MiniZ Operation Manual

rbd instruments

Unpacking and Handling

The packaging RBD Instruments uses when shipping components is designed to withstand the demands of normal shipping activities. However, once the boxes leave our facility, how they are treated is out of our control.

Inspect the inner packaging and components as soon as possible so that you can report any necessary damage claims in a timely manner with the shipping company used. This is especially important when there is evidence of mishandling on the outside container.

Warning! Wear protective gloves whenever handling the MinZ Emitter. The oils on your hands and fingers can adversely affect the performance of the emitter and could create a hazardous condition. If the emitter lamp does come into contact with bare skin, carefully wipe the lamp with Isopropyl alcohol.

Once you have confirmed that all components have arrived intact in their packaging, verify that you have the following items;

- MiniZ Emitter Assembly
- MiniZ Control
- AC Power Cable with country-specific prongs
- Gasket(s) for the flange(s) into which the MiniZ Emitter Assembly(ies) will be mounted
- MiniZ Safety Information. This must **always** be available when the MiniZ is being used.

If any items are missing, please contact RBD Instruments at 541-330-0723 or e-mail us at tech@rbdinstruments.com.

Installing the MiniZ Emitter Assembly

To install the MiniZ Emitter Assembly:

1. **Warning!** Do not touch the Emitter Assembly lamp without wearing protective gloves. Use standard clean vacuum protocols. Clean the Emitter Assembly with isopropyl alcohol if it accidentally comes in contact with skin.
2. Choose a vacuum chamber port that allows for maximum exposure of the emitter to the interior space of the vacuum chamber. This location must also ensure that the emitter does not touch any interior component or the inner wall of the vacuum chamber.
3. Remove the flange from the vacuum chamber port into which you are installing the emitter.
4. Place a gasket onto the open vacuum chamber flange. A gasket is included with your MiniZ shipment for each emitter assembly you are installing.
5. Install the emitter onto the vacuum chamber.
6. Tighten the flange using the appropriate hardware.

Connecting the MiniZ Emitter Assembly and MiniZ Control

*It is **highly recommended** that the AC power to the MiniZ Control is interlocked to your ion gauge so that the MiniZ cannot be turned on if your vacuum chamber is up to air.*

To connect the MiniZ Emitter Assembly to the MiniZ Control:

1. Connect the SHV connectors on the MiniZ Control to the SHV connectors on the MiniZ Emitter Assembly. Turn the connector swivels until the bayonets lock, as shown in the next two photographs.

2. Plug the 2.1 mm AC power cable connector into the AC power receptacle on the front of the MiniZ Control.

   Warning: Ensure that power switch on the MiniZ Control is set to Off.
3. Plug the power cable into the power source.

Getting Started with the MiniZ:

Before you begin to use the MiniZ:

1. Make sure that all the connections are correctly made according to instructions earlier in this manual.
2. Make sure that you have read all the safety information included in this document.
3. Note that you will probably need to run some experiments to determine your optimal operating conditions (for example, the length of time that the MiniZ is on.) Refer to the Principles of Operation later in this manual for more information.
4. Confirm that all viewports in your vacuum chamber are made of materials that do not allow for leakage of UV-C radiation.
5. If your viewports are not made up of UV-C resistant material, confirm that you have installed viewport covers, which are available from RBD Instruments.
6. Wear UV-protective eyewear and clothing when operating the MiniZ.

Operating the MiniZ:

1. Once the pump-down process has been initiated, flip the power switch on the MiniZ control to the "ON" position. The green power indicator will light. The MiniZ emitter lamp will light. The lamp will achieve full power within 1 to 3 minutes.
2. Once the desired vacuum level has been achieved, flip the power switch on the MiniZ control to the "OFF" position. The green power indicator will go out and the MiniZ emitter lamp will turn off.

__Warning! Be sure to disconnect and remove the MiniZ controller and power cable before baking your system. Bakeout temperatures will permanently damage the MiniZ controller__.

If you have any questions, please contact us:
RBD Instruments
(541)330-0723
tech@rbdinstruments.com

Appendix A: Principles of Operation

Energy, imparted to the sorbed water molecules, will raise their internal energy to a high enough level to exceed these weak bonds and allow the molecules to desorb. The two most common energy sources are heat and UV. Heat, the traditional energy source, will result in rapid desorption but it has the disadvantages of heat-up and cool-down time along with thermal pyrolitic degradation problems with some vacuum materials such as O-rings.

UV, though, is essentially a non-thermal effect where the UV energy is imparted directly from the UV source to the sorbed water molecules and thusly requires no heat-up or cool-down time penalty. For systems that will need to operate in the ultrahigh vacuum hydrogen zone below the drydown zone, heat is more effective since it can drive both adsorbed gases from surfaces and absorbed gases from the material's bulk. UV will only be effective on surface-sorbed gas or gas already released from its original source. UV, then, should be viewed as a pumpdown enhancement tool instead of a replacement for a 150° to 200° C bakeout with metal seals.

The UV Source

The UV band encompasses a wide range of wavelengths, and not all UV sources will provide effective energy for desorption. The best results are obtained with a hot cathode mercury (Hg) discharge tube of the type used for ozone (O_3) formation. These are emitters fabricated from ultra-pure quartz and filled with inert gas and a trace of Hg.

When electrically energized, the Hg discharge emits UV light in two major wavelength peaks: 254 nm (about 90%) and 185 nm (about 10%). Only the highly energetic 185nm wavelength UV is effective in increasing net water vapor desorption, and it is the wavelength that converts oxygen (O_2) to ozone (O_3).

Since the 185 nm radiation will be adsorbed by the O_2 in air, the emitters must be operated in vacuum to allow the UV to reach the internal surfaces. This means operating the emitter within the chamber. Since the emitter will be exposed to the vacuum, it's important that they are constructed entirely of vacuum compatible materials.

The Process

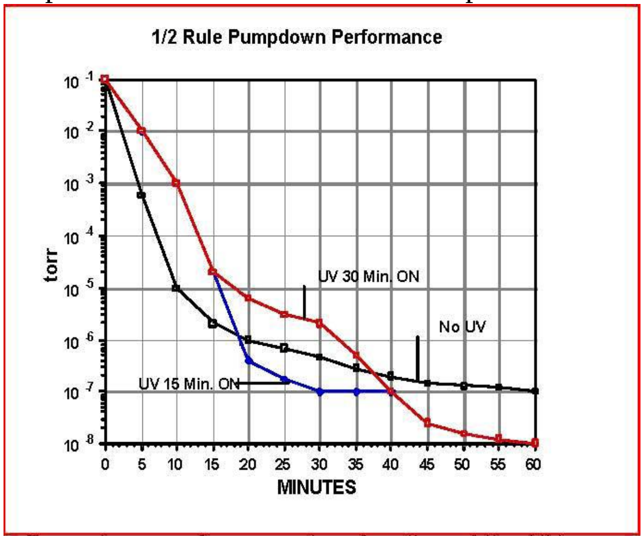
Although it would seem to be intuitive that the emitter(s) should be mounted to provide direct line-of-sight to all surfaces, this is really not required. The UV energy will reflect from internal surfaces to spread through the chamber, but direct desorption is only part of the process. With 185 nm wavelength light flooding the chamber, water molecules that are desorbing or already desorbed will be continually energized with the UV, and as they impact other surfaces prior to being pumped away, they will transfer some of that energy to the molecules on the surfaces. Emitters can even be operated within an appendage nipple as a floodlight with only slightly reduced results.

Thusly, the UV serves, directly and indirectly, as an energy pump to maintain a total high energy level of all the water molecules within the system. In essence, this keeps them in motion until they enter the pump and reduces their chance of resorbing on a surface.

Additionally, the 185 nm radiation converts much of the water molecules to the energetic free radical OH_8. The free radicals also serve to maintain a high energy level. Their effects can be seen in a large increase in carbon dioxide (CO_2) in the residual gases while the emitter is operating. This is caused by oxidation of carbon monoxide (CO) which is always present at 28 amu and the oxidation of hydrocarbons that are always present in trace amounts in the ambient air.

Operation and Results

When used as a pumpdown enhancement tool, UV can accelerate the drydown process in terms of a faster pumpdown. It can also provide a lower ultimate pressure. This can be seen with the example of a working rule-of-thumb that makes use of power level to surface area ratios.
This is called the half-rule, which states that, at a power level of 0.4 mw of UV power (254 nm) / cm^2 of surface area, the pumpdown time to a given pressure will take half the the time it does with no UV if the system is exposed to UV for half of the target time. For example, a chamber that reaches 1×10^{-6} torr in one hour will reach that pressure in 30 minutes if the UV exposure is one-half of that time, or 15 minutes. The second part of the half-rule is that the same system will reach a full decade lower pressure in the same time if is exposed to UV for 30 minutes.



Pumpdown performance is a function of the UV power/surface area ratio and total UV exposure time. UV, properly applied, can provide either a faster pumpdown or a lower ultimate pressure.

The half-rule is based upon timing starting at pressures of about 20 torr. Waiting until a lower pressure is reached is inefficient since the time in attaining the lower pressure will be an effect of the slow net desorption rate. In practice, it’s usually convenient to turn the UV emitter on at the onset of the roughing process.
UV exposure, then, can become a standard technique in enhancing the system’s performance in the drydown zone as long as the UV power and exposure times are properly applied. The performance gains in terms of pumpdown time and/or lower ultimate pressures can result in substantial savings in terms of costs, product thoughput rates, and quality.