



### **Inspection and Maintenance of Hot Zone and Heaters**

The condition of the hot zone shields and/or insulation and heating elements is critical to the efficient operation of the Furnace.



**WARNING!**

**ALWAYS LOCK OUT the Heater Power Circuit Breaker before performing work in the Hot Zone, on the Heating Elements or the Power Leads to prevent INJURY TO PERSONNEL and damage to the Furnace.**

Refractory Metal Hot Zones

Examine the condition of the heating elements on a regular basis. Crystallizing of the heating element is normal and should not be of concern. A small amount of warping is also acceptable as long as the elements are not coming into contact with any grounded objects. Metal heating elements lose a small amount of material every time they are operated near their maximum temperature; if the element has been reduced in size more than 20% in any area replace the element. If there is any sign of arcing or melting on the element, the cause should be located and corrected immediately. Damaged elements should be replaced as soon as possible.

Metal refractory shields warp with use. Slight warping is normal and should not be of concern. The warping will slowly continue as time goes on and eventually the shields will begin to separate at the seams and joints and the zone will begin to lose thermal efficiency. The shield packs should be examined for tightness regularly. If there is any excessive separation of the shields at any seam the shields should be replaced. If there is excessive cracking or any breakage of the refractory metal shields they should be repaired or replaced immediately.

Prior to every run, the hot zone should be examined for any foreign material coming into contact with the elements or shields. Foreign materials, especially metals or carbon will react with refractory metals at high temperature causing melting and/or burning. Any foreign materials should be vacuumed out before running. A resistance test between the heaters and ground should be done prior to each cycle. A minimum of 1000 ohms should be present.



**CAUTION!**

**Refractory metals become extremely fragile after being heated to high temperatures. Caution should be exercised when handling the shields and elements to prevent breakage.**



**CAUTION!**

**Care must be taken to avoid over-heating and burning up the heating elements.**

## Graphite Hot Zones

Examine the condition of the heating elements on a regular basis. Minor pitting of the heating element is normal and should not be of concern. The tightness of the graphite nuts that fasten the elements to the phase bars should be checked weekly. If any of the graphoil washers under the nuts are damaged or missing they should be replaced. Graphite heating elements lose a small amount of material every time they are heated to high temperature; if the element has been reduced in size more than 20% in any area, replace the element. If there is any sign of arcing or burning on the element, the cause should be located and corrected immediately. Damaged elements should be replaced immediately.

Graphite insulation is slowly consumed during use. The condition of the hot zone insulation should be examined regularly. If any of the graphoil laminate is damaged, either that section of graphite insulation needs to be replaced, or the exposed graphite board needs to be coated with a graphite sealant. Failure to do so could cause the insulation in that area to erode very quickly. Any damage or excessive wear to the hot zone should be repaired immediately; failure to do so could lead to poor uniformity and the failure to make maximum temperature.

Prior to every run, the hot zone should be examined for any foreign material coming into contact with the elements or insulation. Foreign materials, especially metals, can react with graphite at high temperature causing the graphite to burn away. Any foreign materials should be vacuumed out before running.

## Graphite Heater Maintenance

Each time the heating elements are heated, a minute amount of the element will vaporize. As the elements decay, and material is being removed, the resistance of the element will increase, resulting in a slight power loss. Normally the PID loops in the PLC will automatically adjust power levels to make up for this loss, but eventually the Furnace will have difficulty reaching the process temperature, and the heating elements will need to be replaced. The following open door test should be performed when a new heater set is installed, or when the hot zone is rebuilt.



**CAUTION!**

**Care must be taken to avoid over-heating and burning up the heating elements.**



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### Step 1

Four people are required for this test. Station them as follows:

- One at the front of the chamber watching for arcs
- A second at the control cabinet
- A third at the heater power supply circuit breaker
- A fourth at the rear of the chamber watching for arcs

## Step 2

Put the system in the **Maintenance Mode** from the **Furnace Main Screen**.

## Step 3

Open both chamber doors fully. Turn on the **Heater Power Circuit Breaker**.

## Step 4

While watching the hot zone, set the power at 100% for 10 to 15 seconds.



**WARNING!**

**DO NOT LEAVE THE HEAT ON FOR MORE THAN 15 SECONDS. If anything starts to glow, immediately shut off the Heater Power Circuit Breaker, close the door, and start pumping the chamber.**

## Composite Hot Zones

Composite hot zones with refractory metal heaters and graphite insulation should follow all applicable procedures listed above. In addition, it is imperative that the heating elements be carefully examined before each run for any graphite particles. Failure to do so can shorten the life span of the heating element significantly.