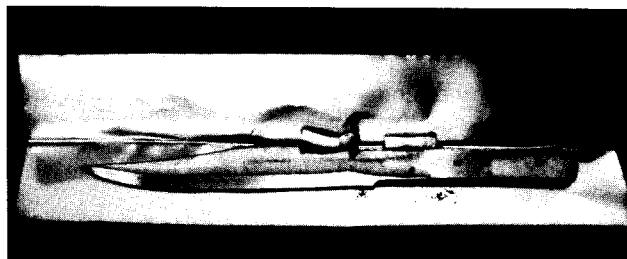
The ideal Rockwell number also depends on the steel. For instance, some knife makers heat treat ATS-34 to 59-60 Rc and 440C stainless to 56-59 Rc.

We recommend that you fire steel scraps for your first few firings. Wrap the scraps in inconel foil and fire them just the way you would a knife. Then take them to a machine shop and have them hardness tested. It will take just a moment to test a batch of scraps, and you shouldn't expect to pay much for this service. In fact some shops will do it free. Grind a smooth area on each scrap where a hardness impression can be stamped.

If the scraps turn out to be too hard or too soft, heat treat another test batch. The instructions tell how to raise or lower the hardness rating by varying temperatures.

## First, Wrap the Knife

When tool steel is heated to high temperature, the carbon on the steel surface oxidizes and forms a scale. This is called decarbonization. The scale has to be ground off after heat treating. A simple way to avoid



## HEAT TREATING

decarbonization is to wrap each knife individually with inconel foil. It is necessary to wrap the knives in foil for hardening but not for tempering. (See Tempering, pg 5.)

*A rule of thumb: any time you heat the steel hotter than 850° F., wrap it in inconel foil.*

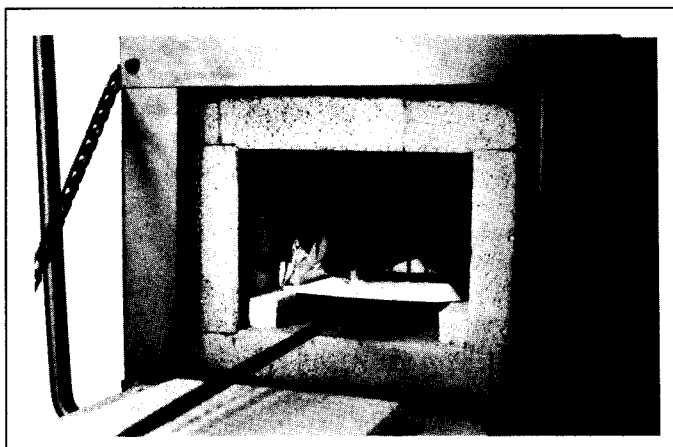
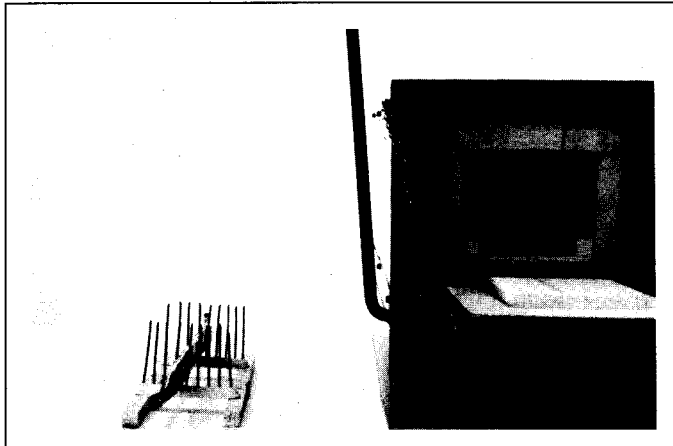
Handle the foil carefully or wear gloves—the foil edges are very sharp. The foil cuts easily with scissors. Place a cigarette butt or small chip of wood next to the knife or part before wrapping in foil. During heating, the cigarette or wood will burn, using up the oxygen inside the foil enclosure and preventing the steel from oxidizing.

Fold over the edges of the foil tightly two or three times so air won't leak in. Make the foil pocket oversized around the knife. This will make it easy to remove the hot knife from the foil.

### Load the Furnace

If you bought a knifemaker's heat treating kit, assemble the knifeholders by inserting the pins in the holes. Place the firebrick supports (long, narrow firebrick pieces) that came with the kit inside the firing chamber. Place two or more firebrick supports next to the furnace on a piece of sheet metal. When you remove the blades and knifeholders from the furnace, they will be placed on these outside firebrick supports.

Place two knifeholders on the outside firebrick supports. Lay your wrapped knives on the knifeholders. You



can place a blade in each space between the pins and fill up the knifeholder. The upright pins separate the knives so they will heat evenly.

Place a heat treating fork under the knifeholders and lift the holders into the furnace. Lay them onto the firebrick supports already in the furnace. Make sure no knife (or whatever else you're heat treating) is closer than an inch from a heating element. If you're heat treating heavy, long blades, it would be a good idea to place an extra firebrick support under the center of the knifeholders for extra support.

*Tip: Load the handle end of the knives in the same direction each time you heat treat. You will be opening the foil wrapper at the handle end when you remove the hot knives, so the handle ends should all be in the same direction.*

### COLOR SCALE FOR TEMPERATURES

Color	Appx. Cone	Degrees F.
Lowest visible red to dark red	022 to 019	885 to 1200
Dark red to cherry red	018 to 016	1200 to 1380
Cherry red to bright cherry red	015 to 014	1380 to 1500
Bright cherry red to orange	013 to 010	1500 to 1650
Orange to yellow	09 to 03	1650 to 2000
Yellow to light yellow	02 to 10	2000 to 2400

### Programmed Firing Rate

Your electronic controller requires a firing rate. For knives and general tools, program a maximum rate per hour (9999° F.). Fire the furnace as fast as the steel will permit.

There are exceptions. If you are reheating a hardened piece of steel that has thin and thick sections, you must heat slowly. This is to prevent warping and cracking. A rate of 400° F./hour would be a good average. Reheating thin objects such as knives, however, is safer. You can heat them at maximum rate.

### Heat Treating Step #1: Hardening

The first step in heat treating is hardening the steel. The blades are hardened by heating to the hardening temperature recommended for the steel you're treating. The blades are "soaked," or held at that temperature for a specified period.

Do not place room-temperature blades into a furnace heated to hardening temperature. Instead, place them inside a cold furnace and let them heat up with the furnace.

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## HEAT TREATING

### Heat Treating Step #2: Quenching

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After the knives are hardened, they are removed from the furnace and cooled quickly. Fast cooling is called quenching. Fast cooling makes the steel retain the hardness developed by the heat. If the steel cooled off slowly, the knives would lose that hardness.

The steels we cover in this manual are either air or oil quenched. Air quenching means cooling by air alone. Oil quenching means cooling by placing the steel in an oil bath.

#### Removing the Inconel Wrapping

Remove the blades from the hot furnace using a heat treating fork. Lay the knifeholders on the firebrick supports outside the furnace. Then remove the blades from their foil wrappers. Do this as quickly as you can while the knives are fresh from the furnace. Follow these steps:

**1** Pick up the foil wrapper with pliers. *Do not grasp the blade with the pliers, only the wrapper.*

**2** Using an old pair of scissors, cut off the wrapper at the handle-end of the knife.

**3** Reach inside the wrapper with tongs and pull the blade out. Hold the handle end of the blade just in case you nick the steel.

#### Air Quenching

**1** Place the blades on the knifeholders after you remove the foil.

**2** Place a fan several feet from the knifeholders. Point the blades toward the fan so the air flows parallel to the blade length.

*If the air hits the blades in a sideways direction, it increases the chance of warpage.*

#### Oil Quenching

Keep a fire extinguisher nearby when working with quenching oil. *Be sure to wear safety glasses and protective clothing in case the hot oil splashes.* Use long-handled tongs to handle the steel, not pliers. The tongs will allow you to handle the blade without placing your hand too close to the oil. (Sometimes the surface of the oil will flame up.)

Use only quenching oil from your heat treating supplier. Do not substitute with motor oil or household oils such as olive oil. They are a fire hazard. Follow the directions that come with the quenching oil. Heat the oil, if necessary, with a piece of hot scrap steel. Heating the oil lessens the temperature shock to the steel.

After you remove the blade from the furnace, remove the inconel foil and rapidly insert the blade into the quenching oil. The steel must be agitated continuously in the oil, so it is easier to quench only one blade at a time.

Lower the blade straight down into the oil tip first. Use a gentle stabbing motion. Lowering the blade into the oil flat, with the blade parallel to the surface of the oil, increases the chance of warpage. When heat treating

long knives or swords, use a deep tank for oil quenching. Lower the blades vertically into the oil holding the handle end with long tongs. Laying them flat in a shallow tank increases the chance of warpage.

The blades must be agitated constantly while immersed in oil. This is because the oil around the steel heats up and must be replenished with cooler oil. Use an up-and-down stabbing motion when agitating a blade. A side-to-side motion increases the chance of warping. While agitating, keep the entire piece submerged.

### Heat Treating Step #3: Tempering

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After the steel is hardened and quenched, it is so brittle that it could shatter if dropped. Tempering the hardened steel will make it durable. Tempering (also called drawing) toughens the steel while retaining most of the hardness developed in the hardening step. You control final hardness of the knife by varying the tempering temperature. The higher the temperature, the softer the knife.

Tempering is done at a lower temperature than hardening. For this reason, wrapping steel in inconel foil at this stage is unnecessary.

To use your Paragon furnace for tempering, allow it to cool 100° F. below the tempering temperature. The hot furnace should be cooler than the tempering temperature because of rebound. The heat stored in the firebricks will raise the temperature after you close the door again. For longest element life, do not force-cool your furnace with a fan. Open its door and let it cool on its own.

#### Heat Treating D-2 (Air Quenching)

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**1** Place your knives in the furnace and heat to 1850° F. Hold that temperature for 15 to 20 minutes.

**2** Remove the blades from the furnace. Remove the foil and cool the blades with a fan. (See quenching section.)

**3** With the door open, cool the furnace to 400° F. without force-cooling. Place the knives and knifeholders back into the furnace with the fork.

**4** Heat the knives to 500° F. Soak for two hours.

**5** Remove the knives. Close the furnace door. Leave the furnace soaking at 500° F.

**6** When the knives have cooled to touch, place them back inside the furnace. Let them soak at 500° F. a second time for two hours. Then remove the knives. Let them cool to room temperature. Heat treatment is completed.

**Higher Rockwell Hardness Rating** To make the steel harder than with the above formula, harden at 1850° F. for 15 to 20 minutes and temper at 300° F. twice for two hours each.

**Lower Rockwell Hardness Rating** To make the steel softer, harden at 1700° F. for 15 to 20 minutes and temper at 500° F. twice for two hours each.

**5** *Wear firing safety glasses during unloading.*

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## FURNACE MAINTENANCE

### Heat Treating 440C (Air Quenching)

**1** Place your knives in the furnace and heat to 1850° F. Hold that temperature for 20 to 25 minutes.

**2** Remove the blades from the furnace. Remove the foil and cool the blades with a fan. (See quenching section.)

**3** Let the furnace cool down to 200° F. without force-cooling. Place the knives and knifeholders back into the furnace with the fork.

**4** Heat the knives to 300° F. Soak at that temperature for two hours. Remove the knives and let them cool to room temperature. Heat treatment is completed.

**Higher Rockwell Hardness Rating** To make the steel harder than with the above formula, use the same formula but quench with dry ice before tempering.

**Lower Rockwell Hardness Rating** To make the steel softer, harden at 1850° F. for 20 to 25 minutes and temper between 400° and 500° F. for one hour. (500° will give you a lower hardness rating than 400°.)

### Heat Treating ATS 34 & 154 CM (Oil Quenching)

**1** Place your knives in the furnace and heat to 1900° F. Hold that temperature for 30 minutes.

**2** Remove the blades from the foil quickly. Quench the blades in oil. (See quenching section.)

**3** Let the furnace cool down to 200° F. without force-cooling. Place the knives and knifeholders into the furnace with the fork.

**4** Heat the furnace to 300° F. Soak at that temperature for two hours. Then remove the knives and let them cool to room temperature.

**5** Place the knives back into the furnace and heat them to 275° F. Soak for two hours. Remove the blades and let them cool to room temperature. Heat treating is completed.

**Higher Rockwell Hardness Rating** To make the steel harder than with the above formula, heat treat just as above, except temper at 250° F. twice.

**Lower Rockwell Hardness Rating** To make the steel softer than with the above formula, heat treat just as above, except temper at 400° F. twice.

### Heat Treating O-1 (Oil Quenching)

**1** Place your knives in the furnace and heat to 1450° - 1500° F. Soak at that temperature for 20 minutes.

**2** Remove the knives from the foil quickly. Quench the blades in oil. (See quenching section.)

**3** Let the furnace cool down to 300° F. without force-cooling. Place the knives and knifeholders into the furnace with the fork.

**4** Heat the furnace to 425° F. Soak at that temperature for one hour. Then remove the blades and let them cool to room temperature. Heat treatment is completed. Rc should be 60.

**Higher Rockwell Hardness Rating** For a hardness of 62 Rc, heat treat just as above, except temper at 350° F.

**Lower Rockwell Hardness Rating** For a hardness of 58 Rc, heat treat just as above, except temper at 500° F.

### Heat Treating A-2 (Air Quenching)

**1** Place your blades in the furnace and heat to 1725° - 1775° F. Hold at that temperature for 20 minutes.

**2** Remove the blades from the foil quickly and cool with a fan. (See quenching section.)

**3** Let the furnace cool down to 400° F. without force-cooling. Place the knives and knifeholders back into the furnace with the fork.

**4** Heat the blades to 500° F. Soak at that temperature for one hour. Remove the knives. Let them cool to room temperature. Heat treatment is completed. Rc should be 58 - 60.

**Higher Rockwell Hardness Rating** For Rc 59 - 61, heat treat just as above, except temper at 450° F.

**Lower Rockwell Hardness Rating** For Rc 57 - 59, heat treat just as above, except temper at 600° F.

# FURNACE MAINTENANCE

## Locating Electrical Trouble

If your furnace stops heating while firing, check fuses or circuit breakers first. Wire heats when an electric current passes through it. If the same current passes through both a small wire and a large wire, the smaller wire will reach a higher temperature. A fuse uses this principle to protect the wiring in a building. It has a small, short wire of low melting temperature metal connected in such a manner that all current passing through the circuit must also pass through the fuse. The fuse wire size is selected so that the maximum safe current the wiring can handle will generate enough heat to melt the wire (i.e. blow the fuse). A circuit breaker uses a tiny heating element to heat a thermostat, which interrupts the current when the maximum safe amount is reached.

A blown fuse or tripped circuit breaker is not necessarily an indication of electrical trouble with your furnace or wiring. A short circuit or "short" causes a large amount of current to flow, generating so much heat that the fuse or breaker opens the circuit almost instantly. If your furnace should blow a fuse after firing for some time, there is little probability of a short. Replace the fuse or reset the breaker, and if it does not blow again as soon as the furnace is turned back on, there is no short in your furnace wiring.

## FURNACE MAINTENANCE

A loose or poor connection at the fuse or breaker will generate heat. If the fuse or circuit breaker panel feels unusually warm, have your electrician check for loose connections, particularly at the center screw of the fuse socket, even in a new fuse box.

### Electrical Troubleshooting

Refer to the troubleshooting section of the electronic controller instructions.

#### SLOW FIRING

Probable Cause:

- Low Voltage

**Remedy:** Speed up firing. If furnace still fires too slowly, have the power company check your voltage and readjust transformer if necessary.

#### NOT ALL ELEMENTS FIRE

Probable Cause:

- Broken Element  
 Disconnected Wire Inside Switch Box

Check above parts. Always **UNPLUG** furnace before opening switch box or touching elements.

#### FUSE BLOWS BUT NOT IMMEDIATELY

Probable Cause:

- Overloaded Circuit

Check to see if other appliances are being used on the furnace's circuit. Have your electrician check the connections in the circuit.

#### NO HEAT IN FURNACE

Probable Cause:

- Tripped Circuit Breaker or Blown Fuse  
 Cord Not Plugged In

**All Models:** Check circuit breakers or fuses, make sure furnace is plugged in. Always **UNPLUG** furnace before removing switch box.

#### HOT PLUG OR OUTLET

Probable Cause:

- Defective Plug or Outlet

**Remedy:** Replace if too hot to hold. Repair before firing the furnace again.

## Element Maintenance

### How to Get the Longest Life Out of Your Elements

The elements in your Paragon furnace should last for many years of normal use. With time, however, the elements will gradually draw less and less power. Elements should be replaced when heat-up time becomes excessive.

High temperature elements are damaged by contact with silica or silica-bearing compounds. If silica touches an element, the element will burn out during the next firing. This type of damage is not covered by warranty.

Also, reduction firing, which removes the oxygen from your furnace, will ruin your elements. The elements are protected by a coating of oxidation, which reduction firing destroys. Reduction is performed at your own risk; elements damaged by reduction are not covered by warranty.

### Reseating a Bulging Element

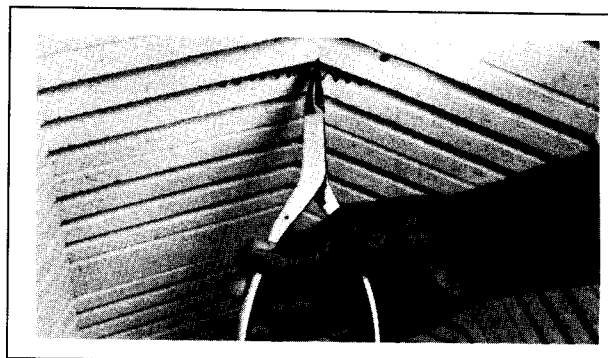
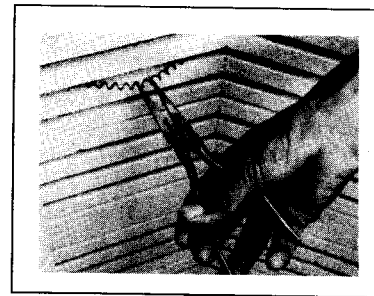
If you seat the elements properly before firing the furnace for the first time, you will probably have no trouble in the future with an element bulging out of the groove. Should an element bulge out of a groove, it must be reseated immediately as follows:

**1** Once an element has been fired, it becomes brittle and will break if it is bent while cold. Follow this procedure to heat element. **Always unplug furnace before touching element with anything!**

Program the furnace to heat at a rapid rate. When the elements glow dull red, touch STOP and **UNPLUG** the furnace.

**2** With a pair of long-nose pliers, shrink the bulging portion of the element by pressing the individual turns in the coils together slightly. Take a little from each turn so that no two turns will be pressed tightly enough to touch.

**3** As the element shrinks, work it back toward the groove and into place. Work rapidly, and at the first sign of stiffness in the coils, stop bending and reheat the



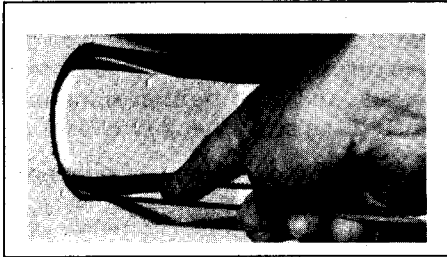


## FURNACE MAINTENANCE

furnace. The elements do not have to be red to be bent safely, as the stiffening can be felt through the pliers.

**4** To lengthen the element to fit into the corners, reverse the above procedure and expand the distance between coils with snap-ring pliers. Use caution, as your warranty covers only elements that fail in service under normal use and not from being broken while cold.

**5** When you have the coils positioned above the dropped recess in the grooves, reheat the furnace, **UNPLUG** the furnace, and run a blunt kitchen knife around the elements to seat them into grooves and to make sure they fit all the way back into each corner.



*It is important that the furnace is unplugged before you touch an element with a knife!*

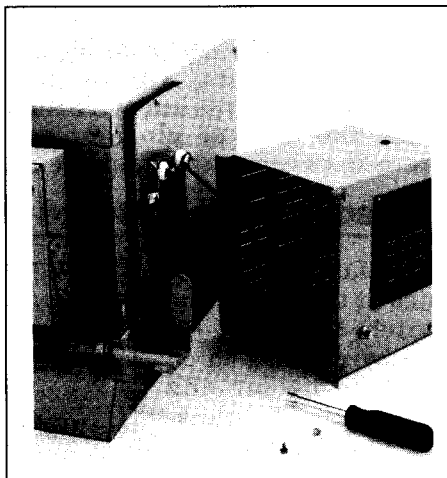
*Do not use a plastic object, such as a comb, to press hot elements into their grooves. Melted plastic ruins elements.*

### How to Replace an Element

The replacement element for your furnace is stretched to fit. However, a little stretching or compressing may be necessary for a perfect fit. It is safe to bend and stretch new elements before they have been fired, but once fired and allowed to cool, elements become brittle and will break if bent.

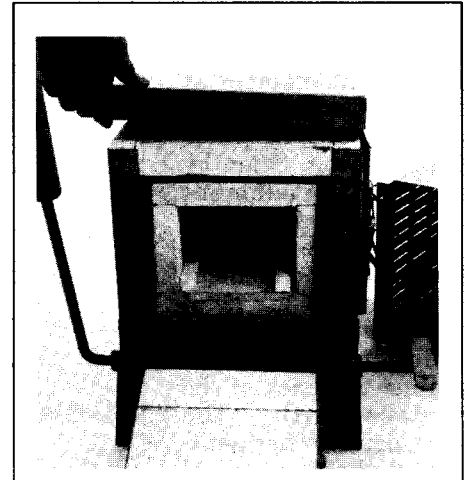
**1** **UNPLUG** the furnace and allow to cool to room temperature.

**2** Remove screws on each side of switch box. Place the switch box next to the furnace on a table, wires still attached.

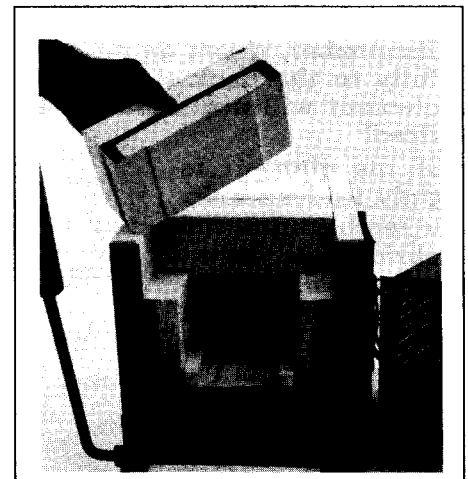


**3** **KM-14D, KM-24D, KM-36D and other long, narrow furnaces:** (This step is not necessary for the PKM-9D, HT-10D, HT-14D or HT-22D. It is helpful but not essential for the KM-14D.)

Remove the screws holding the metal top. Remove the metal top.



Lift out the roof firebricks. Be careful not to disturb the thermocouple.



**4** Remove the screws that hold the lead wires to the element connectors. If your furnace has more than one element, make sure you loosen the correct screws.

**5** On the same connectors, loosen the screws that hold the element and throw old connectors away. Always use the new connectors furnished with the new element.

**6** Remove and save the porcelain insulators that were under element connectors.

**7** Remove the old element carefully to prevent breaking the lip of the element grooves.

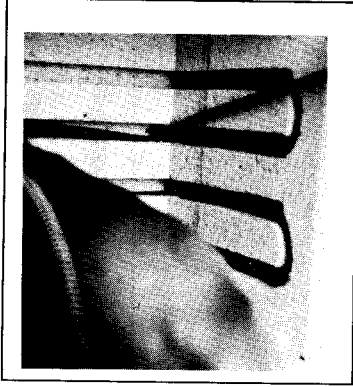
If the old element burned out due to contact with foreign materials, there will probably be a melted, glazed spot in the element groove. Glazed spots left in the grooves may ruin the new element, so dig out any of these spots. The small hole left in the groove will not affect the new element. Small pieces of firebrick in the grooves should be removed with a dry house-paint type brush or vacuum cleaner.

**8** Protect the new element from contact with foreign materials by placing newspaper on the furnace bottom.

## FURNACE MAINTENANCE

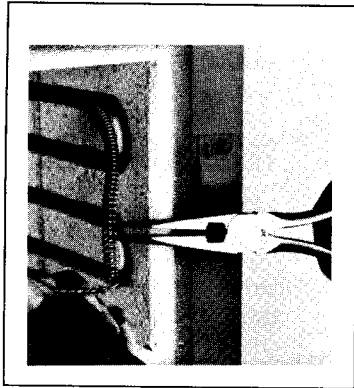
**9** From inside the furnace, push one end of the element into one of the element holes. The element end will appear at the other side of the wall outside the case. Begin threading the element into the groove.

**10** The element must fit all the way into the back of each corner. Making a bend in the element at the corner will help hold the element in place during firing. Start by pushing the element into the first corner with a screwdriver. Make sure the element is pushed as far as it will go into the corner. Hold the element against the back of the corner with the screwdriver. Then gently pull the free end of the element toward you. The element will bend where the screwdriver presses against it.



**Remember, if you do not push the element fully to the back side of each corner, the element will not stay in the grooves when fired!**

If the element is slightly too long when you reach the second firebrick hole, insert element end into the firebrick hole and let the curved groove take up the extra length. You can compress the element with long-nose pliers if necessary. If the element is several inches too long because it was not pushed all the way to the back of each corner, it should be rethreaded.



If the element is too short to reach the second firebrick hole, unthread some of the element. Gently stretch it in your hands. Avoid stretching only a short portion of the element. It is better to distribute the stretch over a longer section.

**11** Press element down into the lower part of the groove with a plastic comb or wooden tongue depressor.

**12** Reinstall the porcelain insulators. Push them flush against the furnace heat shield. They protect element from contact with the case, so they *must not* work their way out after the element connector is tightened into place.

**13** Sandpaper the eyelets of the element lead-wires until bright and clean of all oxidation. (Install new lead wires if insulation on old ones is brittle.) Use the brass screw to connect lead-wire eyelets to the new element connectors. Before tightening screw, adjust eyelet to

where it will be tilted away from the heat shield when the connector is attached to the element. Then hold connector with vice grips and tighten brass screw securely with screwdriver.

**14** Pull end of element tight and install new element connectors even against porcelain insulators to prevent insulators from slipping away from brick wall.

Use stainless screw in the element connector to hold the element. (The brass screw holds the lead-wire eyelet.) Hold connector with vice grips as you tighten the screw with a nutdriver. Tighten the screw until it squeaks, and then tighten some more. (Do not be concerned if the screw head twists off.)

**15** Cut off twisted end of element even with side of element connectors. Leaving the excess element sticking out past element connector could ruin your new element! (The element could short against something in the switch box.)

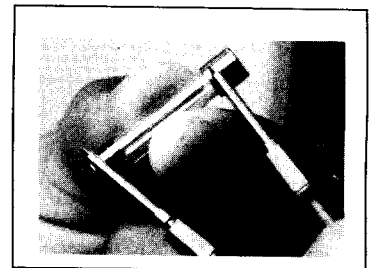


**16** KM-14D, KM-24D and KM-36D: Reinstall roof firebricks and steel top.

**17** As you move the switch box back into place, check to see that no wire touches an element connector. Wires and wire nuts must also not touch furnace's case inside the switch box. **Wires and wire nuts will burn if they touch the case or element connectors.** Replace screws in switch box and tighten into place.

### Replacing Circuit Board Fuse

The fuse holder is located at the back of the switch box. Remove fuse by pressing in on the fuse holder and turning counter-clockwise half a turn.



Replacement fuse:

**SS2-250mA 250V AC**

**WARNING:** Replacing the fuse with one of a higher amperage will void your warranty.

**9** Wear firing safety glasses during unloading.