A WHITE PAPER

The Health Hazards of PM2.5

Why fine particle pollution matters — and the minimum HVAC filtration needed to protect human health

Prepared by SoCal Filters and Service, Inc.
For building owners, facility managers, and property teams
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Executive Summary

Fine particulate matter — commonly called PM2.5 — is the most dangerous and pervasive air pollutant most Americans breathe every day. These particles are small enough to travel deep into the lungs and cross into the bloodstream, where a growing body of peer-reviewed research links them to heart attacks, strokes, asthma, COPD, dementia, weakened bones, and premature death.[1][2]

The problem is especially acute in Southern California. The American Lung Association's **State of the Air 2025** once again named Los Angeles the nation's smoggiest city, and ranked the Bakersfield–Delano and Los Angeles metro regions among the top five for both short-term and year-round particle pollution.[5][6]

HVAC filtration is one of the most cost-effective tools a building operator has to reduce occupant exposure. But the MERV 6–8 pleated filters installed in most commercial buildings today were designed to protect equipment — not people. They capture almost none of the PM2.5 fraction.

> **Our recommendation.** To meaningfully protect building occupants from PM2.5, install filtration rated **MERV 13 or higher** wherever the air-handling equipment can accept the pressure drop. MERV 13 is the lowest MERV rating that is tested and proven to capture the submicron (0.3–1.0 µm) particle range where PM2.5 lives — removing 50% or more of these particles per pass.

1. What Is PM2.5?

Particulate matter (PM) is a mixture of microscopic solids and liquid droplets suspended in the air. The EPA classifies PM by size:[1]

- **PM10** — inhalable particles up to 10 micrometers in diameter (dust, pollen, mold).
- **PM2.5** — fine particles 2.5 micrometers and smaller. A single human hair is roughly 70 micrometers across — about 30 times larger than the largest PM2.5 particle.[1]

PM2.5 comes from combustion: diesel and gasoline exhaust, power plants, industrial processes, woodstoves, and wildfires. A large share forms secondarily in the atmosphere when sulfur dioxide and nitrogen oxides react with other chemicals.[1]

2. The Health Hazards of PM2.5

Because PM2.5 particles are small enough to reach the deepest alveolar sacs of the lung — and in some cases cross directly into the bloodstream — they drive a wide range of serious health outcomes documented across thousands of peer-reviewed studies.[1][2]

Cardiovascular and respiratory disease

Exposure to PM2.5 triggers and worsens asthma attacks, reduces lung function, and is linked to chronic obstructive pulmonary disease (COPD), heart attacks, strokes, and premature death in people with heart or lung disease.[2][5]

Vulnerable populations

The EPA and the American Lung Association identify the following groups as at elevated risk from particle pollution: people with heart or lung disease (including asthma and COPD), older adults, children and

teenagers, pregnant people, outdoor workers, and minority populations that disproportionately live near major pollution sources.[2][5]

Wildfire smoke — a rising PM2.5 threat

Wildland fires now account for roughly **44% of the nation's primary PM2.5 emissions**, according to EPA.[4] Wildfire smoke can travel hundreds of miles and harm health far from the flame front. It contains PM2.5, carbon monoxide, nitrogen oxides, volatile organic compounds, and — when structures and vehicles burn — polycyclic aromatic hydrocarbons and heavy metals.[7]

Beyond the lungs: emerging evidence

Newer research has linked long-term PM2.5 exposure to effects well beyond the respiratory system, including reduced bone mineral density and increased fracture risk in post-menopausal women,[8] as well as cognitive decline and accelerated neurodegenerative disease.

3. Why This Matters in Southern California

The American Lung Association's **State of the Air 2025** ranked Los Angeles the nation's smoggiest city for the 25th time in 26 years, and placed the Bakersfield–Delano region as the nation's worst for both short-term spikes and year-round PM2.5. Los Angeles, Visalia, and Fresno ranked in the top five for year-round particle pollution.[5][6]

Nationally, **156 million Americans — nearly half the country — live in counties that received an F grade for either ozone or particle pollution**, the most in a decade.[5]

25 of 26	years LA has been the nation's smoggiest city
~44%	of U.S. primary PM2.5 emissions come from wildland fires
156M	Americans live in counties with an F grade for ozone or particle pollution
9.0 µg/m³	is EPA's 2024 annual PM2.5 standard (down from 12 µg/m³)

4. The Air Quality Index (AQI) — Updated 2024 Breakpoints

In February 2024, EPA strengthened the National Ambient Air Quality Standard (NAAQS) for annual PM2.5 from 12.0 to **9.0 µg/m³**, and revised the AQI breakpoints to reflect the latest health science. Under the new scale, the Moderate (Yellow) category now begins at 9 µg/m³ rather than 12 µg/m³.[4]

AQI Range	Category	Color	What It Means for Building Occupants
0 – 50	**Good**	● Green	Satisfactory; little to no health risk.
51 – 100	**Moderate**	● Yellow	Unusually sensitive people may notice symptoms.
101 – 150	**Unhealthy for Sensitive Groups**	● Orange	Heart/lung disease, children, older adults affected.
151 – 200	**Unhealthy**	● Red	Everyone may begin to experience health effects.
201 – 300	**Very Unhealthy**	● Purple	Health alert; serious effects possible for all.
301 – 500	**Hazardous**	● Maroon	Emergency conditions; entire population affected.

Source: EPA AQI (2024 breakpoints).
[3] [4]

5. How Air Filtration Is Rated: ASHRAE 52.2 and MERV

Air filters are tested and rated under **ANSI/ASHRAE Standard 52.2**, which measures removal efficiency across 12 particle-size ranges between 0.30 and 10.0 micrometers. Those ranges are grouped into three bins:[9]

- **E1** — 0.30 to 1.0 µm (the core of the PM2.5 fraction)
- **E2** — 1.0 to 3.0 µm (upper end of PM2.5, fine bacteria)
- **E3** — 3.0 to 10 µm (coarse dust, mold spores, pollen)

A single **Minimum Efficiency Reporting Value (MERV)** from 1 to 16 is assigned based on the lowest efficiency measured in each bin. The higher the MERV, the finer the particle the filter is proven to capture.[9]

MERV Efficiency in the PM2.5 Size Range

MERV	E1 (0.3–1.0 µm)	E2 (1.0–3.0 µm)	E3 (3.0–10 µm)	What It Captures
6	—	—	<20%	Pollen, dust mites, textile fibers
8	—	≥20%	≥70%	Mold, spores, hair spray, cement dust
11	≥20%	≥65%	≥85%	Humidifier dust, lead dust, auto emissions
13	**≥50%**	**≥85%**	**≥90%**	**Bacteria, most smoke, PM2.5 fraction**
14	**≥75%**	**≥90%**	**≥95%**	**Cooking oil, most smoke, virus carriers**
15	**≥85%**	**≥90%**	**≥95%**	**Submicron particles, droplet nuclei**
16	**≥95%**	**≥95%**	**≥95%**	**All bacteria, most tobacco smoke**

Shaded rows meet or exceed the recommended MERV 13 threshold for PM2.5 protection. Source: ASHRAE 52.2-2017. [9]

> **Why MERV 13 is the floor.** MERV 8 and MERV 11 filters are **not tested in the 0.3–1.0 µm range at all** — the exact range where PM2.5 lives. MERV 13 is the first rating that both measures and guarantees performance against submicron particles, capturing at least 50% of the 0.3–1.0 µm fraction and at least 85% of 1.0–3.0 µm particles.

6. SoCal Filters' Minimum Filtration Recommendations

The table below reconciles ASHRAE's published recommended minimums by application with current PM2.5 health science. Where ASHRAE's guidance predates the 2024 PM NAAQS update, we have raised the floor to **MERV 13** for any space occupied by people.[10][11]

Building / Space Type	ASHRAE Minimum	SoCal Filters Recommended	Notes
Office buildings	MERV 9–12	**MERV 13**	Protect occupants from traffic PM2.5; matches EPA guidance for COVID-era IAQ.
Schools & classrooms	MERV 6–8	**MERV 13**	Children have developing lungs and higher breathing rates per pound of body weight.
Warehouses with staff	MERV 9–12	**MERV 13**	Diesel forklift & truck exhaust raise indoor PM2.5 dramatically.
Retail, lobbies, hotels	MERV 6–8	**MERV 13**	General public access — includes sensitive groups.
Auditoriums, arenas, worship	MERV 8 (up to 13)	**MERV 13**	High occupant density; meet ASHRAE upper bound.
Healthcare — patient care	MERV 7 + MERV 14	**MERV 8 prefilter + MERV 14**	Per ASHRAE Standard 170.
Healthcare — surgery (Class A)	MERV 13	**MERV 8 prefilter + MERV 14 + HEPA**	Protective environments require HEPA.
Laboratories (chem/phys)	MERV 13	**MERV 13–14**	Chemical exposure risk; add carbon when needed.
Wildfire-smoke events	n/a	**MERV 13 + portable HEPA**	Supplement HVAC with portable HEPA during smoke events.

Source: ASHRAE Handbook (2015); ASHRAE Standard 170; EPA guidance.
[10] [11] [12]

7. Implementing MERV 13 in an Existing Building

Upgrading from MERV 8 to MERV 13 is straightforward in most commercial HVAC systems, but three practical considerations should be evaluated before specifying a new filter:

Pressure drop and fan capacity

Higher-MERV filters have more restrictive media. A modern pleated MERV 13 designed for commercial use typically has an initial resistance of 0.28–0.35 in. w.g. at 500 fpm — slightly higher than a comparable MERV 8. Most variable-air-volume and belt-drive constant-volume systems accept this without issue, but always confirm the unit's total external static pressure budget before specifying.[9]

Total cost of ownership — not just sticker price

A higher-efficiency filter costs more at purchase but the energy penalty is usually modest. Using SoCal Filters' published energy-cost worksheet, a 24×24 filter running at 2,000 cfm, 8,760 hours/year, and $0.14/kWh costs roughly **$96 per filter per year in fan energy at 0.35 in. w.g.** vs. about $69/year at 0.25 in. w.g. — a difference of less than $30/filter/year for a filter that captures 50× more PM2.5.[9]

Change-out intervals and monitoring

Install a Magnehelic or digital differential-pressure gauge across each filter bank and change filters at the manufacturer's recommended final resistance (typically 1.0 in. w.g. for commercial pleats). Do not change on a fixed calendar schedule — local dust loading varies widely between coastal, urban, and industrial Southern California sites.

Layered strategy for wildfire smoke events

During wildfire smoke events, even a MERV 13 main filter bank is improved by running portable HEPA cleaners in occupied rooms. EPA specifically recommends HEPA portable air cleaners as the most effective way to lower indoor PM2.5 during smoke episodes.[7]

8. Conclusion

PM2.5 is the air pollutant most closely tied to serious human health outcomes — and Southern California remains one of the hardest-hit regions in the country. The good news: HVAC filtration is a known, testable, standards-based intervention that dramatically reduces occupant exposure.

Every commercial and institutional building that houses people should be operating with a **minimum of MERV 13 filtration**, with higher-MERV or HEPA where the application demands it. The incremental cost is small. The public-health benefit is meaningful and measurable.

Ready to upgrade your filtration?
SoCal Filters and Service stocks MERV 8, 11, 13, 14, and HEPA filters in standard and custom sizes, delivers throughout the Los Angeles basin from our 20,000-sq-ft warehouse in Paramount, and can survey your HVAC equipment to recommend the right filter for every air handler. Call **424-216-5473** or email **David@socalfiltersinc.com**.

Sources and Further Reading

[1] EPA, "What is PM, and how does it get into the air?" https://www.epa.gov/pm-pollution/particulate-matter-pm-basics

[2] U.S. EPA, "Air Quality Guide for Particle Pollution," EPA-452/F-23-002, Feb. 2023. https://www.airnow.gov/publications/air-quality-guide/air-quality-guide-for-particle-pollution/

[3] U.S. EPA, "A Guide to Air Quality and Your Health," EPA-456/F-14-002, Feb. 2014. https://www.airnow.gov/aqi/aqi-basics/

[4] U.S. EPA, "Wildland Fire, Air Quality, and Public Health Considerations — Fact Sheet," Feb. 2024. https://www.epa.gov/system/files/documents/2024-02/pm-naaqs-wildland-fire-air-quality-fact-sheet-final-1.pdf

[5] American Lung Association, "State of the Air 2025," Apr. 2025. https://www.lung.org/research/sota

[6] American Lung Association, "Los Angeles remains nation's smoggiest city," news release, Apr. 2025. https://www.lung.org/media/press-releases/sota-2025-los-angeles

[7] Marcum, N., "Wildfire smoke can harm human health even when the fire is burning hundreds of miles away — a toxicologist explains why," The Conversation, Jun. 28, 2023. https://theconversation.com/wildfire-smoke-can-harm-human-health-even-when-the-fire-is-burning-hundreds-of-miles-away-a-toxicologist-explains-why-207873

[8] Prada, D., et al., "Air pollution and low bone mineral density," reported in MarketWatch, Feb. 23, 2023; published in eClinicalMedicine (Lancet). https://www.marketwatch.com/story/air-pollution-is-weakening-our-bones-osteoporosis-study-suggests-b9f9a0a2

[9] ASHRAE Standard 52.2-2017, "Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size." https://www.ashrae.org/technical-resources/bookstore/standards-62-1-62-2

[10] ASHRAE, "Recommended Minimum Efficiencies by Application" (ASHRAE Handbook). https://www.ashrae.org/

[11] ASHRAE Standard 170, "Ventilation of Health Care Facilities." https://www.ashrae.org/technical-resources/standards-and-guidelines

[12] U.S. EPA, "Air Cleaners, HVAC Filters, and Coronavirus (COVID-19)." https://www.epa.gov/coronavirus/air-cleaners-hvac-filters-and-coronavirus-covid-19

This white paper synthesizes published guidance from the U.S. Environmental Protection Agency, the American Lung Association, ASHRAE, and peer-reviewed medical literature. It is provided for informational purposes and is not a substitute for site-specific engineering analysis.