American Glovebox Society
ENCLOSURE
Winter 2018/19

Understanding Your Glovebox and the Impact of Changes

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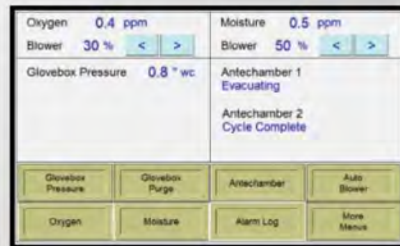

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President's Message

By: Tony Heinz

To those reading this address who have control of whether it is worthwhile for your staff to attend the AGS Conferences, I will share with you my experience on how I got to be the President of this great society. It began a long time ago, so far back I don't remember the date, but I do remember it was in San Diego and I was a young field technician who was asked to talk about leak testing in front of what I remember as being a huge audience (probably 20 people). This was my first time speaking to a crowd, at least a crowd that was curious as to what I had to say rather than to argue about test results. As with most first attempts, things did not go as smooth as I planned but I got through it and, even though my presentation should have been much stronger, the encouragement to continue with the society could not have been greater.

So, how did I get to be the President? Not too long after my initial presentation I joined the standards committee and started to attend conferences regularly. After a few years, I was asked to be on the Board of Directors and, in 2013, was accepted. In 2014, Nate Levene, the current AGS President, challenged me to step out of my comfort zone one more time and work my way up through the officers. With a little reluctance, I accepted. Now that I am President I can say that, true to form, the support and encouragement that I received so many years ago during my first appearance is still alive and well today. As I worked my way through the officer's positions, I obtained professional skills, made several great friends, learned many tricks of the trade, and shared laughs that I will never forget. It was a fantastic decision. I hope that if you have an opportunity to attend or have the opportunity to send a colleague that you do so, you may make a lasting impact on that person's career and life.

This year's conference will be held in one of the oldest cities in America, Boston! With such a rich history, being the starting point of the American Revolution, there are tons of historic sites like Paul Revere's house where he left on his infamous Midnight Ride – "The Redcoats are coming!" and the Boston Tea Party Museum. Boston is a town with a little something for everyone, even if you just want to walk around and admire the beautiful architecture of the old buildings and cobblestone streets. The Boston Public Library is considered an architectural wonder!

Last year we added a great feature to the conference, a new conference app for keeping track of presentations, events, adding photos, and contacting other attendees all with your phone. What a fantastic tool. This year we plan to update our webpage for better navigation with every type of device. AGS to Add webpage info. http://www.gloveboxsociety.org/

I want to give a special thanks to the American Glovebox Society Board of Directors and Standards Development Committee, as well as all the participants, Sponsors, Vendors, Presenters, and Exhibitors, Also, a very special thanks to Dorothy and Crissy, without whom none of this would be possible!

I look forward to seeing you all in July!

Regards,
Tony Heinz
AGS President 2018-2019

AGS American Glovebox Society

The Enclosure

Editor
Justin Dexter
j.dexter@mbraunusa.com

Advertising Manager
Crissy Willson

Design and Production
Tony Monaco

Publisher
American Glovebox Society

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The Enclosure is published by:
American Glovebox Society
526 So. E Street
Santa Rosa, CA 95404

Tel.: (800) 530-1022 or (707) 527-0444
Fax: (707) 578-4406
E-mail: ags@gloveboxsociety.org
Website: www.gloveboxsociety.org

Postmaster: Send address changes to:
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Santa Rosa, CA 95404

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kristin.leeder@cnl.ca

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Dan Payne
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T. (505) 655-9953
rodriguez_j@lanl.gov

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greg.wunderlich@aecom.com

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Understanding Your Glovebox and the Impact of Changes

By: Kendall J. Wahlquist, Idaho National Laboratory

It is important to understand the nuances of a glovebox enclosure, especially when changes are made. A case in point is oxygen level fluctuations after replacing a purification system on a glovebox at Idaho National Laboratory (INL).

Gloveboxes at INL are typically used when nuclear material or its encasements need to be protected from excess oxygen or to protect the workers from potential airborne particles. For example, oxygen requirements can range from 1000 ppm for repackaging neptunium canisters down to 5 ppm for processing plutonium fuel capsules. Clean gloveboxes, i.e. no radiological contamination, operate at a positive pressure to ensure there are no air in-leakage. Contaminated gloveboxes are usually operated at a negative pressure to ensure no radioactive contamination escapes from the glovebox.

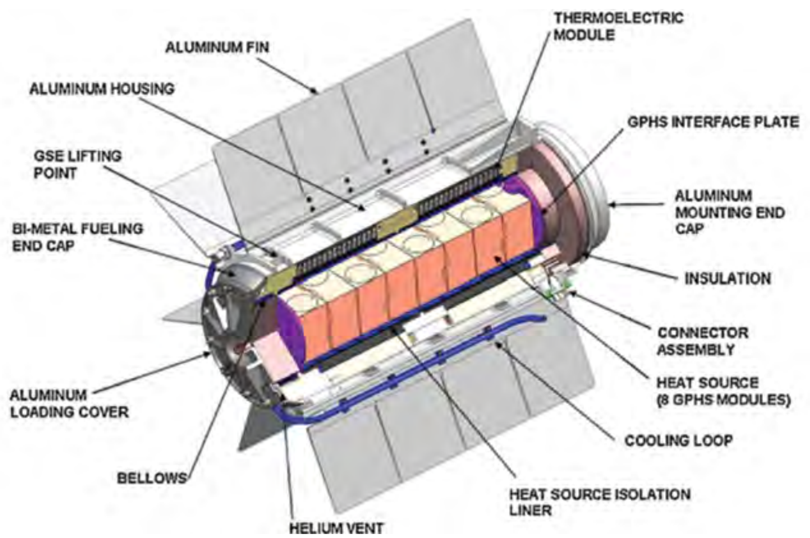

Figure 2 Multi Mission Radioisotope Thermal Generator (MMRTG) used for the Mars Curiosity rover

The Space Nuclear Power & Isotope Technology (SNPIT) group at INL uses several different gloveboxes to support NASA missions. The main purpose of the gloveboxes is to assemble the general purpose heat sources (Figure 1) and install those heat sources into radioisotope power systems (RPS) such as the MMRTG (Figure 2). These gloveboxes have been used to fuel the RPS units for NASA's Pluto New Horizons, Mars Curiosity and many previous deep space missions. There are other gloveboxes used in various support functions such as high temperature bake-out and welding. One of these is the Submarine glovebox.

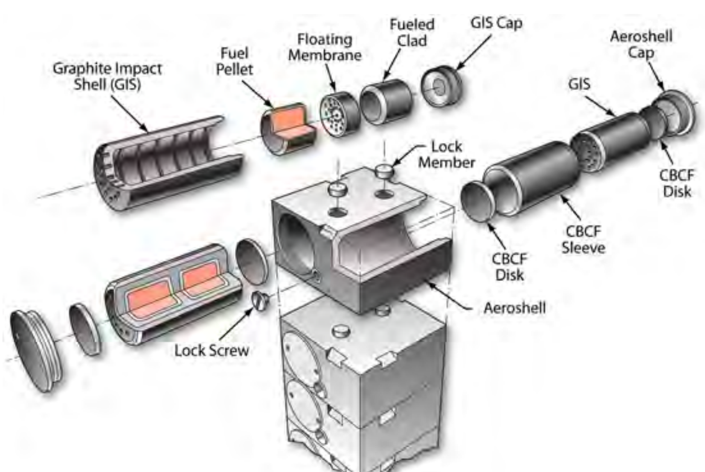

Figure 1 General Purpose Heat Source (GPHS)

The Submarine glovebox (from the Beatles song, it is round and painted yellow) was built in the early 1970s. The glovebox is about 10 feet long and 4 feet in diameter. See Figure 3. It has a lift platen in the center that is used adjust the height of the center of the floor for operator convenience. The glovebox has a large door on each end for the installation and removal of equipment and hardware. There is also a transfer port on one door to allow smaller items to be passed through. The Submarine has been modified over the years from its original design to change the doors, add the lift platen, and various other features as the purpose of the glovebox has evolved. The glovebox is clean, i.e. no radiological or hazardous material contamination. During operations, the atmosphere in the glovebox is argon with oxygen typically maintained below 25 ppm, however stable readings below 5 ppm are not uncommon. When not in use, the argon atmosphere is replaced with air and the two end doors are opened. The design of the glovebox allows a quick atmosphere exchange by pulling a hard vacuum on the glovebox and then backfilling with argon or air, as required.

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Figure 3 Submarine glovebox after upgrades

To ensure technician proficiency of glovebox operations, all of the gloveboxes in the SNPIT group use the same purification system (with minor functional differences). The previous systems were all built in the 1980s and were past their life expectancy. Blowers and switches were failing, wires were coming loose, etc. To ensure glovebox functionality to support future NASA missions, the purification systems started to be replaced in 2012. The Submarine had the last of the old systems and was finally upgraded in 2017.

When the new purification system was installed, most of the associated piping also had to be changed due to different equipment requirements. Along with this, the direction of the recirculation gas was reversed. The old system had the recirculation gas enter near the top of the glovebox and exit at the bottom. The reason for reversing the flow was two fold: Heat removal and gas mixing. Plutonium heat sources with greater than 1000 watt-thermal output would be periodically placed in the Submarine. Since heat rises, it made sense to remove the hot inert gas from the top of the glovebox instead trying to remove it from the bottom. Also, since air molecules (primarily oxygen and nitrogen) are lighter than the inert argon gas, those molecules could more easily flow to the top of the glovebox where they would be removed with the recirculation gas instead of being pushed to the bottom of the glovebox with the recirculation gas.

A performance difference between the old and new purification system was the blower speed or gas flow capacity. The old system had three blowers, each capable of 40 CFM. During normal operations, a minimum of two blowers were used and usually all three were used. The new purifier has two variable speed blowers, each with a 40 CFM flow. However, the new blowers have a lower pump curve than the old blowers so pipe elbows and other restrictions have a greater effect on flow rate. This was one of the drivers for the piping change.

With the old system, a stand-alone oxygen analyzer was plumbed to the glovebox to sample, analyze the sample, and return the sample to the glovebox in a closed loop configuration. Even when the old system was operating on two of the three blowers, oxygen levels below 5 ppm were obtainable. When the purification system was updated, a new oxygen analyzer was plumbed into the recirculation piping. The original oxygen sampling system was kept as a secondary system. See Figure 4 (next page.)

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During acceptance testing of the new system, the system was operated for several days to ensure it could maintain the required oxygen impurity level. Per the purification manufacturer's recommendation, the blower speed was set at about 30% to prolong blower life. That is when an anomaly was noticed with the secondary oxygen analyzer. Every few minutes, the oxygen level would increase from about 2 ppm up to 4 ppm and then drop back down. This continued for hours. This variation was not seen while running the old purification system nor was it seen with the new oxygen analyzer built into the recirculation line. Although the "spikes" were within specification, they were still an anomaly that needed to be understood.

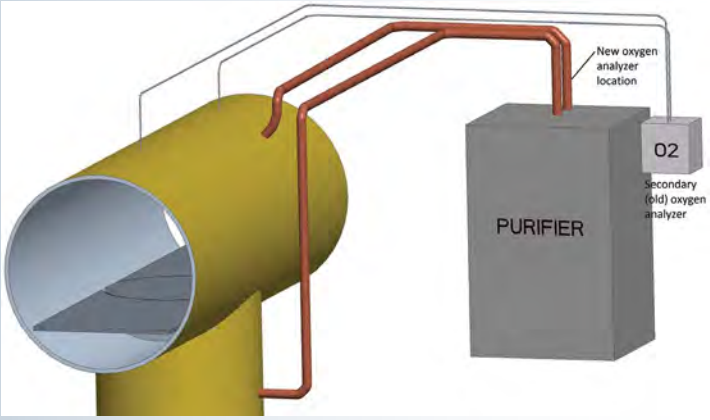

Figure 4 Glovebox system layout (glovebox doors omitted)

Because this was a new purification system, it was being run through its various features so that the operators and engineers could learn and characterize the performance. (Although this new purification system was the same as on the other gloveboxes, it had some enhancement from lessons learned from the other systems.) It was during this learning phase that is was hypothesized that there was a small oxygen pocket at the top of the glovebox.

The design of the system is such that the recirculation gas is extracted about 4 inches below the top of the glovebox. The connections for the secondary oxygen sample are at the very top of the glovebox. See Figure 5. Since oxygen is lighter than argon, the oxygen would settle at the top of the glovebox as anticipated but was not being removed with the recirculation gas. The quantity of oxygen was small enough that it would be extracted by the sample pump, sent through the analyzer where it would show a spike, and then be returned to the top of the glovebox. The sample extraction and return lines on the glovebox are separated by about seven feet. The timing of the variable readings on the analyzer was thought to correspond to the duration of circulating the gas sample through the piping to the analyzer, back to the glovebox, and then migrate across the top of the glovebox back to the sample extraction line.

To test this theory, a fan was passed into the glovebox and pointed at the top of the glovebox. As soon as the fan was turned on, the oxygen level cycling stopped. After the fan was turned off, the cycling slowly returned. Since a fan could not always be in the glovebox, a more practical way to solve the problem was needed. The old system recirculated the gas at 80 or 120 CFM. During the acceptance testing of the new system, the blowers were typically run at 30% of their 80 CFM capacity, or 24 CFM. It was determined that at this low recirculation rate, the gas was not mixing sufficiently in the glovebox. When the blower speed was increased to 50%, the oxygen level cycling dropped significantly. At 70%, there was sufficient gas mixing at the top of the glovebox that the cycling completely stopped.

So what is the solution for the Submarine? Unless the glovebox is being used for operations, it is usually open to air or is operated for a few days every three months to ensure the systems remain functional. Since blower life is a function of its speed and operating duration, and since the blowers are not in continual use, it has been decided to run the blowers at a higher speed to ensure adequate gas mixing. Hopefully this will not have a significant effect on blower life since the blowers are used intermittently.

Even though this condition was discovered on the Submarine glovebox, a review of other systems found two other gloveboxes where the recirculation lines were also lower than the oxygen sample lines. However, in these two cases, the gas sample is plumbed to the process exhaust instead of being returned to the glovebox. This allows any oxygen pockets to be extracted from the glovebox and replaced with fresh argon (to maintain glovebox pressure).

There are a few lessons to be learned from this experience. First, replacing systems or components may allow latent issues to be revealed. If the new purification system had always been operated at >70% blower speed, the potential for insufficient gas mixing may not have been discovered before using lower blower speeds while product was inside the glovebox. Second, it is important for operators and engineers to fully understand their systems and work together so that problems can be resolved quickly and that perceived problems are understood and do not consume valuable resources at critical times.❖

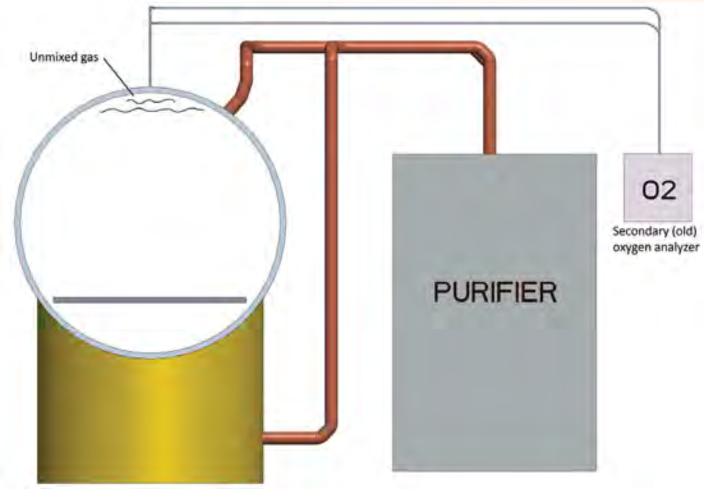

Figure 5 Simplified view of the system (glovebox doors omitted)

Glove Integrity Testing, how important is it?

For many years Glovebox and Isolator glove integrity testing, in Nuclear and Pharmaceutical applications, has been performed by personnel, in some cases infrequently due to time requirements. Regulators have created a need to actively mitigate the potential of a glove breach creating a contamination incident. For this reason, engineered controls are replacing previous administrative controls for glove integrity testing.

A German specialty company by the name of MK-Versuchsanlagen, has taken a very scientific approach to glove integrity testing. MK designs and builds all the components for their testers down to board level. All specific industry standards and customer requirements are implemented and validated. Proven glove recipes are provided. IQ, OQ, and PQ implementation is available to ensure the validity of the test results, ensuring customer satisfaction.

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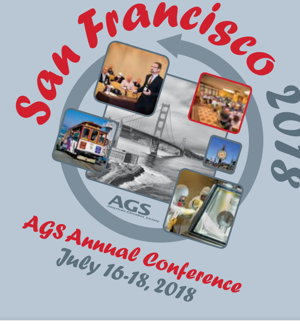

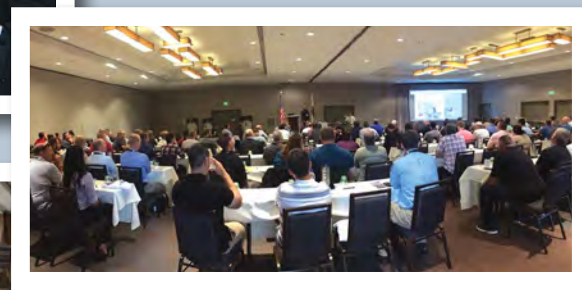

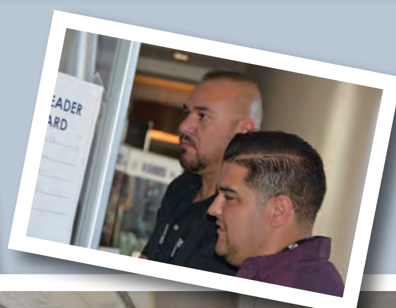

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GUIDELINE FOR GLOVEBOX ERGONOMICS (AGS-G013-2011) Recommendations for the application of sound ergonomic principles to the design, operation, and maintenance of gloveboxes, glovebox appurtenances, and glovebox ancillary equipment.	$125	$200		
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Thoughts from Newman

By: John T. Newman, P.E.

Late Again

I suppose it is fitting, as I sit down to write this issue of Thoughts, due on October 1. As I glance down to the bottom of my computer screen where I see today's date is October 8th, I feel the familiar cold chill in my spine, damn, I'm late again. I have to admit, in life, I am one of those chronic late people. I'm the guy that had to be told to show up for family events an hour earlier than the actual time just so I would be on time. I'm not sure where it comes from but I really do try hard to be on time. I guess it comes from being a perfectionist or always trying to get more done that I have time for. You know, when you get up earlier than usual in the morning to ensure you can get to work on time, you decide now I have time to make a big breakfast, and then you are still late. But then if I don't cause it, the natural world always kicks in and there will be a major traffic jam or my car won't start. I can't win.

"I honestly believe that the most difficult and stressful thing in my career was telling a customer that their project was going to be late. "

There always seems to be more work to do than you have time for. Every time there is a deadline, it always requires working all night or all weekend to get done. And even then, corners have to be cut in order to make it. So much for it being perfect, right? Juggling a deadline in a busy office is always tough. That's when everyone will need something from you or have some kind of insurmountable problem that no one can fix but you. Why is it though, when quitting time comes, those people always get to go home, while you have to work late to get it done?

I honestly believe that the most difficult and stressful thing in my career was telling a customer that their project was going to be late. In my mind, it's even worse than a doctor having to tell someone that their love one just died in surgery. As for most fears, I'm pretty sure this anxiety comes from some very traumatizing experiences that I got early in my life.

Usually, telling someone that their project will be late will cause people to freak out. First there is yelling from the Project Manager, "What do you mean late?" "How could you do this to me?", and it always seems like the world will abruptly end if we don't deliver on time. I've even had someone actually tell me that "people are dying because you are late". No pressure from that, right? Then comes the, "How will you make it up?" "Can you work overtime?" "We need a detailed recovery plan, as to how you will make up the time".

Shortly after that, the Head of Project Management will call, and you go through it all over again, same questions, same end of the world stories. Then the upper management person calls. The really serious table beater. I decree, as they pound on the table, while asking the same questions as the previous people, somehow thinking that their authority will make you all of a sudden not late anymore. I remember in my first job, watching the Vice President of Chrysler Corporation land in his helicopter in our parking lot, to pick up our company president to terrorize him into improving the delivery of the engine test line we were building. Totally humiliating, and the sad part is, no one can go back in time to actually fix the lateness. It just makes going forward miserable.

After all the yelling comes the attempted recovery plan. Regular conference calls to discuss progress will be next, often as frequent as every day. One time, after committing to a final later delivery date (only two weeks late by the way), I was required to send in daily progress photographs, and then participate in a conference call the next morning. It was only me, with what sounded like a room full of people, they would all yell and tell me that from what they saw in the pictures, we weren't going to make it. I would say, "OK then, please give us some more time" in which the reply was, "Oh no, we can't do that". This went on for days. We did actually manage to deliver the equipment when we promised, but the experience was quite traumatizing. And all of the calls? They did not change a thing, it just raised the stress to an unbearable level for everyone.

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Another time, the customer rep visited us weekly, to go through the progress status of every piece part for the project. We had to take all day once a week to satisfy this guy. By the way, this project was the one where "people were dying". Finally, we had just completed the FAT and were scurrying around getting the equipment ready to ship and the phone rings. Our customer tells us that they had some trouble with their drug trials and asked us if we could now hold on to it for a while. What???? After all of the stress and scrutiny for being late, we wound up holding it in our shop for 6 months. Guess we weren't late after all, but the whole process was quite painful, and I'm not sure how many people actually died. It must have been the drug trials that killed them, not us.

Nobody is intentionally late on a project. All reputable manufacturers try very hard to deliver on time, and when the product is standard, on time delivery is easy to manage. Although this becomes progressively more difficult as you venture into the custom equipment side of things. But the expectation for on-time delivery is always just as critical.

So, how do projects get to be late? Many things that can be a factor in the time required for a successful project. First of all, a reasonable amount of time needs to be allowed for the project. From experience, a custom design/build glovebox project will usually take around 6 to 8 months to complete, if it is simple and everything has been done before. If the system is complex and there are things in the design that are new and never been done before, it sometimes can take as long as a year to a year and a half to complete. If you expect it to be done in 3 months, and done right, well guess what, it will be late. How does that go? Do you want it right or right now? In fact, there are a bunch of little sayings that I've heard over the years; "We never have enough time and money to do it right, but we always have time and money to do it over", "Good, Fast, Cheap: You can only pick two". I guess what I'm trying to say, is to allow enough time in the schedule to account for the unexpected, plan for things to go wrong, and it will minimize the potential for being late. And by the way, if someone tells you they can do it in 3 months, don't believe them. And if you ask for an unreasonable delivery in your request for quote, some bidders, the unethical ones, will surly lie just to win the work and they too will be late.

The other classic way for lateness is to get a late start. This happens a lot and this is why. The new project always seems to hit before you are finished with the project that you were previously working on. The expectation is that you will start immediately on the new one, but you can't until you finish the current project. This happens frequently as you can not schedule when you will be awarded new work. Most customers seem to think that you are just sitting there waiting to instantly start working on their project as if you had no other work in house. You wouldn't be a very successful business if that were the case. During the competitive bidding process, if you expect to win, you have to bid with your best price and delivery. Most projects are quoted months ahead of the award, which makes it very difficult to factor in all of your existing in-house work. So, you have to bid it as if you don't have any other work in house, giving you the best chance for winning the job.

In the custom glovebox world, often it is feast or famine, you either have too much work or not enough. There is rarely a steady consistent flow of work. One year we won 5 major projects in one week. As a small business just coming out of a long slow period, we greedily accepted them all. Of course, there was absolutely no way we were going to complete them all on time, so inherently we were late on a couple of them. From a business perspective, it was good having work, but seriously, I think that was the year all my hair turned gray.

The other major cause for lateness is underestimating the scope of work. In the custom world, typically projects are not well defined in the beginning. Some start with nothing more than a sketch on the back of a napkin. But yet we are expected to predict the schedule down to the DAY that it will be completed. We can get pretty close, but I've never been very good at predicting the future. If I could do that, I surely wouldn't be building gloveboxes for a living, I'd be buying lottery tickets and betting on sporting events. It's all the unknowns that make it so difficult, especially when it has never been done before. People who are not in this line of work for a living do not really understand how difficult it can be, with the excruciating level of detail required and the resulting brain damage it causes. The experienced people who do this for a living make it look easy, but trust me, nothing is ever easy.

Then there are all the things that you don't have control over, getting all of your sub-tier suppliers to deliver the correct product on time can be a challenge. I've had wrong long lead purchased parts get delivered, make it through receiving inspection, get placed on the job shelf, and not get discovered until assembly when there is no time left to order a replacement. Fabrication time can be hard to predict for weldments and assemblies that have never been done before. I've seen the welders chase a bulge around a glovebox for weeks before they finally get it flat. Parts get made incorrectly, get warped up like a potato chip from welding, or get fabricated backwards. Parts have missing features, they are out of tolerance, they might be missing material certifications, and probably require re-work or replacement, which no one can predict. Things don't always work like intended and often times need to be redesigned or fixed. I used to say that it separates the men from the boys when it's a week before the customer is showing up for the Factory Acceptance Test, your project

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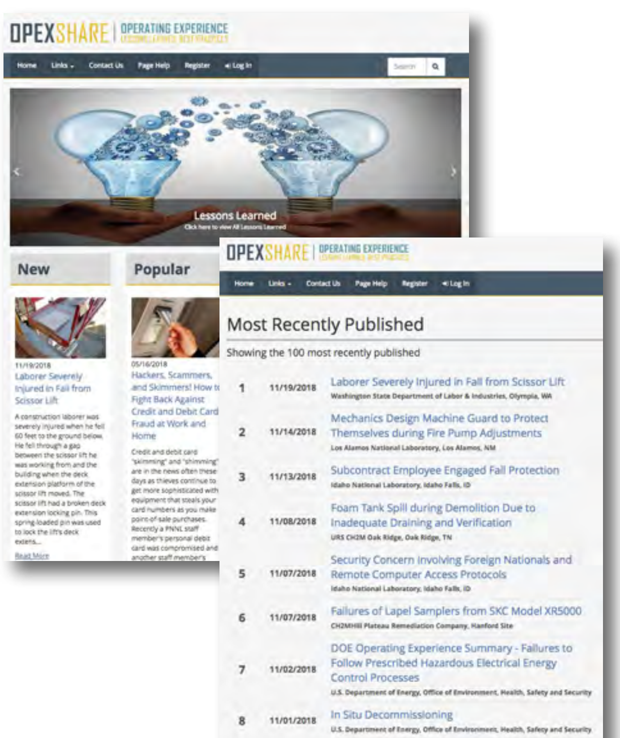
Thoughts from Newman

doesn't work, and you have to figure out how to fix the problem without having to rebuild any major parts or starting over, along with not being late. Hey, no stress there, and I've been in that situation more times than I can count. No one understands why manufacturing people drink so much!

Face it though, none of us would get anything done if we didn't have our schedules and deadlines. We all try very hard to meet them and no one tries to be late on purpose, it's always someone else's fault (LOL). I'm pretty sure we'd all become members to the Procrastinators' Club of America who promote "the philosophy of relaxation through putting off until later those things that needn't be done today." In other words, why do today what you can put off until tomorrow? I dream of the day when I can retire and the first thing I'm going to do is smash my damn clock. ❖



LESSONS LEARNED

Celebrating Success and Process Improvements

By: Stanley Trujillo,
Lessons Learned Sub-Committee Chair

I have been working with lessons learned formally since 2006, and really if I think about it, all my life. Lessons are learned every day whether we realize it or not. However, when I think about lessons learned, I always think about something that went wrong. There is another part of "lessons learned" that we tend to forget about and that is best practices.

Best practice as defined by Merriam-Webster is: "a procedure that has been shown by research and experience to produce optimal results and that is established or proposed as a standard suitable for widespread adoption." So then, why is it that we don't share best practices the way we do lessons learned? If you ask me, it is because most people have a hard time bragging or talking about their successes. We need to change that way of thinking! If you identify a process improvement or find a tool that makes your job way easier, share it (make it personal) so others may benefit!

Last year I wrote an article for the AGS titled "Make it Personal." I spoke about how we need to make it personal and share those lessons learned just as you would with your loved ones. This year I would like to say this: "Celebrate your successes and process improvements!" I encourage everyone to look at your current equipment, your current work practices & procedures, and your current work environment in general and note the successes over the last few years. It's quite possible that others can benefit from the success you have seen, especially at other facilities.

Remember, people do great things every day and even though you may think a best practice or process improvement you developed is not important, share it with the American Glovebox Society, and share it in OPEXShare. You just might be surprised by someone who will thank you for sharing!

StanleyTrujillo
AGS Lessons Learned Sub-Committee Chair ❖