MIDWEST TUNGSTEN SERVICE

Tips

LEAKS AND GAS LOADS

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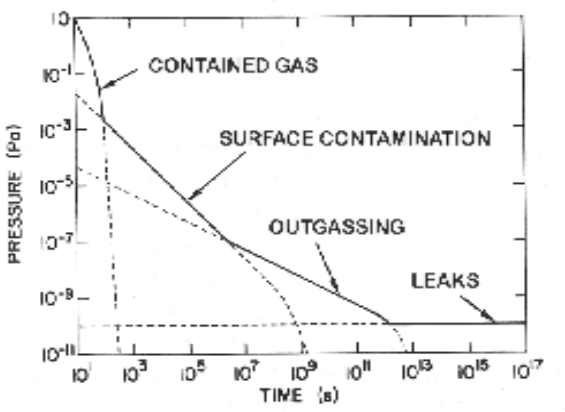
When designing, operating, or repairing a vacuum metallizing system, much attention is given to the removal of gases from the system. The efficiency of the pumping system and size of the pumps is crucial, but only part of the picture. Adding and improving pumping is not a substitute for understanding and controlling the sources of chamber gases. If you are in a leaky boat, you wouldn't simply figure out the most efficient way to bail. You'd probably also try to figure out where the water was coming from and how to stop it. The same thing is true of a vacuum system. An appreciation and knowledge of the sources of gases within the system is the first step toward controlling them. From a practical point of view, these gas sources can never be completely eliminated. The objective is to keep them small enough that the pumping system will be able to reach the required vacuum in a reasonable amount of time and maintain that vacuum level throughout the process. There are five sources of gas that can be found within a vacuum system. The first four are graphed below:



1. Contained Gas - This is the volume of gas contained within the system, or in other words, the air in the chamber when you close the door. This is the major gas load as a chamber begins to pump down. At some point, other gas sources become more prevalent.

2. Surface Contamination - This category covers a lot of ground. Every surface on the inside of the chamber has the ability to hold (adsorb) water and gases. See our Tips **Water Vapor and Vacuum Metallizing** for more information. Porous, rough surfaces are the worst offenders. Unfortunately, this is just the type of surface created when layers of aluminum build up inside a chamber. Additionally, trapped pockets of gas vent when the pressure in them becomes large in comparison to the chamber pressure overall. These are often called virtual leaks.

3. Outgassing - Another potentially large gas load. Vacuum will literally "pull" volatiles and gases from within a material to its surface. Substrates which absorb water, like nylon, are notorious

for this behavior, as are materials with plasticizers.

4. Leaks - When a gas source from outside the chamber is adding to the gas load in an undesirable manner, you have a true leak. For some possible causes of true leaks, see our Tips **Maintaining Your Metallizer**. Virtual leaks are also possible. For instance, oil backstreaming from a pump is not coming from outside the chamber, but behaves as a leak by providing a continuous source of gas. Leaks can also cause discolored parts and adhesion problems.

5. Process Gas - Unlike a leak, a process gas is an outside source of gas which is introduced into the chamber on purpose, usually to create a plasma or to participate in a reaction taking place inside the chamber. Argon, nitrogen, oxygen, and air are common.

The total gas load of a system is the sum of all of the above items. All systems have the first four present to some degree. The fifth item is present by choice.

What does this mean in practical terms? It means that the gas you are trying to pump away comes from different places and knowing the source can help you remove it in the most cost-effective manner. What can you do, specifically?

To know what's happening with your system, first ascertain whether or not all vacuum gauges are functioning and are properly calibrated. If they are not, have them repaired, calibrated, or replaced with new, digital instruments. Call MTS if you need help or direction in accomplishing this.

Check the pumpdown time and ultimate vacuum reached in your empty, clean chamber and carriage on a cold, dry day. This will serve as a good baseline. The predominant gas loads will be #1 and #4. How fast does the pressure rise in your chamber when it is pumped down and sealed off? This will help you distinguish #1 from #4. On a humid day, #2 becomes very important. How does this effect the pumpdown time of your empty, clean chamber? When you add parts, #2 and #3 increase. What does this do to your pumpdown on both a dry and a humid day? These checks, performed at regular intervals, will point out changes in your system performance, the presence of leaks, or contamination of parts. They can even tell you where your pumping system may be weak or in need of improvement, repair, or upgrade.

Create and maintain a log for these tests. Log entries should include time of day, weather conditions, cycle times, ultimate vacuum levels, pump pressures, water flows and temperatures, and any other pertinent data. Historical data is important, especially to new operators or maintenance personnel. This data can also be helpful when quoting new jobs, by making it easier to accurately judge cycle times. For more assistance on job costing, see our Tips **Maximizing Metallizer Throughput**.

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