STANDARD DEVIATIONS: Do You Know The Lab Blowhard?

Greetings,

Well, my swamp cooler is working (barely) again. The cooled air coming in feels a tad better than the dry heat outside and The Boss isn't quite as cranky as usual. Compared to the HVAC system running UPHL my little box is not much to look at; but compared to a biosafety cabinet? It's hard to tell the difference.

Biosafety cabinets (BSC) are one of the most obvious and practical engineering controls. You've probably got one either in use or stuffed to the grills with supplies, right now.

Do you understand how they work and how you work with them? You will!

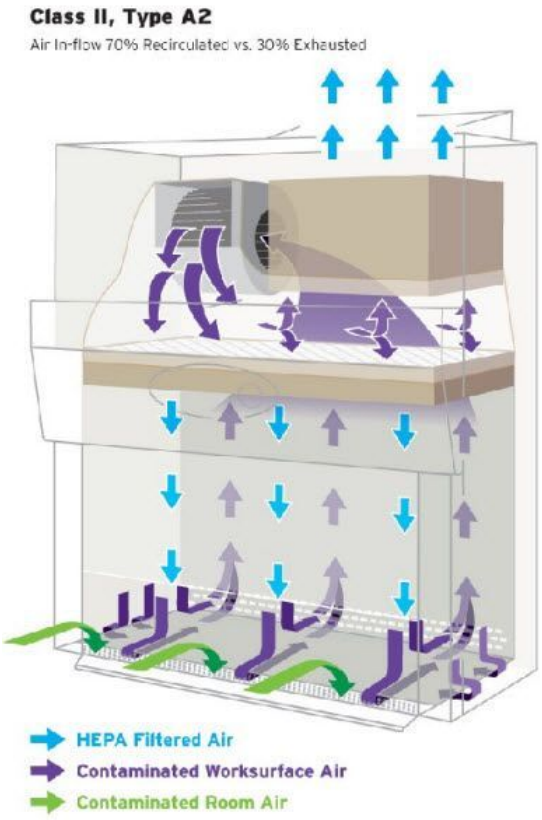
The BSC performs three duties. It protects:

- The technologist using it
- The product/sample being handled
- The environment outside the containment

In a nutshell, the unit draws air from outside of the box through the front grill, filters it, fills the cabinet work space with clean air, takes that used air back and refilters it, sending some of it back while exhausting some.

Hmmm, a box that pulls in air, filters it and pushes that air around sure sounds a lot like my swamp cooler! Sure, it's built a little better and the filters are more expensive, but the principle and concept are identical. Biosafety cabinets are inspected and HEPA filter performance validated at least yearly. I get yelled at for the swamp cooler *at least* that often. The simple technology behind the BSC is keeping us cool at home and safe on the bench.

Understanding just what goes on allows us to work safely within the BSC. Without that understanding we introduce risk to the technologist, jeopardize our samples, and endanger the surrounding personnel and the environment.



{Simplified diagram of air flow in a Type A2 BSC.}

The blower motor inside the cabinet creates a negative pressure that draws air toward the opening. That sucking pressure is coming from the front grill and that is where the air goes in. Outside air does not touch the interior of the BSC. Instead, it goes under the work surface to the space behind the backsplash still being pulled by the blower's negative pressure.

Inflow air is not moving very fast; only 100-110 feet per minute. That's a slow walking pace, you don't even notice it. That's why we often use tape or tissue to visualize the flow.

That open space between the sash and the front grill is a fragile curtain of air that we disrupt with our arms when we work. And that fragility is a risk for aerosols getting out. Fast and/or exaggerated motions easily disrupt the curtain and allow aerosol escape.

{The tape provides a quick visual of air flow inward.}

The air pulled into the front grill flows under the workspace and up behind the backsplash into a chamber where most is then pushed through a HEPA filter down onto the work area and some is allowed to rise up through another HEPA filter and is vented out of the BSC. Seventy per cent of the air recirculates in the cabinet and 30% gets shunted out, cleaner than it came in. All the air that contacts the material being handled (or vented out) is HEPA filtered.

In an empty BSC the downward flowing air falls gently in a broad sheet all across the area of the interior until it hits the surface. There it splits in two directions, toward the front and the back where the intake grill and backsplash grill allow the air to recycle back to the blower and start another filtered pass. The constant flow pushes cleaned air onto and over samples, plates, hands and everything inside the cabinet, keeping all of it bathed in freshly filtered air.

And it's all good until we start stuffing the BSC with supplies and material that get in the way. Any item that sits on the work table of the BSC is an obstruction to the uniformity of the air flow. As that sheet of air drops slowly to the surface, the pipettes, tip boxes, racks, stacks of plates, waste containers, flasks, and instruments all deflect and alter that airflow. Now the product we are so carefully handling is subjected to a bunch of tiny vortices of air that have the potential to move contaminant across the work surface. If there are any aerosols or microbes on those supplies, they are affected by the turbulence created by the deflections; and that can lead to problems.

{Overcrowding forces air to bounce off of the supplies toward the tiny work space where any contamination would be concentrated.}

That nice, clean, even sheet of filtered air never makes it to the surface, where we are handling specimens. Now we're working in a swirling pocket of air that is cascading down off of the miscellaneous junk all around our organism/sample.

All the clutter blocks the grills at the rear, too. This changes the blower motor as it must compensate to draw through a smaller aperture. We accept that there are supplies we must use in the BSC, but the rule of thumb is to keep those supplies to the minimum needed for our task and maintain as much of the open surface as possible. Despite what we think, it's better to have some of those supplies outside the BSC.

Best practice for BSC use is to keep only the essential tools within the cabinet and restock from a clean supply when needed. There are some things that we can leave inside the cabinet permanently (pipettes, vortex, etc.) and other things we place inside just when used (pipette tips, plates, reagents, etc.).

{Only the bare necessities.}

Of course, everything in YOUR cabinet is necessary *and clean*, right? There's no way that anything may have been handled with dirty gloves when placed inside; no way that other samples might have aerosolized, splashed or spilled onto any of the cabinet supplies. Besides we take everything out and thoroughly disinfect after each use! Unless you don't.

Cleaning the BSC is a chore that takes dedication and devotion. This is the clean space that we must maintain to keep clean. Bleach is the common disinfectant and it works. The problem is that sodium hypochlorite is an aggressive oxidizer, and eats away at stainless steel. When bleach is used, it needs to be followed with something to clean up the bleach! Seventy percent ethanol and/or deionized water are used to remove bleach residues once the disinfection dwell time is reached. Removing all material from the BSC to clean may not always be practical. **Tough.** Routinely (that's your call) disinfecting the *entire* BSC is good laboratory preventive maintenance, and good biosafety.

The biosafety cabinet is simple, yet vital tool in our toolbox of engineering controls. Its safe use and function depend on our understanding, proper use, and care.

Have a great week and be safe,

Bryan