



BSC MythBusters

Can overcrowding a BSC lead to a loss of protection?

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BSC MythBusters

There are a lot of rules, “guidelines”, rumors, and myths for using a biosafety cabinet.

Which are true?

Which are not?

WHY?

A recurring Baker webinar series that puts common BSC beliefs through controlled testing.

Biosafety cabinets (BSCs)

A ventilated enclosure for work with biohazard agents assigned to biosafety levels 1 through 4.

All BSCs contain one or more HEPA filters and a motor/blower.

Provides three types of containment:

- Personnel protection
- Product protection
- Environmental protection



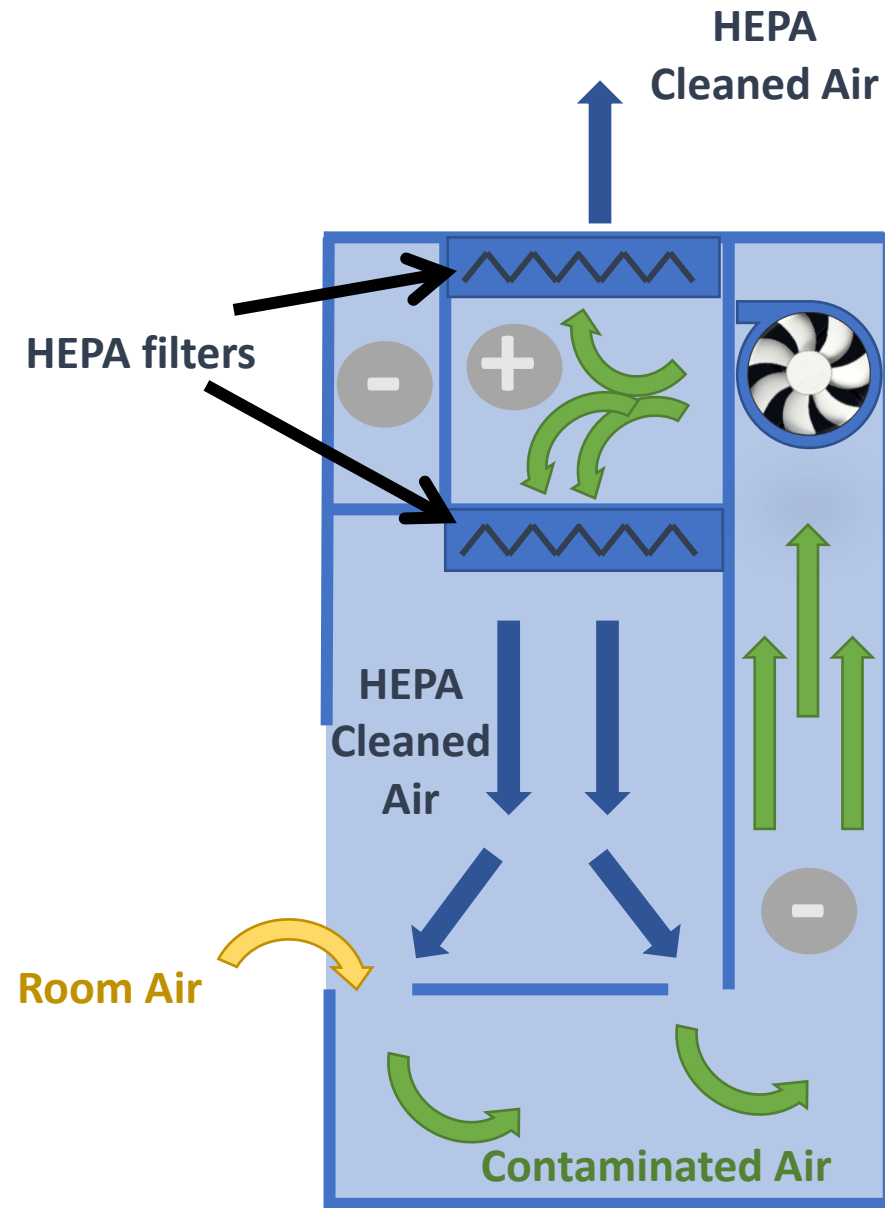
BMBL, 6th Edition, 2020

Class II Type A2 BSCs

Personnel, product and environmental protection from particulates and aerosols.

Minimum 100 fpm intake air.

Partial recirculation.



Normal BSC operation

- Strong front intake air
- Side suction slots
- Downward HEPA filtered air
- Smoke split to front and back
- Momentum Air Curtain
- ReadySAFE mode
- Partially recirculating air

Airflow demonstration video <https://youtu.be/H-qXtsMdEsE>

MYTH: Can overcrowding a BSC lead to a loss of protection?

Theoretical reasons FOR

- The airflow is blocked and the BSC stops “working”
- Motor/blower is not strong enough to overcome a full cabinet of restrictions

Theoretical reasons AGAINST

- Air can flow around objects
- The front grille is the most important. As long as that is open it is fine.
- Motor/blowers have reserve capacity to overcome obstacles.

How do you define “overloaded”?



But to be more specific

“Overloaded” means unable to meet the guidelines for BSC operation by NSF Standard 49 for performance due to object obstruction.

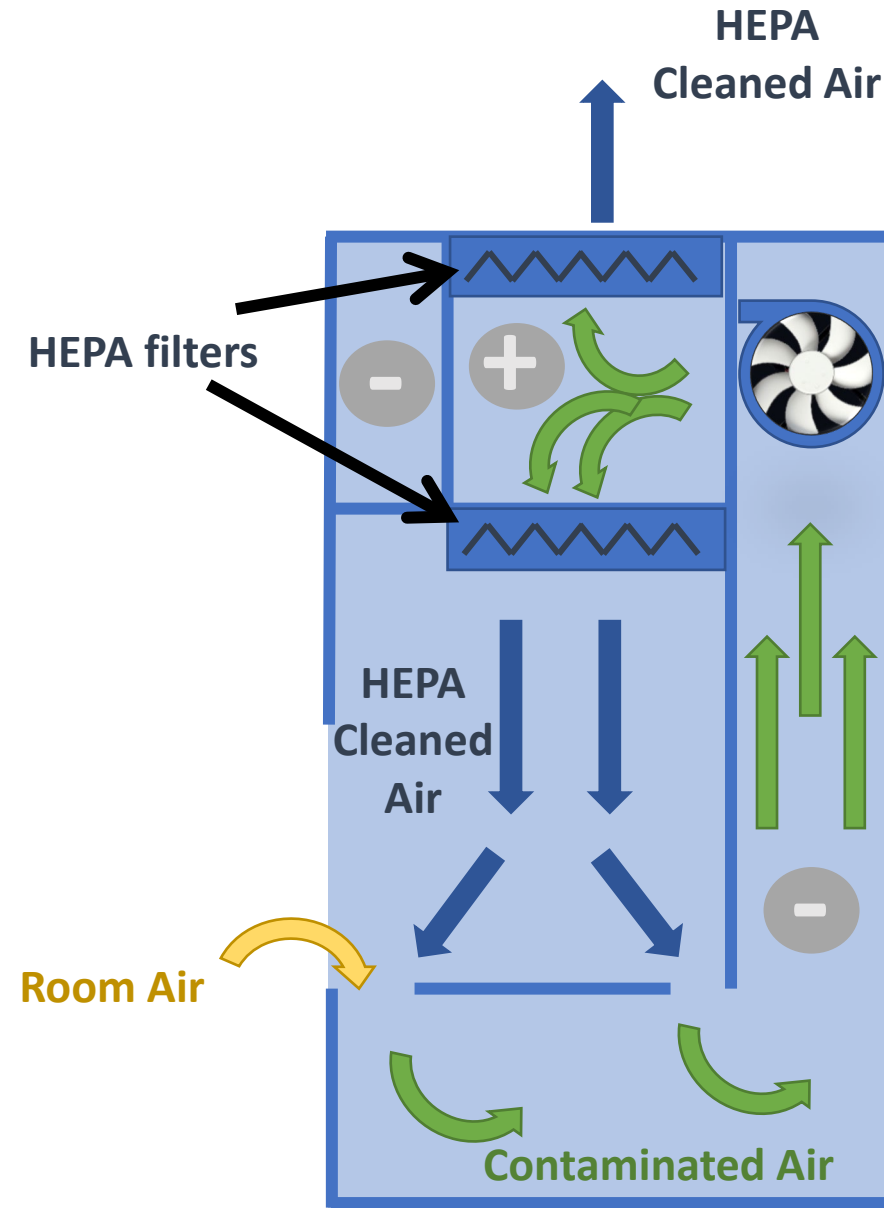
Air cleanliness and aerosol microbiological testing

In practice: containing more “stuff” than needed for the exact task at hand.

BSC airflows

BSCs are dependent on specific directional airflow to create containment of particles.

Obstacles in the way of airflow could disrupt the ability to maintain containment.



How do you define “overloaded”?



Air cleanliness

An easy way to assess whether containment has been lost is to see if room particles are making their way into the BSC work area.

The outside air should be “dirtier” than the BSC, so we can count how many particles enter by means of a particle counter.

Particle counting



Air cleanliness: ISO 14644-1 cleanroom standards

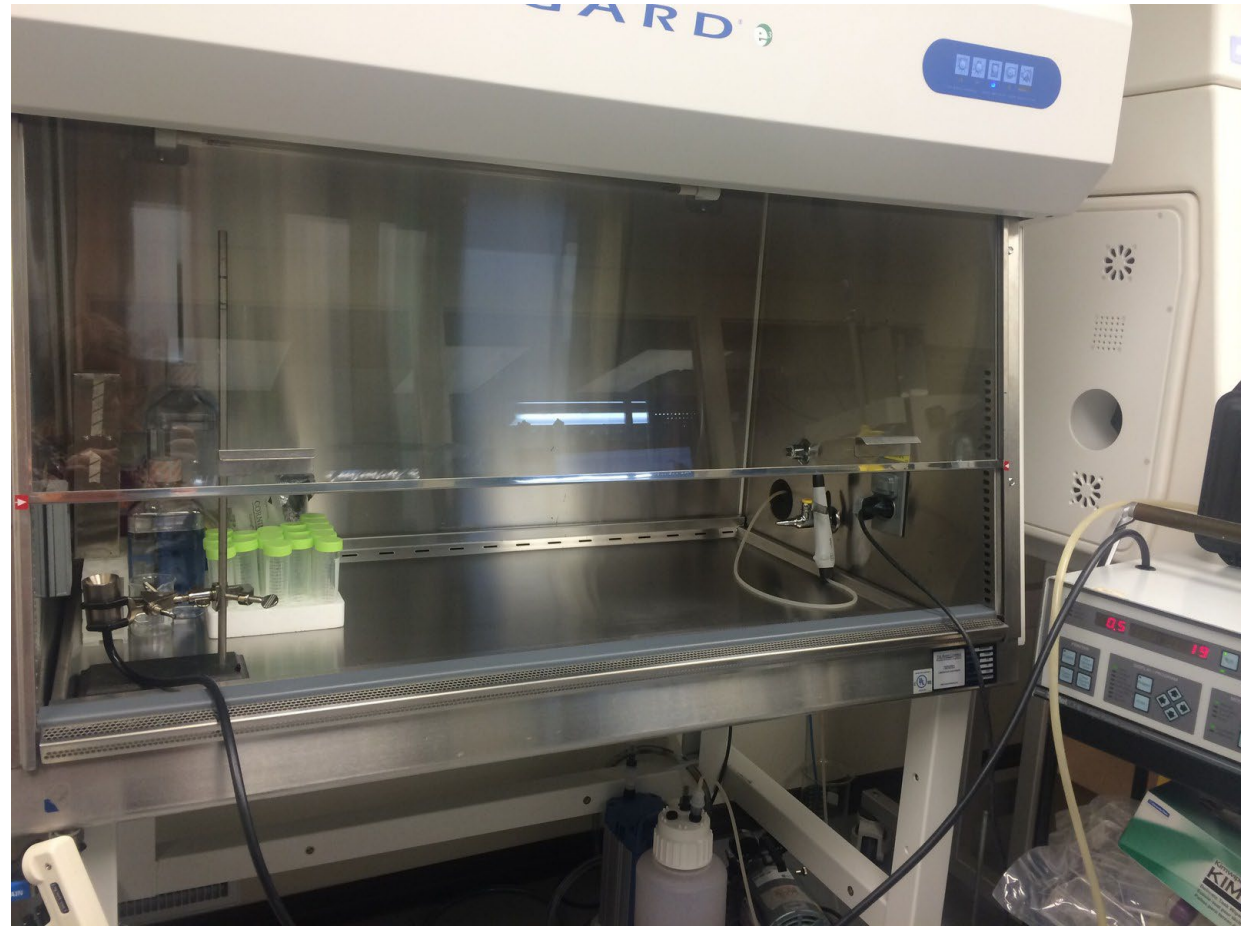
ISO 14644-1 Cleanroom Standards

Class	maximum particles/m ³						FED STD 209E equivalent
	≥0.1 μm	≥0.2 μm	≥0.3 μm	≥0.5 μm	≥1 μm	≥5 μm	
ISO 1	10	2.37	1.02	0.35	0.083	0.0029	
ISO 2	100	23.7	10.2	3.5	0.83	0.029	
ISO 3	1,000	237	102	35	8.3	0.29	Class 1
ISO 4	10,000	2,370	1,020	352	83	2.9	Class 10
ISO 5	100,000	23,700	10,200	3,520	832	29	Class 100
ISO 6	1.0×10 ⁶	237,000	102,000	35,200	8,320	293	Class 1,000
ISO 7	1.0×10 ⁷	2.37×10 ⁶	1,020,000	352,000	83,200	2,930	Class 10,000
ISO 8	1.0×10 ⁸	2.37×10 ⁷	1.02×10 ⁷	3,520,000	832,000	29,300	Class 100,000
ISO 9	1.0×10 ⁹	2.37×10 ⁸	1.02×10 ⁸	35,200,000	8,320,000	293,000	Room air

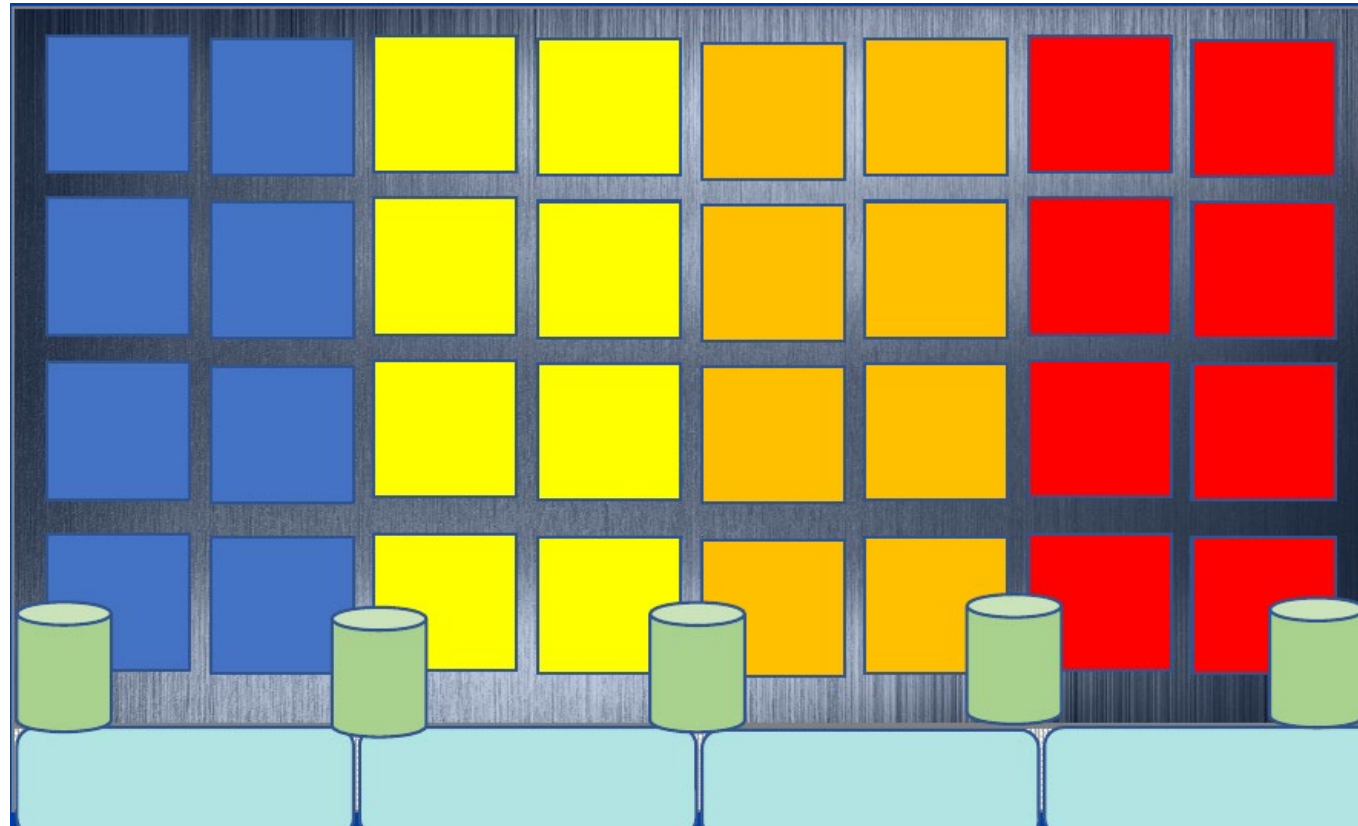
Experimental set up

Particle counter probe placed just inside the work area of a 4 ft Class II Type A2 BSC (SterilGARD) and 0.5 μm particles were recorded.

Challenges to the cabinet were added to test performance.

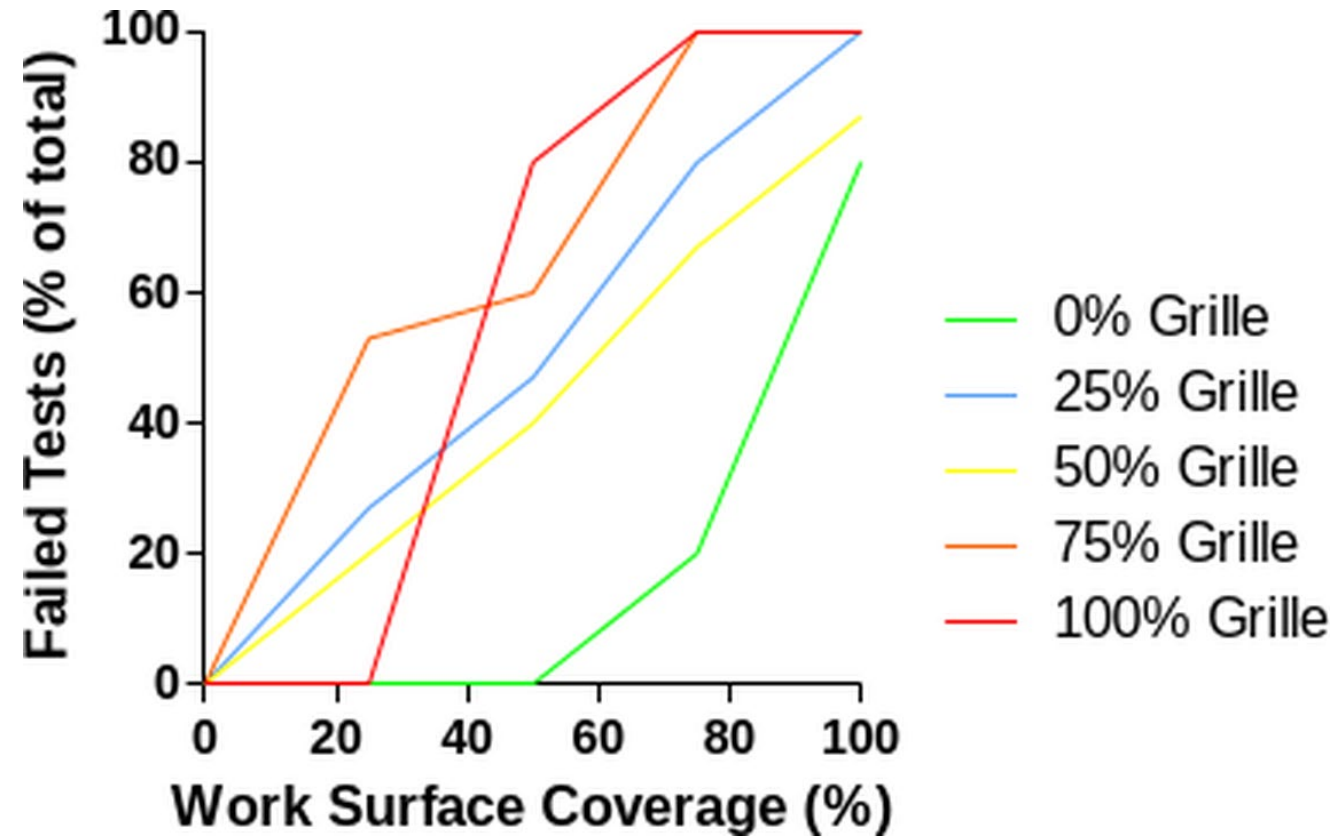


Experimental set up



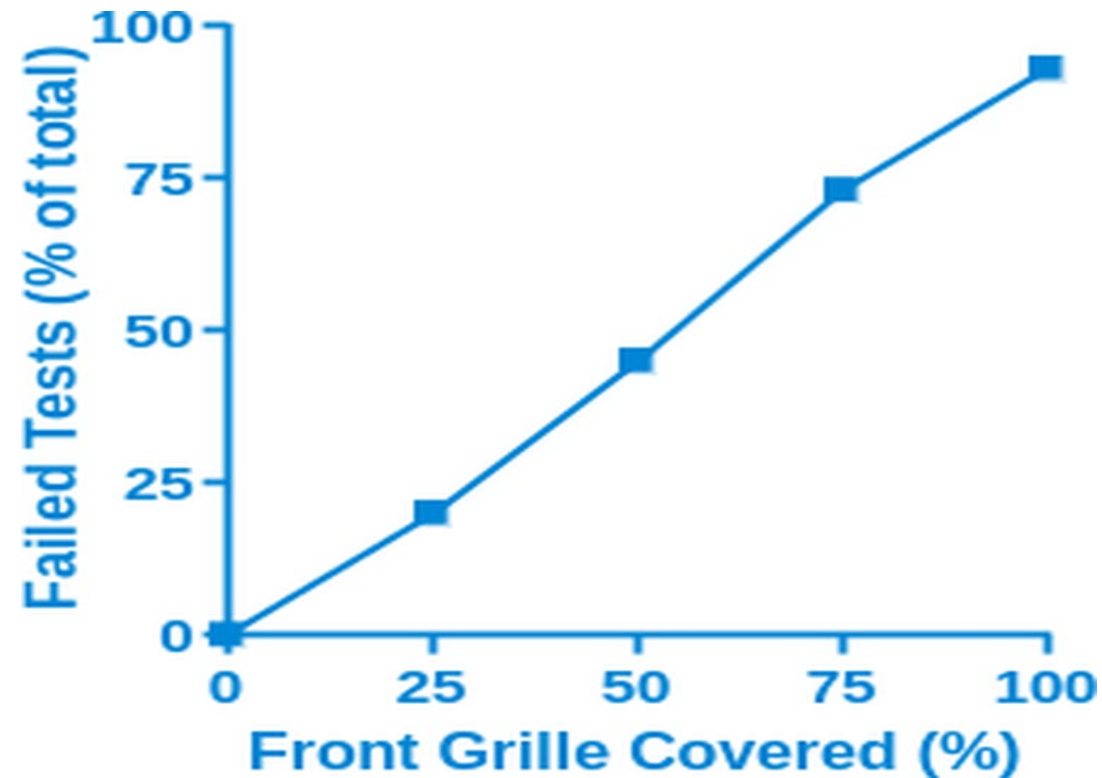
Progressively increase the quantity of objects within the workspace, as well as measure particles along the entire front opening.

Particle count results



Failed test = does not meet ISO Class 5 air cleanliness.

Breaking down the results: part 1

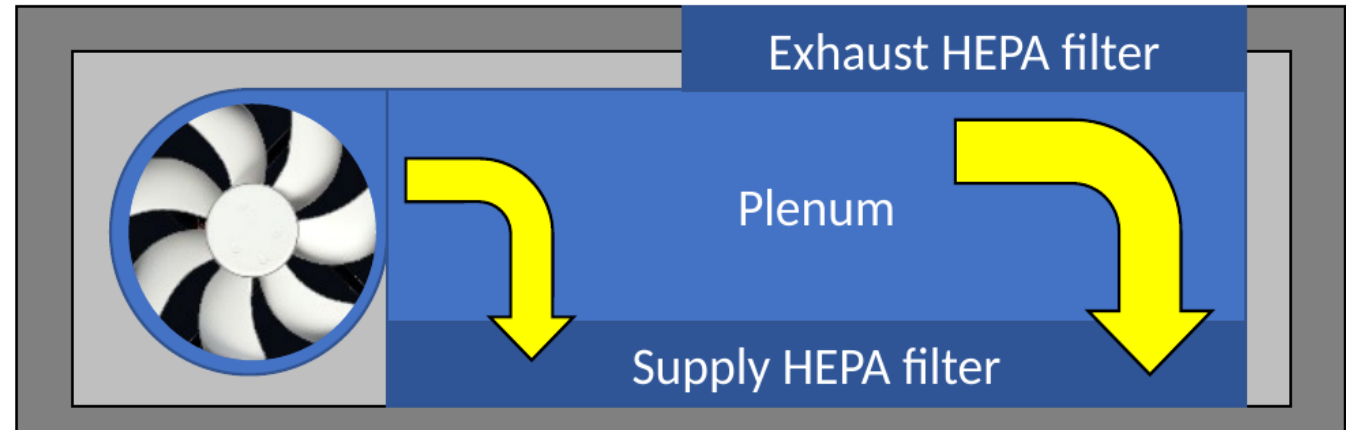


The more you cover the grille, the greater the chance it will not meet air cleanliness standards.

Breaking down the results: part 1

Slightly more tests passed on the right side of the cabinet work area than the left.

This is likely due to Baker's cabinet design.



Conclusions: part 1

- Covering the front grille will lead the BSC to fail ISO Class 5 standards.
- The BSC can handle up to 75% coverage, with no grille covering, before losing air cleanliness.

Experimental design: part 2

Aerosol microbiological tests

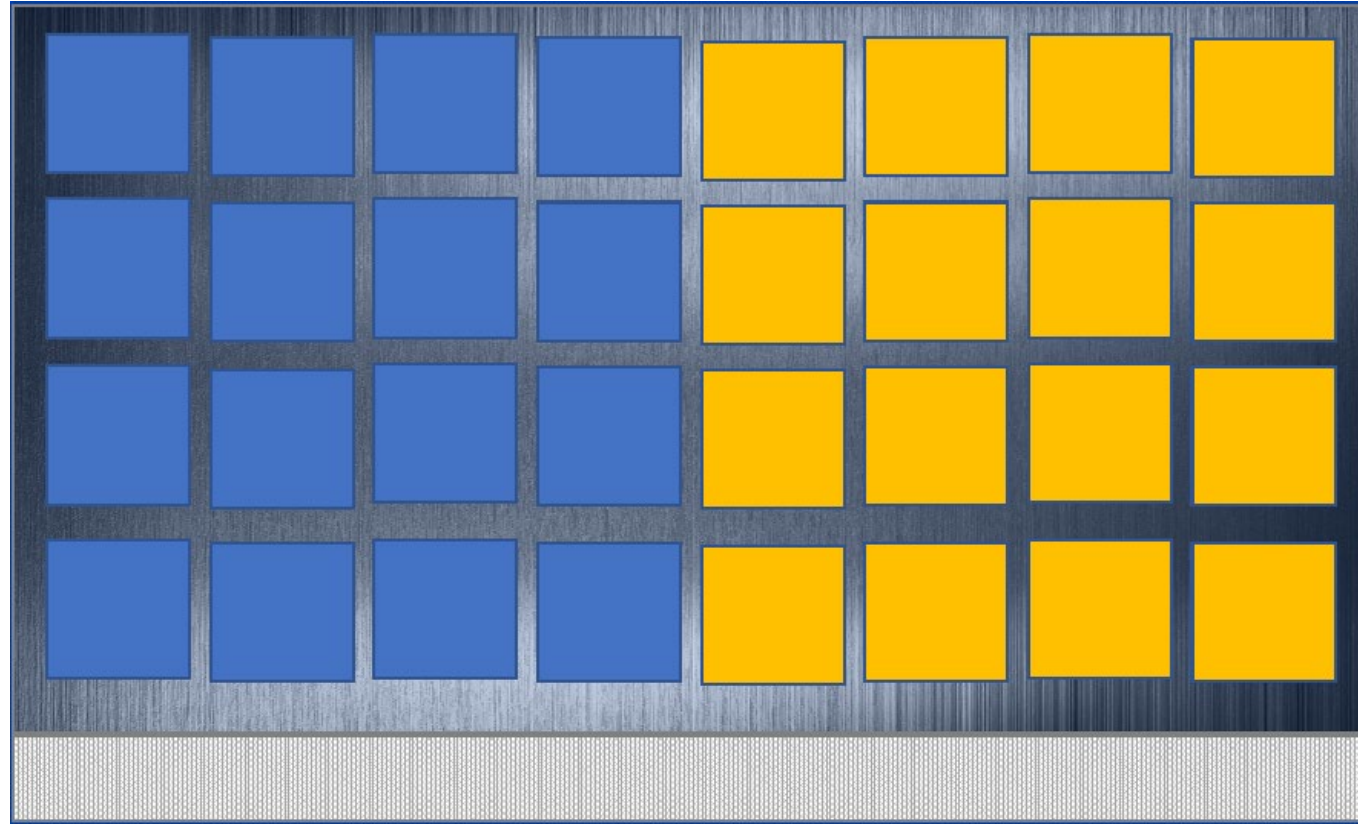


Product protection test



Personnel protection test

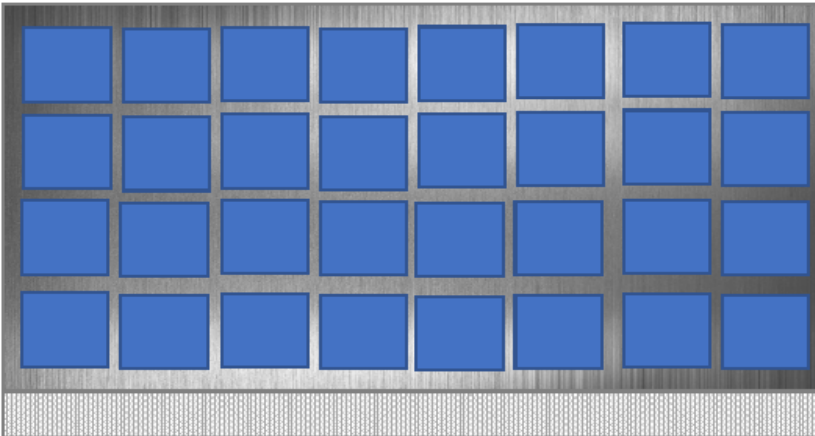
Experimental set up



Microbiological aerosol testing for product and personnel protection.

Microbiological test results

100% area coverage

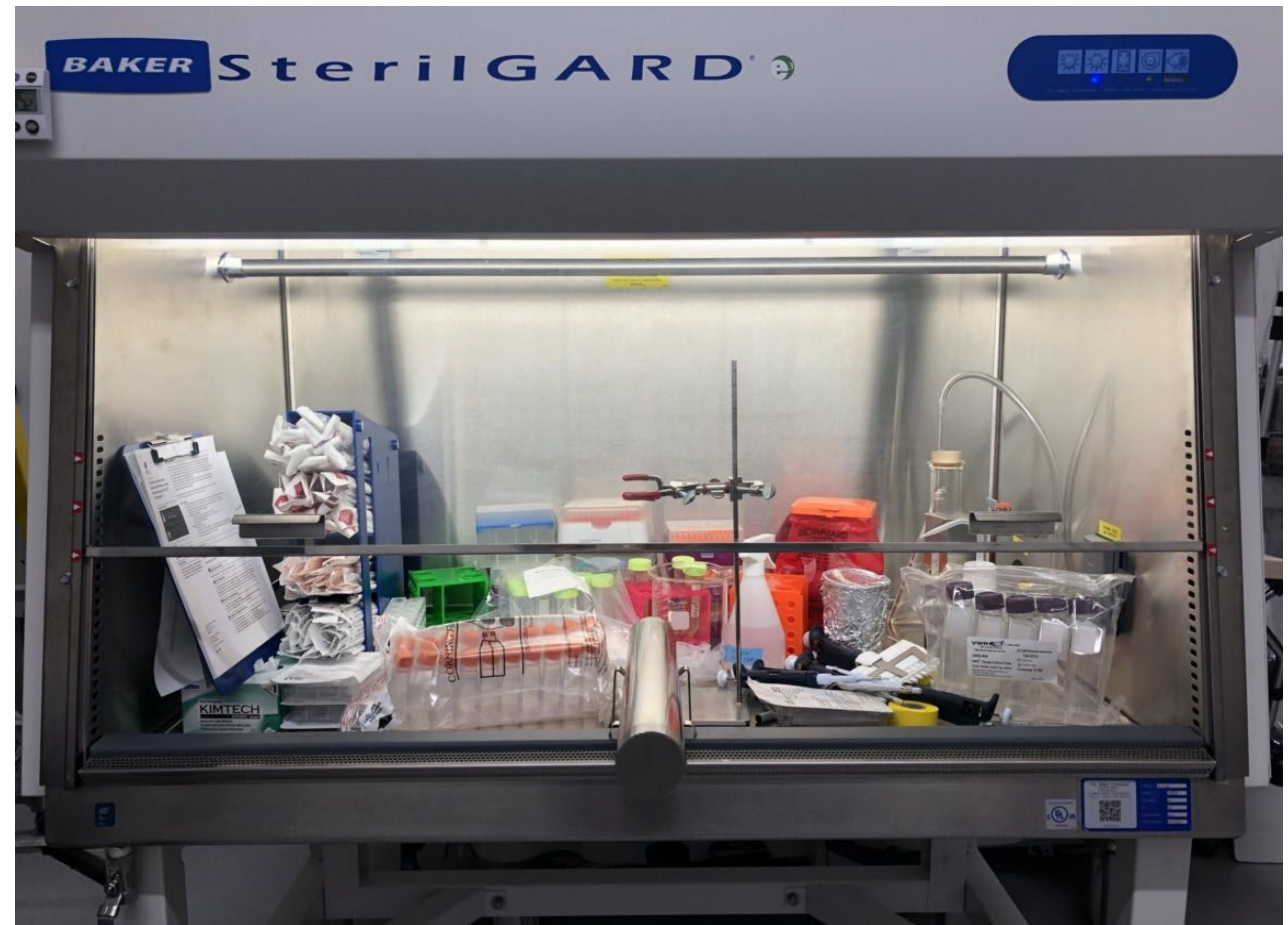


FAIL

Personnel protection test

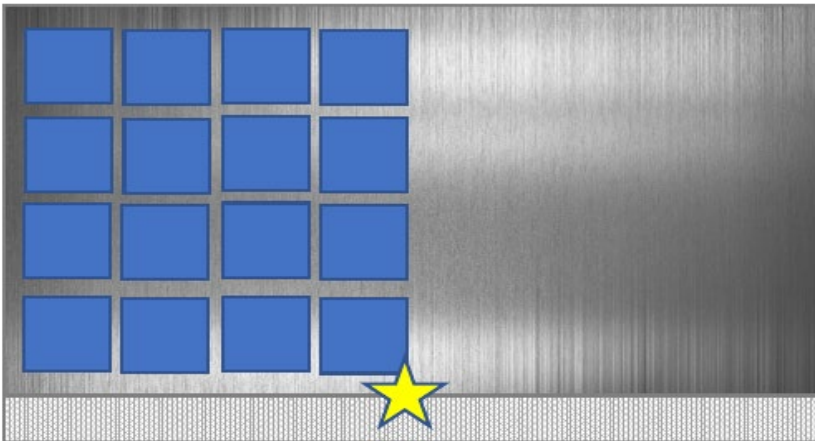
PASS

Product protection test



Microbiological test results

50% area coverage

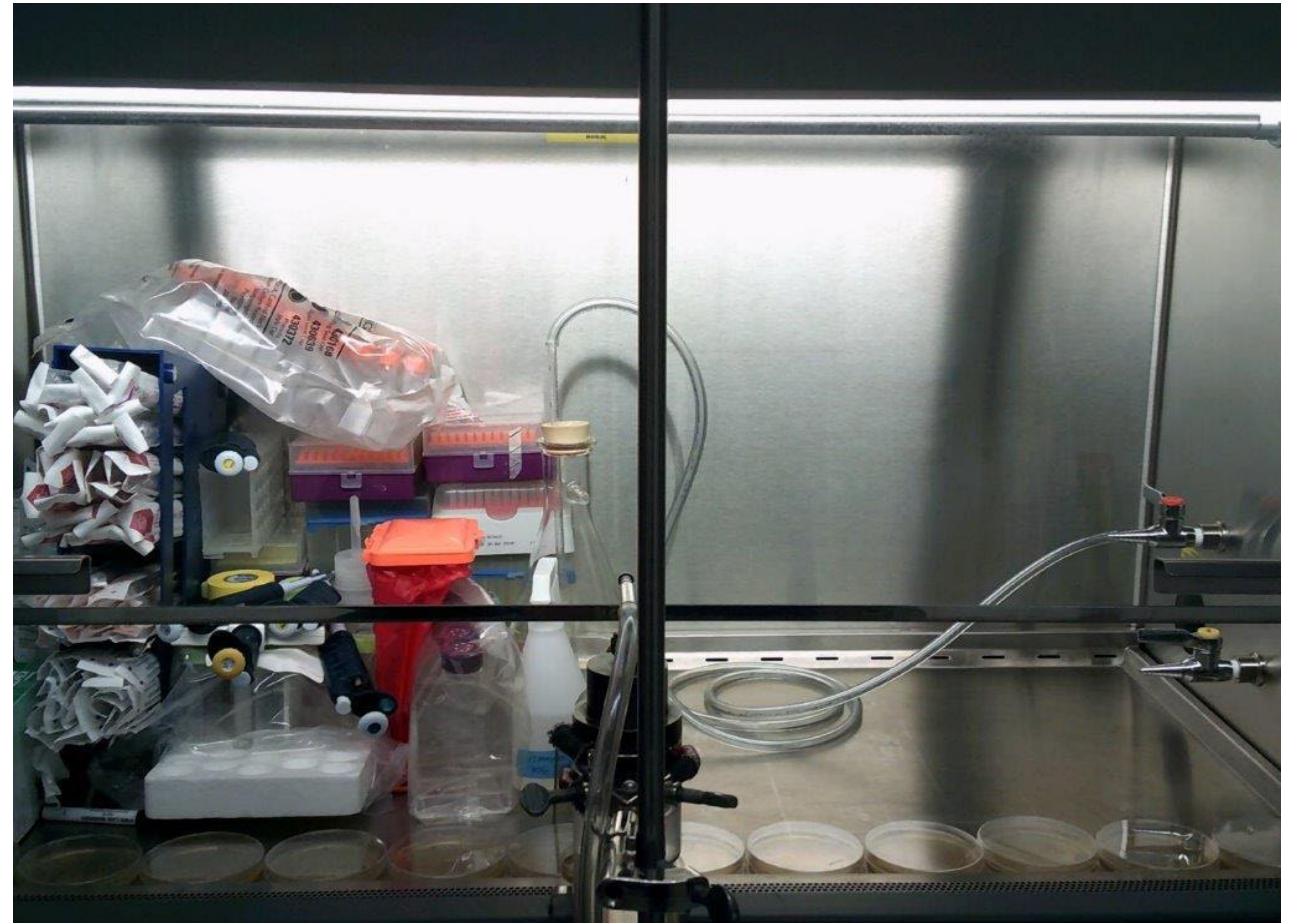


PASS

Personnel protection test

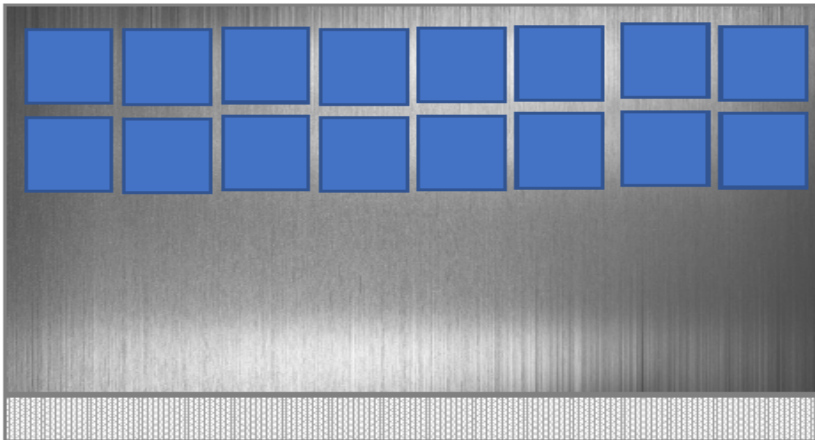
PASS

Product protection test



Microbiological test results

50% area coverage



PASS

Personnel protection test

PASS

Product protection test



Conclusions: part 2

- Filling the BSC with objects may lead to a loss of personnel protection.
- Microbiological testing corroborates air cleanliness testing that above 50% coverage is needed before ill effects are noticed.

Notes of importance

These are static tests conducted in a BSC in our factory “as manufactured” and not “in use”. In a real use situation there would be much more movement of arms in and out of the front access opening, as well as movement of objects within the cabinet. That kind of use is hard to model in a biotest and may only tell part of the story.

The biotesting was also conducted with the front access opening uncovered. Covering the grille would lead to immediate failures.

We do this testing all the time with large equipment

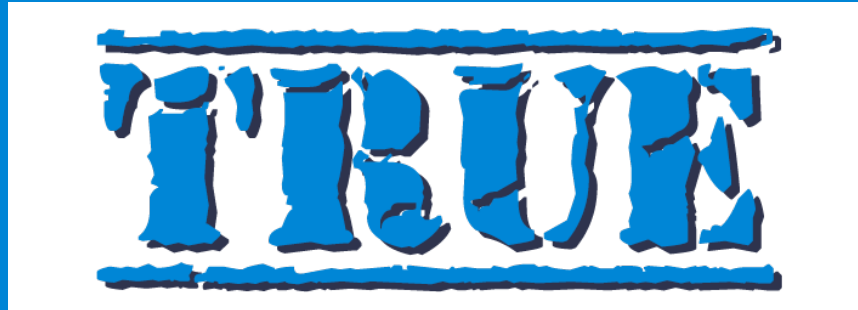
- Cell sorters
- 3D bioprinters
- Liquid handlers

They all pass if they are not too tall and are kept away from the front grille.



BSC MythBusters

Can overcrowding a BSC lead to a loss of protection?



A very full work area or a covered front grille will lead to a loss of protection.

Rule of thumb

Only have inside the BSC what you need for the procedure you are performing at that time.

BSCs are not storage cabinets.

BSC MythBusters: upcoming topics

- Can you use volatile chemicals in a Class II Type A2 recirculating BSC?
- Does heat really affect my protection?
- What disinfectants can I use in my BSC?
- Is a UV light effective?
- Can a HEPA capture DNA?
- Can two or more people work in a BSC at the same time?

Follow Baker on LinkedIn to keep up with all the new science!



Thank you

Questions, or want a 1-on-1 discussion on the points covered in this webinar?

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