

IBC Position on Bunsen Burner Use in Biosafety Cabinets

Background:

The Bunsen burner was once a part of every microbiology laboratory and is still widely used today. In the past, microbiologists had to rely on the use of open flames to ensure sterility while performing certain procedures. As modern technology has advanced with the introduction of biological safety cabinets and sterile disposable items, the need for an open flame has become virtually obsolete. The Center for Disease Control and Prevention (CDC) in the Biosafety in Microbiological and Biomedical Laboratories (BMBL) 5th edition states that “open-flames are not required in the near microbe-free environment of a biological safety cabinet” and “create turbulence which disrupts the pattern of air supplied to the work surface” jeopardizing the sterility of the work area and safety of the worker. In addition to the CDC, many institutions across the country, the major biosafety cabinet manufacturers and the World Health Organization (WHO) also strongly discourage the practice.

The use of Bunsen burners inside of a biological safety cabinet is not recommended because it:

- Disrupts airflow, compromising the protection of the worker and the product. The Class II BSC maintains product protection through delivery of laminar flow (air volumes traveling in a single direction at a constant speed – without turbulence) down over the work area of the cabinet. The heating of air from the Bunsen burner causes up-flow of air that mixes with the down flowing airstreams to produce turbulence and recirculation within the working area. The notion of laminar flow may be completely destroyed and any aerosols generated beneath the burner may be carried to other parts of the cabinet, jeopardizing the product and personnel working within the cabinet.
- Causes excessive heat build-up within the cabinet. As most Class II BSCs recirculate the majority of the air within the cabinet, heat from the Bunsen burner builds up over time. The excessive heat can inactivate and degrade components in media such as vitamins, amino acids and growth factors, possibly below the threshold for finicky cell lines. In addition, the excessive heat may make it an uncomfortable environment for the worker, leading to errors and mistakes.
- May damage the HEPA filter or melt the adhesive holding the filter together, compromising the cabinet’s integrity. An open flame has the capacity for melting the bonding agent that holds the HEPA filter media to its frame. This destroys the HEPA filters effectiveness, leading to loss of containment in the positive pressure plenum. Technical Safety Services (TSS) will charge \$181 for decontamination of the cabinet, \$250 for filter replacement labor, \$250-\$1000 for the filter, and \$130 for recertification each time the HEPA filter needs to be replaced.

Labconco Corporation image of a biosafety cabinet HEPA filter damaged from use of an open flame inside the cabinet.



- Presents a potential fire or explosion within the cabinet. The cabinets are not constructed to be explosion proof. If the flame was to go out, there was a leak, or the valve was not shut off completely, flammable gas would be introduced to the cabinet at a steady rate. In the case of a Class II A2, where 70% of the air in the BSC is recirculated, concentrations of the flammable gas could reach explosive potential and pose a serious risk to not only the cabinet, but to the user and the laboratory it is occupied in. Electrical components like the fan motor, lights, or electrical outlets could ignite a flash fire with a spark in this volatile environment. Manufacturers often post their cabinets with warning labels stating that flammable materials should not be used in the cabinet.



BSC fire. Source: Stanford University, *Use of open flames in Cabinets/Tissue Culture Hoods* (May 29, 2003).

- Inactivates manufacturer's warranties on the cabinet. Biological safety cabinet manufactures are opposed to the practice and will assume no liability in the event of fire, explosion or worker exposure due to the use of a flammable gas in their cabinet.
- Automatically voids UL approval. Underwriters Laboratories Inc. (UL) is an OSHA approved independent product safety certification organization that develops standards and test procedures for products, materials, components, assemblies, tools and equipment, chiefly dealing with product safety. The use of a Bunsen burner in the cabinet will void UL approval of that piece of equipment.
- Requires hook-up of central gas source. Some laboratories may not be fitted with gas lines and will require costly room renovations for retrofitting. Facilities will also need to install plumbing from the house lines to the cabinet. If the cabinet needs to be moved, this will incur additional costs from Facilities. In addition, gas connectors are generally not supplied with new biosafety cabinets without customer insistence and at an additional cost.

Cited Quotes from Agencies and Manufacturers:

NIH/CDC: National Institutes of Health and the Centers for Disease Control and Prevention:
 "Open flames are not required in the near microbe-free environment of a biological safety cabinet. On an open bench, flaming the neck of a culture vessel will create an upward air current which prevents microorganisms from falling into the tube or flask. An open flame in a BSC, however, creates turbulence which disrupts the pattern of HEPA-filtered air supplied to the work surface."

WHO: World Health Organization's Laboratory Biosafety Manual:
 Open flames should be avoided in the near microbe-free environment created inside the BSC. They disrupt the airflow patterns and can be dangerous when volatile, flammable substances are also used. To sterilize bacteriological loops, micro-burners or electric "furnaces" are available and are preferable to open flames.

Public Health Agency of Canada; The Laboratory Biosafety Guidelines:
 The provision of natural gas to BSC's is not recommended. Open flames in the BSC create turbulence, disrupt airflow patterns and can damage the HEPA filter. When suitable alternatives (e.g., disposable sterile loops, micro-incinerators) are not possible, touch-plate micro-burners that have a pilot light to provide a flame on demand may be used.

NSF/ANSI Standard 49 – 2009 published by NSF International, Annex G; Section G.3.3.1:
 Service valves allow inert gases, air, or vacuum lines to be plumbed into the BSC. Although many users connect gas to a service valve in the cabinet, this practice should be avoided because open flames in a Class II BSC disrupts the airflow, and there is the possibility of a buildup of flammable gas in BSC's that recirculate their air.

The Baker Company (BSC manufacturer):

The Baker Company does not endorse the use of flammable gasses within BSC's under any conditions. There are alternatives to open flames such as small electrical incinerators, use of disposables, and proper aseptic technique.

NuAire (BSC manufacturer):

NuAire doesn't recommend the use of natural gas within the BSC and assumes no liability for its use. **USE AT YOUR OWN RISK.** The Bunsen burner flame within the BSC not only contributes to heat build-up; it also disrupts the laminar air stream, which must be maintained for maximum efficiency. If the procedure demands use of a flame, a Bunsen burner with on demand ignition is strongly recommended. Do not use constant flame gas burners. During use, the Bunsen burner should be placed to the rear of the workspace where the resulting air turbulence will have a minimal effect.

Recommendations:

- Use disposable sterile loops and lab supplies.
- Autoclave utensils and equipment.
- Replace Bunsen burners with electrical incinerators for sterilization.
- If a flame is absolutely necessary, use a touch-plate microburner to provide flame on demand.

Alternatives to Continuous Flame Bunsen Burners:



Safety Lab Gas Burner

Safety enhanced laboratory gas burner with "Touch Free" IR-Sensor and button function. (Approx. cost \$532)



Bacti-cinerator

Utilizes infrared heat to incinerate organic material deep within the ceramic funnel. (Approx. cost \$100 used \$350 new)



Touch-O-Matic Bunsen Burner

(Approx. cost \$85, free with EH&S trade-in program)



Glass Bead Sterilizer

The glass beads in the well are maintained at 250 °C for complete destruction of microorganisms and spores in just seconds. (Approx. cost \$388)



FLAMEBOY Portable flame sterilizer

(Approx. cost \$500)