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Common Laboratory Safety Engineering and Equipment Controls

Proper lab equipment is paramount to ensure scientist, environment and experiment protection when operating in a laboratory setting. Proper lab infrastructure requires engineering controls for scientists to safely conduct their work. The content of this article is meant as a high-level overview of the various engineering and equipment controls commonly present in laboratories. Additional information, including detailed descriptions, video tutorials and air flow schematics, can be found for specific equipment on the manufacturers websites.*

Figure 1. A Class II Biological Safety Cabinet

Biological Safety Cabinets (BSC)

- Class II Biological Safety cabinets are the most common BSC class found in BSL1 and BSL2 laboratories.
  - This class of BSC protects the person, product and the environment.
- Inward airflow protects the operator, HEPA-filtered particle-free air flowing protects the product, and clean air exhausts through a HEPA filter to protect the environment.
- BSCs are meant for the use of infectious agents and to maintain sterility to its contents.
- **Uses:** Cell culture, formulation, and performing in vitro assays, handling biohazardous materials.
- A simplified comparison of the various classes of biological safety cabinets includes:
  - Class I BSC – Protects operator and environment only
  - Class II BSC – Protects operator, environment, and product (this class includes Types A1, A2, B1, B2 & C1 BSC)
  - Class III BSC – Protects user, product, and environmental protection and used for specialized laboratory facilities dealing with deadly pathogens

Photos are shown for visualization purposes only and not meant as an endorsement of the product or manufacturer.

Figure 2. Chemical fume hoods (ducted) in a laboratory setting.

Fume Hoods

- Fume Hoods protect the person and the environment.
- There is no protection from air contaminants for the contents being manipulated within the fume hood.
- There is no HEPA filtration of the air exhausted from ducted fume hoods.
- Ductless fume hoods are less commonly found in chemistry labs as they recirculate the air flow through filters specific for carbon, ammonia and/or formaldehyde.
- **Uses:** chemical reactions, preparing hazardous drugs, chromatography using organic solvents and manipulating reagents with harmful or dangerous fumes.

Figure 3. A benchtop laminar flow hood

Laminar Flow Hoods

- Laminar flow hoods protect the product within the work surface.
- There is no protection to the user or the outside environment.
- Airflow pushes aerosols and particulates from the work surface towards the operator.
- Laminar flow hoods provide a sterile environment within the work area and should only be used for non-infectious agents.
- Vertical laminar flow hoods are more commonly used than horizontal laminar air flow hoods.
    - Air enters through a HEPA filter at the top of the cabinet and downward towards the work surface to create a sterile work environment.
- Both Biological Safety Cabinets and Laminar Flow Hoods both provide a clean, sterile work area.
- Laminar flow hoods are available as both floor and bench top configurations.
- **Uses:** Formulation, electronics assembly, contamination sensitive PCR.

Figure 4. Ventilated balance enclosure with top mounted HEPA air filtration

Ventilated Balance Enclosures (VBE)

- Ventilated balance enclosures used for weighing substances with turbulent-free airflow.
- VBEs protect the user from inhaling air particles associated with the compounds being weighed.
- VBEs include HEPA/Blower air filtration and circulate the internal air of the enclosure into the lab.
- VBEs can also be attached to a house exhaust system.
- **Uses:** Weighing potent compounds, active pharmaceutical ingredients (API) and compounding.

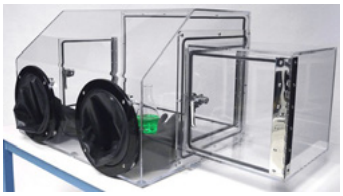

Figure 5. A two-glove nitrogen glove box

Glove Boxes

- Look very similar to VBEs and Class III BSCs however serve a very different function.
- Glove boxes provide a separate atmosphere (ex. nitrogen, argon) to manipulate materials.
- Sealed and can be used under positive or negative pressure.
- **Uses:** Protect chemicals or materials that are air or moisture (water) sensitive, moisture or air sensitive reactions.

While this list and its descriptions are by no means exhaustive, we wanted to help you differentiate engineering and safety control equipment by its function, usage, and utilization of air flow. There are also countless resources available on the web that will provide greater detail and recommendations. The end application of the equipment should be the primary discerner when evaluating the installation of any of the above equipment. A tabulated high-level summary of the content discussion is shown below.

Table 1. High Level Summary of Commonly Used Laboratory Engineering and Equipment Safety Controls

	Protects			
	Person	**Contents**	**Environment**	**Most Common Usage**
Class I BSC	x		x	BSL1
Class II BSC	x	x	x	BSL1/2
Class III BSC	x	x	x	BSL2+/3
Laminar Flow Hood		x		Clean Room, Assembly, Formulation, PCR
Fume Hood	x		x	Chemistry
VBE	x			Chemistry/Biology/Formulation
Glove Box	x	x	x	Chemistry/Formulation

Whether your lab requires a biological safety cabinet, chemical fume hood, or any other engineering and safety control equipment, it is important to manage and understand the essentials of proper lab infrastructure. Lab and facility planning teams are a key function of the real estate process for life science companies as they understand and capture these key functions prior to due diligence of prospective spaces.

Interested in learning more on how we can help? Send us a note:
Sharon Wilhelm
Lab and Facility Planner
sharon@t3advisors.com