TECHNICAL BULLETIN
GENERAL INFORMATION

Nuaire Inc.
2100 Fernbrook Lane
Plymouth, MN 55447-4722
U.S.A.

Phone: 763.553.1270
Fax: 763.553.0459
Toll Free: 1.800.328.3352

Discussion of Canopy Versus Hard Connection Of Class II, Type A2 Biological Safety Cabinets

William Peters
VP Engineering

The topic of canopy versus hard connection of Class II, Type A2 Biological Safety Cabinet (BSC's) has long been a matter of discussion over the years. Safety professionals have interpreted the many revisions of both the NSF 49 standard and the CDC/NIH Biosafety in Microbiological and Biomedical Laboratories (BMBL) guidelines differently when exhausting type A2 BSC's. In addition, certifiers also added to the discussion. Prior to the 1992 NSF 49 standard, most certifiers didn't have the resources to properly test canopy connections and thus would typically recommend hard connections that could utilize an exhaust duct measurement to assure the correct inflow velocity. Not until recently was the direct measurement of inflow velocity available as a tool (5 years after the 1992 NSF 49 standard took effect) did the certifiers have the means to properly test a canopy connection. Now all NSF listed BSC's have published acceptance criteria allowing direct measurement of inflow velocity. A canopy connection can now be properly installed and tested assuring containment performance.

During the last NSF 49 standard review process for the 2002 revision. The joint committee of the NSF Standard 49 reviewed Annex E, "Recommendations for Installation". The topic of canopy versus hard connection was of primary concern due to the various past interpretations and the current use of direct measurement for inflow velocity, as discussed above. As we know, the installation of the BSC, room location, mechanical, and electrical interfaces has as much to do with the BSC containment performance as the BSC design itself.

When discussing proper exhausting of a BSC, it adds another level of complexity to the installation. In review of exhausting BSC's, the sole purpose of exhausting a BSC is to remove non-particulate matter, i.e. toxic gases and vapors from the BSC if present. If only biological materials are present (particulates), the BSC should be room recirculated. This would include the use of surface disinfectants in the amount required for sufficient efficacy i.e. Alcohols, Halogens, Phenolics, Quaternary ammonium compounds.

If toxic gases and vapors are expected to be present during the use of the BSC, the CDC/NIH states, "Type A2 cabinets used for work with minute quantities of volatile toxic chemicals and trace amounts of radionuclides required as an adjunct to microbiological studies must be exhausted through properly functioning exhaust canopies." Type A1 BSC's, having contaminated positive pressure plenums should never be used with minute quantities of volatile toxic chemicals and trace amounts of radionuclides and thus there is no need to exhaust and only room recirculate.

During the Standard 49 review process, an in depth discussion of exhausting A2 BSC's took place. Hard connection of the exhaust and its associated issues were discussed. The discussion first took the position that if we continue to recommend hard connection, what criteria must be established to assure a proper installation.

The criteria discussed were the following:

1) Being a hard connection, the internal blower must be interlocked in the event of low exhaust flow or an exhaust system failure. This is accomplished by installing an exhaust monitor in the duct above the BSC and electrically interlocking the BSC fan via a relay. This will assure that if there is not sufficient exhaust, the BSC fan will shut down and not push any contaminated materials out through the work access opening.

2) A gas tight damper should be installed above the exhaust transition for shut-off during a decontamination process.

3) The cabinet fan on/off function requires interlocking to the exhaust on/off function or let the BSC run 24 hours a day. This will avoid room air being drawn into the clean side of the workzone supply HEPA filter. In addition, it would remove the possibility of fan reverse rotation that could possibility occur if exhaust air flow is allowed to rotate the fan wheel when the fan is turned off.

Once the above criteria was established, a discussion occurred that asked the question; Has anyone seen a correct hard connected installation that meets all the above criteria in field to date? The answer that most of the committee members gave was very few. Most are installed meeting some of the criteria above, but not all of it. This means in most cases, some form of containment performance is being compromised when a hard connection is installed.

Another issue of discussion that has a large impact on installations today versus several years ago is multiple BSC's on a single exhaust system or ganged system. From the installation perspective, ganged systems have the advantages of being more efficient and cost effective to install. However, the level of exhaust system complexity increases, as well as HVAC balance issues within the facility. BSC's with hard connections on ganged systems typically require a Constant Air Volume (CAV) valve on each BSC to assure proper exhaust volumes. BSC's being constant air volume devices cannot tolerate large deviations from their nominal operating setpoint without impacting containment performance. A properly operating CAV valve will exhaust a constant air volume and make the necessary air volume adjustments to within +/- 5% thus maintaining BSC containment performance.

Systems that don't utilize CAV valves can be subject to fluctuations caused by other exhausting devices on the system, i.e. BSC's, fume hoods, etc. In addition, variations in supply volume (room or facility air volume balance) can also impact BSC containment performance. Hard ducting BSC's must be done correctly on all aspects of the system to assure BSC containment performance.

The discussion then turned towards the canopy connection. The committee first decided that the term canopy would be used in Annex E and throughout the standard for uniformity issues. In the past, terms such as thimble or air-gap had also been used to describe the canopy connection.

The discussion then continued on the canopy connection for a Class II, Type A2. The consensus of the committee was that the canopy connection is really considered the desired exhaust method because the air gap on the canopy allows for exhaust system fluctuation to occur and not affect the BSC containment performance. The committee did realize that if there was not sufficient exhaust flow present, toxic gases and vapors would be pushed out into the lab through the canopy air gap. So, as with hard connections, an exhaust alarm should be installed in the exhaust duct above the BSC. This will warn the BSC user that there is a problem with the exhaust system and that they should, as early as possible, complete their work. During the time needed to complete the work, the BSC will continue to provide containment for biological particulates.

Canopy performance was also reviewed by the committee. A properly designed canopy should not allow the inflow velocity to drop below containment levels in the event of an exhaust system failure. And on the other side, a canopy shouldn't exhaust too much air from an energy loss perspective. The committee settled on the paragraph below, as stated in Annex E to describe the canopy connection.

"A properly designed and installed exhaust canopy will allow a Type A1 or A2 cabinet to maintain acceptable inflow velocity at the front access opening even when the flow through the exhaust canopy is completely stopped. The performance of the exhaust canopy should be assessed by either the manufacturer of the exhaust canopy or the user to assure awareness of the performance characteristics of the exhaust canopy with the particular model of cabinet being exhausted".

The committee, after discussing and developing the above paragraph for the canopy connection, returned to the discussion of hard connection. In the subsequent discussion, the more discussion that took place dealing with all the conditions that must be met for a successful hard connection installation. The more the committee wanted to direct future installations towards canopy connections. The majority of the committee members felt that given the installation issues of past hard connections, the current use of direct inflow measurement and more ganged exhaust systems increasing exhaust system complexity. Why recommend hard connections anymore when there is a better way in canopy connections. So, Annex E was revised as discussed above. After much more discussion, the committee decided to make a strong statement towards canopy connections by recommending that no type A BSC be hard connected

Annex E, being part of the NSF/ANSI 49-2002 standard is a recommendation for installation. If a lab safety professional still would like to hard connect a type A2 BSC, it can be done successfully taking into account the criteria discussed above. It would also be advantageous to bring both facility air balancing and BSC certification personnel into the process, as soon as possible to assure a successful installation. However, as stated in the NSF/ANSI 49-2002, the canopy connection should be standard and only under very special circumstances should a hard connection be considered.

The purpose of this technical bulletin is for information only. Being a NSF 49 joint committee member, the discussion within represents my perspective of the topic and does not represent the official opinion of the NSF 49 joint committee and should not be used as such.