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Department of Health Care Access and Information

Designing Hospitals for Wildfire Smoke:
HVAC Strategies for Resilience and Readiness

By

Abdel K Darwich, PE, ASHRAE Fellow, LEEP AP, HFDP

Mikhail Fuks, PE, HFDP, DBIA

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SAMANTHA MILLER,
Architect, LEED AP
Senior Architect
State of California, Department of Health Care Access and Information
Samantha.Miller@hcai.ca.gov
(916) 440-8492

MIKHAIL FUKS,
PE, HFDP, DBIA
Director of Engineering
Pan-Pacific Mechanical
HBSB Member
mikhailf@ppmechanical.com
(310) 357-7031

ABDEL DARWICH, PE
ASHRAE Fellow,
LEED AP, HFDP
Principal, ***Guttmann and Blaevoet Consulting Engineers***
HBSB Consulting Member
adarwich@gb-eng.com
(916) 921-1981

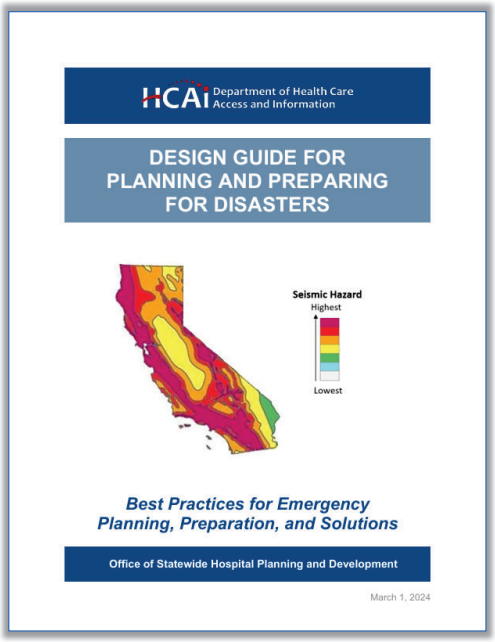
Department of Health Care Access and Information

OSHPD
Office of Statewide Hospital Planning and Development

HBSB
Hospital Building Safety Board

Why A Guide?

- Facilities managers want to know what they can do to be prepared
- Provide a resource to help evaluate how past events could impact future regulations and design requirements
- Provide a repository of information during crucial times
  - The guide presents various scenarios and design options to aid facilities, staff, and design teams in understanding additions to facilities and planning for future flexibility effectively
- Limit “Anything Goes” policies!
- Best practices for facilities to be better prepared for a disaster



How to Apply the Guide

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Alterations

- Planning for the unknown
- Providing flexibility in existing buildings
- What can be done ***now?***
- Adapting existing services and system
  - Facility access
  - Utility services
  - Emergency projects

New Facilities

- Planning for the unknown
- Go beyond code minimums during design
- Go beyond the code
- Include potential flexibility for future care types
- Identify options and provide best practices to allow for quick implementation

Who Should be Using the Guide

- Facility Operators
- Architectural and Engineering Design Teams
- Local Agencies, Planners
- Contractors
- Other people involved in planning for future impacts and reacting to situations when they arise

Purpose

At the start of the COVID 19 pandemic, facilities were struggling to find ways to provide safe patient care: safe for the staff as well as the patients.

OSHPD received many calls and questions as to what we were doing to assist.

In addition, people were asking what was going to change in how OSHPD did plan reviews and what code changes were anticipated for future code cycles.

OSHPD assembled people knowledgeable in healthcare regulations, planning, design, and operations. This included professionals, engineers, facility representatives, contractors, and many others that had experience in the many aspects of addressing and reacting to the pandemic and other emergencies.

The Emergency Design Task Force (EDTF) was born.

Emergency Design Task Force

The EDTF was tasked with identifying specific areas of concern for multiple types of events, such as pandemics, but also including wildfires and earthquakes amongst others. They were to look at how these past events could impact future regulations and design requirements.

It was determined that for normal everyday operations, the current regulations are fairly sufficient to meet the basic needs. Minor revisions are coming.

Adaptation

Adaptation

But what about those facilities that wanted to go above and beyond the basic needs?

Most, but not all, options to prepare for future events would most likely fit into this group.

The technology and processes learned would be optional approaches that a facility could decide to incorporate into their existing or proposed buildings. These options could include:

- switchable air volumes
- redundant services
- new technologies

If these were in place now, the facility would have flexibility in deployment in the future.

HCAI | HOSPITAL BUILDING SAFETY BOARD WEBINAR SERIES

2026 Schedule

Design Guide for Planning and Preparing for Disasters

Information at: https://hcai.ca.gov/facilities/building-safety/resources/building-safety-construction-webinars/

Session 1 – May 14, 2026

Wildfire and Wildland-Urban Interface Readiness for HealthCare Facilities

A preparedness-focused webinar examining wildfire and wildland-urban interface (WUI) risks, mitigation strategies, and operational planning measures to help healthcare facilities enhance resilience, continuity, and life safety during wildfire events."

Session 2 – June 10, 2026

Designing Hospitals for Wildfire Smoke: HVAC Strategies for Resilience and Readiness

An expert-led webinar exploring HVAC design strategies, filtration technologies, and operational best practices that help healthcare facilities maintain safe indoor air quality and operational continuity during wildfire smoke events.

Session 3 – July 7. 2026

Power Resilience, Regulatory Compliance, and the Future of Healthcare Infrastructure

A forward-looking webinar examining how healthcare organizations can strengthen power resilience, navigate evolving regulatory requirements, and modernize infrastructure systems to support reliable patient care and operational continuity.

Session 4 – TBD

Infection Control – HVAC + Design

A focused webinar on HVAC design, ventilation strategies, and air quality management practices that support infection prevention and control in healthcare environments.

Session 5 – TBD

Infection Prevention – Operations:

Designing Healthcare Facilities for Resilience, Surge, Readiness, and Infection Control Across Every Operational Mode

Session 6 – TBD

Hazard Vulnerability Analysis: A Systemic Approach to Risk Identification and Resilience Planning

A comprehensive webinar exploring hospital hazard vulnerability assessment methodologies, risk prioritization strategies, and preparedness planning to strengthen healthcare resilience and emergency readiness.

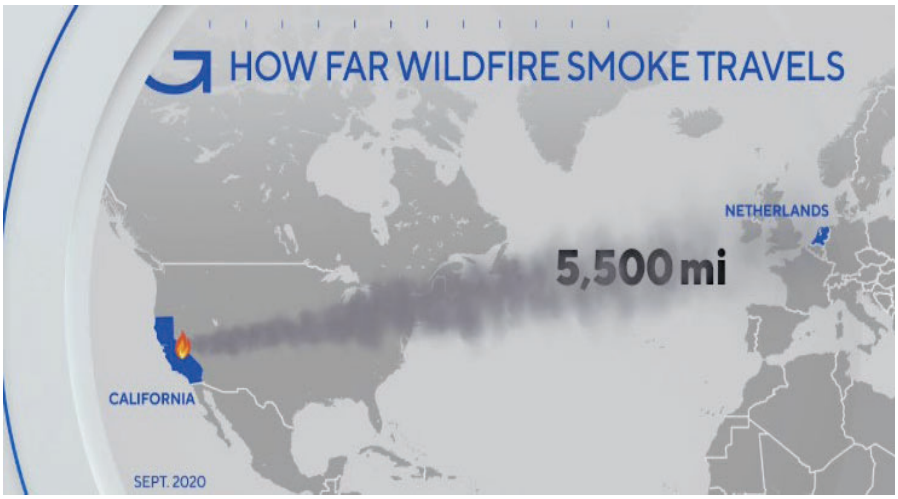
Agenda

- Background
  - Why this presentation?
  - What is wildfire smoke composed of?
  - What happens during a wildfire?
  - Types of Filters
  - Sources : HCAI DGPPD and ASHRAE Guideline 44
- Concepts to protect buildings from wildfire smoke
- Knowing first
- Planning second
- How does wildfire smoke enter a building
- Measures to mitigate wildfire smoke
- Healthcare Facilities Extra Precautions
- Triple Murphy's Law
- The future

Wildfire Smoke is a hazard!

Smoke from Wildfires is also a hazard in addition to the fire itself

It can travel hundreds and thousands of miles!

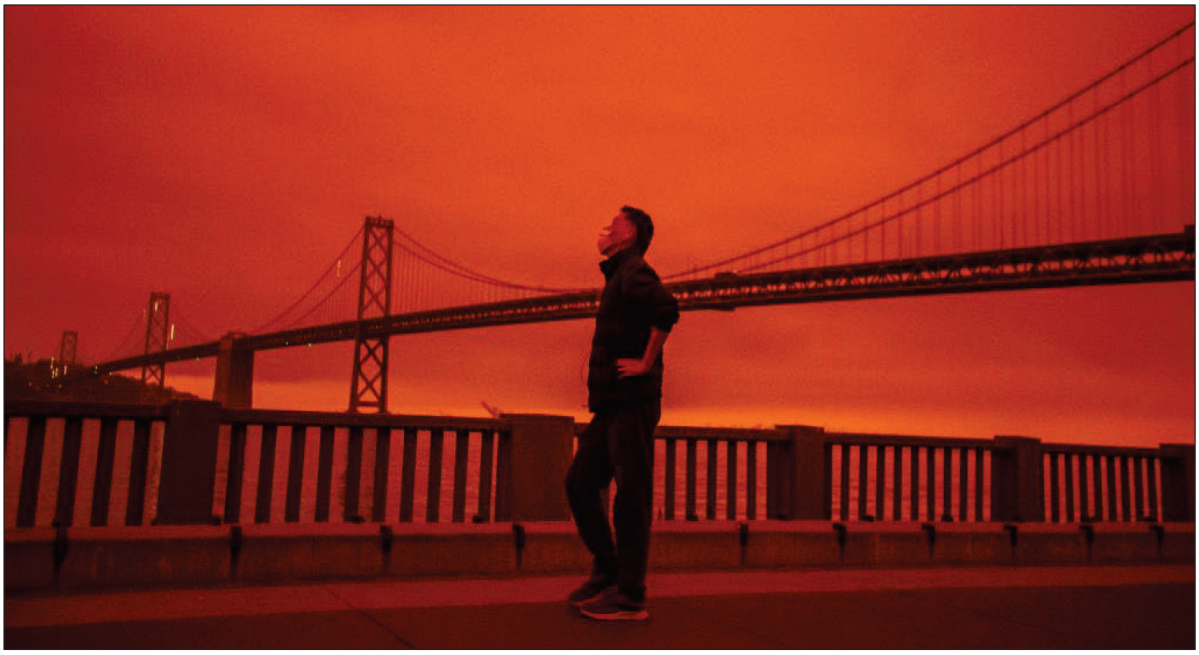


Sacramento

October 2018

Sacramento

November 2018

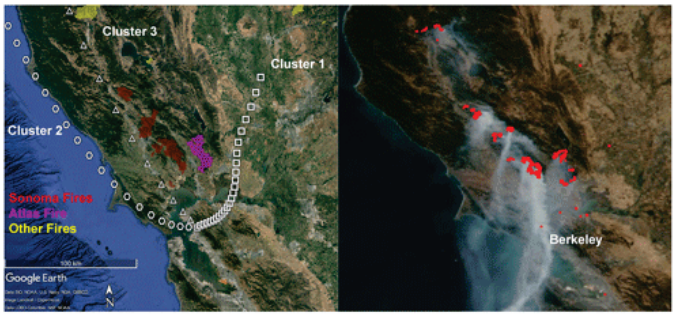


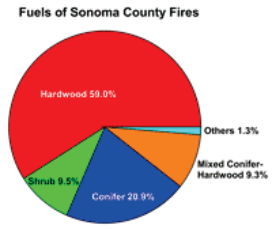
San Francisco September 2020

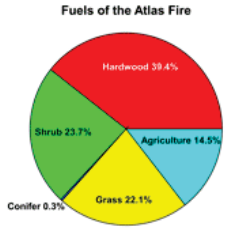
Los Angeles 2025

What is wildfire smoke composed of?

- Wildfire smoke composition depends upon multiple factors
  - the types of wood and vegetation burning
  - the moisture content
  - the fire temperature
  - wind conditions
  - other weather-related influences
- Getting more complicated with Wildfires/Urban fires





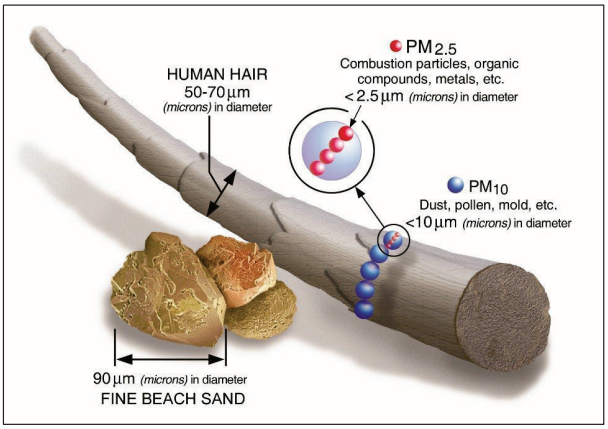


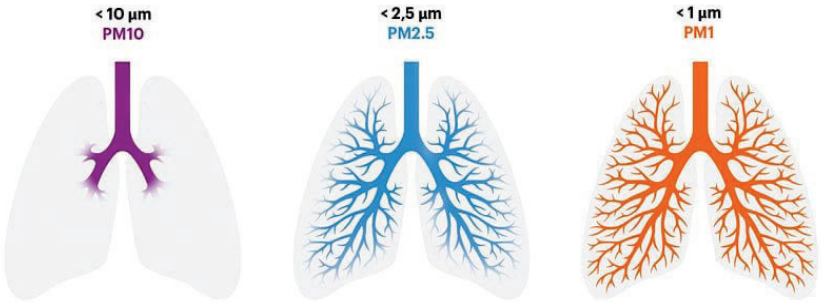
What is wildlife fire composed of?

- Gases
  - Oxides of nitrogen (NOX)
  - Volatile organic compounds (VOCs) – *most "smellable"*
  - Ground-level ozone (O3) formed when NOX and VOCs interact with UV in sunlight
- Particles
  - Composition : Carbon, heavy metals
  - Size : All sizes but PM2.5 *most dangerous*
  - Recent research showing ultra fine particles present

PM2.5

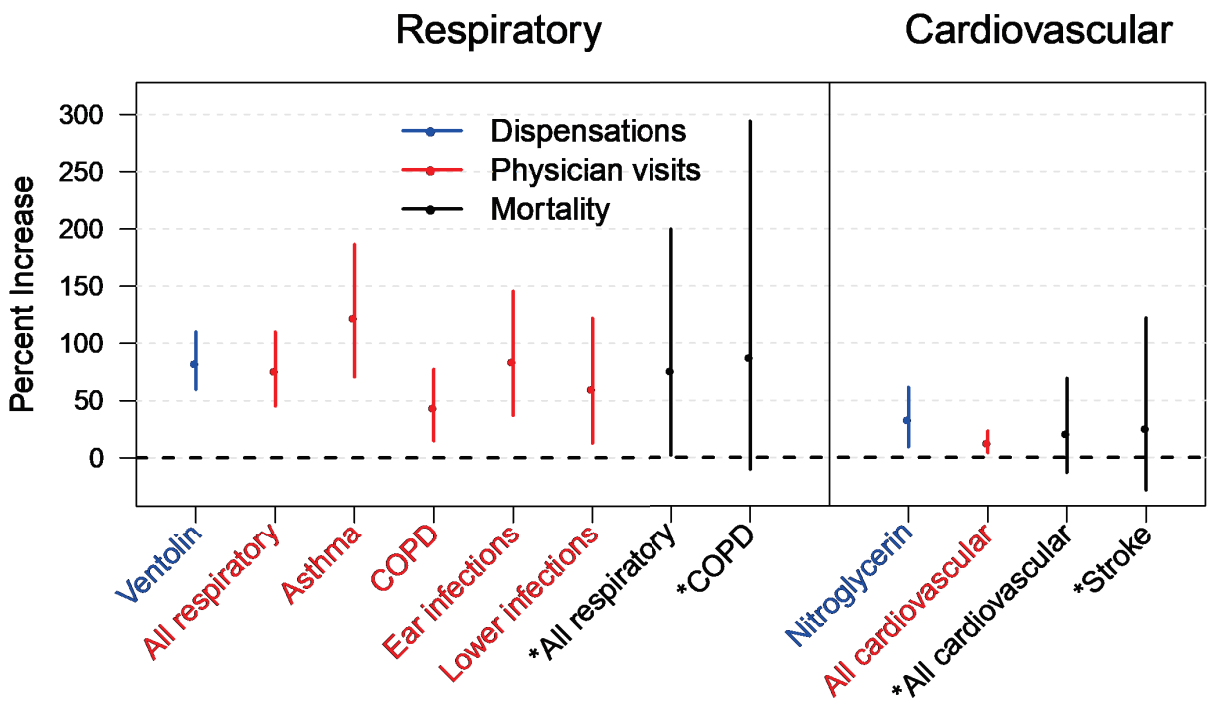
- Particulate Matter with particles that are 2.5 microns or less in diameter (PM2.5).
- Penetrates deep into the human lungs. Documented adverse heat effect.
- Most noticeable increase in wildfires





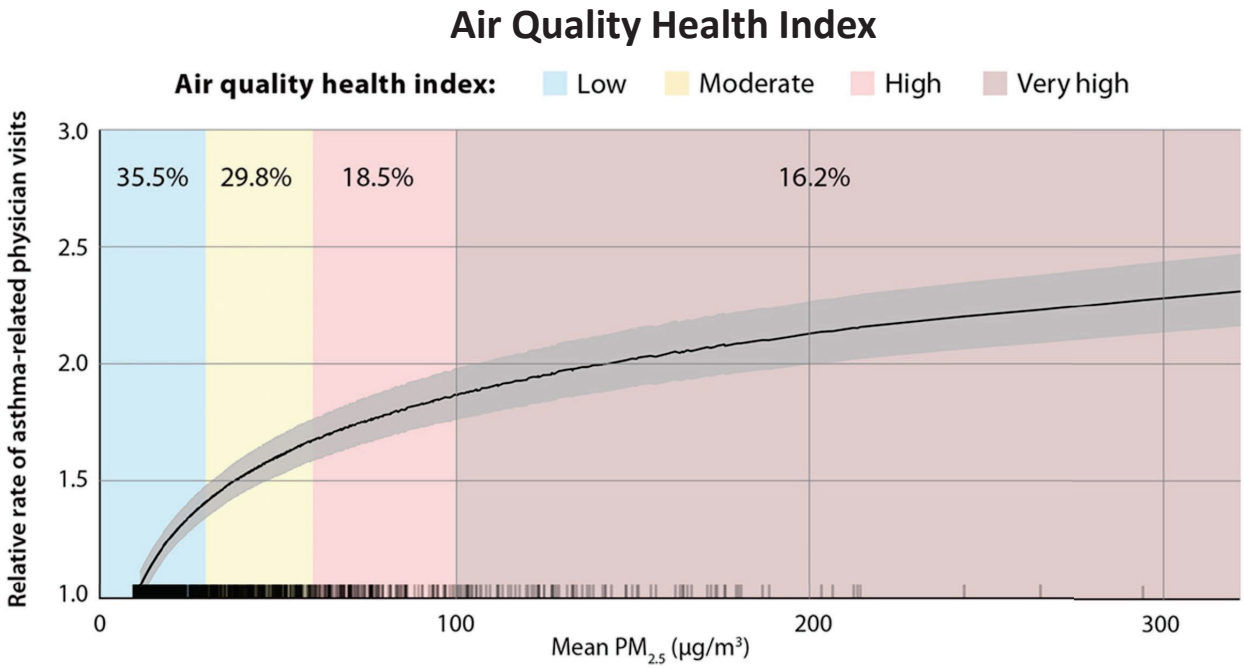
Acute Effects on a Smoky Day in British Columbia

(100 µg/m³ $PM_{2.5}$)



*Unpublished data

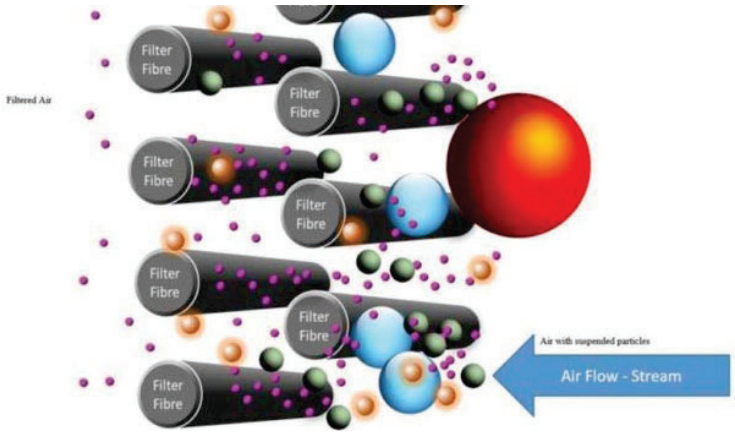
The Acute Effects are NOT Linear



bcmj.org/bc-centre-disease-control/public-health-paradox-wildfire-smoke

Types of filters

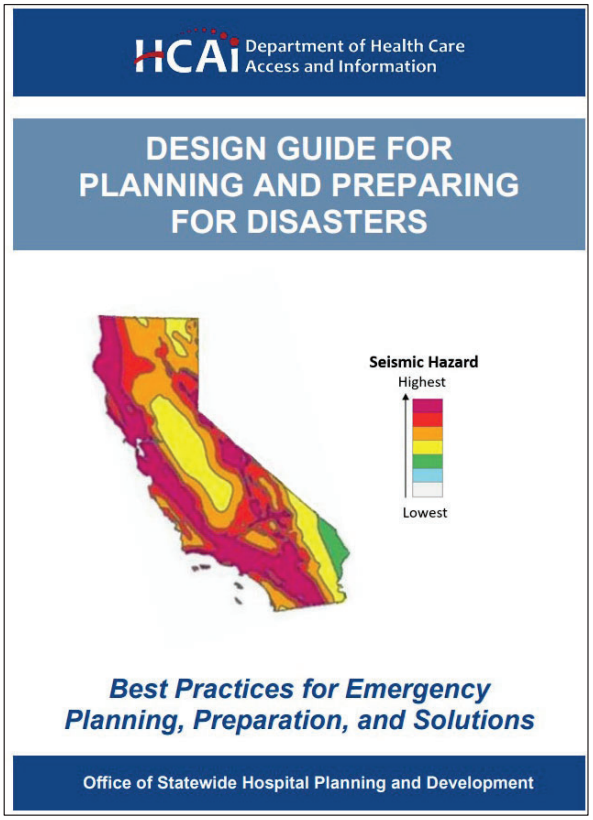
- Particulate filters
  - Stops particulate by interception
  - Cannot stop gases
  - MERV/HEPA rated filters
- Gas Phase filters
  - Physical
  - Chemical



Sources of Info

1. HCAI/OSHPD- Design Guide for planning and preparing for Disasters

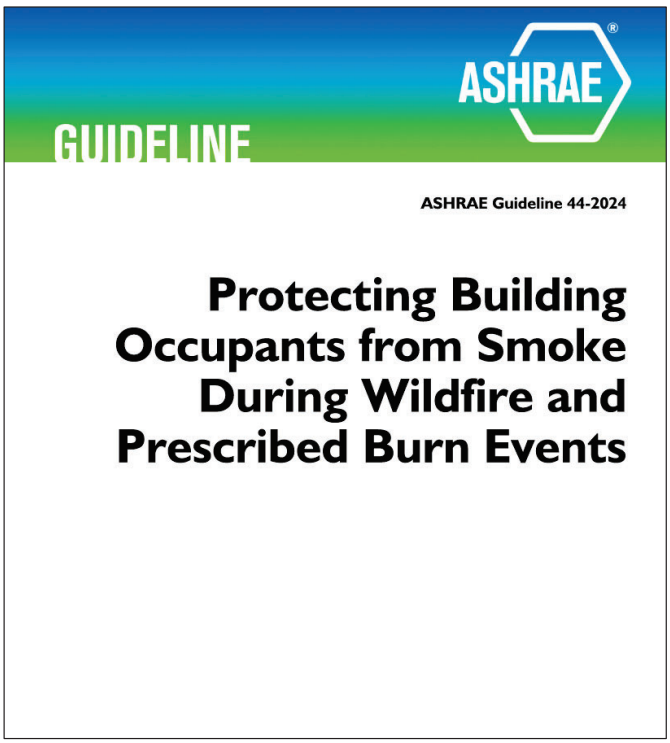
- Worked on it 2020-2022
- Published in March 2024
- Section 7 is titled “HVAC System Considerations for Handling Smoke During Wildfires
- The guide will be updated based on recent research and publication



Sources of Info

2. ASHRAE Guideline 44

- Committee started July 2021
- Detour : Published a white paper in 2022. Used as a basis for HCAI DGPPD.
- Published Guideline 44 in January 2025
- Free access after LA and Canadian fires



24

Protecting a building from a wildfire smoke

Key concepts

- Knowing
- Planning
- Preventing smoke from getting indoors
- Removing smoke contaminants that get indoors

Knowing first…

PM2.5 sensors

- Recommendation: install permanent PM2.5 sensors
  - Outside (not Outside Air intake) OR data can be obtained online from an adjacent regional monitor
  - Entryways: in hallways, ambulance bays, and loading docks near a building entrance to assess smoke ingress in the building
  - High occupancy areas, or areas occupied by at-risk populations

Knowing

Planning second…

- Extended periods of significant smoke are no longer a surprise.
- There is no longer such a thing as fire season.
- Planning is key. A plan is necessary for the next wildfire.
- **Nothing good happens at the last minute**

Planning

Planning second…

Develop a Smoke Readiness Plan (SRP): 4 parts. More details in DGPPD Section 7.2 and Guideline 44 Section 6.

Questions to get started:

- Will the building be occupied during a smoke event?
- If so, for 1 day? Or for the duration?
- Any specific areas of refuge?

1. Preparation section
   - The What: Specific building elements for controlling smoke
   - The Who: Roles and responsibilities of staff responsible for implementing the plan
   - The how much: Expected costs associated with implementing the plan

Planning

Planning second…

Develop a Smoke Readiness Plan (SRP):

2. Testing section
   - Test all components, sensors and the overall plan
3. Implementation section
   - When to implement the plan
4. Return to normal operations
   - When and how to return to normal operations

Coordinate Smoke Readiness Plan with Infection Control Group in healthcare facilities.

Planning

Communication of the smoke readiness plan (SRP)

- Facilities O&M should know the SRP and be trained on implementing it
- For new project, include in the OPR (Owner Project Requirement) and the BOD (Basis of Design)
- Include in Sequence of Operations and make sure it is commissioned

Planning

How does wildfire smoke enter a building?

- **Intakes** - outdoor air intakes at HVAC systems
- **Doors** - entrance and egress points into the building
- **Envelope elements** - windows, skylights, or other penetrations in the opaque envelope
- **Leakage** through the opaque envelope
- **Emissions** from contaminated clothing from occupants

Preventing

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Outdoor air intakes measures

- Minimize outdoor air
- Do not completely shut down outdoor air!
- Disable economizers
- If 100% OA, consider going to recirculation
- Seal any ducts that are outdoor and under negative pressure
- Natural ventilated spaces – switch to mechanical

Preventing

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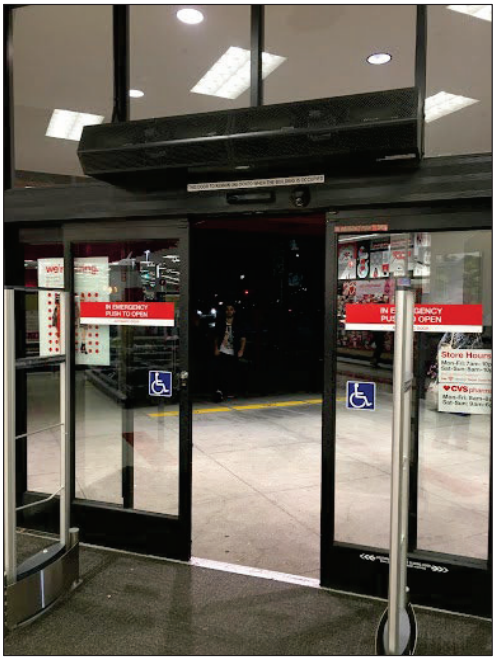
Doors/Entrances measures

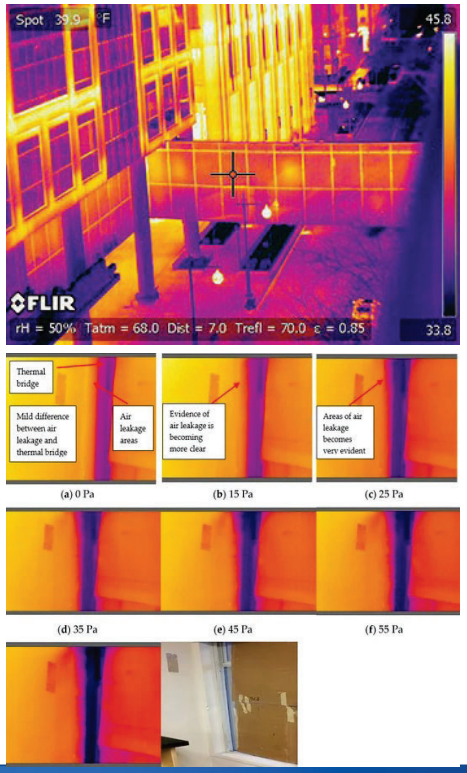
- Positively pressurized vestibules at all entrances
- Air curtains at all frequently used doors like ED, loading docks
- If new building, avoid doors facing prevailing wind direction



Preventing

Envelope measures

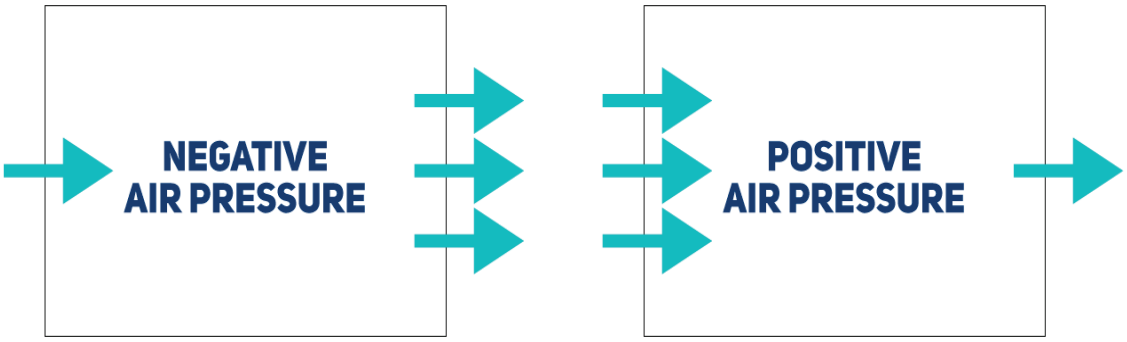
- Weatherize the building envelope, doors, and windows to reduce smoke infiltration by sealing and caulking cracks
- If existing building:
  - Visual inspection
  - Professional inspection
- If new building:
  - Commission the envelop
  - Set air leakage goals



Preventing

KEEP your building positive

- Always keep outside air more than exhaust air
- Use your BMS! Building Management System
- Install airflow measuring stations if needed



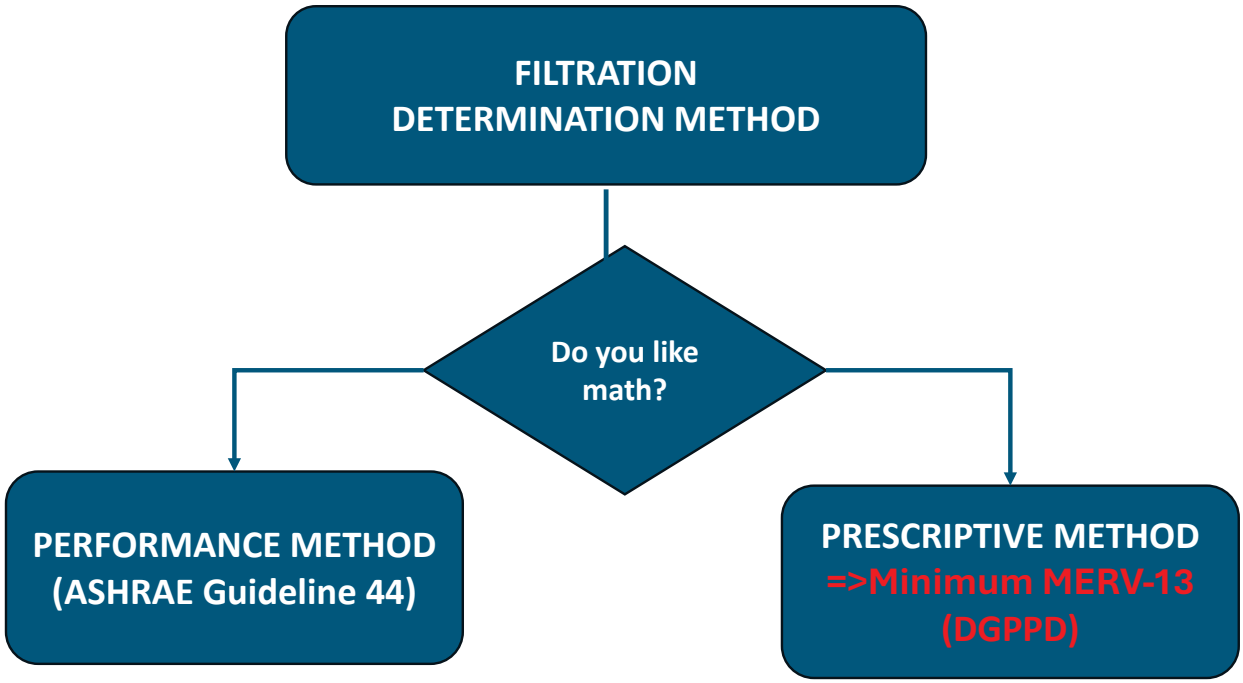
Preventing

Filtering wildfire smoke

- Most important goal: filter PM2.5 → Particulate Filters
- Optional: Filter gases
- What filter efficiency is needed?

Figure 7.3 – Filter Before and After Load From Wildfire

Removing



Removing

Chapter 5

Prescriptive Method
Filter minimum MERV method

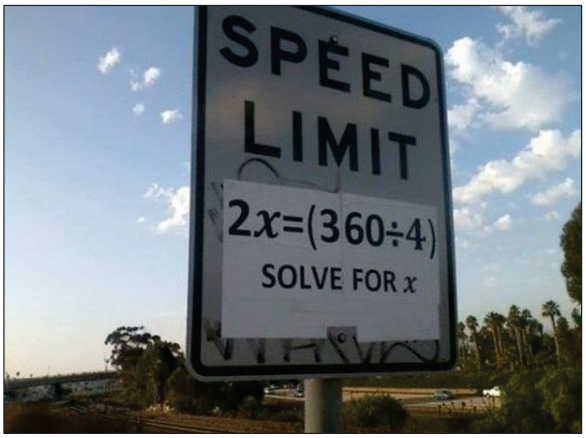
- MERV = Minimum Efficiency Reporting Value
- DGPPD and ASHRAE Guideline 44 → Minimum MERV-13
- MERV-13 will stop 85% of PM2.5 passing through

Removing

Filter efficiency Performance method

ASHRAE Guideline 44 equation with the following variables:

- Outdoor PM2.5 concentration
- Airflow
- Indoor PM2.5 concentration
- Filter efficiency



Removing

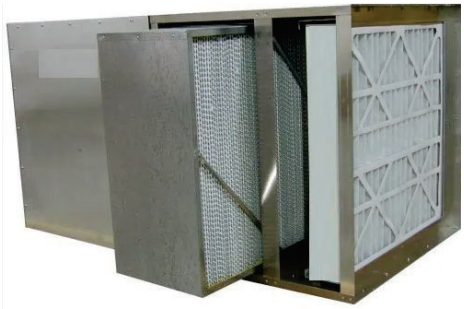
Other filter considerations

- Frequency of filter change during a wildfire event
  - ASHRAE Guideline 44 gives a method and example
  - Filter loads. When does it fail?
  - Anticipate to change filters very frequently and have them in stock
- Inspect existing filter frames for any leakage!

Removing

Filters-going beyond the minimum

- Have empty racks in AHUs for HEPA and gas phase filters (e.g. carbon filters)
- Need to size the fan and the VFD to account for extra pressure drop
- Extra filtration -> extra energy usage



Removing

Portable air cleaners

- Additional localized filtration
- Purchase in advance and store
- Make sure they do not generate ozone
- Rating is still residential by AHAM. CADR = Clear Air Delivery Rate.
- For wildfire fire smoke, AHAM recommends CADR equal to the size of the room in square feet, e.g., for a room of 120 sq.ft , the CADR should be 120
- For new projects, plan for more power outlets and storage space
- The deployment of PACs in health care facilities should be reviewed with the facility infection control team. Given the large areas in hospitals, the airflow from PACs may become large enough to compromise infection control.

Removing

Non-HVAC filters in hospitals

- Non-HVAC filters will also load up from wildfire smoke
- Medical Air Compressor –Filter on air intake
- Filter in medical equipment like NICU incubators
- Have a full inventory and lots of spare

Healthcare facilities

- Continuous operation under even severe wildland fire smoke. Hospital emergency departments near the fire must remain operational to treat firefighters and affected community residents.
- Hospitals may contain clean rooms (e.g., compounding pharmacies). Smoke could rapidly load the filters in these areas.
- Spaces in health care facilities have to maintain a certain pressure (positive or negative). Consult with Infection control before changing OA or changing pressure especially in :
  - Operating room suites
  - Nurseries and pediatric care
  - Patient waiting and outpatient care areas
  - Patients in hematology/oncology units who may have compromised immune systems

Requirements

Comply with any of the following options for up to two points:

Option 1. Management Mode for Episodic Outdoor Ambient Conditions — New Construction Only (1 point)

This option applies to LEED BD+C: New Construction projects only.

Design systems with the capability to operate an episodic outdoor event management mode as described in *ASHRAE Guideline 44*. The mode should address varying outdoor conditions or events that could negatively influence indoor air quality, such as wildfire smoke. Include the management mode in the design and commissioning documents. Verify proper implementation of the mode during commissioning.

The future

- Wildfires will be a continuous threat
- Buildings MUST be designed for this disaster
- LEED v5 will have one credit point for applying Guideline 44 to mitigate wildfire smoke

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Triple murphy's law

- EARTHQUAKE + PANDEMIC +WILDFIRE ?
- YES in August to November to 2020 in Northen California
- Wildfire = Minimize Outside Air
- Pandemic = 100% OA (maybe not after ASHRAE 241)
- What to do ?

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Thank You

Questions

Abdel K Darwich adarwich@gb-eng.com
Mikhail Fuks mikhailf@ppmechanical.com