



H&V News Safety Summit 2021

Clearing the air – the battle for IAQ






Lead sponsor since 2011

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23 March 2021

Clean Air in London's mission

	Air pollution	Greenhouse gases
London or any city	Air pollution, cities, health and justice	
Rest of world		

Clean Air in London's mission for COP26 and beyond

	Air pollution	Greenhouse gases
London or any city	Air pollution, cities, health and justice	 COP26
Rest of world	 COP26	 COP26

(c) 2021 Clean Air in London

What is air pollution?

- Local air pollution and greenhouse gases
- Local air pollution comprises particles and gas
- Particles are regulated as a lump for health and legal purposes e.g. $\text{PM}_{2.5}$ and PM_{10} . Typically, particle mass or number concentrations
- Cloud of gases can include carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3) and many others
- Pathogens e.g. COVID-19

What is the health advice?

Air pollution is the world's largest environmental health risk

- WHO Air Quality Guidelines 2005 (published 2006)
- WHO Housing and health guidelines (2018)

<https://www.who.int/publications/i/item/9789241550376>

“In the absence of updated or indoor-specific guideline values, the air quality guidelines are considered applicable for indoor exposure as well. An update of these guidelines is under way.” Section 8.2, Page 95

- Inquest into the death of Ella Roberta Adoo Kissi-Debrah focused on illegal levels of NO₂ i.e. traffic air pollution. Air pollution ‘significantly caused’ and ‘significantly contributed’ to her death
- New WHO Air Quality Guidelines are expected in 2021. May include particle number concentrations

Where can I find information about outdoor air pollution?

- Monitoring – real time, scientific monitoring
 - Defra's national and locally managed monitors
<https://uk-air.defra.gov.uk/networks/network-info?view=nondefraaqmon>
 - London Air Quality Network
 - Air Quality England
- Defra and other alert forecasts but 'maps' look 'Green' 330 days of the year
- Modelling – 20 metre to one kilometre square grids
- Other sources e.g. addresspollution.org
- Your own monitoring e.g. NO₂ diffusion tubes

What's different indoors?

- 'Supply' air from outside can include traffic and other pollutants
- Pollution from indoor sources
 - Cleaning products
 - Cooking – carbon monoxide (CO) and oxides of nitrogen (NO_x)
 - Dust
 - Fireplaces, stoves and candles
 - Furniture
- Pathogens such as COVID-19

We spend around 90% of our time indoors

Which pollutants should I measure?

- Particle number and mass concentrations
- Carbon dioxide
- Carbon monoxide
- Formaldehyde
- Nitrogen dioxide
- Ozone. Likely to be an increasing concern. Most-irritant for humans
- Volatile organic compounds
- Other environmental metrics: Humidity, temperature and pressure
- Wellbeing and profitability: Sickness, energy and productivity

Improving indoor air quality

Address traditional pollutants and COVID-19

1. What pollutants are you targeting? Pathogens? PM₁. Traffic pollution?
2. What building constraints e.g. ducted system or standalone units
3. Quality, temperature, humidity of supply air? Location of air intake?
4. If multiple technologies are used, which work(s) best?
5. 'Cleaning' or 'treating' the air? If 'treating', distance and airspeed?
6. 20% supply air; 80% recirculation is typical with five air changes/hour
7. Multi-stage filtration can provide cumulative 'cleaning' e.g. 70%→97%
8. What UK, EU or international guidance or standards apply?
9. Ongoing compliance (e.g. cleaning), monitoring and improvements
10. We need to 'walk and chew gum' to reduce energy and improve air quality

Don't forget the new planning system

London Plan March 2021

14 mentions of the importance of reducing people's exposure to air pollution or poor air quality

Knightsbridge Neighbourhood Plan 2018 -2037

Policy KBR34(D): Healthy air

Major development must demonstrate that it is designed to ensure that indoor air quality complies with the latest WHO guidelines for short and long term air quality including particulate matter (PM_{2.5} and PM₁₀), nitrogen dioxide (NO₂), carbon monoxide (CO), formaldehyde and volatile organic compounds (VOCs). Carbon dioxide (CO₂) concentrations in indoor air should also be considered. Compliance with such standards is also encouraged on medium development and substantial refurbishment schemes

Good guidance

Much evidence confirming airborne transmission of COVID-19

- ‘Ashrae Epidemic Task Force’ (6 January 2021) - Core recommendation for Reducing Airborne Infectious Aerosol Exposure
<https://www.ashrae.org/file%20library/technical%20resources/covid-19/core-recommendations-for-reducing-airborne-infectious-aerosol-exposure.pdf>
- BESA – A beginner’s guide to indoor air (March 2021)
<https://www.thebesa.com/knowledge/shop/products/a-beginners-guide-to-indoor-air-quality/>
- WHO – Roadmap to improve and ensure good indoor air ventilation in the context of COVID-19 (1 March 2021).
<https://www.who.int/publications/i/item/9789240021280>

World Health Organisation guidance

“The risk of getting COVID-19 is higher in crowded and inadequately ventilated spaces where infected people spend long periods of time together in close proximity. These environments are where the virus appears to spread by respiratory droplets or aerosols more efficiently, so taking precautions is even more important.” Note: corrigenda

Executive summary. Page ix, March 2021

<https://www.who.int/publications/i/item/9789240021280>



ASHRAE EPIDEMIC TASK FORCE

Core Recommendations for Reducing Airborne Infectious Aerosol Exposure

1. *Public Health Guidance* - Follow all regulatory and statutory requirements and recommendations for social distancing, wearing of masks and other PPE, administrative measures, circulation of occupants, reduced occupancy, hygiene, and sanitation.
2. *Ventilation, Filtration, Air Cleaning*
 - 2.1 Provide and maintain at least required minimum outdoor airflow rates for ventilation as specified by applicable codes and standards.
 - 2.2 Use combinations of filters and air cleaners that achieve **MERV 13** or better levels of performance for air recirculated by HVAC systems.
 - 2.3 Only use air cleaners for which evidence of effectiveness and safety is clear.
 - 2.4 Select control options, including standalone filters and air cleaners, that provide desired exposure reduction while minimizing associated energy penalties.



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Latest UK, EU and international standards

Those who write 'guidance' may not understand the latest 'standards' or that most buildings need ventilation, temperature control and filtration

- BS EN 16798-3: 2017. Energy performance – Ventilation for buildings
- BS EN ISO 16890:2016. Particulate air filters for general ventilation
- BS EN ISO 10121-2:2013. Gas phase air filters for general ventilation
- ASHRAE 52.2-2012 – Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size

Ashrae filter test standards refer to 'Minimum Efficiency Reporting Value' (MERV) which have approximate equivalent ratings in ISO 16890:2016 e.g. the recommended equivalent of MERV 13 is ePM₁ 80% (or ePM₁ 60% minimum)

<https://www.ashrae.org/technical-resources/filtration-and-disinfection-faq>

Airborne liquid aerosol droplets from infected people

Hazardous droplet size range
Mobility and Viability for infection

Droplet
0.5 μm
diameter



4 approx. Sars-CoV-2 diameters

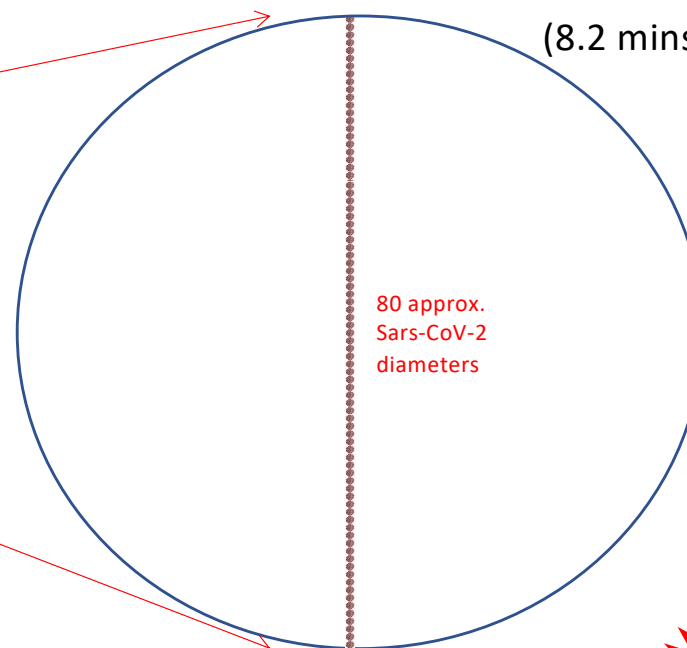
This is the aerosol droplet size range that needs to be removed as it remains airborne for a longer period of time

0.5 μm
Highly mobile - light
Highly penetrating
Large in number
Long airborne capability (41 Hours / 5 Feet)

Borderline infection viability
Sensitive to air conditions – e.g. evaporation

10 μm
diameter

10 μm
Mobile gravity limited
Less penetrating
Less in number
Short airborne time
(8.2 mins / 5 Feet)



80 approx. Sars-CoV-2 diameters

NEW - Covid19 virus size at 0.12 μm to 0.16 μm

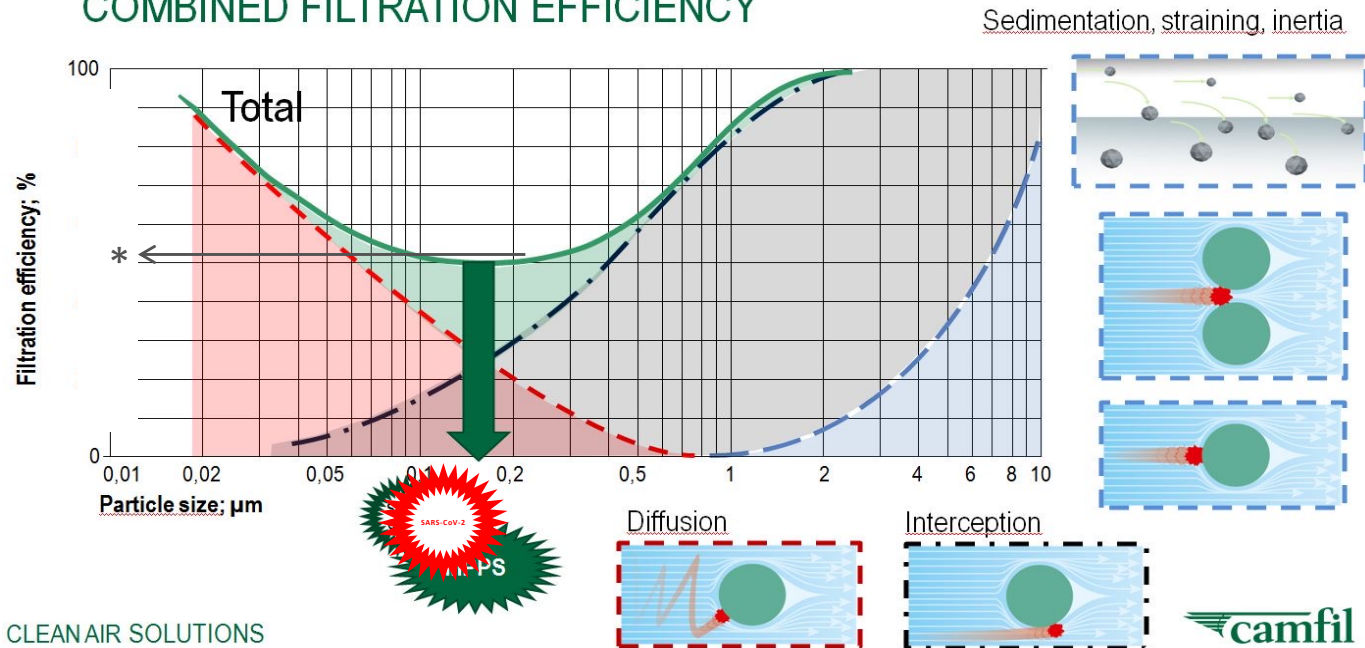


BS EN 1822:2019 HEPA filter testing using MPPS to challenge the filter



COMBINED FILTRATION EFFICIENCY

Dip in graph illustrative at 99% not 50%



CLEANAIR SOLUTIONS

HEPA MPPS – matches Covid19 virus size at 0.12µm to 0.16µm so test efficiency is accurate.

BS EN 1822-1 2019		
Filter class and group	Overall value	
	Efficiency (%)	Penetration (%)
E10	≥ 85	≤ 15
E11	≥ 95	≤ 5
E12	≥ 99.5	≤ 0.5
H13	≥ 99.95	≤ 0.05
H14	≥ 99.995	≤ 0.005
U15	≥ 99.9995	≤ 0.0005
U16	≥ 99.99995	≤ 0.00005
U17	≥ 99.999995	≤ 0.000005

EN1822:2019 tested HEPA filters are capable and fit for purpose



*


Understand the technology being used in your building (E&OE)

	Building clean indoor air technology	Process	Performance standard	Independent testing
	'Air cleaning' – HVAC or standalone air filtration		BS EN ISO technical standards	
	Particle air filtration for general ventilation	Mechanical particle removal	BS EN ISO 16890:2016	Yes
	High efficiency particle air filtration e.g. HEPA	Mechanical particle removal	BS EN 1822:2019 ISO 29463:2017	Yes
	Molecular or gas phase air filtration e.g. carbon	Adsorption Chemisorption	BS EN ISO 10121-2:2013 WHO Air Quality Guidelines	Yes
	Electrostatic air filtration	Electrostatic particle removal	?	?
	'Air (or surface) treatments'			
1	Ultraviolet germicidal irradiation e.g. UV lamp	Irradiation	BS ISO 15714:2019	?
2	Photocatalytic oxidation	Chemical	?	?
3	Pulsed light	Irradiation	?	?
4	Ionisation	Ion particle effect	?	?
5	Ozone	Chemical	?	?
6	Green technologies e.g. vegetation	Biological	?	?
7	Thermal disinfection or desiccation	Irradiation	?	?
8	Microwaves	Irradiation	?	?
9	Ultrasonication	Energy shock	?	?
10	Plasma technology (similar to corona)	Irradiation	?	?
11	Corona discharge (ionisation related)	Irradiation	?	?
12	Free radicals	Electron pairing	?	?
13	Chemical disinfection	Chemical	?	?
14	Antimicrobial coatings	Chemical	?	?

Air filter groups and classes

Group or type of particle air filters	Filter class ISO 16890 or EN1822 for E10 and above	Example of use	Average collection efficiency for the most penetrating particle size (MPPS)% EN1822	ISO 16890 tested PM efficiency for particles %	ISO 16890 Gravimetric Arrestance of test dust ISO 15957-L2 %
Coarse	ISO Coarse 70%	Warehouses			70%
Medium	ePM ₁₀ 50%	Protection of ventilation systems		PM ₁₀ 50% removed in one pass	
	ePM _{2.5} 50%			PM _{2.5} 50% removed in one pass	
Fine	ePM ₁ 70%	Schools		PM ₁ 70% removed in one pass	
	ePM ₁ 80%	Laboratories		PM ₁ 80% removed in one pass	
	ePM ₁ 85%	Healthcare		PM ₁ 85% removed in one pass	
Efficient particulate filters	E10	Precision tooling	85% @ MPPS		
	E11		95% @ MPPS		
	E12		99.5% @ MPPS		
High efficiency particulate filters	H13 and H14	Operating theatres	Over 99.95% @ MPPS		
Ultra low penetration air filters	U15, U16 and U17	Space craft	Over 99.9995% @ MPPS		

British and European standard BS:EN 16798-3 *for buildings since 2017*

Outdoor Air Quality (ODA)		Supply Air Quality (SUP) e.g. SUP 1 for higher indoor air quality			
		SUP 1 (High)	SUP 2 (Medium)	SUP 3 (Moderate)	SUP 4 (Low)
Increasing pollution 	ODA 1 eg. countryside	ISO coarse + ePM ₁ 85%	ISO coarse + ePM ₁ 80%	ePM ₁ 70%	ePM ₁₀ 50%
	ODA 2 eg smaller towns	ePM ₁ 70% + ePM ₁ 85%	ePM ₁₀ 50% + ePM ₁ 80%	ePM ₁₀ 50% + ePM ₁ 70%	ePM ₁₀ 50% + ePM _{2.5} 50%
	ODA 3 eg city centres	ePM ₁ 70% + GF + ePM ₁ 85%	ePM ₁ 70% + GF + ePM ₁ 85%	ePM ₁₀ 50% + ePM ₁ 70%	ePM ₁₀ 50% + ePM _{2.5} 50%
GF = Gas filter (carbon filter) and/or chemical filter. Table based on appendix A.3 “Use of air filters” in European standard BS:EN 16798-3					

EN779 classifications are outdated and replaced by ISO16890. Indoor air depends on supply, recirculation and indoor sources

Guidance needing updating for the latest standards

- HTM-03 (1 November 2007): Indoor air quality in hospitals may be no better than warehouses
<https://www.gov.uk/government/publications/guidance-on-specialised-ventilation-for-healthcare-premises-parts-a-and-b>
- BB101 (23 August 2018): Referred to outdated standards when published
<https://www.gov.uk/government/publications/building-bulletin-101-ventilation-for-school-buildings>
- NICE guidance – Indoor air quality at home (8 January 2020). Air cleaning?
<https://www.nice.org.uk/guidance/ng149>
- All guidance and standards will need updating for new WHO Air Quality Guidelines 2021

We can protect ourselves from 90% of air pollutants for up to 90% of the time

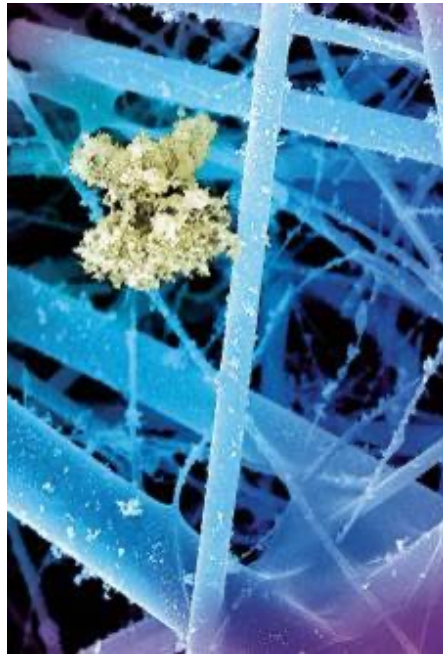


Photo of soot particles in air filter

Photo: Lennart Nilsson

If your office has a mechanical ventilation system or air conditioning (i.e. it is likely to contain the necessary ducting) please ask your facilities manager:

“Does our ventilation system include regularly maintained air filters that comply fully with BS EN 16798-3 (2017)?”

Or ask about standalone units

For further advice please visit www.camfil.com or call 01706 238 000

Climate change and COP26

- Energy efficiency
- Increasing air pollution concern
- Ozone increasing
- Urban heat island effect – more air conditioning
- Vector borne diseases e.g. mosquitoes and malaria

Remember that buildings may have ventilation, air conditioning and/or air filtration or none of these.

Next steps

Address traditional pollutants and COVID-19

- New WHO Air Quality Guidelines in 2021
- UN right to a safe, clean, healthy and sustainable environment
- Air Quality Expert Group report on indoor air quality in the UK
<https://uk-air.defra.gov.uk/news?view=273>
- Call for a new Clean Air Act to include indoor quality where H&S applies
https://cleanair.london/app/uploads/CAA_New-Clean-Air-Act_First-draft-011220.pdf
<https://publications.parliament.uk/pa/bills/lbill/2019-2019/0021/20021.pdf>
- UN Climate Change Conference (COP26) in November 2021
- Update guidance and standards for new WHO Air Quality Guidelines



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Useful links

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- Defra's national network <https://uk-air.defra.gov.uk/>
- Defra – locally-managed automatic monitoring
<https://uk-air.defra.gov.uk/networks/network-info?view=nondefraaqmon>
- London Air Quality Network
<https://londonair.org.uk/LondonAir/Default.aspx>
- Air Quality England <https://www.airqualityengland.co.uk/>
- Indoor air standards
<https://www.feta.co.uk/associations/hevac/specialist-groups/filter-group>