GREENHECK Industry White Papers
FROM THE INSIDE OUT
A technical educational paper for engineers and contractors in the air movement and control industry.

Damper Application Considerations for Laboratory Exhaust Systems

Most of the focus of a laboratory exhaust system is on the fans. Overlooking the construction, sizing, and control of the isolation and bypass dampers can result in operating difficulties and system failure. Understanding damper design and applications in laboratory exhaust systems is critical to the success of the design, installation and control of the laboratory exhaust system.

Many laboratory exhaust system suppliers recommend that the system dampers be fabricated of aluminum blades (these are typically commercial dampers). As you know, aluminum is not as structurally strong as steel. The dampers that should be specified and installed in critical, higher pressure laboratory systems should be specified of corrosion-resistant, formed airfoil steel blades that are welded, capable of withstanding the high differential pressures associated with an exhaust system. Following is an explanation with reference to the isolation and bypass air damper application.

Isolation Dampers

Referring to Figure 1, with Fan 1 running and Fan 2 on standby, exhausting laboratory effluent at (let's say) 8 in. wg, the differential pressure across Fan 2's closed isolation damper is 8 in. wg. Under a moderate to high differential pressure, a commercial aluminum damper will have blades deflect, deform, and bend, causing the damper to bind and not actuate properly (open, when needed).

Additionally, there will be considerable air leakage into the exhaust system across the closed damper, because the damper blade edges are pulled away from the jamb seals.

This also results in reducing exhaust system containment and causing Fan 2, the standby fan, to spin backwards.

With regard to isolation damper control, the standby fan should be started and the damper actuator energized simultaneously. Opening Fan 2's isolation damper, the standby fan, without energizing Fan 2 first, will reduce containment pressure in the exhaust system — ambient air will leak in through Fan 2 and cause Fan 2, the standby fan, to spin backwards. When Fan 2 is started (energized) in this

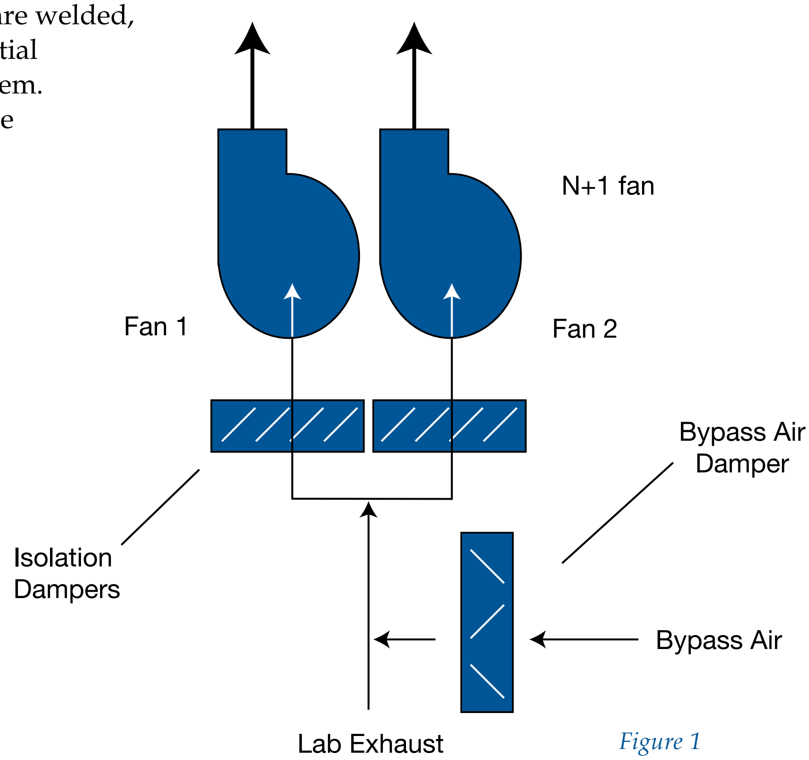

Figure 1

GREENHECK Building Value in Air.
P.O. Box 410 • Schofield, WI 54476 • 715.359.6171 • Fax 715.355.2399

back spin condition, it may cause the fan to run in the wrong direction, the motor starter to trip out or overload, or result in mechanical drive failure due to the sudden reversal shock of the drive system.

Another important consideration is to have the isolation dampers be corrosion-resistant coated, equal to the fan coating. An additional note about isolation damper actuator power — if the fans use soft starters or VFDs, the actuators cannot be powered off the motor power wiring. Separate power must be provided for the actuator(s).

Bypass Air Dampers

With regard to bypass damper sizing, it is imperative that the bypass dampers be uniquely sized for each application, based upon specific application requirements. (Bypass air cfm and fan static pressure). See Figure 1.

Bypass dampers have to be sized to bypass the required cfm equal to the laboratory exhaust flow turndown (the variable laboratory exhaust volume) at design static pressure. If the bypass damper is sized too large, there will not be good flow modulation control; too small and the damper will not bypass the required air for turndown. Additionally, since these dampers are sized for bypassing large volumes of air at a high differential pressure (system static pressure vs. ambient pressure; the differential across the bypass damper) the dampers typically have small face areas. The air velocities of bypass dampers therefore can be as high as 6,000-7,000 fpm — another reason NOT to use commercial aluminum blade dampers, as commercial dampers will vibrate and fail at these high velocities.

Finally, bypass damper control speeds are dependent on fume hood densities in an application. The fewer the number of fume hoods in a variable volume system, the faster the bypass damper needs to respond to the exhaust airflow volume changes.