

Connecticut Green Bank Multifamily Housing Air Filtration Policy Guidelines and Requirements

The US EPA states that very small air pollution particles from highways and railroad yards are of concern for people living in residences nearby. These small airborne particles can create special health concerns for children, the elderly, and other vulnerable people living near highways and railroad yards. Nationwide, concerns have grown about traffic-related air pollution especially for minority populations and persons of lower socioeconomic status who experience higher residential exposure to traffic and traffic-related air pollution. A substantial number of Connecticut residents live with asthma. For residential projects near highways and railroad yards, air quality is a special concern, particularly those in the core cities of Bridgeport, Hartford, and New Haven, which are each ranked in the top 40 most challenging US cities for those living with asthma. These concerns are detailed further in the overview section below, where references are also provided to additional information. Since the health of Connecticut residents is a core part of the Connecticut Green Bank mission, this policy has been adopted for projects near high-volume roadways, railway switching yards, and other areas with significant local sources of small particulate air pollution.

Since smaller particles can penetrate further into the lungs, the size of air pollution particles is important in understanding and addressing this problem to the extent practical with building heating, ventilation, and air-conditioning systems. Smaller particles in the air are referred to as Particulate Matter or PM for short, with the terms PM 10 and PM 2.5 being used to refer to progressively smaller particle size. The terms “fine” and “ultra-fine” PM are also used similarly.

Typical heating, ventilation, and air-conditioning (HVAC) systems in multifamily residential buildings are provided by the manufacturers with ordinary air filters, which do little to remove these small particles, and only effectively remove larger particles. By upgrading these filters or providing other means of upgraded filtration independent of the HVAC systems, more of these smaller particles can be removed. The ability of air filters to effectively remove airborne particles is rated with a performance rating known as MERV, which stands for Minimum Efficiency Reporting Value. This rating is determined using an industry standard widely used in the USA by the heating and air-conditioning industry. The higher the MERV rating, the more effective the filter is against the smaller particles of particular health concern. More information on filter ratings is provided at the end of this document.

This policy does not address gas phase air pollution or contaminants such as ozone or combustion gases. Gas phase pollutants are complex, and air cleaning systems to remove them are rarified – these are found on submarines and in some airports, but are not typically found in most buildings.

Air Filtration Policy

Projects seeking Connecticut Green Bank financing located near highways, railway switching yards, or other areas with high concentrations of ambient PM are required to install and maintain a minimum level of air filtration, and to provide operators with training and occupants with information on the care and use of the systems and air filtration. This is because airborne Particulate Matter (PM) from highways and railroad yards is recognized by the scientific community and the US Environmental Protection Agency to cause or be associated with a variety of adverse health conditions, particularly for children, the elderly, and other vulnerable occupants.

Central air handling equipment shall be equipped with air filters with a rating of at least MERV 13. Dwelling units with operable windows shall also be provided with filtration with a rating of at least MERV 13, whether in a recirculating terminal unit or as a separate filter unit.

Specific distance from the roadway or other source to trigger MERV 13 filtration requirements will be reviewed by the Connecticut Green Bank on a project by project basis. Studies have shown the greatest impacts in effect zones ranging from approximately 300 to 500 yards.¹ Multiple environmental factors play a role in the radius of effect, such as wind, vegetation, etc. It may be prudent to conduct outdoor air quality testing as a predevelopment activity for Green Bank-funded projects near major roadways.

Occupant education is a key requirement of this policy. Improved air filtration is most effective when system fans are on and windows are closed. Even dwelling-unit filtration may have a limited effect on PM concentrations when windows are open.

The Standard of Care

The only available standard of care for filtration requirements for outdoor air intake is established by the American Society of Heating, Refrigerating, and Air-conditioning Engineers (ASHRAE), which develops national standards for the USA on indoor air quality and other topics in their competence using the American National Standards Institute (ANSI) consensus process. ANSI/ASHRAE Standard 62.1-2016 *Ventilation for Acceptable Indoor Air Quality* is the current ANSI approved version, and provides the basis for this Connecticut Green Bank policy on air filtration.² This standard requires *all* air conditioning systems to have air filters rated at least MERV 8. Because higher levels of air filtration do not substantially address PM_{2.5} unless they are rated MERV 13 or better, MERV 13 is the minimum required by the Connecticut Green Bank for projects located near highways, railway switching yards, or other areas with high concentrations of ambient PM. Even higher MERV ratings are encouraged since their effectiveness against PM_{2.5} is even greater.

¹ www.healtheffects.org/publication/traffic-related-air-pollution-critical-review-literature-emissions-exposure-and-health

² Standard 62.1-2016 covers all building types except low-rise residential; this type is addressed in ANSI/ASHRAE Standard 62.2-2016. This latter standard does not include any standard of care for filtering outdoor air intake.

ASHRAE Standard 62.1-2016 requires the investigation of outdoor air quality for suitable use as ventilation air both on a regional and on a local, site-specific basis. Regional air quality criteria for attainment or nonattainment with the *National Ambient Air Quality Standards* (NAAQS) notably include Particulate Matter over 10 microns (micrometers or 10^{-6} meters, a human hair is about 75 microns in diameter), referred to as PM10; and Particulate Matter over 2.5 microns. Connecticut includes nonattainment areas for ozone (a gas phase contaminant), but since September of 2013 the entire state has been designated by the US EPA as attaining compliance with PM10 and PM2.5.³ Despite this regional attainment status state-wide, localized areas such as those near highways and railway switching yards present significant risk for PM10 and PM2.5 above levels considered acceptable under the NAAQS (150 and 35 micrograms per cubic meter, respectively, on a 24-hour averaging basis). Because of this significant risk, the Connecticut Green Bank requires MERV 13 air filters or better for projects located near highways, railway switching yards, or other areas with high concentrations of ambient PM. In some cases, the investigation of outdoor air quality for suitable use as ventilation air on a local, site-specific basis as required by ASHRAE Standard 62.1-2016 may raise even more specialized local concerns such as gaseous contaminants from a local source. Such project-specific issues may require more extensive solutions. For example, while more effective particle filtration benefits occupants, it will not address gas-phase contaminants. Creative solutions for acceptable indoor air quality are encouraged and will be considered on a project by project basis.

Overview

The health of Connecticut residents is a core part of the mission of the Connecticut Green Bank. In the affordable multi-family sector, the Bank shares concerns that have grown nation-wide about traffic-related air pollution, reported by the Center for Disease Control as follows, “A growing body of evidence demonstrates that minority populations and persons of lower socioeconomic status experience higher residential exposure to traffic and traffic-related air pollution than nonminorities and persons of higher socioeconomic status.”⁴ The National Institutes of Health has published research on respiratory health risks for children living near railyards.⁵

Nearly one-tenth of Connecticut residents live with asthma⁶, according to the US Center for Disease Control. For these Connecticut residents, air quality is of special concern, particularly those living in the core cities of Bridgeport, Hartford, and New Haven, which are each ranked in the top 40 most challenging US cities for those with asthma.⁷ While acceptable indoor air quality is important for all, it is critical for asthma sufferers and other vulnerable sectors of the population.

Health Issues

Airborne particulate matter (PM), as is found near high-volume roadways and railways, is associated with a variety of adverse health conditions, particularly in children, according to the US Environmental

³ http://www.ct.gov/deep/cwp/view.asp?a=2684&q=321762&depNav_GID=1744

⁴ www.cdc.gov/mmwr/preview/mmwrhtml/su6203a8.htm

⁵ www.ncbi.nlm.nih.gov/pmc/articles/PMC4703713/

⁶ https://www.cdc.gov/asthma/most_recent_data_states.htm

⁷ <http://www.aafa.org/page/asthma-capitals.aspx>

Protection Agency (EPA). The EPA states, “People with heart or lung diseases, children, and older adults are the most likely to be affected by particle pollution exposure.”⁸ The EPA further states that, “Exposure to such particles can affect both your lungs and your heart. Numerous scientific studies have linked particle pollution exposure to a variety of problems, including: premature death in people with heart or lung disease, nonfatal heart attacks, irregular heartbeat, aggravated asthma, decreased lung function, [and] increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing.”

The scientific consensus on the dangers of airborne PM from nearby highways and major roads is well-established and accepted by various governmental organizations, based on a range of available research. The Health Effects Institute, in *A Special Report of the HEI Panel on the Health Effects of Traffic-Related Air Pollution*, stated, “...the evidence is sufficient to support a causal relationship between exposure to traffic-related air pollution and exacerbation of asthma among children.”⁹

It has been estimated that 53,000 U.S. deaths annually are attributable to automobile emission air pollution, with many more being affected by non-fatal illness.¹⁰ For comparison, there are 32,000 U.S. deaths a year from auto collisions.¹¹ In California, these concerns have focused attention on this issue.¹² In San Francisco and Los Angeles, residential projects near high-traffic roadways are required to include MERV 13 air filters.¹³

Filter Upgrades

EPA recommendations for air filtration in schools near roadways state that, “In schools with central HVAC systems, medium-efficiency filters (MERV 6–7) tend to reduce particle concentrations by approximately 20% to 65%, while higher performance filters (MERV 11–16) can reduce particle concentrations from 74% to 97% relative to outdoor concentrations.”¹⁴ While not the only answer to airborne contaminants, and certainly not addressing all of the air pollution risks from highways and rail, upgraded air filters are widely considered a viable and practical response.

Filter Ratings

MERV is a rating for particulate air filters used by the industry to rate the ability of an air filter to remove varying percentages of different particle sizes. MERV ratings are determined by tests performed according to an industry standard, *ANSI/ASHRAE Standard 52.2-2017 -- Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size*. MERV ratings lower than 13 do not require testing with ultrafine particles under 1 micron, which are of particular concern for health, and perform poorly against these fine particles if so tested. The table below also shows that filters rated

⁸ www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm

⁹ www.healtheffects.org/publication/traffic-related-air-pollution-critical-review-literature-emissions-exposure-and-health

¹⁰ lae.mit.edu/wordpress2/wp-content/uploads/2013/08/US-air-pollution-paper.pdf

¹¹ www.fars.nhtsa.dot.gov/Main/index.aspx

¹² sandiego.urbdeazine.com/2015/05/28/what-is-a-safe-distance-to-live-or-work-near-high-auto-emission-roads/

¹³ www.sfdph.org/dph/eh/Air/Article38.asp

¹⁴ www.epa.gov/schools/best-practices-reducing-near-road-pollution-exposure-schools

MERV 8 and below are not tested for PM2.5, as they would perform poorly against fine particles if so tested.

TABLE 1: APPLICATION GUIDELINES

MERV Std 52.2	Intended Dust Spot Efficiency Std 52.1 (2)	Average Arrestance	Particle Size Ranges	Typical Applications	Typical Filter Type
1 - 4	<20%	60 to 80%	> 10.0 µm	Residential/Minimum Light Commercial/ Minimum Equipment Protection	Permanent / Self Charging (passive) Washable / Metal, Foam / Synthetics Disposable Panels Fiberglass / Synthetics
5 - 8	<20 to 60%	80 to 95%	3.0-10.0 µm	Industrial Workplaces Commercial Better / Residential Paint Booth / Finishing	Pleated Filters Extended Surface Filters Media Panel Filters
9 - 12	40 to 85%	>90 to 98%	1.0-3.0 µm	Superior/Residential Better/Industrial Workplaces Better/Commercial Buildings	Non-Supported / Pocket Filter / Rigid Box Rigid Cell / Cartridge V-Cells
13 - 16	70 - 98%	>95 to 99%	0.30-1.0 µm	Smoke Removal General Surgery Hospitals & Health Care Superior/ Commercial Buildings	Rigid Cell / Cartridge Rigid Box / Non-Supported / Pocket Filter V-Cells
MERV Std 52.2	Efficiency		Typical Applications		Typical Filter Type
17 - 20 ¹ <i>Deleted from ASHRAE</i>	99.97%-99.9999%		Hospital Surgery Suites Cleanrooms Hazardous Biological Contaminants Nuclear Material		HEPA ULPA

Note: This table is intended to be a general guide to filter use and does not address specific applications or individual filter performance in a given application. Refer to manufacturer test results for additional information.

(1) ASHRAE does not have a test procedure for HEPA testing and has thus dropped the MERV 17 - 20 classifications.

(2) ANSI/ASHRAE 52.1 ranges are provided for reference only. The ANSI/ASHRAE 52.1 Standard was discontinued as of January 2009.

Table downloaded September 25 2017 from <https://www.nafahq.org/understanding-merv/>

Conclusion

Based on the information presented here, air filtration upgrades along with maintenance staff and tenant education requirements are seen as prudent by the Connecticut Green Bank for projects near highways, railway switching yards, and other significant sources of fine particulate.