Issue 46
Nov. 2015
Division of Technical Resources
Office of Research Facilities
National Institutes of Health
Technical News BULLETIN

Laboratory Exhaust Manifolds

Overview

When searching for ways to save on laboratory exhaust system construction cost and looking to save energy in the process, manifolding laboratory components is one strategy that should be considered. Connecting multiple fume hoods to a common exhaust duct, and having a centralized exhaust fan with an appropriately redundant fan, will contribute to cost and energy reduction goals. Careful selection of system components and controls as well as a close evaluation of the functions and operating conditions are essential.

Intended Benefits

When laboratory exhaust components are manifolded, there are multiple benefits in comparison to individually exhausted systems, including:

- Increased redundancy
- Greater personnel Safety
- Augmented exhaust fume dilution
- Better opportunity for flexible design changes
- Reduce equipment capacity of the exhaust system

On the energy side, other benefits include:

- Less number of fan installations
- Less energy needed to exhaust through the exhaust stack, as dilution may have occurred upstream of the exhaust fan
- Due to the manifolded equipment; larger airflow may potentially be used as a source for energy recovery
- Lower energy usage when variable air volume (VAV) hoods and variable speed drives are used due to smaller exhaust system

Evaluation of the Design Parameters

There are several factors that need to be evaluated when manifolding laboratory exhaust systems. In general, fume hood exhaust shall not be combined with general exhaust unless the exhaust streams are compatible. Under such conditions, the fume hoods and general exhaust may be combined only after penetrating the last fire partition on the floor or if the devices are served from the same laboratory unit. Due to the variety of work performed at each laboratory hood, establishing the type and quantity of chemicals and other toxic elements that require exhaust and dilution, can be extremely difficult. In a multiple manifolded hood system, one or more fume hoods may be operating at any given time. As a result, when using (VAV) hoods, the dilution may not occur as expected. The diversity factor for (VAV) hoods shall be based on the usage and should be evaluated with user and with approval of DOHS. The diversity factor shall not be less than 70%. The image in the Figure 1 shows multiple (VAV)

Figure 1: Manifold, Single Fan

fume hoods manifolded to a single header exhaust ductwork connected to a single exhaust fan also called a Weiber Manifold Fume Hood[1]. Although this arrangement can save energy, it does not provide redundancy due to the single fan operation as required by DRM.

Figure 2[2] shows similarly manifolded fume hoods operating as a constant volume system with two single-stage centrifugal fans manifold to a single stack. Although the DRM requires separate stacks, exception when fans are operating 50% capacity are permitted. Although there may be provisions for redundancy, there are no provisions for energy savings.

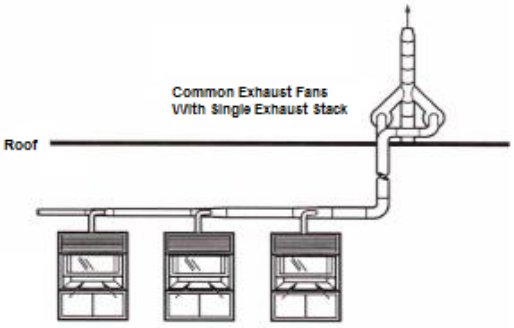

Figure 2: Manifold, Redundant Fans

The design of a stack with dual exhaust fans requires further performance evaluation, whether it is designed for one fan to operate a full capacity or both fans operating a partial capacity, allowing full redundancy.

In both cases, the airflow within the stack may not be stable, generating additional static pressure that will need to be evaluated in order to determine the additional energy required to maintain the minimum stack velocity, approximately 3,000 feet per minute. Depending on the system and requirements, an alternate option to the two single-stage centrifugal fans shown in Figure 2 is the use of high plume dilution fans as shown in Figure 3 that can provide a more compact and efficient system.

Figure 3: High Plume Dilution Fans

Conclusion

When laboratory exhaust system is required, coordination with the architect and the authority having jurisdiction is necessary to ensure that the latest codes and regulations are followed during the design.

Combining exhaust fans into one stack configuration will require close performance evaluation to ensure efficiency, safety and reliability. Regardless of the exhaust fan configuration selected, the roof area needs to be evaluated to allow for guy wires and accessibility for service.

Reference and Further Reading:

(1) http://www.cleanroom-equipments.com/dealer/Fume-Hood-Manifold-System.html
(2) Laboratories for the 21st Century: Best Practice Guide – Manifolding Laboratory Exhaust systems, April 2007, pp 4-6
(3) http://ateam.lbl.gov/Design-Guide/DGToc.htm
(4) Industrial Ventilation: A Manual of Recommended Practice, 22nd Edition, American Conference of Governmental Industrial Hygienists, Inc., 1995.
(5) ASHRAE Journal, (Vol. 47, No. 7, July 2005).