Electrical Requirements:
Because of the many possible configurations, your furnace is shipped without a plug. Preferably you should hard wire the unit directly into the service box. If this is not possible, be certain that the unit is fitted with a plug rated properly for your furnace as per the specifications below.

EF-60
amperage draw for this unit is 27.5 amps at 220 volts. It is recommended that you use a 40 amp circuit and a 40 amp plug.

EF-135
amperage draw for this unit is 45 amps on 220 volts. It is recommended that you use a 50 amp circuit and a 50 amp plug.

EF-200
Amperage draw for this unit is 54 amps on 220 volts. It is highly recommended that this unit be hard wired to a wall box. Plugs and receptacles only rate as high as 60 amps. Although this is enough, the plug may not last as long as you might wish. Your circuit should be 70 amps.

Placement:
Your furnace placement should allow for at least 12” - 18” clearance all around from any combustible materials.

Thermocouple (T/C)
Your furnace is fitted with an "R" type thermocouple with a ceramic sheath. It was removed for shipping and needs to be placed back in the furnace. The mounting hole is located on the top of the furnace inbetween the door arms. Position the T/C with the screw cap facing the front of the furnace. Remove the cap. Take the 3/8” flexible conduit with the green wire in it (thermocouple wire) and put it through the strain relief on the back of the T/C housing. Now attach the two wires to the terminal block inside the T/C cap. The wires attach to the two outer-most screw terminals with the red wire going to the negative side (the terminal block is marked with a + and - for positive and negative.
Furnace Door Adjustment:
The door may need to be adjusted from time to time to insure a good seal against the port opening. With the door in a fully closed position were the wheels are touching the stop tabs at both ends, start by loosening the anchoring bolt. Push the door up against the port. Now, inspect it all around to make sure it is closed at the top and bottom. Use the tilt adjustment bolts to tilt the door front to back or side to side. Then tighten the anchoring nut.

Safety Switch:
The door on your furnace is equipped with a mercury tilt switch that cuts the power to your elements when the door is opened. The switch is located in the small electrical box mounted to the side of the furnace door assembly. When you open the door, the box swings down and shuts off the power. The red light on your furnace control box will shut off. If it does not, close the door and examine the switch. The wired end should be pointing down. Re-adjust if needed. If the switch is in correct position, call us for technical assistance.
Furnace Firing

Your furnace has been fired at our factory to cure the refractory and test the electrical circuitry. We fired the unit for a 24 - 36 hour period at 235 degrees to “set” the castable, which optimizes their strength. The first firing at customer location should be done with attention and care as it will significantly affect the life of the crucible and upper chamber castings.

Your furnace will need to be vacuumed out to eliminate the dust generated during transit, especially the heating chamber and crucible. Check for loose mortar dabs (the dabs of material that help the elements stay on the shelves). This should be done before charging your first melt.

During your first firing the furnace may throw off considerable steam and condensation may puddle beneath the furnace. To help evacuate this moisture, pull the cap off the vent cap (top of furnace, see photo prior page) and prop the door open a little bit until the air temperature reads 1000 °F (540 °C) is attained. You may also notice an acrid smell during the first firing. This is the binders in the insulation and is a one-time happening.

Initial Firing Schedule
Refer to the controller instruction sheet that came with your furnace to write your cold start program. See recomended cold start programs.

Cooling Procedure
When shutting down your furnace, you can simply set your temperature controller to shut off (see manual for your controller). Shut the door and let the unit come down to room temperature. This will usually take a couple of days.
As a result of heating and cooling, your crucible will develop hairline cracks over a period of time. This is not unusual and should not affect your production. Cracks and voids that occur in the upper chamber can be repaired with mortar and furnace coat available from Denver Glass Machinery, Inc.
Furnace element replacement
For all coil type elements.

The proper installation of your new elements is imperative to the life of the coils. First of all, we are going to assume that the unit has cooled enough to start. Then make sure that the power has been disconnected at the plug or circuit breaker. **TIP:** while you are doing your shelf preparation, take your elements and put the tails through the return. We curl the elements in the opposite direction of how they lay in the furnace for shipping. By doing this step you will change the metal’s memory and they will lay back on the shelf rather than try to crawl off.

**First: Removing old elements.**
1. Unscrew the screw(s) that hold the control panel to the furnace body and let the panel swing open on its hinges.
2. With a large screwdriver and wrench, remove the terminal lugs (4 or 6) that clamp the wires to the element tails.
3. With a small cold chisel and hammer, remove the dabs of mortar that are retaining the elements inside the chamber. Chip them off as completely as possible without damaging the shelf.
4. Remove the elements. They will break apart as you pull them out, so don’t be too concerned about it.
   - **Once the elements have been removed,** clean the shelves thoroughly. We cannot express the importance of this enough.
   - Vacuum any loose particles out first.
   - Then use a strong magnet to make certain that there are no leftover pieces of the elements still on the shelves.
   - If your elements melted, check the area where it occurred for any pooling of metal and chip it out of the shelf. **It must be removed.**
   - Vacuum again.

**Shelf preparation.**
1. Using the mortar, fill any areas on the shelves that may have gotten chipped in the process of removing the elements and cleaning.
2. Mix a small amount of shelf coat with some water so that it has the consistency of paint and put a very thin coat of it on the shelves.
3. **Wait for the mortar to dry completely. It is very important that you do not install the elements into the wet mortar.** You can speed up the drying process by setting a fan to blow into the furnace.

**TIP:** Purchase a 1" wire brush that fits into a hand held drill. You can find them at a hardware store. Use it to clean the areas where you want to put the mortar dabs. This will help them sick better. As the chamber gets old it takes on contaminants which can prevent the mortar from sticking to the casting.

**Installing the new elements.**
1. Even though it is necessary to work the elements into position, you should not force them. **They can break.** Start with the top elements. They are the hardest to reach and it’s best to get them out of the way first.
2. Once the elements have been installed, wrap them with strips of newspaper every 8" or so (see attached drawing "A"). Apply dabs of mortar to the shelf casting where you have wrapped the element with the paper. Do not get mortar on the elements (this is what the paper is for). Keep your hands wet while working with the mortar. Take a small amount and roll into a ball about ping pong ball size. Press it onto the shelf. It will stick to the casting better if you feather it out a bit. the mortar dab should not be so large as to cover the element. It only needs to be approx 1/4 of an inch up from the shelf.
3. Now on the outside where the elements come through,
   - If you haven’t already removed the mullite tubes, do so and pack the area around the element tails with fiber blanket. This is to stop the outgassing from the chamber past the tails.
   - Push it far enough into the hole so that the mullite tube does not just push through it and defeat the purpose.
   - Also, you do not need to pack it in so tight that you would create a problem next time you need to change the elements. All that we need to do here is stop the chimney effect.
   - Reinstall the mullite insulating tubes.
**On older models it is highly recommended that you change the grommets every time you install new elements. They are inexpensive and a very important part of the system.**
Reconnecting the wires. (Refer to drawing "B")

1. Make certain that your wires look good. Some discoloring is normal, but if they appear encrusted or have become brittle, replace them. (You should always have some on hand.)
2. If the element tails are so long that they would touch the panel box when it swings back shut, cut them off with a hacksaw or a large bolt cutter. Leave one and one half to two inches outside the furnace wall.
3. While placing the terminal lug, situate it so that the screw contacts the element tail and the wire is compressed into the point side of the lug.
4. With your large screwdriver and wrench, tighten the lugs as tight as you can.
5. Close the control panel and screw it shut.

Start up.

1. Ramp at 80 degrees per hour to 150 degrees and hold for one hour. This will dry the mortar dabs.
2. Ramp at 80 degrees per hour to 1000 degrees and hold for an hour. This will allow the elements to naturally scale themselves. This helps to protect them from the caustic enviroment.
3. Now you can pull the cap off the vent tube and ramp it to your melting temperature. see example programs.

The environment inside an electric furnace is very static. There is no input of outside air to be burned. There is no wind and there is no outgassing. It is just a chamber of hot air. The extreme high temperatures required in a gas furnace are not necessary in an electric furnace. It is recommended that you never go over 2200 degrees.
**Recommended firing schedule for a cold furnace using Batch**

Place a couple of bags of the batch into the cold furnace as this will help melt the other bags once it is up to the melt temperature. Adding some cullet will help too.

- Enter 80 degrees an hour for the ramp rate
- Enter 1000 degrees for the temperature
- Enter 1 hour for the hold
- Enter 80 degrees an hour for the ramp rate
- Enter 2200 for the temperature set point
- Enter 10 degrees for the hold time to do your melt. Your batch should be in paper sacks with approx. 12-15 lbs of batch in each. Load the batch in using a scoop or ladle. Put the sack on the ladle and wet the sack with a spray bottle (so it doesn’t go “flame on” when you open the door). Once you have it loaded;
- Enter the ramp rate (specific for your controller) to go as fast as possible.
- Enter 1900 for the temperature to do your squeeze
- Enter 3 hours for the hold. This is usually enough time to squeeze.
- Enter 100 degrees an hour to climb to your blow temperature (2150)
- Enter the specific command for your controller for an indefinite hold.

**Recommended firing schedule for a cold furnace using cullet**

First, either preheat the cullet (nuggets) before loading by heating them in your annealing oven or kiln to around 1100 degrees F. Once up to temp, trickle them into the furnace. Or, use the quench method by heating the glass in your annealer or kiln to 1100 degrees. Take a 5 gallon bucket with small holes drilled into the bottom and place this bucket into another 5 gallon bucket with water in it. Pour the hot glass into the bucket to thermal shock the pieces into smaller sizes. Put the wet glass on pads of newspaper to dry before loading into a hot furnace. Never load cold glass into a hot furnace.

Load some of the glass into the cold furnace as this will facilitate the melting of the rest of the glass to be loaded.

- Enter 80 degrees an hour for the ramp rate
- Enter 1000 degrees for the temperature
- Enter 1 hour for the hold time
- Enter 80 degrees an hour for the ramp rate
- Enter your working temperature
- Enter the specific command for your controller for an indefinite hold.