



## **Functional Specifications Phase Vacuum Drying Oven.**

### **Description of the Oven**

The automatic vacuum drying oven consists of a round chamber with doors on either end that house three usable stainless steel shelves and one non-usable stainless steel radiation shelf. The shelves are supported by a stainless steel plate which serves to direct the air flow over each of the shelves. The exposed edges of the shelves are rounded to provide easy cleaning. Stainless steel radiation baffles in the back and on the front door of the oven serve also to direct the flow of air across the shelves. The stainless steel used in this portion of the oven is 316L and has a finish of 0.5 $\mu$ m. On a panel just below the lowest shelf are located ten (10) female connections for RTD sensors to be used to measure temperatures during validation of the oven and the drying process.

The temperature of the oven is controlled by the temperature of the gas coming from a heat transfer system. The main component of the heat transfer system consists of a manifold. The manifold contains a stainless steel fan, a stainless steel finned heater and a high temperature HEPA filter housed in a stainless steel frame. Gas from the HEPA filter can flow to the inlet stainless steel piping which connects to the oven chamber or to a dry vacuum pump. The direction of the gas flow is directed by two pneumatic stainless steel valves. Gas to the heat transfer manifold stems from a second stainless steel outlet piping which also contains a stainless steel pneumatic valve. All piping in this segment of the oven is fabricated from 304 stainless steel.



Graphic recorder	Upper and lower pressure set points Alarms Input batch data Data in graphic and tabular form Real time data display
Data Export	USB thumb drive
Total Weight	450 kg
Dimensions:	825 x 1320 x 2032 (mm) (width, length, height)
Air Changes in Oven	20 air changes per hours.
Operating Environment:	Ambient Temperature - 0 °C to 50 °C Storage Temperature -40 °C to 71 °C Humidity <75% @ <40 C
Power:	240 VAC (50Hz)      2500 watts
Air Supply	90 psi
Warranty:	One year (extended warranty available)
<b><u>Suggested Spare Parts</u></b>	Desiccator Unit Pall Cartridge Filter HEPA Filter (ambient temperature) HEPA Filter (high temperature) Finned Heater Recorder Paper Pneumatic Valve

## **Class B Oven Environment**

The oven is maintained at all times in a Class B environment by the air passing through HEPA filters during intake, circulation and evacuation. The air exhausted from outer chamber will be Class B by passing through a HEPA filter.

The high temperature and ambient HEPA filters are rated at a minimum efficiency 99.97% for 0.3 micron particles.

Make-up air and vent air for the oven is pre-filtered by a Pall PTFE membrane with a particle rating 0.003 µm before passing through a HEPA filter.

A Class V environment is maintained in the oven by placing it in a Stand-By mode that will ensure the oven remains at Class B even if the classification of the surrounding environment changes.

All filters are readily accessible for validation and replacement.

## **Operating Procedure**

After entering the batch data and drying control parameters (or established drying process recipe) into OCS controller, the VENT button on the controller is pressed which will cause the valve to the desiccator system to open and increase the pressure in the oven to one atmosphere. On opening the inner-oven door, the valve to the desiccator system will close but the fan in the manifold will continue to operate. The bags of closures are loaded in the drying oven and the door is held close while pressing the START button on the control system.

On starting the oven the valve to the inlet piping of the oven will close. The system will turn off the fan, turn on the vacuum pump and open the valves to the vacuum pump and RH sensors. The oven chamber will be evacuated to a set pressure. Upon reaching the set pressure the fan will be turned on and the valves to the RH sensors and the vacuum pump

are closed and the valve to the inlet of the oven is opened which now allows air to circulate through the oven.

The heater is turned on and the air is now heated at a rate of 1 °C/min. to a set point temperature. The air is maintained at the temperature set point for the defined initial soak period. At completion of the initial soak period a valve to one of the RH sensors is opened and the humidity is recorded. The initial purge is conducted by closing the valve to the inlet of the oven and turning off the fan and heaters. The oven is evacuated as described above. At a given set pressure the valve to the second RH sensor is opened and the humidity is determined. The chamber and RH valves are evacuated to a given set pressure. The valves to the vacuum pump and RH meters are closed and the valve to the inlet piping to the oven is opened while the outlet valve from the oven is closed. The valve to the desiccant system is opened. At a given oven pressure the fan and heater are turned on and valve to the desiccant system is closed and the outlet piping valve to the manifold is opened. The air temperature is adjusted at 1 °C/min. to a given set point for a soak period.

At the end of the soak period the valve to the inlet of the oven is closed and the valve to one of the RH sensors is open. The RH and temperature are measured and recorded. The vacuum pump is turned on and the valve to the vacuum pump is opened and the fan and heater are turned off. At a given pressure the valve to the second RH sensor is opened and the relative humidity is determined. The chamber and RH valves are evacuated to a given pressure. The valves to the vacuum pump, RH meters and outlet piping to the manifold are closed and the valve to the inlet piping to the oven is opened. The valve to the desiccant system is opened. At a given oven pressure the fan and heater are turned on and valve to the desiccant system is closed and the valve for the outlet piping to the manifold is opened. The air temperature is adjusted at 1 °C/min. to a given set point for a soak period.

After the last purge cycle, the oven is now cooled at 1 °C/min. When the oven temperature reaches 50 °C the outer door to the oven can be opened. The bags can now be

removed at any time by pressing the VENT button on the controller and this will cause the valve to the desiccator system to open and increase the pressure in the oven to one atmosphere. The recording of the oven data is terminated. On opening the inner-oven door, the valve to the desiccator system will close but the fan in the manifold will continue to operate. After removing the bags from the oven, the oven door is held close while pressing the STANDBY button on the control system. The valve to the inlet piping of the oven is close and the control system will turn off the fan, turn on the vacuum pump and open the valve to the vacuum pump. Upon reaching the set pressure the fan will be turned on and the vacuum pump valve is closed and vacuum pump turned off. The valve to the inlet of the oven is opened to allow circulation of the air in the oven. In this mode the oven can be maintained in a Class B condition even if the room housing the oven is no longer Class B.