Proposal Summary

Laboratory Airflow

Updated: April 24, 2023
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Introduction

The document summarizes proposed revisions to the California Energy Code (Title 24, Part 6) discussed during a utility-sponsored stakeholder meetings on January 31, 2023 and May 10, 2023. The Statewide Utility Codes and Standards Enhancement (CASE) Team is seeking input and feedback. To provide your comments, email info@title24stakeholders.com by May 25, 2023

Measure Description

L Occupancy

This measure would add the L (Laboratory) occupancy group to the list of occupancy groups covered by Title 24. Most labs are either B (Business) or E (Educational) or H (Hazardous), all of which are already covered by Title 24.

Nighttime Setback

Currently Title 24 prescriptively requires most labs to have variable air volume controls and be capable of reducing occupied airflow rates to the minimum needed for ventilation, pressurization, EH&S, etc. This measure would expand that requirement by saying labs must use occupancy sensors or other means to further reduce airflow rates when spaces are unoccupied. This measure also expands the VAV requirement to labs with a required minimum ≥ 10 air changes if the maximum rate exceeds the minimum required rate.

Exhaust Air Heat Recovery

This measure would prescriptively require exhaust air heat recovery for most large labs in most climate zones. A sensible recovery ratio of 45% would be required, which can be achieved with run-around coils.

New Exhaust Fan Control Option

Currently 140.9(c)3 prescriptively requires lab exhaust systems greater than 10,000 cfm to meet one of the three current options listed below. This measure would add a fourth option to that list. This measure would also say that lab exhaust systems do not have to meet 140.9(c)3 if they meet 140.4(c) and do not have to meet 140.4(c) if they meet 140.9(c)3. 140.4(c) is the prescriptive Fan Power Budget that was added in 2022 and is typically lower than Option B below.

Current option	Low power, 0.65 W/cfm or 0.85 W/cfm with filtration, constant speed fan
Current option	1.30 W/cfm but VAV exhaust fan speed control with turndown limited by measured wind speed and direction
Current option	1.30 W/cfm but VAV exhaust fan speed control with turndown limited by contaminant sensing
New option	1.30 W/cfm but VAV exhaust fan speed control with turndown to 60%.

Reheat Limitations

Many labs incur very large reheat penalties because they have a central air handler that cools large quantities of outside air that is then sent to multiple zones, many of which then reheat this large volume of air with 2-pipe hot water reheat coils. Per this prescriptive measure, air handlers serving multiple space conditioning zones shall not include mechanical cooling and each zone shall include heating and cooling capacity to prevent cooling at the air handler and reheating at the zones. 4-pipe zone coils piped to accept hot or chilled water would meet this requirement. Separate heating and cooling coils at each zone also meets it. The measure does not apply to vivaria, BSL3 labs, or climates where ASHRAE Standard 62.1 recommends active humidity control.

Data Needs/Stakeholder Information Requests

Technical Feasibility: Are there any reasons to exempt certain labs from any of the above requirements?

Standard Design Practices: Please share your experiences (good or bad) with night setback, exhaust air heat recovery, exhaust stacks without bypass dampers, and zonal systems with heating and cooling capacity.

Costs:

- Are there are any special cost considerations that are specific to laboratories related to implementing nighttime setback?
- Can you provide incremental cost information for exhaust air heat recovery or 4-pipe vs 2-pipe systems?

Data may be provided anonymously. To participate or provide information, please email DJ Joh, djoh@energy-solution.com directly and cc info@title24stakeholders.com.

Draft Code Language

The proposed changes to the Standards and Reference Appendices are provided below. Changes to the 2022 documents are marked with red underlining (new language) and ~~strikethroughs~~ (deletions).

SECTION 100.0 – SCOPE

(a) Buildings Covered. The provisions of Part 6 apply to all buildings:

1. That are of Occupancy Group A, B, E, F, H, I, **L,** M, R, S, or U; and

SECTION 140.4 – PRESCRIPTIVE REQUIREMENTS FOR SPACE CONDITIONING SYSTEMS

1. **Fan systems.** Each fan system moving air into, out of or between conditioned spaces or circulating air for the purpose of conditioning air within a space shall meet the requirements of Items 1, 2 and 3 below.

1.1 **Fan power budget.** For each fan system that includes at least one fan or fan array with fan electrical input power ≥ 1 kW, fan system electrical input power (Fan $kW_{design,system}$) determined per Section 140.4(c)1(B) at the fan system design airflow shall not exceed Fan kW_{budget} as calculated per Section 140.4(c)1(A).

EXCEPTION 1 to Section 140.4(c)1: Laboratory or factory fan exhaust systems greater than 10,000 CFM complying with 140.9(c)3.

SECTION 140.9 – PRESCRIPTIVE REQUIREMENTS FOR COVERED PROCESSES

(c) **Prescriptive requirements for laboratories and factories ~~laboratory and factory exhaust systems~~.**

140.9(c)1 Airflow reduction requirements. ~~For buildings with~~ laboratory ~~exhaust~~ systems ~~where the minimum circulation rate to comply with code or accreditation standards is 10 ACH or less, the design exhaust airflow~~ shall be capable of reducing ~~zone~~ space and fume hood exhaust and makeup airflow rates to the greater of

a) 6 ACH_{10} (1.0 cfm/ft2) or lower, (ACH_{10} is air changes per hour for a 10 foot high ceiling.)

b) the regulated minimum occupied circulation rate to comply with code, accreditation, or facility environmental health & safety department requirements~~, or~~

c) the minimum required to maintain occupied pressurization requirements~~, whichever is larger.~~

Variable exhaust and makeup airflow shall be ~~coordinated~~ automatically controlled to achieve the required space pressurization at varied levels of demand and fan system capacity.

Laboratory exhaust systems shall also include occupancy sensors, and/or other controls as necessary, to further reduce zone exhaust and makeup airflow rates to unoccupied rates no

higher than the greater of:

a) 4 ACH_{10} (0.67 cfm/ft2) or lower,

b) the regulated minimum unoccupied circulation rate to comply with code, accreditation, or facility environmental health & safety department requirements, or

c) the minimum required to maintain unoccupied pressurization requirements.

~~**Exception 1 to Section 140.9(c)1:** Laboratory exhaust systems serving zones where constant volume is required by the authority having jurisdiction, facility environmental health & safety department or other applicable code.~~

Exception 1~~2~~ to Section 140.9(c)1: New zones on an existing constant volume exhaust system.

140.9(c)2 Exhaust System Transfer Air. Conditioned supply….

140.9(c)3 Fan System Power Consumption. All newly installed fan exhaust systems serving a laboratory or factory greater than 10,000 CFM, shall meet subsection A and either B, or C~~, D~~:

~~A. System shall meet all discharge requirements in ANSI Z9.5-2012.~~

~~B. The exhaust fan system power shall not exceed 0.85 watts per cfm of exhaust air for systems with air filtration, scrubbers, or other air treatment devices. For all other exhaust fan systems the system power shall not exceed 0.65 watts per cfm of exhaust air. Exhaust fan system power equals the sum of the power of all fans in the exhaust system that are required to operate at normal occupied design conditions in order to exhaust air from the conditioned space to the outdoors. Exhaust air does not include entrained air, but does include all exhaust air from fume hoods, hazardous exhaust flows, or other manifolded exhaust streams.~~
~~**EXCEPTION to Section 140.9(c)3B:** Laboratory exhaust systems where applicable local, state, or federal exhaust treatment requirements specify installation of air treatment devices that cause more than 1 in. of water pressure drop.~~

~~C. The volume flow rate at the stack shall vary based on the measured 5-minute averaged wind speed and wind direction obtained from a calibrated local anemometer.~~

~~i. At least two anemometers shall be installed in a location that experiences similar wind conditions to the free stream environment above the exhaust stacks and be at a height that is outside the wake region of nearby structures.~~

~~ii. Look-up tables shall be used to define the required exhaust volume flow rate, as a function of at least eight wind speeds and eight wind directions, to maintain downwind concentrations below health and odor limits, as defined by the 2018 American Conference of Governmental Industrial Hygienists Threshold Limit Values and Biological Exposure Indices, for all contaminants, or as defined by applicable local, state, or federal jurisdictions, if more stringent.~~

~~iii. Wind speed/direction sensors shall be certified by the manufacturer to be accurate within plus or minus 40 fpm (0.2 m/s) and 5.0 degrees when measured at sea level and 25°C, factory calibrated, and certified by the manufacturer to require calibration no more frequently than once every 5 years.~~

~~iv. Upon detection of anemometer and/or signal failure, the system shall reset the exhaust volume flow rate to the value needed to maintain downwind concentrations below health and odor limits for all contaminants at worst-case wind conditions and shall report the fault to an Energy Management Control System or fault management application which automatically provides notification of the fault to a remote system provider. The system shall have logic that automatically checks for anemometer failure by the following means.~~

a) If any anemometer has not been calibrated within the manufacturer's recommended calibration period, the anemometer has failed.

b) During unoccupied periods the system compares the readings of all anemometers. If any anemometer is more than 30% above or below the average reading for a period of 4 hours, the anemometer has failed.

c) Wind speed and wind direction readings shall be sampled at least 10 times per minute. If the difference between the maximum and minimum readings from the average of either the wind direction or the wind speed over a one minute period is less than 10% of the average value, the measurements shall be considered a signal failure.

d) Other error signals sent by the anemometer.

v. Before an occupancy permit is granted for a laboratory or process facility subject to Section 140.9(c)3C, the applicable equipment and systems shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Reference Nonresidential Appendix NA7.16. 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.

D. The volume flow rate at the stack shall vary based on the measured contaminant concentration in the exhaust plenum from a calibrated contaminant sensor installed within each exhaust plenum.

i. A contaminant event threshold shall be established based on maintaining downwind concentrations below health and odor limits for all chemicals at worst case wind conditions, as defined by the 2018 American Conference of Governmental Industrial Hygienists Threshold Limit Values and Biological Exposure Indices, or as defined by applicable local, state, or federal jurisdictions, if more stringent.

ii. At least two contaminant concentration sensors shall be Photo Ionization Detectors (PID) certified by the manufacturer to be accurate within plus or minus 5% when measured at sea level and 25°C, factory calibrated, and certified by the manufacturer to require calibration no more frequently than once every 6 months.

iii. Upon detection of sensor and/or signal failure, the system shall reset the exhaust volume flow rate to the value needed to maintain downwind concentrations below health and odor limits all contaminants at worst case wind conditions and shall report the fault to an Energy Management Control System or fault management application which automatically provides notification of the fault to a remote system provider. The system shall have logic that automatically checks for sensor failure by the following means.

a) If any sensor has not been calibrated within the manufacturer's recommended calibration period, the sensor has failed.

b) During unoccupied periods the system compares the readings of all sensors. If any sensor is more than 30% above or below the average reading for a period of 4 hours, the sensor has failed.

iv. Before an occupancy permit is granted for a laboratory or process facility subject to Section 140.9(c)3D, the applicable equipment and systems shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Reference Nonresidential Appendix NA7.16. 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.

A. System shall meet all discharge requirements in ANSI Z9.5-2022 Section 6.4

B. The exhaust fan system power shall not exceed 0.85 watts per cfm of exhaust air for systems with air filtration, scrubbers, or other air treatment devices. For all other exhaust fan systems the system power shall not exceed 0.65 watts per cfm of exhaust air. Exhaust fan system power equals the sum of the power of all fans in the exhaust system that are required to operate at normal occupied design conditions in order to exhaust air from the conditioned space to the outdoors. Exhaust air does not include entrained air, but does include all exhaust air from fume hoods, hazardous exhaust flows, or other manifolded exhaust streams. **EXCEPTION to Section 140.9(c)3B:** Laboratory exhaust systems where applicable local, state, or federal exhaust treatment requirements specify installation of air treatment devices that cause more than 1 in. of water pressure drop.

C. Exhaust system shall comply with all of the following:

i. The sum of the occupied minimum circulation rates of the spaces served by the fan system shall be less than 60% of the fan system design flow rate

ii. The design exhaust fan system power shall not exceed 1.3 watts per cfm of exhaust air when operating under full load design conditions.

iii. The system shall include variable speed controls so that exhaust system fans shall draw no more than 40% of the design fan power when the exhaust stack air flow rate is operating at 60% of design flow rate.

iv. The stack flow shall be no higher than the larger of:

a) The space exhaust flow rate, or

b) The minimum acceptable stack flow rate

v. Exhaust system design and control results in calculated outdoor contaminant concentrations in compliance with applicable federal, state, or local regulations

vi. The minimum acceptable stack flow, as defined using the procedures and system definitions included in ANSI Z9.5 (2022) Appendix 3, shall be one of the following:

a) Less than 60% of the design stack flow rate during normal operation (simple turndown control system), or

b) dynamically reset based on measured wind speed and/or wind direction and assumes worst case emissions rate and shall be less than 60% of the design stack flow rate for at least 70% of the hours during a Typical Meteorological Year (TMY) for the site (wind responsive control system); or

c) dynamically reset based on measured contaminant concentration and shall be less than 60% of the design stack flow rate when measured contaminants in the exhaust system plenum are below the threshold contaminant concentration value (monitored control system)

EXCEPTION 1 to Section 140.9(c)3: Fan exhaust systems complying with 140.4(c)1

140.9(c)4 Fume Hood Automatic Sash Closure. Variable ….

140.9(c)5 Reheat Limitation. Air handlers serving multiple space conditioning zones shall not include mechanical cooling and each zone shall include heating and cooling capacity, such as 4-pipe VAV, to prevent cooling at the air handler and reheating at the zones.

Exception 1 to Section 140.9(c)5: Additions or alterations to existing air handling systems serving existing zones without heating and cooling capacity.

Exception 2 to Section 140.9(c)5: Systems in locations where the outdoor dew point temperature is greater than or equal to 66°F at the ASHRAE 2% annual dehumidification design condition.

Exception 3 to Section 140.9(c)5: Systems dedicated to vivarium spaces or to spaces classified as Biosafety Level 3 or higher.

140.9(c)6 Exhaust Air Heat Recovery. Buildings with greater than 10,000 CFM of laboratory exhaust shall include an exhaust air heat recovery system that meets the following:

1. A sensible energy recovery ratio of at least 45% at heating design conditions and 25% at cooling design conditions
2. Heat is recovered from at least 75% of all lab exhaust air
3. The system includes a run-around coil pump or other means to disable heat recovery

4. The system includes a bypass damper or other means so that the exhaust air pressure drop through the heat exchanger does not exceed 0.4”w.g when heat recovery is disabled.

Exception 1 to Section 140.9(c)6: Additions or alterations to existing laboratory exhaust systems that do not include exhaust air heat recovery.

Exception 2 to Section 140.9(c)6: Buildings where the total laboratory exhaust rate exceeds 20 cfm/ft2 of roof area.

Exception 3 to Section 140.9(c)6: Buildings in Climate Zones 6 or 7 in jurisdictions where gas heating is allowed.