Biological Safety Cabinet

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Part I. HEPA & ULPA Filters

Part II. Different Types of Cabinets

- Class I, Class II and Class III BSC
- Differences between A2 and B2 BSC
- International Standards

Part III. Biosafety Cabinet Certification

Part IV. Common user mistakes

HEPA & ULPA Filter

HEPA: High Efficiency Particulate Air
ULPA: Ultra Low Penetration Air

Important definitions:
- HEPA: 99.99% - at 0.3 microns

- ULPA: 99.999% - at 0.12 microns

The “classical” definition of **HEPA** filter is 99.97% at 0.3 microns, but nowadays all BSC and LF in US use 99.99% at 0.3 **µ**m

HEPA/ULPA Capability

Removes a broad range of airborne contaminants:

- Fine dust
- Smoke
- Bacteria (typical size: 500 to 0.3 micron)
- Soot
- Pollen
- Radioactive particles
- Impurity ion -> can affect Integrated Circuit speed

Types of Cabinets

- Biohazard Safety Cabinet (BSC)
- Laminar Flow Cabinet (LFC)
- Fume Hood

Laminar Flow Cabinets

- Product protection (no personnel protection)
- Not for biohazard agents or chemical fumes

Biosafety Cabinets

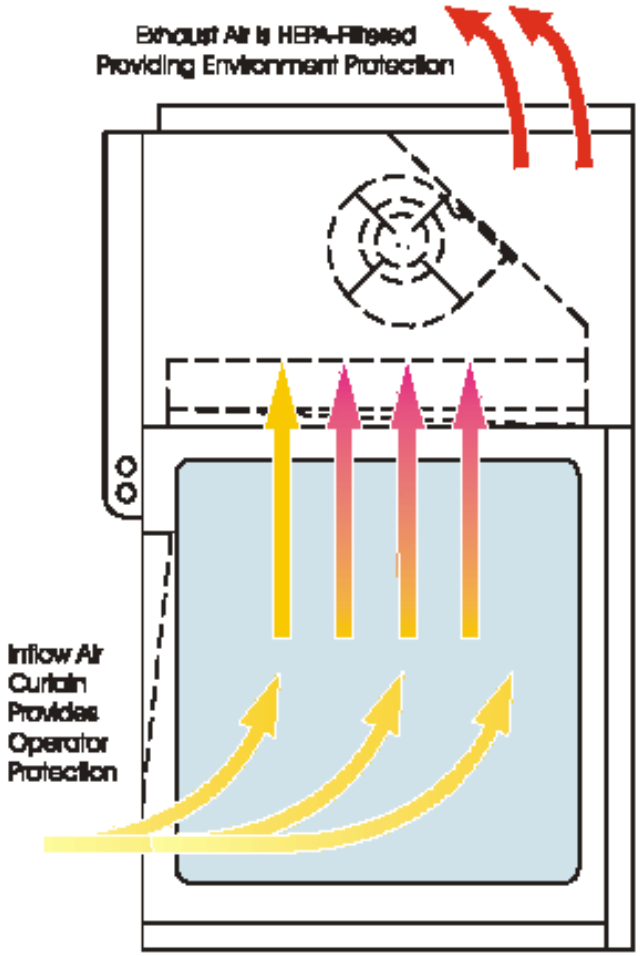
- Class I BSC: Personnel and Environment Protection
- Class II & III BSC: Personnel, Product and Environment Protection
- HEPA filters (not for chemical vapours)

Fume Hoods

- Removes toxic chemical (ducting sys./ductless)
- No HEPA filter -> not for biohazard agents

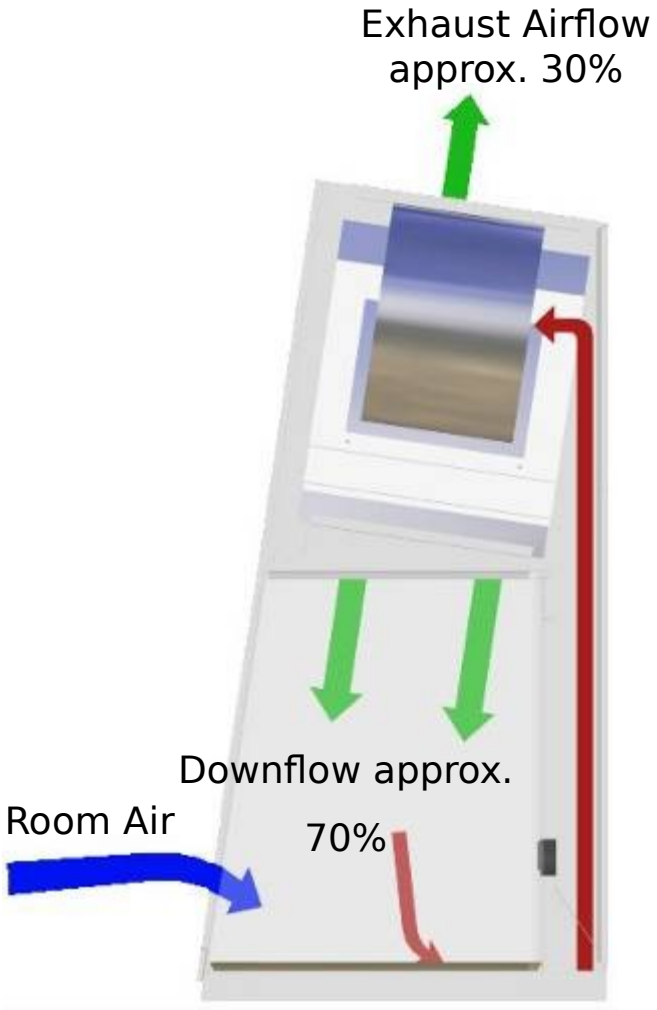
Class 1 BSC

- Only operator protection (not product)
- Biosafety level 1, 2, 3
- Inflow away from operator
- HEPA filtered exhaust to environment
- Current trend: to Class 2



Class 2 A2

- Recirculating cabinet airflow
- No chemical / toxic vapours containment without ducting
- Approx. 70% recirculating and 30% exhaust

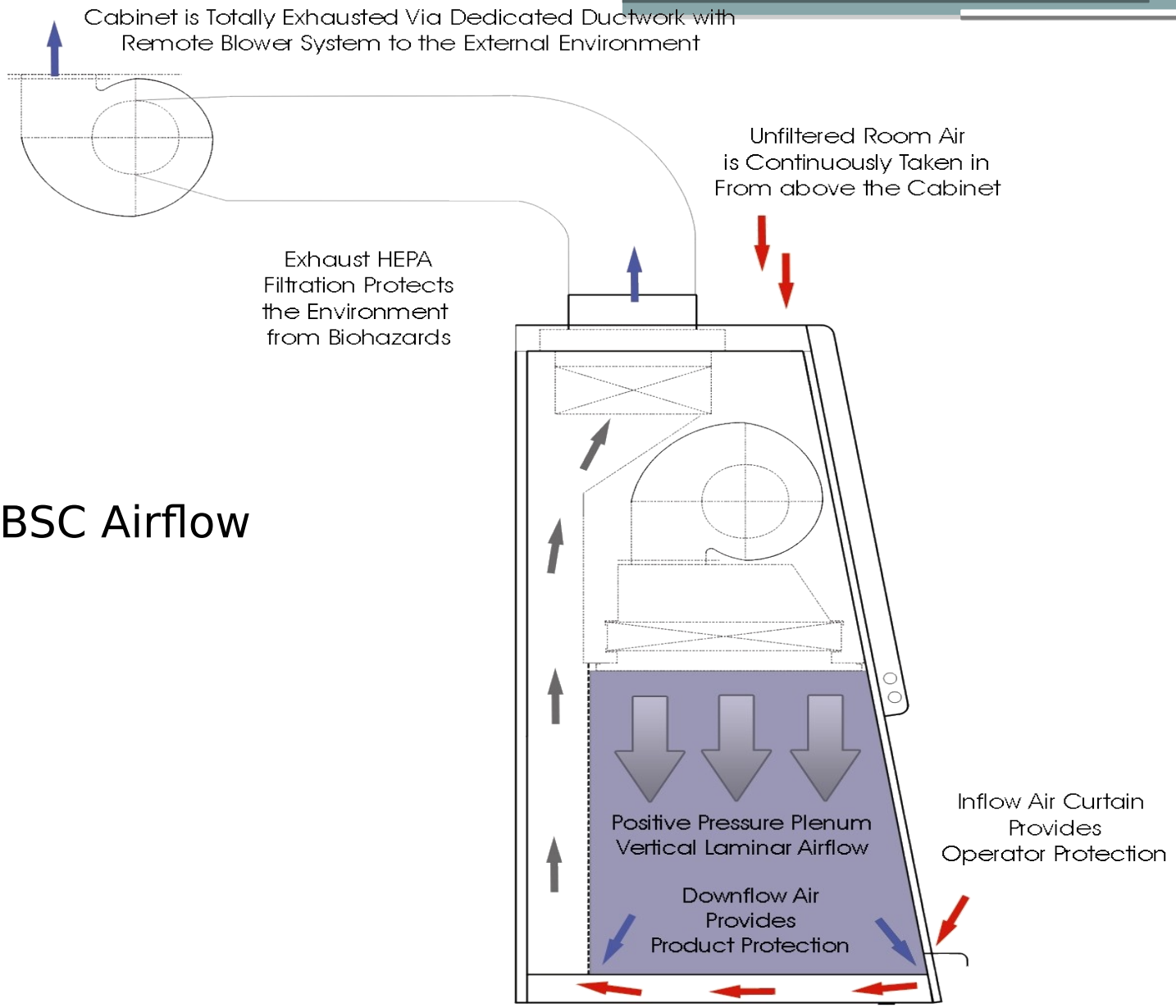


Class II Type A2 BSC: Ducting

Class II Type A2 can’t be used for chemical vapours. Chemical vapour buildup in cabinet & lab is dangerous. Class II Type A2 BSC can be ducted using a non-airtight (thimble) duct.

Thimble duct: have holes for room air
Bldg. exhaust fluctuations affect cabinet airflow

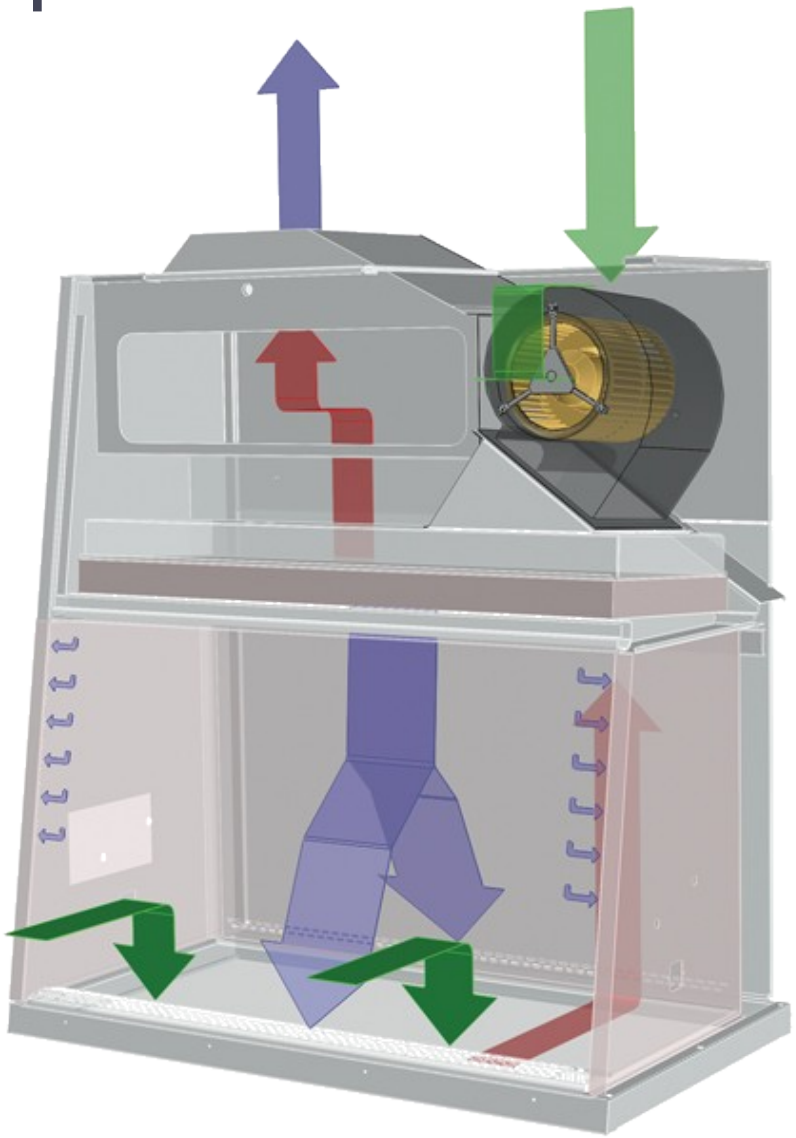
Class II B2 BSC Airflow



Class 2 Type B2

- **Total exhaust cabinet (no recirculation)**
- Both biological and chemical vapor containment
- Care with chemical: should not destroy filter
- **High exhaust air volume**
- Interlock system: if building exhaust fails
- Dedicated exhaust fan with dynamic balancing
- Exhaust fan -> precisely match the cabinet:
  - airflow volume
  - static pressure
- Inflow and downflow are opposite each other
- High level of expertise for install & maintenance

Class 2 Type B2 BSC: Airflow



Class 3 BSC

International Standards for Class II

- US Standard ANSI/NSF49
- European Standard EN12469
- Japanese Industrial Standard JIS K3800
- South African Standard SABS VC 8041:2001
- British Standard BS5726*
- German Standard DIN12950 Teil 10*
- French Standard NF X44-201:1984*

*now obsolete. Replaced with the harmonized EN12469

Testing List

No	Test	Field EN & NSF	Production Per EN	Production Per NSF	Type Per EN	Type Per NSF
1	Inflow velocity	√	√	√	√	√
2	Downflow velocity	√	√	√	√	√
3	HEPA / ULPA filter leak test	√	√	√	√	√
4	Smoke pattern / airflow visualization	√	√	√	√	√
5	Site installation assessment (ex: alarm)	√	√	√	√	√
6	Light intensity		√	√	√	√
7	Noise level		√	√	√	√
8	Vibration level		√	√	√	√
9	Electrical safety testing to IEC 61010		√	√	√	√
10	Pressure retention / soap bubble			√	√	√
11	Microbiological personnel protection				√	√
12	Microbiological product protection				√	√
13	Microbiological cross-contamination				√	√
14	Microbiological performance envelope					√
15	Motor / blower performance					√
16	Drain spillage trough leakage					√
17	Resistance to overturning					√
18	Resistance to distortion					√
19	Resistance to deflection					√
20	Resistance to tipping					√
21	Secondary inflow velocity correlation to DIM					√
22	Powder coating chemical resistance					√
23	Powder coating abrasive resistance					√
24	Cabinet design evaluation					√

Common User Mistakes

Common User Mistakes

- Confusing a vertical laminar flow cabinet for a Class II BSC
- Failure to identify the type of BSC needed for their operations
- Class II B2 cabinet not necessarily “safer” than a Class II A2 cabinet (A2 cabinets can also be ducted out when necessary)
- Inappropriate choice of installation site / cabinet location
- Inappropriate usage / maintenance of the BSC

Common User Mistakes: Illustration

Blocking of airflow perforations with objects

Proper Operation

- Slow deliberate movements that will not disrupt airflow, minimize arm movement
- When an alarm is activated, do NOT use the cabinet
- After usage, wipe down the cabinet with cleaning agents
- Work as far into the cabinet as possible
- Work starting from clean to “dirty” objects
- Do not block airflow perforations with objects/equipments

UV Lamps

- Germicidal UV lamps **are not substitutes** for proper cleaning of BSC workzone
- May cause **performance degradation**
- May compromise personnel safety when proper precautions are not taken

Bunsen Burners

- The use of Bunsen burners in LFC and BSC **is discouraged**
- Compromises cabinet's operator and cross-contamination protection when used

Filter damage due to bunsen burner usage within workzone

Thank You