THE BAKER COMPANY

Exhaust System Requirements for Class II, Type B2 (100% exhaust) Biological Safety Cabinets

Baker Models SG403TX and SG603TX

The total exhaust BSC requires a number of exhaust system provisions for proper long-term operation. Some of these provisions are unique to all BSC's and some are unique to the Type B2 cabinet.

Dedicated Exhaust System vs. Manifold:
A dedicated exhaust system for a single total exhaust cabinet or several total exhaust cabinets is usually the best choice. The nature of the material used in this type of cabinet often requires duct construction and exhaust effluent treatment not required by other types of exhaust equipment. The relatively high static pressure requirement of this type of cabinet compared to other types of exhaust equipment creates system balance problems, and higher energy consumption and noise when a manifold system is attempted.

Flow and Static Pressure Requirements:
The table below tabulates the flow and static pressure requirements for both models.

		Exhaust Flow Range (CFM)	Static Pressure (inches of water column)	
Model	Exhaust Collar Diameter		Total Resistance (Clean to 50% loaded)	Reference Pressure (new cabinet)
SG403TX	10"	750 to 800	1.4 to 1.8	1.0
SG403TX	12"	750 to 800	1.2 to 1.6	1.0
SG603TX	10"	1150 to 1200	2.0 to 2.5	1.0
SG603TX	12"	1150 to 1200	1.5 to 2.0	1.0

The exhaust flow range is relatively narrow in order for the cabinet to operate within the allowable air balance as specified by NSF Standard 49. The building exhaust system should have provisions to control the flow within this range.

The static pressure is listed for two places in the cabinet:
Total Resistance: The value is measured at the outlet collar of the cabinet and is the value used for system design. This value must be added to all the other pressure losses in the system when sizing the exhaust fan. The low value static pressure requirement is for a new cabinet with a clean filter. As the cabinet runs, the exhaust HEPA filter will load with particulate and the cabinet

resistance will increase. The high static pressure value is for a HEPA filter that has loaded 50% beyond its initial value.
Note: *There are other resistive elements in the cabinet so this high value is not 50% greater than the initial value.*

The building exhaust system must be designed to create the higher static pressure value at the collar. This assures that the system will be able to deliver the required flow when the exhaust HEPA becomes loaded. The exhaust system requires a means to throttle back to create the low pressure value at initial installation and to throttle up as the filter loads.
The control of the exhaust system may be achieved several ways such as:

- Placement of a constant flow valve in the exhaust duct
- A variable speed fan reacting to a flow measuring station in the duct
- Manual adjustment of a damper or fan speed.

The system flow will vary as a function of the filter-loading rate and the operational position on the fan curve, if there are no automatic controls installed in the system. Many systems have been installed without automatic controls where the flow stays within specification during the time interval between certifications - usually 6 months or 1 year.
Generally, if the system flow is set at the high end of the range and will not decrease beyond the low end of the range when subjected to a 0.1" w.c. increase in static pressure, then the system will stay in balance between certification intervals. During certification, the system flow control can be adjusted manually to compensate for filter loading.
The automatic systems can do this automatically but the controls must be sensitive enough to maintain the flow range and tuned properly to prevent hunting.

R**eference Pressure:** This value is for the plenum above the exhaust filter, but below the collar. This value is not the loss through the entire cabinet but the loss up to the plenum above the filter. This reference pressure value is listed since a more stable and easily accessed pressure can be measure here. The pressure at this position can be used as a reference during initial installation to determine if the proper flow is being achieved and as an indicator of filter loading at later certification times.

Testing and Decontamination:
Biological Safety Cabinets usually become contaminated with biohazards as a result of their use. Prior to certain maintenance and certification procedures the cabinet will need to be decontaminated to prevent risk to the test and service personnel. This is generally done by isolating the cabinet and introducing a decontaminating gas. A means of sealing the cabinet from the exhaust system is required. The Baker Company offers an airtight damper that can be placed in the exhaust duct above the cabinet for this purpose. The airtight damper adds approximately 0.1" w.c. resistance to the system.
During the decontamination procedure there is no air being exhausted from the room through the cabinet. The HVAC system design must have provisions to maintain proper lab ventilation and pressure during this procedure. The decontamination procedure purposely creates high concentrations of hazardous gas inside the cabinet and is thus a time of relatively high potential risk. During the decontamination procedure there may need to be:

- A bypass into the cabinet's exhaust duct
- An increase in general room exhaust
- A decrease in room supply or some other provisions.

Two key test procedures required during certification to assure the cabinet is operating properly are the HEPA filter leak test and airflow. Each require provisions in the exhaust system:

Exhaust filter scan: The exhaust transition on the cabinet has a removable panel that provides access for scanning the downstream face of the exhaust HEPA filter. This procedure requires an auxiliary blower to push the air through the filter since the exhaust system blower will not be able to pull the air through with the access panel removed.
Exhaust filter probe: The exhaust air stream may be probed, as an alternative to scanning the filter. This procedure requires a sealable port in the exhaust duct to insert the aerosol photometer probe.

Air flow: The exhaust duct must have provisions for measuring the airflow accurately. The 25th edition of the Industrial Ventilation Manual recommends measurements be taken at least 7 duct diameters after, and at least 1 duct diameter before any elbows, duct entries, or other major obstructions to straight line flow. Sealable penetrations should be provided for at least two axes at 90 degrees to each other at an acceptable location in the duct.

Alarms and Interlocks:
NSF Standard 49 requires manufactures to interlock the cabinet supply airflow blower such that it will shut off within 15 seconds of a 20% decrease in exhaust flow. A thermal anemometer probe positioned in the cabinet's exhaust plenum sensing flow, coupled to an electronic circuit, creates an audible and visual alarm, and interrupts power to the supply blower within 15 second of a 20% decrease in exhaust flow. To test the functionality of the alarm, the exhaust system must contain a means of reducing flow to the alarm level. This may be done with a variable speed fan or a damper in the duct system.
A visual caution light is displayed instantaneously at the 20% decrease. An unstable exhaust system may cause flickering of the caution light followed by intermittent cycling of the cabinet's supply fan along with audible and visual alarms. The interlock is provided as a safety measure against pressurizing the cabinet workspace and pushing contaminates into the lab. At no time should one attempt to defeat this interlock. If the exhaust system fails, the cabinet blower will shut down and the alarm system will activate.

Starting the System:
The Baker Company recommends that the exhaust system and the cabinet operate continuously. The cabinet air system is designed for continuous operation. Upon initiating the exhaust system flow make sure the cabinet sash is open and make sure the blower wheel is not rotating (by removing the prefilter over the cabinet blower). Turn on the cabinet blower once rated exhaust flow is established.
The cabinet blower cannot start, because of the interlock, until the exhaust flow is established. If the sash is closed air may be pulled through the cabinet blower by the exhaust system, often causing the blower wheel to spin backwards. In this condition, when the cabinet blower switch is turned on the blower will continue to run backwards and the blower will not deliver the proper flow in this condition. ***Always check to see that the cabinet blower wheel is stationary prior to switching the supply motor on.***