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Against Mandatory Installation of Automated Sash Closure Devices

Additional submitted attachment is included below.

To: California Energy Commission - Statewide Codes and Standards Team

From: Thomas C Smith

Subject: Comments for California Energy Commission: Docket No. 17-BSTD-01, 2019 Building Energy Efficiency Standards PreRulemaking – Automatic Sash Closure Devices for VAV Fume Hoods

Date: August 4, 2017

Introduction

I applaud efforts to reduce energy consumption through improving the efficiency and effectiveness of fume hoods and laboratory ventilation systems. However, I am opposed to the rule change and addition of Section 140.9(c)2 Prescriptive Requirements for Fume Hoods (See Section entitled Proposed Code Language). In my opinion, the rule change should not require automatic sash closure systems on VAV fume hoods in any lab that is fume hood driven or otherwise. In my opinion, the energy calculation and cost savings calculations are flawed as they are based solely on theoretical predictions of airflow reduction, they over report actual energy reduction and they under report actual maintenance and management costs. Furthermore, the addition of automatic sash closures serves to increase the complexity of VAV systems that already demonstrate significant challenges for lab facilities to manage and maintain.

I recommend the Codes and Standards Team consider mandating implementation of a lab ventilation management plan (LVMP) as required by the ANSI/AIHA Z9.5-2012 American National Standard for Laboratory Ventilation and provide access to training for all people involved in the design, operation, maintenance, management and use of VAV fume hoods and lab ventilation systems. When properly implemented, a LVMP will maximize both lab safety and energy efficiency for the lifecycle of the systems. The following describe my primary reasons for not supporting the requirement of automatic sash closures:

- **Flawed Energy and Cost Saving Calculations:** The Cal/OSHA Code of Regulations, Sub Chapter 7. General Industry Safety Orders and the ANSI/AIHA Z9.5-2012 American National Standard for Laboratory Ventilation require laboratories to provide safe and healthy work environments that are free of injurious concentrations of airborne hazards. Activities in laboratories vary widely and use of prescriptive specifications for laboratory and fume hood air changes rates is inappropriate and must be based on hazard evaluation or a risk assessment. The calculated savings are based on a generic representation of lab air change rates and fume hood minimum flow that do not reflect actual conditions nor the population and type of fume hoods that exist throughout California. Furthermore, the calculation of incremental maintenance costs does not reflect the potential for degradation of the mechanical components nor the actual time and cost required to access and repair failed components beyond the sensors. Finally, the energy savings do not include the increased parasitic energy consumed by the closure devices and they are based on the inappropriate assumption that flow reduction through a fume hood translates to an equivalent reduction in flow through the exhaust fans and the air supply system. This assumption is purely theoretical and has not been substantiated by peer reviewed publications. Savings derived from sash closures would require that all components of both the VAV exhaust system and the VAV air supply system are calibrated and operating properly over the range of possible airflow at all times. Data from system tests conducted and reported by Exposure Control Technologies, Inc. indicate this is a bad assumption and theoretical flow reductions are often unrealized due to improper calibration and operation of VAV system components over time.

- **Failure to Consider Increased Complexity and Premature Degradation**: Variable air volume (VAV) fume hoods and lab ventilation systems are complex, difficult to manage and challenging to maintain. The International Institute for Sustainable Laboratories (I2SL) conducted a survey of facility managers and stakeholders responsible for ensuring proper performance of laboratory ventilation systems. More than 70% of respondents indicated that the complexity of modern VAV fume hoods and laboratory HVAC systems is outpacing the availability of skilled operators and resources necessary to properly design, operate, and maintain long-term performance of VAV systems. Data from Exposure Control Technologies, Inc. indicates that the performance of even properly commissioned VAV systems can degrade 30-50% over a 5 to 10-year period. Adding automated sash closure devices can create additional and unnecessary complications without assurance that the sash closure device will result in actual energy savings through commensurate reduction in flow through both the exhaust and air supply systems.
- **Lack of Training Programs and Standards:** At present, there are no formalized training courses in California to train people in proper design, operation, maintenance, management and use of variable air volume lab ventilation systems. No standards or methods are referenced or provided in California to verify and validate proper modulation of flow for variable air volume exhaust and air supply systems serving laboratories. Without standards for testing and maintaining performance of VAV systems, any calculated energy savings may go unrealized due to improper operation and modulation of complex VAV systems. Installation of automatic sash closure devices may exacerbate this problem.

Proposed Code Language

SECTION 140.9 – PRESCRIPTIVE REQUIREMENTS FOR COVERED PROCESSES
140.9(c)2 Prescriptive Requirements for Fume Hoods

1. Variable air volume fume hoods in scientific laboratories shall have an automatic sash closure system that complies with the following:

   a) Have an accessible manual override of positioning with forces of no more than 10 lbs (45 N) mechanical, as specified by ANSI/AIHA Z9.5-2012, 3.1.1.4;

   b) Occupant sensors shall meet the requirements in Section 110.9(b)4 and shall have suitable coverage and placement to detect occupants in front of the fume hoods. Each occupant sensor shall control no more than one fume hood;

   c) Automatically close the sash after a maximum of 5 minutes of inactivity;

   d) Have obstruction sensing capabilities that stop travel during sash closing operations, as specified by ANSI/AIHA Z9.5-2012, 3.1.1.4;

2. Acceptance for fume hoods: Before an occupancy permit is granted for fume hoods subject to 140.9(c)2, the equipment and systems shall be certified as meeting the Acceptance Requirement for Code Compliance, as specified by the Reference Nonresidential Appendix NA7. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA7.16.

EXCEPTION 1 to Section 140.9(c)2: Scientific laboratories not determined to be fume hood driven per TABLE 140.9-B. *TABLE 140.9-B FUME HOOD DRIVEN LABORATORY SPACE DETERMINATION*

Fume Hood Density	Ceiling Height < 10ft				Ceiling Height ≥ 10ft and < 15ft				Ceiling Height ≥ 15ft			
Hood linear ft/ 1,000 ft² lab area	Occupied Dilution Ventilation Setpoint (ACH)				Occupied Dilution Ventilation Setpoint (ACH)				Occupied Dilution Ventilation Setpoint (ACH)			
	≤8	9-10	11-12	13-14	≥15	≤8	9-10	11-12	13-14	≥15	≤8	9-10	11-12	13-14	≥15
<15.5															
15.5 to <16.9				EXEMPT					EXEMPT						
16.9 to <18.3													EXEMPT		
18.3 to <19.7															
19.7 to < 21.1															
21.1 to <22.5		FUME HOOD DRIVEN					FUME HOOD DRIVEN								
22.5 to ≤25.3												FUME HOOD DRIVEN			
>25.3															

Components of Modern VAV Fume Hoods and Lab Ventilation Systems

The design, construction, operation and use of laboratory fume hoods and ventilation systems affect the ability to control airborne chemicals, meet safety requirements and satisfy the building occupant's demand for ventilation. Lab ventilation systems can range from simple, constant air volume (CAV), independent exhaust and supply systems to complex, variable air volume (VAV), manifolded systems capable of modulating airflow for multiple spaces to provide a range of operating modes. Figure 1 and the associated Table below depict and describe a complex, modern, VAV exhaust and air supply system capable of modulating flow in response to changes in the demand for ventilation such as opening and closing sashes on VAV fume hoods or responding to detection of airborne contaminants in the lab environment. The diagram is provided to exhibit and describe the number of systems, sub-systems and components that must operate properly to realize the savings associated with automatic sash closures. The number of components and complexity of operation coupled with a lack of skilled operators and standards for integration, testing and maintenance diminishes the probability of realizing significant long-term savings from installation of automatic sash closures.

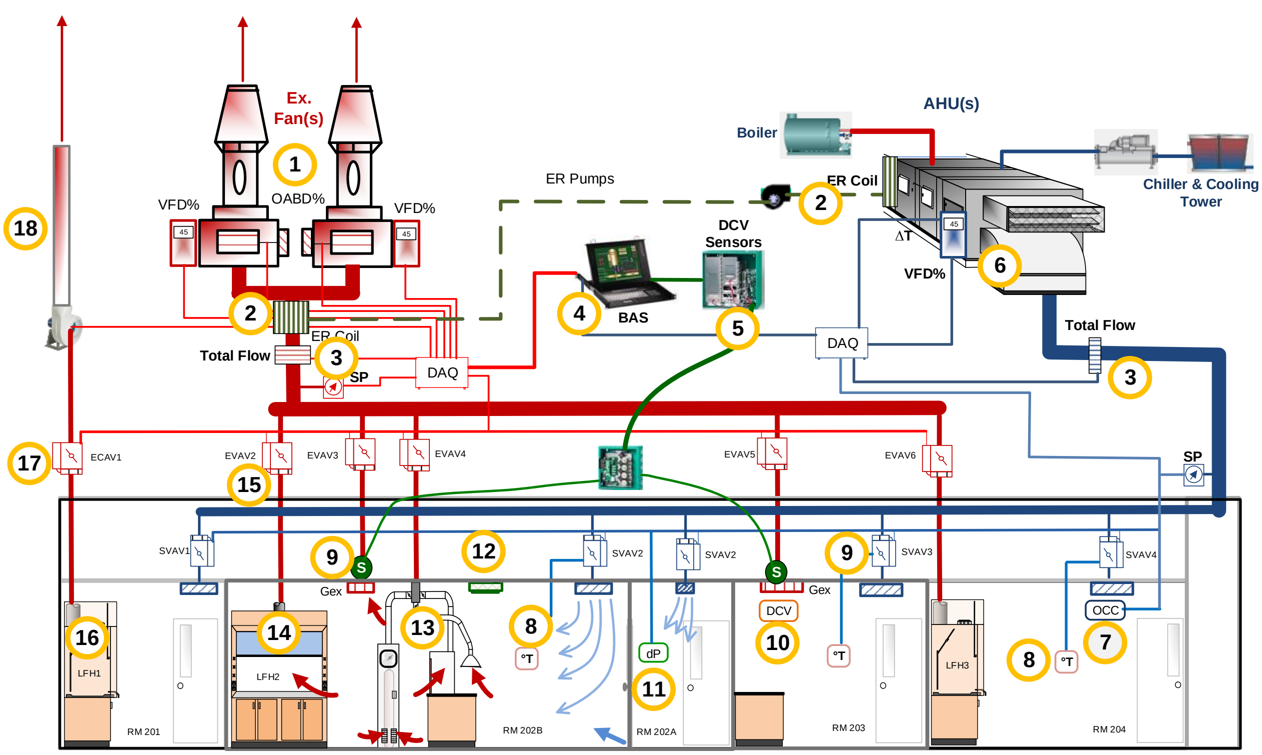

Figure 1 Diagram of typical components and attributes of a modern VAV laboratory ventilation system.

Table 1 Components of a modern Variable Air Volume Laboratory Ventilation System

No.	Component / Feature	Description
1	Redundant N+1, induced flow (Venturi) exhaust fans with Variable Frequency Drives and outside air bypass dampers (OABDs)	Dual exhaust fans (N+1) with, induced flow, venturi type, exhaust fans and stacks with continuous power back up. Installation of redundant venturi fans enables better plume discharge at lower flow and better system dependability. The combination of the variable frequency drive (VFD) and outside air bypass dampers (OABD) optimizes the ability to reduce flow, but provides sufficient plume discharge. Flow control can be optimized by tuning the sequence of operations and modulating when required.
2	Energy Recovery System	Various types of energy recovery systems can be employed depending on the hazards in the exhaust. The type can affect efficiency and potential for recirculation of exhaust. Options include run-around loops (least efficient, but safest), heat pipes (more efficient) and rotary heat exchangers (most efficient, potentially least safe).
3	Flow Monitors and System Sensors	Exhaust and air supply systems often employ flow and static pressure sensors. The measurement of total flow in addition to system static pressure improves system sensitivity flow tracking and enables reset of static pressure during periods of reduced demand. The ability to achieve better sensitivity and reduce static pressure can enable significant additional savings.
4	Building Automation System (BAS)	The building automation system can monitor operation, detect operational problems and trend operation over time to provide useful operating metrics.
5	Contaminant Sensing Demand Ventilation Control	A network of sensors can be installed to sample air quality and modulate or increase flow when chemicals are detected enabling minimum airflow when contaminants are not detected in the environment. Improves ability to increase flow for additional dilution when necessary rather than increasing flow to operate continuously for possible spill scenarios.
6	Air handling Unit supplying 100% outside air to labs	Air handling units can provide 100% outside or be equipped to recirculate some portion of air supplied to the building. Recirculation is generally discouraged for labs that handle airborne hazards.
7	Occupancy Sensors	Occupancy sensors detect presence of people in the lab and enable flow to be reduced or setback when labs are vacant. Flow reduction lowers the air change rates potentially enabling accumulation of concentrations and exposure upon re-entering the lab prior to purging. Unoccupied air changes rates can be critical to mitigating overexposure upon entering a lab.
8	Temperature Sensor	Temperature sensors (sometimes referred to as thermostats) detect room temperature and translate the signal to the air supply discharge temperature control or other source for maintaining room temperature specifications.
9	Air supply controls and diffusers	The volume and distribution of room air supply can be critical to controlling room temperature, dilution and assisting with contaminant sweep and removal from the space. Improper location and type of diffusers can cause short circuiting that reduce efficiency or cause high velocity cross drafts that can interfere with ECD capture and containment. Reducing airflow through diffusers below original design conditions can adversely affect safety and room temperature control.
10	Demand Control Ventilation (DCV) that detects Airborne Contaminants	Chemicals and/or other air contaminants can be accidently released in the environment. When detected by sensors, the ventilation rate can be increased to promote faster dilution and removal. The detection of contaminants can be reported through the building information systems to alert occupants or responsible stakeholders such as EH&S.

No.	Component / Feature	Description
11	Anteroom with Critical Room Pressure Monitoring and Controls	Labs with need for isolation to help prevent migration or escape of airborne hazards to non-lab spaces can be equipped with anterooms or vestibules to serve as an additional barrier to isolate the space and room pressure monitors to indicate the airflow direction and differential pressure.
12	Airborne Contaminant Filtration System	Chemicals and/or other air contaminants can be accidently released in the environment. Filter units can be installed with different types of filters to scavenge airborne contaminants and assist with air movement and the effectiveness of the room ventilation systems. Some filter units are equipped with contaminant detectors and/or sensors to detect and alert users and responsible stakeholders such as EH&S.
13	Exposure Control Devices (i.e. local exhaust ventilation)	Exposure control devices (sometimes called local exhaust ventilation) such as ventilated safety enclosures (VSDs), snorkel exhaust arms, and hazardous gas cabinets can be installed to assist with source capture and reduce risk in the lab and need or reliance on room dilution ventilation for primary means of protection. The ECDs must be appropriate for the airborne hazard and activity.
14	Exposure Control Device (Variable Air Volume Fume Hood)	Exposure Control Devices called Variable Air Volume (VAV) fume hoods provide a high level of protection, but modulate flow in response to changes in use of the fume hood. A VAV fume hood reduces flow depending on sash opening area, occupancy or other conditions. The minimum flow must be sufficient to maintain containment, dilution and removal of contaminants generated within the hood under that operating mode. Use of prescriptive minimum flow in the absence of a risk assessment can potentially compromise hood performance and lab safety.
15	VAV Exhaust Flow Controller	VAV terminals or valves are comprised of sensors, actuators and flow dampers to modulate exhaust flow to satisfy the flow requirements of the VAV fume hood or other exhaust devices in the lab.
16	Exposure Control Device (Constant Air Volume Fume Hood)	Constant air volume (CAV) fume hoods are designed for a constant volume of exhaust flow from the fume hood. CAV operation is sometimes necessary for containment or where high rates of contaminant generation could cause problems at reduced flow and lower duct transport velocities.
17	CAV Exhaust Flow Controller	CAV terminals or airflow control valves are utilized to maintain a constant flow of air through the exhaust device regardless of operating mode.
18	Exhaust Discharge Stack System	The design height and outlet velocity can be critical to ensuring adequate discharge of contaminated exhaust air from the lab and ECDs. The height, velocity and stack design can affect the migration of the contaminated plume and potential for exposure of people working on the roof and nearby. A common problem resulting from improper discharge of airborne hazards is re-entrainment into the air supply systems.

Conclusions

Section 140.9(C)2 Prescriptive Requirements for Fume Hoods should not be considered for inclusion in the California Building Energy Efficiency Standards at this time without further substantiation of their independent contribution to energy savings and real costs to install, manage and maintain across the population of fume hoods installed in California. Energy savings are only realized when airflow is reduced through the exhaust fans and air supply systems. Automatic sash closures require energy to operate, increase system complexity and degradation over time will increase costs and further burden facilities management and maintenance.

Recommendations

Consider mandating lab facilities implement LVMP as required by the ANSI/AIHA Z9.5-2012 American National Standard for Laboratory Ventilation. Section 2.1 of the standard states “An LVMP shall be implemented to ensure proper operation of the lab ventilation systems, help protect laboratory working with potentially hazardous airborne materials, provide satisfactory environmental air quality and maintain efficient operation of the laboratory ventilation systems.” The cost burden to install automatic sash closures will more than offset the cost of implementing a LVMP for most facilities. Figure 2 depicts the elements of a comprehensive LVMP.

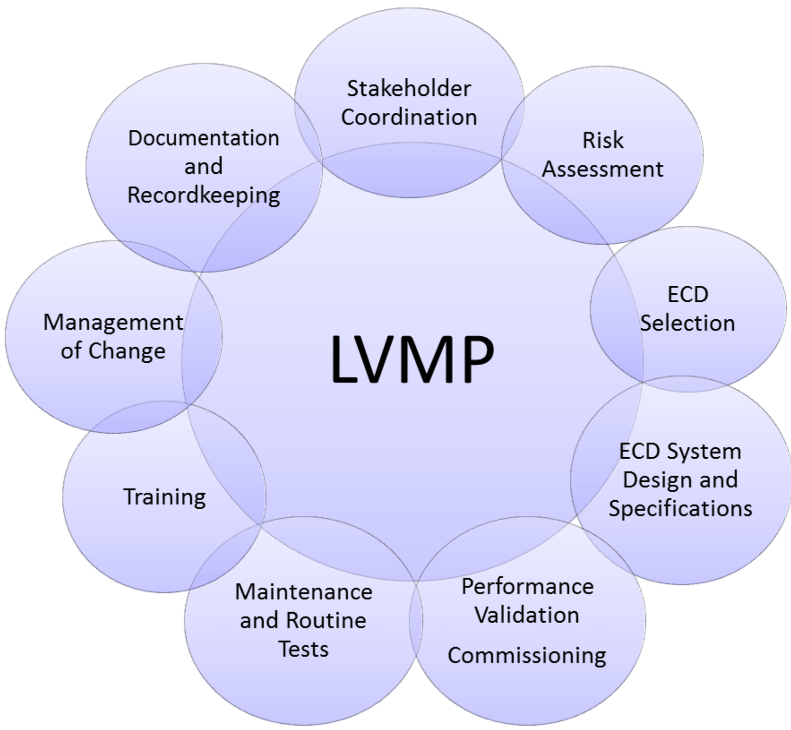

Figure 2 Elements of a Comprehensive LVMP

Most importantly, maximizing both lab safety and energy reduction can be realized by provision of training, guidelines and standards to assist lab facilities with design, operation and management of modern, highly complex, multi-component, VAV lab ventilation systems. Consider providing the methods, tools and standards to help facilities ensure efficient and effective operation. Provide guidelines and methods to measure, monitor and maintain proper performance over the lifecycle of the systems. An effective monitoring program with appropriate analytics combined with management of change and training will provide the most efficient and cost-effective solutions.