

Ask the Experts:

Using Ergonomic and Workflow Analyses to Configure a Biosafety Cabinet



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When purchasing a new biosafety cabinet (BSC), how can you ensure that it meets your laboratory's needs? This includes being an adequate size and containing the appropriate features and items necessary for the laboratory work you plan to perform in it. Reviewing your laboratory processes and workflow before purchase can assist you in selecting the right size cabinet and any configurations that may be required for your workflow. Also, since individuals may be working at the BSC for several hours at a time, it is important to consider the BSC's size, probable equipment and materials set up, and how the cabinet can be used by many different individuals in a way that is comfortable and ergonomically appropriate for all of them. In this article, we will discuss how to conduct a workflow analysis to select and configure your new biosafety cabinet and some important ergonomic considerations for BSC use, work zone set-up, and available customization.

Biosafety Cabinet Workflow Analysis

Prior to conducting a workflow analysis to configure your new BSC, you should have completed a risk assessment that identifies the specific class and type of cabinet necessary to safely handle the biological materials that will be used in the laboratory. If you need assistance performing a risk assessment for your laboratory work, consider reviewing: [Biosafety Cabinet Selection in the Context of Risk Assessment](#). A BSC workflow analysis is an evaluation of work tasks and activities to identify aspects of the cabinet or setup that may need to change to improve both work efficiency and user comfort. BSCs come in several standard widths typically ranging from 3 feet to 6 feet and should be selected based on the laboratory's scientific and personnel needs in addition to available space. An easy way to determine what BSC width is suitable for your laboratory uses is to mark out that area on an open benchtop and do a dry run of the intended procedures with the needed equipment contained in that marked out space!

While conducting these practice experiments, it is important to consider all of the potential services, equipment, power, and BSC configuration needs to ensure an adequate biosafety cabinet is selected. If specific services (gases, air, vacuum lines) will be needed for the lab work, they should be considered before purchase, so they can be plumbed into the unit in advance.¹ Additionally, if other laboratory items need to be connected to equipment that must be contained inside of the BSC, port tubing and negative pressure passthroughs can also be included in the side wall(s) of the BSC before purchasing. These ports can assist in safely and securely making the connections while not disrupting the biocontainment functionality of the cabinet. When specific integral equipment must be present within the BSC work zone (such as IV bars or rods) based on the work being performed, ensure these pieces are provided or recommended by the manufacturer of the BSC as these items can potentially impact the airflow within the BSC.¹ Electrical outlets can be installed within the BSC, but their output may be limited based upon the electrical draw of the BSC itself. It is important to consider the amount of power that will be needed to support the scientific operations and equipment as well as the BSC.¹ If identified as necessary, UV lights can be used in BSCs for the laboratory's

process(es), but you should note that they are not recommended by NSF/ANSI 49-2022 to be installed in biosafety cabinets.¹ Finally, when performing this dry run, it should be assessed if the work is more comfortable or necessary to do while standing. Biosafety cabinets with base stands often come with the capability to be lifted to different heights.¹ The BSC height may be set once at installation, but it is possible to adjust potentially any time if the base stand is motorized and includes hydraulic lift. This height adjustment may be needed if the work in the BSC changes (e.g., from a seated to a standing procedure).

During this test period, if possible, you should have multiple individuals perform the mock lab work to consider the different heights and abilities of all of its users within your laboratory. If the work zone is found to be too crowded with the necessary processing equipment to safely work in, consider a larger BSC width, if possible. Alternatively, if the work zone is found to be too large and/or the individual using the BSC cannot reach all of the items that are needed for the scientific procedures, consider either a smaller BSC width or the addition of BSC accessories and ergonomic work aids that may improve access and comfort.

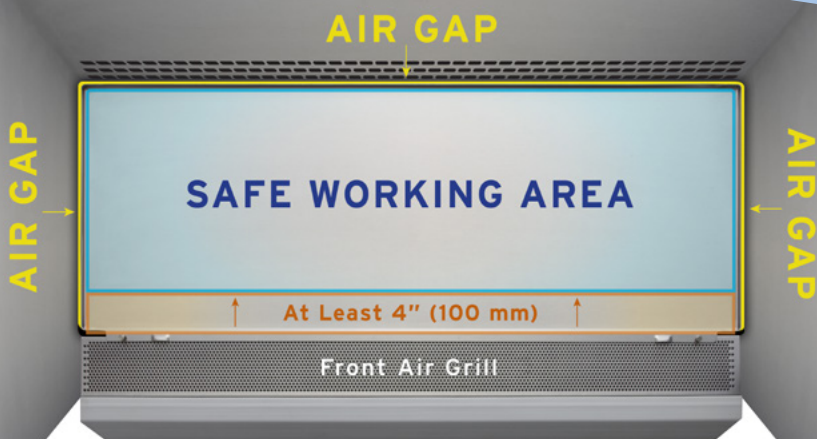
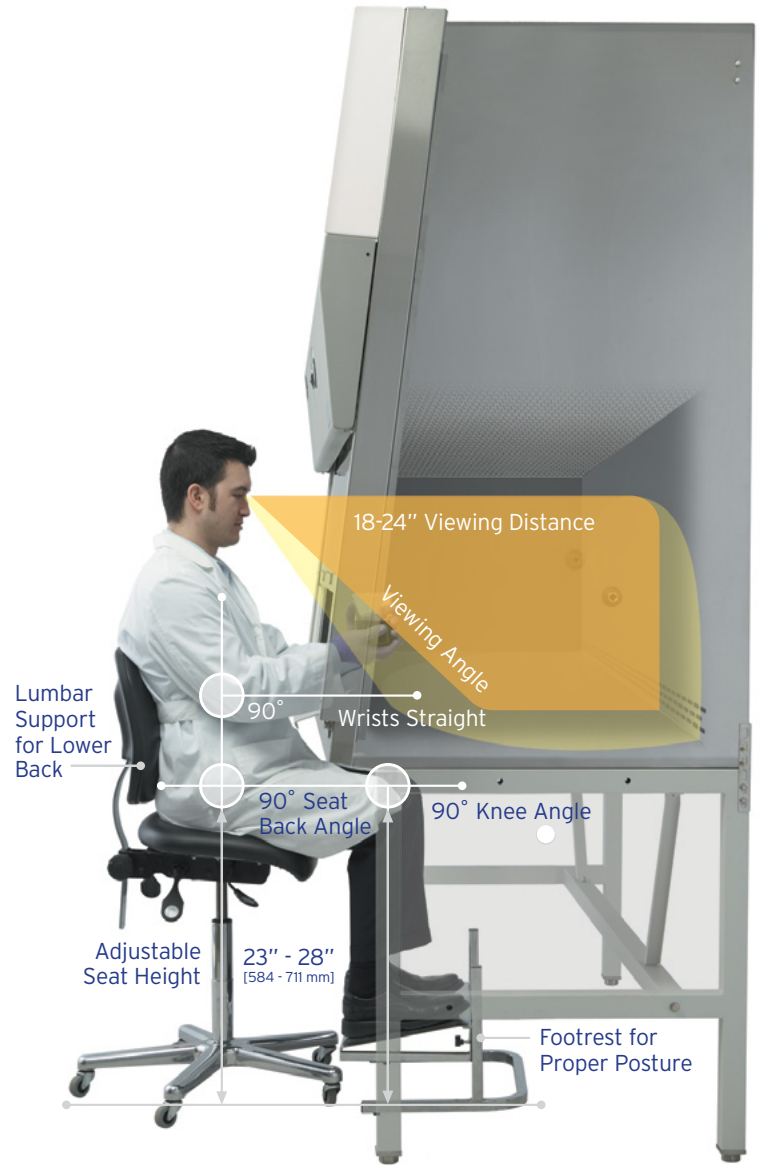


Class II Biosafety Cabinets are often available in several nominal widths; ensure you understand which size would be best for your specific workflow.

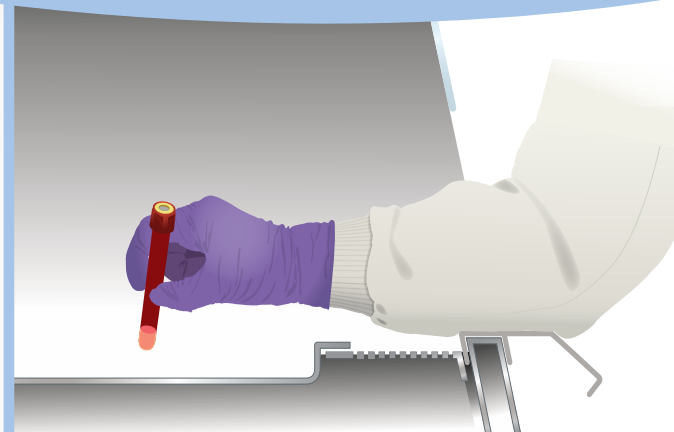
Biosafety Cabinet Ergonomic Considerations

Laboratory work conducted in BSCs can lead to stress, fatigue, and potentially ergonomic injuries of the arms, neck, shoulders, and back of individuals.^{1,3} Therefore, consideration of ergonomics and evaluation of how individuals conduct work in the BSC is critical for the health and safety of BSC users.¹ This evaluation should include review of the lab worker's posture while seated or standing at the BSC, the work zone set up and location of equipment inside the BSC, and the adequacy of lighting and angle of view of the BSC's entire work surface.¹ BSC users should also be encouraged to take breaks periodically during work to rest to avoid fatigue and ergonomic injuries.¹

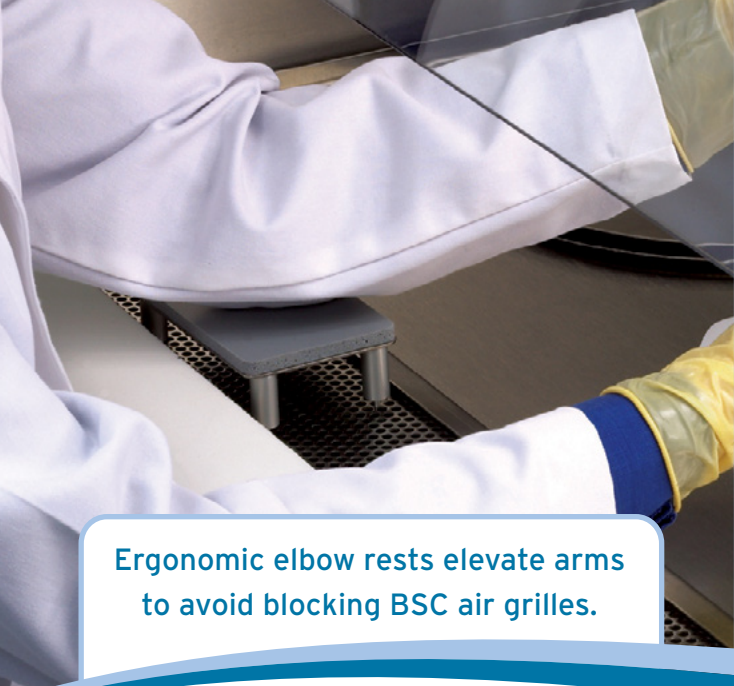
There are many recommendations for how to configure the BSC for optimal efficiency and comfort including the use of BSC accessories and ergonomic devices that can be purchased if identified as needed during this worker ergonomic assessment. When working at a BSC, individuals should ensure that their face is above the BSC's front sash, behind the glass panel.² This can be accomplished by setting an adequate BSC height for standing operations, or by adjusting their chair or stool height when seated, so their armpits are in line with the bottom of the BSC's front sash.³⁻⁶ When deciding on the chair or stool for use at the BSC, consider an adjustable chair with added back support and/or back and seat controls to support proper posture.^{1,3} Depending on the type of lab experiments being conducted, lab workers may spend hours sitting in this chair in front of the BSC; having a comfortable chair can be very important to their work. If a BSC user's feet cannot reach the floor when seated in their chair, or if the individual needs additional lumbar support, a footrest on the floor or added foot support on the chair should be used.^{1,3}



Always be mindful of the BSC air gaps while working.



Never cover the BSC's front air grille.



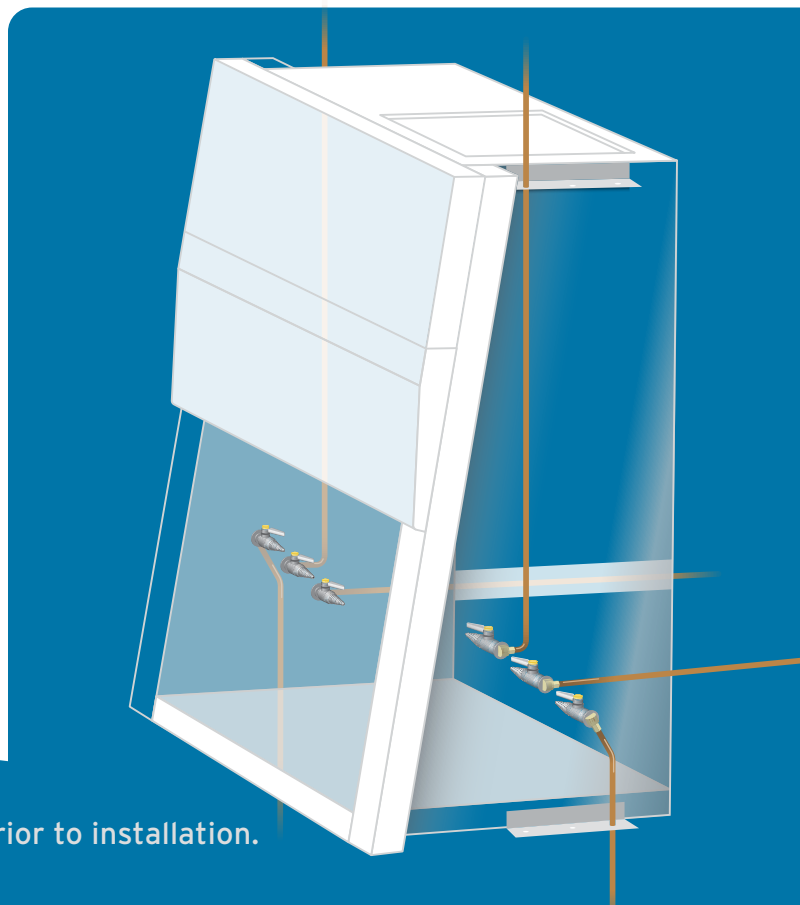
Ergonomic elbow rests elevate arms to avoid blocking BSC air grilles.

Rotating turntables can be used to increase reach and usable work surface area in the BSC.



When working inside the BSC arms should be bent at a 90-degree angle at the elbow to avoid arm and shoulder stress and injury.² This ergonomic arm placement may entice individuals to rest their forearms or elbows on the BSC's front grilles or the work zone, which can disrupt the airflow dynamics of the cabinet and should be avoided whenever possible.^{2,3,7} Some BSCs are designed with integrated ergonomic arm and elbow rests that allow the BSC user to maintain their arms in a comfortable position but also lift them above the front air grille enough to avoid blocking the grille opening and allow for proper BSC airflow.^{1,3} For BSCs that do not include these arm rests, they can often be purchased separately from the manufacturer and easily installed in the cabinet.² The biosafety cabinet should be certified with these supplemental devices in place to ensure that they do not impact the biocontainment of the BSC and its proper airflow patterns.² To avoid strain on the neck and shoulders, the BSC's work zone should be set up in a way that BSC users are able to reach all necessary equipment and supplies easily.¹ BSC appropriate rotating turntables can be placed on the work zone, while avoiding blocking the air grilles, to minimize the needed reach by BSC users.¹ These can be beneficial both for individuals with a shorter reach and for laboratory procedures where there are a lot of supplies that are needed regularly. Also, as you set up the BSC work zone, try to avoid conditions that cause glare or reflections on the BSC's front sash that may make it difficult to see the entire BSC work surface while you are working.¹ If needed, BSCs can be purchased with glass side walls and/or work surfaces that can be propped up to improve visibility of all areas of the BSC work zone.

During the BSC workflow analysis and/or ergonomics assessment, it can become clear that a standard BSC may not be appropriate for the proposed work. This could be due to the overall size needed for the workflow or equipment (especially larger, automated processes), incorporation of multiple ergonomic devices in the work zone, necessary external connections, electrical requirements, or added weight. For more information about designing custom BSCs and how they can be customized consider reviewing [Bespoke Biosafety: Building a Custom Biosafety Cabinet Around Your Laboratory Automation Equipment](#).



Consider whether you'll need plumbing in the BSC prior to installation.

Overall Conclusions

Conducting a workflow analysis is an important step in selecting an appropriately sized BSC for your scientific processes and the ergonomic needs of your laboratory's BSC users. You can do a dry run of these procedures on the benchtop to identify the necessary BSC width, plumbed services, location of equipment and supplies, and power supply needs. It is recommended to have multiple users do this evaluation to select the correctly configured BSC. You should also do an ergonomic assessment of those users' posture, their work zone set up and accessibility of equipment, and their field of vision of the BSC's work surface. The BSC should be set at an appropriate height for standing or an adjustable chair should be used that keeps the user's face above the BSC's front sash

opening. Consider ergonomic chairs with built-in foot support or adjustable footrests to support lab workers' posture and their backs. Accessories can be purchased that support workers' arms/elbows within the work zone that are raised as to not block the front air grilles and disrupt cabinet airflow. Additionally, rotating turntables can be utilized to increase the accessibility of supplies and equipment within the BSC, so long as they do not block any air grilles or impact the BSC's airflow patterns. BSC sizing, configuration, and ergonomic accessories are all very important aspects to consider when purchasing a new biosafety cabinet to support your BSC user's health and comfort while conducting their workflow.



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