DRY AIR OR NITROGEN:
You Be The Judge

AN ARTICLE
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Traditions, they die hard. It is not particularly what tradition that you have that you just can't seem to shake, or it could be that you started it and you don't want to loose face. It is the fact that some people are simply resistant to change, no mater what the evidence. This stubbornness comes at a very high price and not just career wise, but economically.

The tradition of today is the very old argument between the two schools of thought in the pressurization industry between Dry Air and Nitrogen, since SF6 largely went away years ago. There are numerous manufacturers that operate a substantial business from the manufacture and repair of Dry Air equipment. These venerable houses of service are well known names and are held in high regard for the products that they sell. Dry Air pressurization equipment is not typically cheap in quality or price. This equipment ranges from the very simplistic insertion of a canister of pretty blue crystals in to the air stream all the way to elaborate heated and cooled systems involving compressors, various gasses and other desiccants to provide the absorptive abilities from actual beds to condensation systems, or both.

While this Dry Air scheme can get very elaborate and is used in numerous industries from drying the air used by your tire shop to transmission line pressurization, and high voltage switch gear, the alternative is simply Nitrogen.

No one actually knows when this debate started. Telephone companies have been using pressurized nitrogen to fill and dry copper trunk line cables since the dawn of paper insulation and the lead jacket. This could date back to the 1930's. Dry Air has easily been around since the 1940's. For our talk today, the idea of using one or the other to fill up a piece of transmission line could not have come terribly much before the advent of closed coaxial cable or sealed wave guide.

DECISION VS TRADITION:
This is where the savvy engineer is able to weigh the facts and come up with an informed opinion. This opinion should include first hand knowledge about the devastation that a transmission line fire can cause but fortunately for some of you guys, you have managed to miss that boat and glean this knowledge second hand. Short of having this sooty, oily mess in your pocket of experiences, you have to listen to the empirical evidence.

THE GALVANIC TABLE:
Here is one of the many things that flunked most of us out of chemistry class. When you put dissimilar metals in an electrolyte, a voltage is created. When this voltage is created, the byproducts are usually, green, black, brown, tan and typically fuzzy, and sometimes, all at the same time. This byproduct can be graded in severity from mild as in a tarnish, to severe as in corrosion. Neither of these items is conducive to the orderly conduction of Radio Frequency Energy. In the mild category, a single metal such as Fine Silver Plating becomes acted upon by the most minute water molecule and the result is Silver Oxide. Silver Oxide, while arguably conductive, is also abrasive and accelerates the destruction of the surfaces that it is mated with during frictive contact during assembly and thermal cycling. This is one reason why you should burnish and clean new bullets and other products before use. The sand paper effect is slow but can become dramatic.
On the extreme side, those fuzzy corrosive crystals are not only conductive but can become dislodged and fall downward on to an insulator surface due to gravity, and if enough of these crystals, and silver oxide flakes align just right before Aquarius, the resulting arc across the insulator and ensuing fire is a delight for marshmallow roasters around the world.

SIMPLE THINGS;:
So, it should all seem so simple. Avoid tarnish and corrosion at all costs. If you can avoid tarnish and corrosion, things will run much more smoothly until lightning comes to call and erases all your best efforts. Let's look at the laundry list of the typical piece of Rigid Line.

THE PLAYERS:
Copper
Silver
Brass
Stainless Steel
Beryllium copper
Lead
Antimony
(Teflon, and Butyl Rubber)

Since we can agree that none of these metals play well together in any kind of liquid contact with each other, we can now get to the heart of the facts and start new traditions.

WHAT IS DRY AIR?
Logic dictates that it is the regular stuff that we breathe with as much humidity taken out as possible. While these humidity numbers are well below 1 percent, the fact remains that humidity is a component to the stuff you are pumping in to your million dollar investment of copper and brass modern art. Water is deliberately being introduced one molecule at a time in to a supposedly sealed system that we have all agreed upon that is not a good candidate for water wings. Perish the thought that you have a leak anywhere in the system and you use a large quantity of this fresh air. We can come back to this part of the logic later.

A NEW CONSIDERATION:
Oxygen. This element on the table is a key factor to the generation of all of the above forms of degradation to the list of dissimilar metals that is above. Oxygen promotes the development of the most mild tarnish to the harshest of corrosive crystals. It is important to also consider that our friend the Oxygen molecule plays a key roll in the support of combustion. This is where the chemistry gets tricky and we will not bore you with the formulas. Suffice to say, the presence of Oxygen in a normal running situation can cause creeping long term molecular degradation that only your Line Sweeper can find during the preventive maintenance cycle that you perform every year.

You can of course wait until the extra tower light goes out and look there. In either case you will learn where the failure in your system is. Now things get even trickier. Let us say that your system is having a bad day and you are about to loose a bullet joint at a flange around 800 feet above ground level. This joint gets very hot and when it crosses the 900 degree Fahrenheit mark, and when one of the two parenthetic materials in the build list starts to ooze oils and emit a very toxic and corrosive gas called Fluorine, things get worse in a hurry. Fluorine is a nasty gas and other than being lethal when inhaled, it can start to further degrade and etch all of the metallic surfaces within your line as the joint continues to heat, ooze and outgas. During this three way process in an oxygen atmosphere, the oils from the Teflon ignite and the Bar-B-Que starts along with the requisite smoke and greasy soot. Wow, what a great visual. You think to yourself, my line is up there flaming away internally, annealing the outer wall of the pipe and will eventually start to drool molten copper, brass and stainless steel BB's inside the line from the arcing that is about to happen, and my Watt meter won't even see it. These molten materials occasionally makes its way outside the line after the outer has melted away. It is when the line starts to drool these flaming parts on to the dry grass field below, that your 1000 gallon diesel fuel tank looks like a problem. Notice the photo with the charcoal watch band spring and missing insulator which clearly shows the ravages of an oxygen environment after a typical watch band spring failure in 3-1/8" Rigid.

CAN WE AVOID MOST OF THIS?
Yes. In a word, Nitrogen. But,,, traditions die hard. You think to your self that you have been a Dry Air kind of guy since you got in the business and why change now? The answer is that changing your evil ways is the right thing to do. The answers are simple.

In a Nitrogen environment, there is no measurable humidity. There is no measurable Oxygen. There can be no support mechanism for combustion or the molecular degradation from tarnish or corrosion. With one simple change of your evil ways, you can look forward to your next typical watch band spring failure and have the much more palatable results. Of course the choices are yours to make and I welcome your comments.