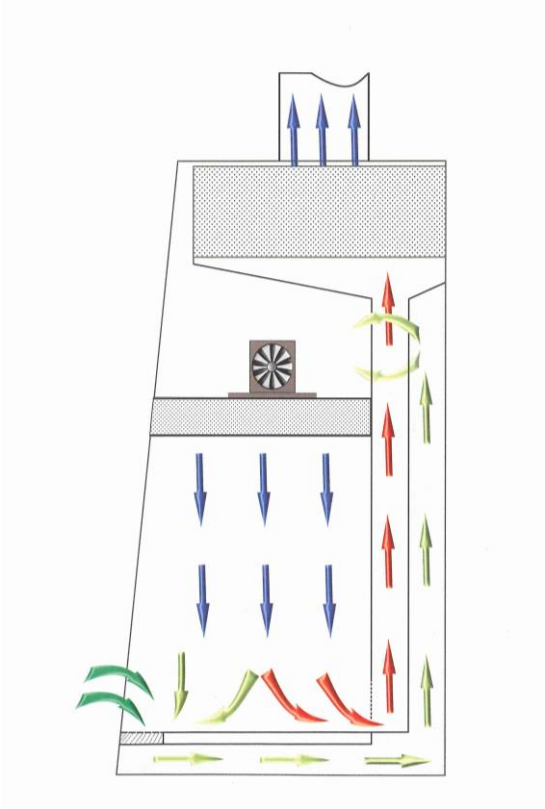
Clarifying the "Type C1" Biosafety Cabinet

Background

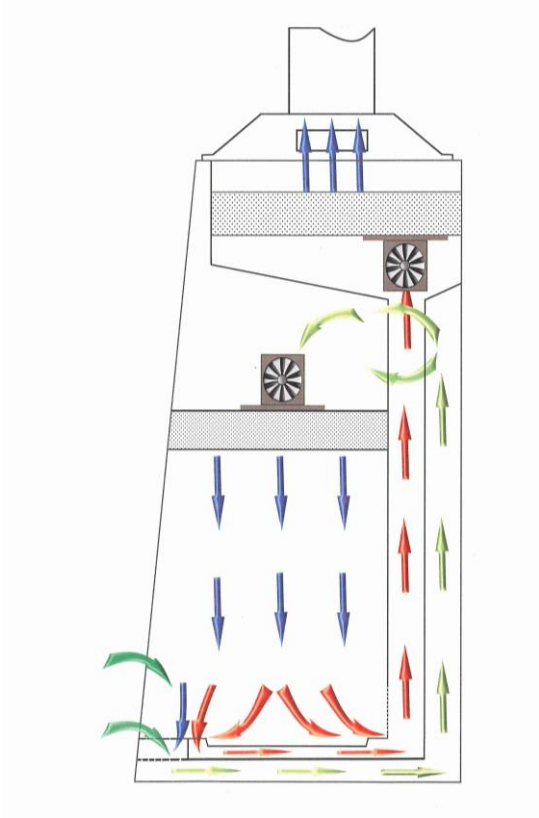
Over the last couple of years, a slightly different style of Class II Biosafety Cabinet was introduced into the life science market. The manufacturer of this new style cabinet designated it as a Type C1 because it could not be precisely defined with the current definitions as stated in the NSF/ANSI 49-2014 standard. The NSF joint committee on Biosafety Cabinets has been reviewing this new style of cabinet along with the current cabinet definitions. It has been decided that the new cabinet style will be defined as a type C1 and will be listed as such in the NSF listings. The current cabinet types will remain the same; however all the cabinet definitions have been updated to align with each other in terms clarity and airflow function and will be released on the NSF/ANSI 49-2016 revision.

So what is different about a Type C1 cabinet?

The type C1 cabinet is basically a type B1 cabinet in terms of airflow pattern. The cabinet exhausts approximately 60% of the work zone airflow through a dedicated portion of its centered depressed work tray/grill pattern and recirculates the remaining airflow, approximately 40% of work zone airflow through the non-dedicated portion work tray grill area. However, what makes type C1 cabinet different from a type B1 is that it has an internal exhaust motor/blower to push the airflow through the exhaust HEPA filter. Traditional type B1 cabinets require the facilities exhaust system to pull airflow through the exhaust HEPA filter and thus require to be direct connected. This new style cabinet is more like a type A2 with respect to exhaust in that it can be exhausted back into the room or through a canopy exhaust connection. In terms of exhaust requirements, the type C1 will use a bit more exhaust volume than a type B1 and a type B1 requires a bit more negative pull or static than a type C1.



Type B1 Airflow Pattern



Type C1 Airflow Pattern

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Where the type C1 cabinet **should be applied for use?**
Since type C1 cabinet exhausts a majority of the work zone airflow, the application of the cabinet should be the same as a type B1. Both of these cabinets are used in applications where greater amounts of volatiles are used than are commonly allowed by a canopy connected type A2. Both cabinets recirculate a portion of airflow. Due to recirculation, a thorough a risk assessment process must be performed followed by specific use work instructions to assure that users work in the exhaust portion of the work zone. In addition, since the type C1 cabinet has an internal exhaust motor/blower and electrical connections within the exhaust airflow of the cabinet. The risk assessment must consider the exposure risk of volatiles used and their concentration levels within the exhaust airflow that comes in contact with the cabinets internal exhaust blower.

Can the type C1 cabinet be used without exhaust?
Yes, since the cabinet has an internal exhaust motor/blower pushing the airflow through the exhaust HEPA filter like a type A2 cabinet, it can be used as room recirculated. However, just like a room recirculated type A2, no volatiles may be used when room recirculating. However even if this cabinet is functioning in room recirculation mode, the recessed area in the center of the work tray, dedicated to exhaust cannot be modified due to the grill pattern. This unique work surface configuration may restrict the use of equipment and other procedures commonly done in a BSC that require a flat work surface. Most all other cabinets today use a flat work surface across the entire work tray with no limitations (i.e. depressions or grills).

Can the type C1 cabinet be easily room recirculating or exhausted?
The type C1 cabinet can be room recirculated or exhausted just like type A2. However, laboratory building requirements today with regard to ventilation cannot be altered so easily. When a laboratory is designed, the ventilation requirements for both supply and exhaust are calculated for pressure, air change rates and removal of heat load. If a cabinet needs to be changed from room recirculated to exhausted, all these requirements would have to be recalculated and physically changed along with the installation of a facility exhaust duct/system.

Can the type C1 cabinet replace a type B2?
In most cases NO! The type B2 cabinet exhausts 100% of the work zone airflow providing the greatest flexibility as to the type and quantity of volatile materials used without specific use work instructions. The type C1 cabinet, similar to a type B1 may be used in cases for energy savings or where there is limited exhaust capability, but again because of the recirculation portion of the work zone airflow an application risk assessment must be performed along with specific use instructions. As with all volatile use in biosafety cabinets, the risk assessment must include worst case scenarios of spills and container breaches to evaluate maximum concentration exposure.

What is the exhaust connection used on the type C1 cabinet?
The type C1 cabinet is exhausted through a canopy transition like a type A2. However, the canopy function is different than a type A2 canopy as it could also be called a “One way canopy”. The function of the type C1 canopy has a one way flap, which is allowed to open, in the event that the facility exhaust system pulls too much exhaust airflow. The flap allows the additional airflow to be taken from the room to prevent it from being pulled through the cabinet resulting in a loss of product protection just like the function of a canopy connection on a type A2. If there is insufficient exhaust or an exhaust failure, a low exhaust alarm will activate and the type C1 cabinet can be programmed to react one of two ways; The cabinet airflow can be turned off within 15 seconds (the same condition that is present in either a type B1 or type B2 cabinet) or the internal exhaust motor/blower will continue to run for up to 5 minutes providing for what is termed an “Active protection cycle”. However, as a result, the exhaust duct will become positively pressurized. Since it is known that *Pressurizing contaminated ducts is not a recommended practice per AIHA/ANSI Z 9.5-2012, section 5.4.3.5, Laboratory Ventilation.* The requirements to use this feature of the type C1 cabinet per NSF/ANSI 49-2016 is both a risk assessment of usage and that the duct system be sealed and tested as class A (a leakage of less than 3.0 CFM per 100 ft^2 of duct surface area at 1.0 inch w.g.) as described in HVAC air duct leakage test procedures-2012 (Sheet Metal and Air Conditioning Contractors National Association (SMACCNA).

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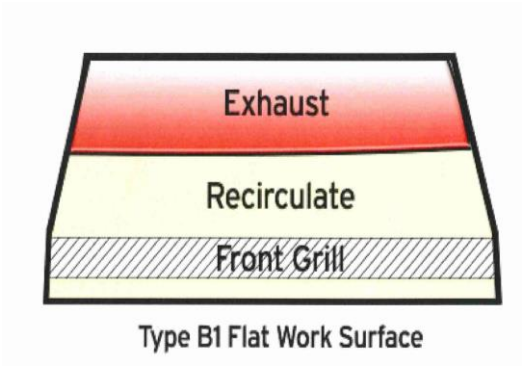
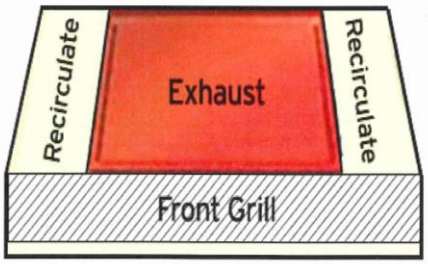
Is there an advantage with the type C1 cabinet in terms of the work zone exhaust airflow pattern?
The type C1 cabinet has a work zone exhaust airflow pattern that is different than a traditional type B1 cabinet. The type B1 cabinet exhausts the work zone airflow from the spilt line (middle of the work tray) to the rear. The type C1 cabinet exhausts the work zone airflow from the center of the depressed work tray/grill area by the use of an additional plenum under the work surface. Both cabinets require specific use work instructions to describe the exhausting vs. recirculation portions of the work zone airflow. However even with specific use work instructions for either the type B1 or the type C1 cabinet, dynamic movements of the user will cause overlaps in the exhausted vs. recirculated portions of the work zone. It is inevitable that some amount volatile materials will be recirculated. If no recirculation is desired, then using a type B2 cabinet is the only choice. *From a cabinet usage standpoint, Per the CDC-NIH BMBL 5th edition, appendix A, Primary Containment for Biohazards: Selection, Installation and Use of Biological Safety Cabinets. "It is always best practice to perform any aerosol generating (biological) or volatile generating (chemical) behind the front to rear split line in any cabinet".* In addition to work zone usage, clean ability of the type C1 cabinet at the grill areas and under the work tray is impacted with the additional plenum versus type A2, B1, B2 cabinets with one large pan and no obstacles or crevices that may harbor contaminates.



Type B1 Flat Work Surface



Type C1 Center Depressed Work Surface

Conclusion

The intent of this document is to clarify the recently introduced (type C1) of biosafety cabinet.
To summarize specific points from the discussion above:

1) The type C1 cabinet has been added to the NSF/ANSI 49-2016 cabinet definitions as well as all the other cabinet definitions have been updated to align with each other in terms of airflow function.

2) The airflow pattern of the cabinet is basically the same as a current type B1 exhausting approximately 60% and recirculating 40% of the work zone airflow. The differentiating design feature is an internal exhaust motor/blower that allows it to be room recirculated.

3) Due to recirculation of work zone airflow, a thorough a risk assessment process for both a type B1 and C1 must be performed followed by specific use work instructions to assure that users work in the exhausted portion of the work zone. The risk assessment for the type C1 must also consider the internal motor/blower exposure risk of volatiles (ignition) used and their worst case (spill) concentration levels within the exhaust airflow.

4) Use for replacement of a type B2 application is limited, just like a current type B1 due to the recirculation portion of the work zone airflow.

5) The depressed center work tray/grill area may be conducive when used as an exhausting cabinet, but limits full work tray usage when used as room recirculating. In addition, the grill area and additional plenum under the work surface impacts work zone clean ability.

6) The safety feature of "Active protection cycle", if is programmed to be used, causes the contaminated duct to become positively pressurized. To mitigate, NSF/ANSI 49-2016 requires both a risk assessment based on usage and that the duct system be sealed and tested as class A (a leakage of less than 3.0 CFM per 100 ft² of duct surface area at 1.0 inch w.g.) as described in HVAC air duct leakage test procedures-2012 (Sheet Metal and Air Conditioning Contractors National Association (SMACCNA).

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