

**Instruction Manual for  
Airco Temescal – CV 8, Ebeam Evaporator**

## **CAUTION:**

Due to the nature of HV and high current, If in case of any emergency or Fire, please hit the emergency off button and if in case you see any fire use the fire extinguisher which is near the system to put out the fire.

### **Electron Beam Evaporator:**

The E-beam evaporator is used to deposit any metal or dielectric on to a substrate. This is the specialty of the E-beam over the thermal deposition system. The depositions made with the E-beam evaporator are high purity and they have good adhesion.

The electron beam evaporator has an electron gun which is operated at a very high voltage (10 kV) and current (~1 A). When a tungsten filament within the ebeam system emits electron from thermionic emission and it produces an electron beam which hits the metal on the pocket. The metal acts as a resistive load gets hot from the high voltage and current. The beam curls up to 270 degree in to a crucible which loads to thermal evaporation of the target and direct beam of material towards the substrate which is at the top of the chamber. The whole process is done under vacuum.

### **Apparatus Description:**

The Airco Temescal Electron Beam evaporator has a chamber which can reach a high vacuum pressure and can deposit any metal or dielectric. The chamber can be pumped down to  $2 \times 10^{-7}$  torr.

### **Automatic Valve Controller:**

The E-beam Evaporator has an automatic valve controller AVC-485 which controls the vacuum system. It has two operating modes, Automatic and Manual modes. In our laboratory, we use the automatic mode for which the procedure is explained below.

### **XYS-8 Sweep Control:**

The XY-8 Sweep Control has the ability to adjust the beam in either a longitudinal or latitudinal position. In general, the controls are roughly already set correctly.

**Note:** The Beam position for both longitudinal and latitudinal positions should be at the center and the sweep should be turned fully anti-clockwise.

### **High Voltage Control:**

This part contains interlocks and indicators which will allow the E-beam to turn on the high voltage.

1. The “Power ON” indicator will glow when the power to the E-beam is given via the power supply.
2. The “Door” indicator will glow when the three doors of the power supply unit is closed properly, **Caution:** Do not turn try to close the doors when the key is turned to ON position in high voltage control unit.
3. The “Air” Indicator will glow when the air is supplied to the system within the range of 80 to 100 psi.
4. The “Vacuum tank” and “Vacuum gauge” indicator will glow once the chamber is pumped down to the operating pressure.
5. The “PC cards” and “keylock” will turn on once all the above interlocks is released and the key is turned to the ON position from OFF position.  
**Note:** The Key should be turned to ON position only at this point when all the indicators glow.

### **Gun Control Unit:**

The gun control has some interlocks which will allow the Filament to turn ON.

1. The “Auxiliary” is provided to the user or the customer by the manufacturer to have an interlock if needed.
2. The “Gun water” interlock will release and the indicator will turn on when there is sufficient water to the filament and has the required temperature.
3. The “Focus” indicator is turned on when there is sufficient current flowing and the beam position is generally correctly set already.

**Note:** The Emission current knob should be rotated to fully anti-clockwise direction and the beam position should be at the centre.

### **Deposition Monitor:**

The Thin film monitor should be programmed according to the metal used. The density, Z – ratio and final thickness should be set for each type of the metals or dielectric used.

**Note:** There is table near the system which has the density and Z-ratio values for various types of metals and dielectrics which are typically used.

### **Ion Gauge Controller:**

The Ion gauge controller is used to continuously monitor the chamber pressure and display the value in torr. The set points are already set in the system, so do not change them.

### **CV-8 Power Supply:**

The power supply is connected to the E-beam with a high voltage cable which has the three phase voltage supply. Check whether the three doors are closed properly before starting to use the system.

**Note:** If you leak water or an oil leakage, you will hear a weird nose.

## **Vacuum System:**

The Airco-Temescal CV-8 system has a fast pumping high vacuum system. It contains a dual stage mechanical pump and a CTI- Cryogenics cryo-pump. The mechanical pump is used to get to the acceptable pressure where the cryo-pump can start pumping which usually is about  $10^{-3}$  torr. Our cryo-pump starts pumping at  $10^{-3}$  torr and the cryo pump starts it can create a vacuum as low as  $2 \times 10^{-7}$  torr. (Within half hour or so).

## **Coating Procedure:**

1. If the chamber is already pumped down, press STOP in the automatic valve control so the pumping will stop and after a few minutes press VENT then the chamber will vent to ATM completely. Wait till the pressure inside the chamber is completely vented and the reading shows ATM which is the atmospheric pressure. There is an interlock, if the pressure is not high enough the lid will not go up.
2. Once it shows the ATM reading, turn the knob to raise which is located at the front of the door and use both hands to press the green button which will raise the chamber. Press until you see the holders for the substrate.  
**Caution:** Do not touch the chamber while raising it.
3. Place the metal which is to be deposited in to the graphite crucibles, if they are empty or low place more in the pockets directly.
4. Wear gloves and place the substrate on to the holders carefully and place the pins carefully on top of the substrate to hold them. Place them slowly as you can break the substrate as it will be snapping them quickly.
5. Now, lower the chamber by turning the knob to lower and push the two green buttons gently so the chamber is lowered.  
(Check to make sure the thin film oscillator crystal is not in “error” or “xtal fail” before closing)
6. After the chamber is lowered, press the START button on the automatic valve control which should start the roughing pump. **Note:** It is always good to check whether the roughing pump is connected to the supply. Beware the roughing pump is noisy and it will start with a sudden sound. The Hi-vac valve will be opened when the pressure is acceptable and the rough and fore valves will be closed automatically when the cryo pump starts pumping on the chamber.
7. When the Ion gauge shows the operating pressure  $10^{-6}$  –  $10^{-7}$  torr in its display. You can start coating the substrates.

8. After the chamber reaches the operating pressure, turn on the key to the ON position in the high voltage control. Press the HV ON switch so that the high voltage is applied. Turn the voltage adjust knob slowly to a sufficient voltage ie., 10kv
9. Now, turn on the GUN FIL ON switch so that the filament is turned on. Before, applying the emission current check whether the switch is on the emission current and not on the side of filament current.
10. Turn on the Emission control knob slowly till you see an arch which is clearly hitting on the metal. You could watch the beam using the glass window on the chamber. It will be Blue with pink glow  
**Caution:** The Emission current should not be beyond 1.2 A at any point.
11. Switch the motor to the run position and use a nominal speed to run the motor. Shutter will be closed at this point, after a few seconds wait you may close the shutter and the deposition will start on the substrate. You can monitor the thickness of the coating on the deposition monitor. Close the shutter when you reach the thickness level you desire.
12. Reduce the emission current to zero slowly and stop the motor.
13. Switch off the Gun filament by pressing the GUN FIL OFF.
14. After a few seconds wait, turn the high voltage off by pressing the HV OFF.
15. Turn the key to off position.
16. Now press STOP in automatic valve control and after few minutes press VENT and wait till the chamber is vented to atmosphere.
17. Now turn the knob to “Raise”, after the chamber is at atmosphere and push the green buttons to lift the chamber.
18. Take the coated substrates carefully out of the holders.
19. Close the chamber by turning the knob to the “Lower” and pushing the green buttons.
20. Once the chamber is lowered press the START button in the automatic valve controller.  
Note: check whether the roughing pump is connected to power supply before pressing the start button