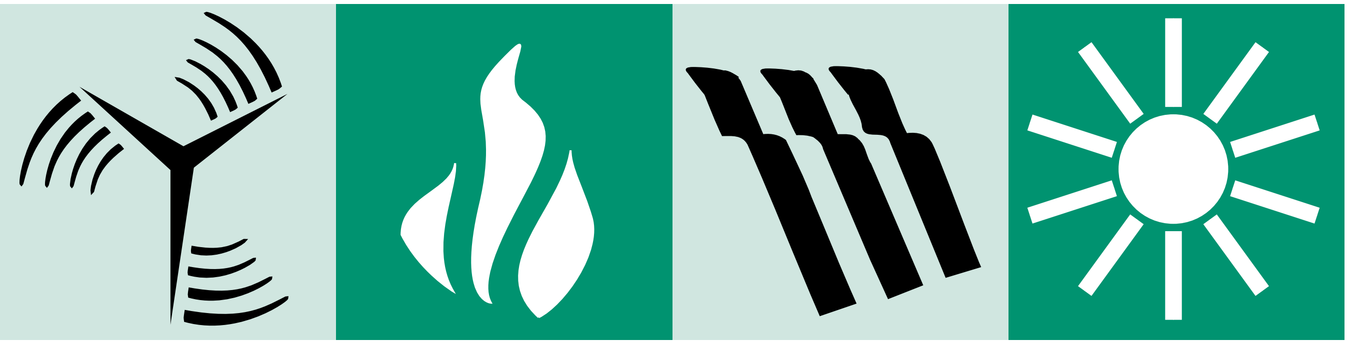

LABORATORIES FOR THE 21ST CENTURY: BEST PRACTICE GUIDE

MANIFOLDING LABORATORY EXHAUST SYSTEMS

Introduction: Why Manifold?

Manifolding laboratory exhaust in laboratory buildings provides substantial energy and first-cost savings opportunities when compared to separately ducted, multiple exhaust fans. A manifolded system also offers a number of benefits, including:

- Increased fume dilution
- Enhanced personnel safety
- Augmented redundancy
- Improved design flexibility
- Probable energy recovery

Experience has shown that during laboratory retrofit projects, manifolded exhaust systems reduce construction costs and help avoid operational disruptions.

This best practice guide is one in a series created by the Laboratories for the 21st Century ("Labs21") program, a joint program of the U.S. Environmental Protection Agency and U.S. Department of Energy. Geared towards architects, engineers, and facilities managers, these guides provide information about technologies and practices to use in the design, construction, and operation of safe, sustainable, high-performance laboratories.

Energy Efficiency and Manifolded Exhaust

A basic, manifolded exhaust system, with a primary fan and a backup unit in a common duct system, has higher energy efficiency than multiple, dedicated fans working independently. Manifolded exhaust systems save energy in four ways:

1. **Reduces fan power**, in part due to less pressure drop in duct work.
2. Provides an **adjustable airflow system** that can modulate energy needs in response to a varying requirement.
3. Requires **less energy to disperse exhaust plumes** due to increased dilution and momentum of effluent.
4. **Increases energy recovery** opportunities.

Even greater efficiency can be realized over a basic manifolded arrangement when advanced design practices are used, including variable air volume fume hoods, multiple fans, and variable speed drives, which will be covered later in this guide and in referenced case studies.

Fan Power Reduction

Manifolded exhaust systems reduce the number of fans and the ductwork needed when compared to individual fume hood exhaust systems. Therefore, less ener-

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gy is used to move the exhaust air, due to consolidation of numerous small fans into a larger and more efficient fan, and the reduction of ductwork pressure drop with larger dimension ductwork. See Labs21 Best Practice Guide, Low-Pressure-Drop HVAC Design for Laboratories.

Adjustable Airflow

A manifolded exhaust system can be designed to accommodate varying fume hood airflow. Since it is unlikely that all hoods will be fully operational at one time, the inherent flexibility of a manifolded exhaust system allows it to adjust its airflow rate accordingly to save energy. This concept, also known as "diversity," can also be applied to sizing the manifolded exhaust system, to reduce manifold size and initial costs. However, caution is advised when considering a diversity factor, since a variety of issues needs to be considered, including future laboratory "growth."

Exhaust Plume Dispersion

Manifolded exhaust systems have increased dilution, making exhaust streams less hazardous. In addition, combining numerous hood exhausts increases the momentum of this more dilute stream. Consequently, a manifolded exhaust stack disperses a less hazardous stream into a plume more effectively than a single-fan-per-hood arrangement. See Labs21 Best Practice Guide, Modeling Exhaust Dispersion.

Energy Recovery Opportunities

A manifolded exhaust system maximizes the opportunity to recover energy contained in the conditioned air stream that is being exhausted from the laboratories. There are numerous design and operational challenges with recovering this energy, including: device corrosion, added air- system pressure drops, increased maintenance costs, operational durability, and control complexity, to name a few. Still, depending on the lab's geographical location, exhaust-stream energy recovery, in the form of both heating and cooling energy, can be worth the design challenges and maintenance issues. See Labs21 Best Practice Guide, Energy Recovery for Ventilation Air in Laboratories.

Advantages of Manifolding Lab Exhaust

Fume Dilution

Increased internal dilution, with respect to the building's ductwork system, and enhanced external dilution, with respect to the building's envelope, are advantages of manifolded fume hood systems. A chemical spill or odor generated in one hood is diluted by the combined flow of all of the hoods, reducing concentration before reaching the exhaust fan outlet. Additionally, when multiple fume hood exhausts are mixed with general room exhaust, increased internal dilution of the exhaust stream is achieved. Combining contaminated exhaust air from each floor of a multistory building in a header duct serving multiple labs will increase dilution even further.

Personnel Safety

Safety of laboratory personnel can be increased when laboratory exhausts are manifolded. A manifolded design can readily include built-in fan redundancy. Fan redundancy can automatically provide backup to maintain exhaust flow. By eliminating multiple laboratory exhaust systems, maintenance personnel will spend less time on a lab's roof or in a mechanical space, thus minimizing exposure to hazardous chemicals from the serviced system and adjacent systems.

First-Cost Savings

Manifolded exhaust systems can be less costly than individual systems due to less material and installation labor. Fewer fan ducts, ceiling and roof penetrations, electrical connections, and exhaust terminals typically yield a smaller first-cost capital investment. Individual, nonmanifolded systems require a larger "footprint" for the same hood count and airflow volume. Increased shaft space for ductwork will require a tradeoff in lab square footage. Since a laboratory building's exhaust system must be operational at all times, a connection to an emergency power source is usually provided. A manifolded exhaust system is less costly to connect to an emergency power source than numerous individual exhausts fans. In addition, fewer fans lead to a Building Automation System (BAS), fire alarm and smoke control system simplifications, and cost savings.

Design Flexibility

Modern laboratory facilities should have the ability to respond to changes in research, technology, and personnel needs. Manifolded fume hood exhaust systems, with their inherent flexibility, can help modern labs accommodate these changes. Many possibilities exist for adjusting and expanding manifolded systems without affecting a building structure. For example, hoods can usually be moved or added with only minor changes in the HVAC system. When modifying a laboratory space, tapping into the manifolded exhaust duct or plenum uses significantly less energy than a dedicated exhaust fan. Redundant fans allow maintenance operations to proceed without impacting laboratory operations, so maintenance costs are reduced. The fan system capacity may be increased many times without disrupting laboratory operations.

Basic Manifold Design

Initial Considerations

Despite the considerable benefits laboratory exhaust manifolding can provide, a lab's design parameters will determine whether manifolding is appropriate. For example, while multiple exhaust fans effectively dilute hazardous fume hood exhaust, individual exhaust systems are usually more applicable in single-story buildings that have a small number of widely separated standard fume hoods. In the latter scenario, an extended ductwork to a manifolded exhaust system may not be economically justifiable. Otherwise, the use of individual fume hood exhaust systems should be limited to special processes and hoods with pertinent, restrictive codes and regulations, e.g., perchloric acid fume hoods. When contemplating a manifolded exhaust system, consider the following four topics:

Exhaust Compatibility

Perchloric acid and radioisotope hoods and biological safety cabinets are segregated from general chemical exhaust due to incompatibility or special operating conditions, which may necessitate one hood per dedicated set of fans (standard for perchloric acid), or one type of hood per dedicated set of fans (e.g., all radioisotope hoods manifolded together). Biological safety cabinets (BSCs) used in Biosafety Level 1 (BL1) or Level 2 (BL2) work or just tissue-culture work can be manifolded with chemical fume hoods and lab general exhausts. Biosafety Level 3 and 4 (BL3 and BL4) labs and select "agent" labs that work with highly infectious or toxic agents are prohibited from manifolding.

Fume Hood Number and Location

The larger the number of fume hoods, the greater the operating and installation economy that can be realized from a manifolded system.

Required Flexibility

If more hoods may be added or relocated in the future, then an appropriately sized manifold system will provide the greatest degree of flexibility. See sidebar, "Advantages of Manifolding Lab Exhaust," for more information.

Codes and Standards

A manifolded fume hood exhaust system based on best-practice safety and engineering principles needs to be specified by the designer. Therefore, applicable codes and relevant standards should be reviewed, and designs should be made in compliance with them. Note that for every facility, "the authority having jurisdiction" can adopt a "standard(s)" as a "code." Therefore, any standard, such as those listed below, can have "the force of law," when so stipulated by "the authority."

During schematic design, the laboratory user or research group needs to provide the designer with a complete list of chemicals that are currently in use or will be used in the laboratories. This will assist in the selection of appropriate exhaust system materials based on code compliance and compatibility with chemicals or agents to be used (and anticipated for future use) in the labs. If particulates are present in the exhaust, sufficient transport velocities in accordance with codes and adopted standards must be maintained in the ducts at all times.

Codes

- International Code Council (ICC), International Mechanical Code (IMC), Section 510. Stipulations in this code do not preclude manifolding fume hood exhausts so long as concerns for proper chemical compatibility and mixing are met.
- From the IMC, Section 502.10: "Exhaust ducts penetrating fire barrier assemblies shall be contained in a shaft of equivalent fire-resistive construction."
- If a lab is IBC "Group H-5," then emergency power is required for HPM exhaust ventilation systems per Section 415.9.10. The exhaust ventilation system is allowed to operate at not less than one-half the normal fan speed on emergency power where it is demonstrated that the level of exhaust will maintain a safe atmosphere.
- Check with your authority having jurisdiction over code compliance. Some standards may have been adopted by this authority as part of code requirements. (See "Standards," below.)

Standards

- OSHA 29 CFR 1910.1450, "Occupational Exposure to Hazardous Chemicals in Laboratories."
- NFPA 45-2004, Chapter 6, "Laboratory Ventilating Systems and Hood Requirements."
- ANSI / AIHA Z9.5, "American National Standard for Laboratory Ventilation," American National Standards Institute, Inc. / American Industrial Hygiene Association, ANSI / AIHA Z9.5, 2003.
- *Industrial Ventilation: A Manual of Recommended Practice — 24th Edition.* The American Conference of Governmental Industrial Hygienists, Inc. (ACGIH), eds. Cincinnati, OH. ISBN: 1-882417-42-9, 2001.

Basic Manifold Configuration

Typically considered a standard design approach, Figure 1 shows a "basic" manifold configuration that connects constant volume (CV) fume hoods into a common duct. Depending on the number of hoods in a lab space and the desired air change rate per hour (ACH), sufficient air may be exhausted through the CV hoods to satisfy the ACH required. If not, a "general" exhaust would also need to be tapped into the manifold ductwork.

Labs with operations involving low-hazard chemicals can be combined into common manifolds. Lab fume hoods using incompatible chemicals or other agents must not be manifolded without careful consideration of the quantity, types, and concentrations of agents that may be present. In all cases, see ANSI Z9.5, Section 5.3.2.1, for further discussion.

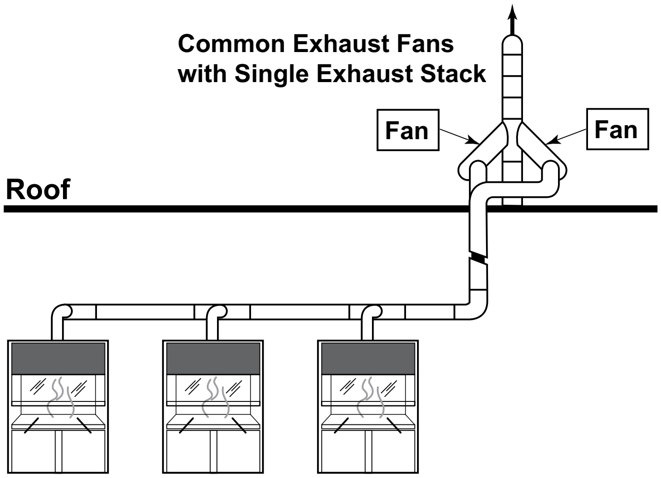

Figure 1. Simple centralized exhaust system.

Two Fans

In a basic manifolded exhaust system configuration, two fans are connected to a common plenum to provide exhaust capacity: one fan is the primary or "lead" fan, and another fan is the backup or "lag" fan to the primary. In this basic design, each fan's capacity is equal to the maximum total exhaust requirement of the connected labs, with all hoods and equipment in use. The active fan operates at a constant full speed to provide both required exhaust flow and a resulting stack exit velocity. Thus, a manifolded exhaust system mitigates the problem of a single fan-per-hood failure, since backup capacity is readily available for the connected hoods. In addition, fan inspection and critical maintenance can be accomplished without shutting down the entire system.

Fan Types

Centrifugal fans have efficient flow and pressure characteristics that are most often used in a manifolded exhaust system. Specialized axial-type exhaust fans are available for constant or variable air volume manifolded exhaust systems (discussed below). These fans are designed to move large amounts of ambient air into the exhaust plume as it is discharged from their stacks at a high upward velocity. The induced ambient air provides additional dilution. The high plume velocity reduces the tendency for wind to push the exhaust back down toward the building. However, these specialized induced-air fans require higher energy use, since they flow larger amounts of air in order to increase exit plume velocity.

Ductwork and Stack

Manifold ductwork can be arranged to serve all or specific groupings of laboratories and their fume hoods, typically on a particular floor or in a wing of a building. One large centralized exhaust backbone plenum serving the total exhaust needs of a laboratory building helps maximize the energy benefit of a manifolded exhaust system. Manifolded exhaust systems may use horizontal or vertical exhaust headers, or a combination of the two. When designing the ductwork layout, attention should be given to potential "system effects" that unnecessarily increase turbulence and pressure drop, which results in higher fan energy use. Ductwork should be as straight as possible, with minimum elbows. As a matter of due diligence, the manifold exhaust ductwork system should be tested for its overall leakage rate, and the responsible engineer should document these test results in the building's permanent records.

Usually, a manifolded system's stack can be more conveniently located away from laboratory intakes to minimize potential re-entrainment. To the extent possible afforded by the facility's layout, it is advised to cluster or group the exhaust stacks to enhance plume dispersion.

Dampers

Dampers must be used in manifolded exhaust systems to provide fan isolation. Manifolds with outlet gravity-style backdraft dampers are a minimum-design necessity to prevent reverse-flow short circuits through idle (lag) manifolded fans. Damper configuration, material, actuator type, end switches, and seals are some of the necessary design considerations. Monitoring the manifold's damper positions with the laboratory facility's building automation system (BAS) is recommended.

Good Manifold Design Practice

When compared to the basic constant-volume (CV) manifolded exhaust system presented above, energy-efficiency improvement in the range of 30 percent can be achieved with “good” design practice. The following three “good practice” enhancements to the basic design approach provide pragmatic energy-use reductions without excessive expenses or design complications (see Figure 2):

1. **Exhaust less conditioned air.** Reduce conditioned air exhausted from a building by using variable air volume (VAV) systems, including VAV fume hoods and a bypass damper.
2. **Modulate fan speed.** Decrease exhaust fan power by using variable speed drives (VSDs) to modulate exhaust fan speed.
3. **Set back duct static pressure.** Reduce exhaust fan energy use by lowering manifold duct static pressure during off-hours operation (static pressure reset).

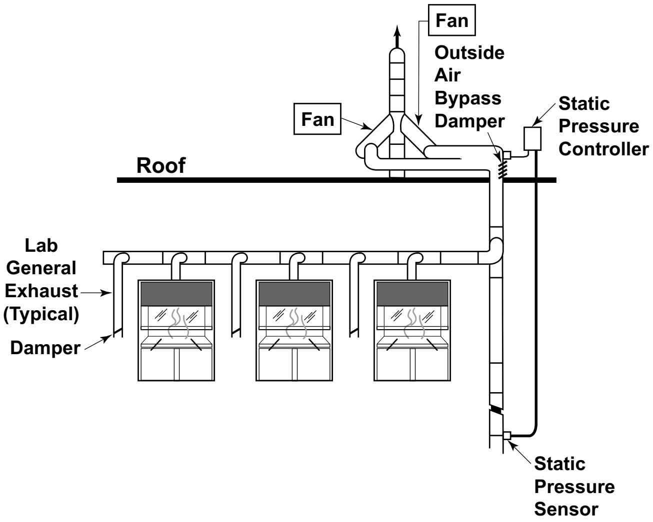

Figure 2. Good manifolding design practice.

Exhaust Less Conditioned Air

Summary

- Use VAV lab hoods.
- Track changing VAV hood exhaust volume with a bypass damper.
- Ensure that lab general exhaust, plenum bypass damper, static pressure sensor(s), and controls maintain the minimum lab air change rate and desired directional airflow.
- Operate exhaust fans at a sufficient speed to meet exit velocity requirements.

Considerations

When VAV hoods are connected to a manifolded laboratory exhaust system, the manifolded system experiences changing airflow volume caused by varying fume hood sash positions. This good-practice manifold configuration uses an inlet, or bypass damper, located in the exterior central exhaust plenum. Modulating the bypass damper provides a constant exhaust duct static pressure, while the constant fan speed provides a constant stack exit velocity. This constant pressure control approach does not save exhaust fan energy, but it does reduce the amount of exhausted conditioned air from the facility, while providing the required stack exit velocity. A good manifolded system design also has a motorized isolation damper at the inlet of each fan connected to the centralized plenum.

Modulate Fan Speed

Summary

- Add variable speed drives (VSDs) to the exhaust fans to further reduce energy use.
- Modulate bypass damper to maintain sufficient exhaust volume in response to hood operations; as more hoods are opened, the bypass damper modulates to a closed position.
- Operate exhaust fans at a reduced speed, maintaining the minimum required stack velocity until the bypass damper is fully closed.
- Increase exhaust fan speed to provide necessary volume flow when the bypass damper is fully closed and more hoods are opened.
- Modulate the bypass damper until it is fully open to maintain minimum stack exit velocity when all fume hood sashes are in a “closed” position, e.g., off-hours operation.

Considerations

The design of a manifold with a bypass damper for tracking changing manifold volume can be enhanced by adding variable speed drives (VSDs) to the exhaust fans. Varying the speed of the primary exhaust fans with VSDs saves more energy than only using a bypass damper.

First, the design must provide adequate stack discharge velocity for an “absolute minimum” airflow that results when all fume hood sashes are in their closed (minimum) position. This velocity requirement is provided with the manifold bypass damper (noted above) in its full open position. Second, as increased exhaust capacity is required (due to an increased open sash area), the bypass damper is eventually modulated to a fully closed position by the control system. Typically, this airflow volume is considered a "most-likely minimum" airflow that is predicted by a chosen fume hood "diversity factor." Third, airflow volume greater than the most-likely minimum is provided by continuously adjusting fan speed with the VSD in response to duct static pressure changes in the manifold plenum caused by more fume hood sashes being opened. Finally, with maximum volume demand on the system, the primary fan operates at maximum speed with all hood sashes open.

When using variable speed drives, it is important to choose a fan type that has flow characteristics well suited for the airflow volume ranges resulting from fume hood activity. Additionally, these multiple fan arrangements provide redundancy in the system, for safety.

Set Back Duct Static Pressure

Summary

- Reset the static pressure operating point for the manifolded system with the building automation system (BAS).

Considerations

Energy-efficient control of a manifolded exhaust system is accomplished with direct digital control (DDC) that is part of the facility's BAS. Monitor duct static pressure in at least two locations by placing one static pressure sensor in the exhaust plenum, just after the entry of the main exhaust inlet duct; and placing the other sensor in one of the exhaust system duct branches at the location where the static pressure is anticipated to be at the lowest (the least negative) value. Typically, this will be in the longest exhaust system branch duct, at the farthest end from the exhaust plenum; however, pressure sensor quantity and location(s) are highly system-dependent.

The following DDC input information and output controls are recommended:

Input Information

- Exhaust stack discharge air velocity: Maintain the exhaust stack discharge air velocity above the required minimum.
- Fan speed input: Verify variable speed drive operation.
- Fan failure/status: Automatic/bypass start of standby exhaust fan(s).
- Manifold duct static pressure: Used for controlling fan speed and starting standby fan(s).
- Isolation damper position end switches: Verify full opening or closure of damper.
- Bypass damper position: Verify damper position.

Output Control

- Start/stop fan: Initiate fan operation through variable speed drive (VSD).
- Fan speed output: Modulate VSD control of fan speed to maintain the duct static pressure set point.
- Isolation damper operation: Initiate opening/closing of damper.
- Bypass damper operation: Continuous positioning of damper to maintain the duct static pressure set point.

Better Manifold Design Practice

Additional energy-efficiency improvements in the range of a 50 percent reduction compared to a CV system can be realized when "better" design practice is added to the good-design practice for manifolded exhaust systems, presented above. The following three good-design-practice enhancements substantively reduce energy use (see Figure 3):

1. **Stepped fan operation.** Reduce fan power by stepping operation of constant volume fans.
2. **Modulate fan speed.** Decrease exhaust fan power by using variable speed drives (VSDs) to modulate exhaust fan speed.
3. **Evaluate plume dispersion.** Diminish energy needed for plume generation by performing dispersion analyses.

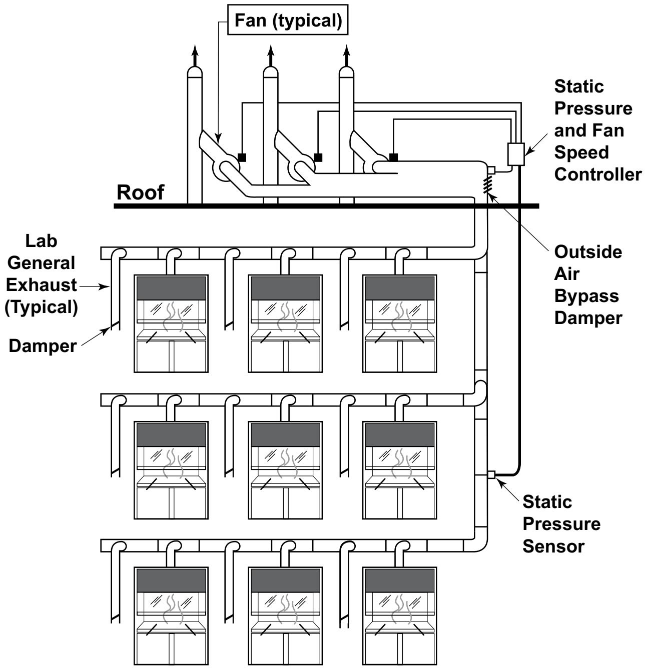

Figure 3. Better manifolding design practice.

Stepped Fan Operation

Summary

- Uses multiple fans and stacks connected to common plenum.
- Provides necessary stack exit velocity.
- Uses less fan energy in smaller diameter stacks.
- Requires isolation dampers, controls, and programming to start/stop multiple, stepped fans.

Considerations

Using a set of multiple exhaust fans provides greater operational flexibility and increased redundancy than one primary fan. The number of fans connected to a manifold exhaust system is influenced by a variety of factors, including:

- Total airflow volume
- Diversity, i.e., the ratio of minimum to maximum flow or the percent of theoretical maximum flow
- Required stack exit velocity
- Hazard analysis
- Effluent dispersion needs

Therefore, a "better" design practice uses multiple fans sized for partial volume so the airflow can be stepped up or down by starting or stopping additional fans. A minimum of three exhaust fans — two primary and one standby — are used; more fans may be incorporated. In general, exhaust airflow volume is adjusted by individually sequencing the fans connected to the manifold's common plenum. This approach reduces energy by exhausting less air during low hood use. When using three constant-volume fans, each unit is sized to provide 50 percent of the required maximum volume exhaust airflow. Therefore, with one fan operating, the manifold system can provide up to 50 percent of the maximum design capacity; with two fans operating, 100-percent capacity is provided. The third fan provides backup in the event of either primary fan's failure. Each of these constant-volume fans generates the required stack exit velocity.

Better manifolded exhaust systems use high-quality, leakage-rated, motorized isolation dampers, between both the inlet and outlet of each exhaust fan, which do not allow stack exhaust air of an operating fan to be drawn through a nonoperating fan.

Modulate Fan Speed

Summary

- Add VSDs to each exhaust fan (a minimum of three VSDs).
- Operate two primary fans in parallel to maintain minimum required stack velocity.
- Maintain minimum stack exit velocity with a bypass damper when all fume hood sashes are in a "closed" position, e.g., off-hours operation.

Considerations

As described above, a stepped operation of three exhaust fans, sized at 50 percent of maximum capacity, improves energy efficiency. However, building on this approach, increased efficiency can be realized by modulating each fan's capacity with an associated VSD, thus providing a variable-volume capability.

As in the good-design approach, a modulating bypass damper ensures that the required stack exit velocity is provided below a most-likely minimum airflow condition (see Figure 3). When the most-likely minimum airflow through the manifold system is reached, i.e., when the system "diversity" is reached, the bypass damper will be fully closed. Increased volume flow, above the most-likely minimum, is provided by increasing the speed of the primary fans, in parallel, with their VSDs. In this way, compared to the good-design-practice approach, greater efficiency is achieved by operating two smaller fans with smaller diameter exhaust stacks in parallel than by operating one large fan with a larger diameter stack. In addition, in the event one primary fan fails, the other operating primary fan immediately speeds up to maintain the required volume airflow. The backup (standby) fan is then brought online gradually. Note that more than three fans can be used, but control and maintenance become increasingly complex and costly as more fans are added.

Evaluate Plume Dispersion

Summary

- Evaluate stack exit velocity to a lower energy use that ensures safe and effective operation.

Considerations

There is an associated energy cost to dispersing an exhaust stack's plume. Within the manifolded exhaust system's ductwork, combining many hood and general exhausts increases effluent dilution. Therefore, a fundamental benefit of a manifolded system is a diluted effluent being expelled from its stack(s). By carefully studying this diluted plume's dispersion, exhaust fan energy use can be reduced. (See sidebar on "Benefits of Manifolding Fume Hood Exhausts — A Dispersion Modeling Perspective." Also see Labs21 Best Practice Guide, Modeling Exhaust Dispersion.)

When considering a stack exit velocity, it is recommended that plume dispersion calculations or atmospheric modeling be performed to evaluate exhaust re-entrainment rather than to use a "design standard." These evaluation techniques will account for the beneficial dilution and momentum provided by a manifolded system, and will likely result in a lower stack exit velocity, thus saving exhaust fan energy.

Manifold Performance Examples

Case Studies

Minnesota College Retrofit

A completed renovation project for a lab at Minnesota College, a small private educational institution, provided a net reduction from 30 dedicated exhaust fans to six arranged on three plenums. Each fan, sized for approximately 67 percent of the full load, provides backup capacity and growth potential. This project demonstrated a manifolded lab exhaust system's improved design flexibility and increased fume dilution, while providing a substantial energy reduction.

Genentech, Inc.

The flexibility of manifolded exhaust systems enabled Genentech to promote its science and save energy simultaneously. By using VFD-driven fans in the exhaust manifold system, a quarter-million-sq-ft lab project has saved approximately $100,000 in annual operating costs when compared to a constant volume/air bypass manifolded design. In another instance when even more hoods were needed on another manifolded exhaust system that would not accommodate larger exhaust fan motors, disruptions to research activities were minimized while lab hood sashes were changed sequentially from operating vertically to horizontally. Horizontal hood sashes, sized to fit the science, reduced energy demand from 30 ten-foot hoods by a third.

Energy Evaluations

National Renewable Energy Laboratory (NREL)

The NREL Science and Technology Facility (S&TF) exhaust-air system incorporates six (20,000 cfm each) parallel exhaust fans, one of which is always available as backup. The fans in the S&TF are staged according to building exhaust needs, an improvement on the typical lab construction where all exhaust fans run 100 percent of the time at a constant speed, and pull in bypass air when building exhaust requirements are less than exhaust-fan capacity. A DOE2 energy analysis comparing the six-fan design to three 50,000 cfm fans (with one always available as a backup), including stacks and dampers, determined that the six-fan design saved approximately $4,700 per year in energy costs, and provided an eight-year simple payback.

Benefits of Manifolded Fume Hood Exhausts — A Dispersion Modeling Perspective

One of the benefits associated with manifolded exhaust systems is an increased momentum, resulting in improved plume rise of the discharged flow. For example, a 10,000 cfm exhaust will achieve a plume rise about three times greater than a 1,000 cfm exhaust discharged at the same velocity, wind conditions, and stack height. Increasing the distance the plume rises above the emitting building is effective in avoiding recirculation zones, and will result in improved overall dispersion.

A second benefit of manifolding is increased internal dilution of the combined exhaust stream. For a typical worst-case scenario where a large release would occur in one fume hood, the exhaust in a manifolded system would be diluted "internally" prior to being discharged to the atmosphere (i.e., contaminated exhaust is diluted by "clean" air in other fume hoods).

The total dilution achieved by the exhaust stream at a receptor location (e.g., air intake, window) is the product of internal dilution (between the point of contamination and point of discharge) and external dilution (between the stack top and the receptor). As the internal dilution of a system increases, less outdoor stack exhaust dilution will be needed. Therefore, savings in energy costs and stack design requirements can be achieved. In addition, a single stack for a central exhaust system will be easier to position to reduce the impact on building air intakes than multiple individual exhaust stacks.

Provided by Simona Besnea with RWDI

Conclusion

A holistic, team-based approach is important when determining the design and appropriateness of a manifolded exhaust system. Design decisions regarding fan type, stack location, plenum configuration, ductwork details, controls, and screening systems need careful attention to optimize the energy reductions inherently obtainable with a manifolded exhaust system.

Architectural and mechanical designers may need to collaborate with specialized consultants to perform dispersion studies, re-entrainment analyses, and acoustical reviews. Developing the system's control sequence, and conducting performance-based commissioning with experienced professionals offer the best likelihood of achieving success. Thorough training of maintenance personnel will ensure efficient, long-term operation.

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