

Dan Spohn

From: ARM, Inc. <dspohn@arminc.com>
Sent: Tuesday, March 13, 2018 12:23 PM
To: dspohn@arminc.com
Subject: Contamination, more than just a dirty word.



Advanced Research Manufacturing 719-538-5959
Innovative High Purity Gas Supply System Solutions

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Dear Dan,

Wooo hooo 2018! The end of any year gives rise to "lists". Top 10 of this or that from the year in question. Thought I'd try my hand at a list, but after a number of attempts, I found that I couldn't generate a list of anything that wouldn't offend at least some people. So I thought I'd generate a top 5 list of... "lists I'd like to generate for myself". I tried a top 10 but it just got redundant with all the duplication so like a good stew I boiled it down a bit.

1) List of people I should really stay in touch with more....

Obvious is family members, but there are a number of people that helped me along the way in my career and I need to let them know that it was much appreciated, some deserve more than the annual Christmas card....

2) List of things I'm not going to let bother me this year....

This is a tough one, there aren't too many but darned if they aren't bothersome! Ex:sub-woofers pounding in the car in front of me at the light, I think I'm getting old)

3) List of good things I'm going to look out for and acknowledge in others....

Courtesy and kindness of course, and people that let me know something is amiss with my attire....

4) List of words and phrases I'm not going to use in 2018....

I'll start out easy with '2017' and I'm sure 'are you going to eat that' will make the list....

5) List of what makes my dog happy.

This is the most important list and one I will try to emulate in myself, when a family member comes in the door, when someone else makes me dinner, when I can lie in the warm sun for a snooze, when I beat the cat to the couch....

But that's not what I want to talk about.....

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#1 Contamination Source in High Purity Gas Delivery Systems

Assuming proper materials of construction were used and that precleaning procedures were executed and proper fabrication and welding techniques were employed, the single biggest source of contamination in high purity gas delivery systems are leaks.

Many industries requiring high purity gas have implemented the use of stainless steel for all plumbing and components. The most stringent require the use of 316L stainless steel with electro-polished wetted surfaces to roughness reading of <10Ra. Materials and components once cleaned for high purity use are typically packaged in specialty bags with inert gas back fill. All of these steps and the associated costs are in part done to protect the investment in state of the art bulk purifiers that provides up to 9N pure gas, to the delivery system.

Ideally all joining of pipe, tubes fittings and components should be welded. For maintenance welded connections can be cumbersome and costly to break and remake to replace a failed component such as a regulator or valve. Hence many connections can exist that can easily be broken and remade. In high purity and ultra-high purity systems these are typically face seal fitting that use a metal gasket between the toroid sealing surfaces. These fittings and the care that needs to be exercised when making and breaking the connections was reviewed in an earlier newsletter <http://www.arminc.com/assets/nl-v1-3.pdf> (High Purity Face Seal Fittings, How Tight is Tight?). As noted in that article, even the smallest imperfection in the toroid can result in a leak.

So it seems logical that a leak in a face seal fitting would present a bigger problem with loss of high purity gas to atmosphere, and this is no doubt a concern. Common sense would say that gas would always flow from the higher pressure inside the pipe or tube to the relatively low atmospheric pressure outside the pipe or tube, but this is not necessarily the case. In fluid dynamics (fluid is defined as something that takes the shape of its container, so technically gas is a fluid) the Bernoulli principle as applied to an eductor can explain how atmosphere could actually flow into the high purity gas stream. Any differences in diameter between the fitting IDs and the gasket ID in a face seal type fitting can mimic the design of an eductor, causing a negative pressure in the annulus between the end of the fitting and the face of the gasket. Any nick or scratch in the face seal toroid or gasket could then allow atmosphere to enter that annulus and become entrained in the gas stream inside the tube.

Contamination in High Purity Welds

A great deal of time, effort and money is invested in assuring purity of the process gases used in the semiconductor, medical and aerospace industries. The use of electro-polished 316L stainless steel tubing and components, special cleaning and packaging of materials and clean room production all add to the cost per cubic foot of any high purity and ultra-high purity gas.

Getting the high purity gas from a bulk container on the gas pad to the tool within the facility using that gas, incorporates hundreds if not thousands of high purity welds. Orbital welding equipment, offering the highest level of control and repeatability, has been adopted as the standard to produce high purity welds. This equipment relies heavily on the use of inert gas, typically Argon, to provide a barrier preventing the formation of oxides within the weld and the heat affected zone surrounding the weld. This is important as oxides can and eventually will reach the tool using the gas and can cause damage to the product being produced as well as the equipment producing the product.

The inert gas, Argon in this story, is supplied to the tubing/fittings/components being welded as well as the orbital weld head itself. Argon purge on the inside of the plumbing being welded displaces any atmospheric oxygen and blankets the inside surfaces. The Argon supplied to the weld head covers both the tungsten electrode used to accomplish the weld as well as the OD of the plumbing being welded. During welding, with no oxygen present, no oxide formation will occur as long as the purge remains long enough to allow the weld and heat affected zone to cool below the point where oxides will form.

Oxygen isn't the only gas impurity of concern with high purity welding. Other gas contaminants to worry about include Nitrogen and Carbon Dioxide. Nitrogen can produce nitrides very deep in the weld depending on exposure time to the molten pool. Nitrides can increase the hardness of the weld and reduce the corrosion resistant properties of the base metal. Carbon dioxide can produce similar results and often oxidizes faster. If mixed with moisture it can produce carbonic acid within the weld zone.

Further research into the affects of contaminants in high purity welding can be easily done via the Internet. I searched "purge gas importance in orbital welding" and found a plethora of information that contributed to this article.

Sad news from ARM, Inc.

Sad news is never easy to pass on. Von Morrow, the President and owner of ARM, Inc. has passed away. He will be missed by family, friends and employees alike.

We are on a course that none of us at ARM ever expected to have to navigate. All of us at ARM appreciate your patience as the path forward solidifies and our thoughts and efforts turn from mourning the loss, to moving forward.

Thanks for reading this far!

We understand that there is very little time in the day to read all the newsletters that make it to your inbox. We will strive to not be 'that company' spamming the world with useless information seemingly every other day for no better reason than some webinar told them that is what they should do.

As noted above if you opt out we will honor your request. If you do tho, you may want to like us on Facebook or follow us on LinkedIn so you can keep your inbox clear, but still keep in touch with what is going on with ARM Inc. in the gas world.

Sincerely,

Dan Spohn
ARM, Inc.



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