Specialised Ventilation for Healthcare Society

Air Filter Working Group

Change in Air Filter Test and Classification standards

Document SVHSoc.02-V1.2
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The Specialised Ventilation for Healthcare Society (SVHSoc.)

The Society was formed in November 2014 with the aim of bring together those who were practicing or wished to become Authorising Engineers (Ventilation) (AE(V)) or who have a more general interest in Ventilation in the Healthcare setting.

- The SVHSoc. meet several times a year at various locations around the UK.
- Full membership of the Society is open to registered AE(V)'s.
- The Society "Code of Conduct" is issued with all quotations for AE(V) services.
- The Society maintains a register containing details of practicing AE(V)s.
- A set of competencies have been drawn up for prospective AE(V)s.

- Associate membership is open to anyone interested in Ventilation for Healthcare.
- A significant portion of the Society meetings is given over to discussing and clarifying interpretation of HTM03-01 and other healthcare ventilation standards.

Looking ahead the SVHSoc. would expect to be involved in any update or rewrite of Healthcare ventilation standards.

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The following documents have been issued by SVHSoc. to help clarify Healthcare Ventilation requirements

SVHSoc.01-V1.2	Operating Theatres - Energy Control Strategies and the Surgeon's panel Published April 2017
SVHSoc.02-V1.2	Change in Air Filter Test and Classification standards Published November 2018

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Air Handling Unit Filters

Background

This guidance note has been developed in response to the new BS EN 16798-3:2017 which has replaced BS EN13779:2007. The BS EN defines the recommended last filter stage in air conditioning in correlation with the outside air quality and the required indoor air quality.

The air filter test standard and efficiency classification system were changed in 2016 from BS EN 779:2012 to BS EN 16890:2016. The guidance will explain how to determine the Outside Air Quality, pick the appropriate Supply Air Category and select a suitable filter classification.

It is important to recognise that in the Healthcare setting these new standards are not concerned with airborne infection protection but relate to the "Breathable" air quality for all persons within a building.

Standards of filtration required for infection control are given in HTM 03-01; Specialised Ventilation for Healthcare Premises; Part A. These will typically equal or exceed the "Breathable" air quality requirements and may include the need for HEPA filters.

For further information regarding "Air Quality" values please refer to Appendix 1

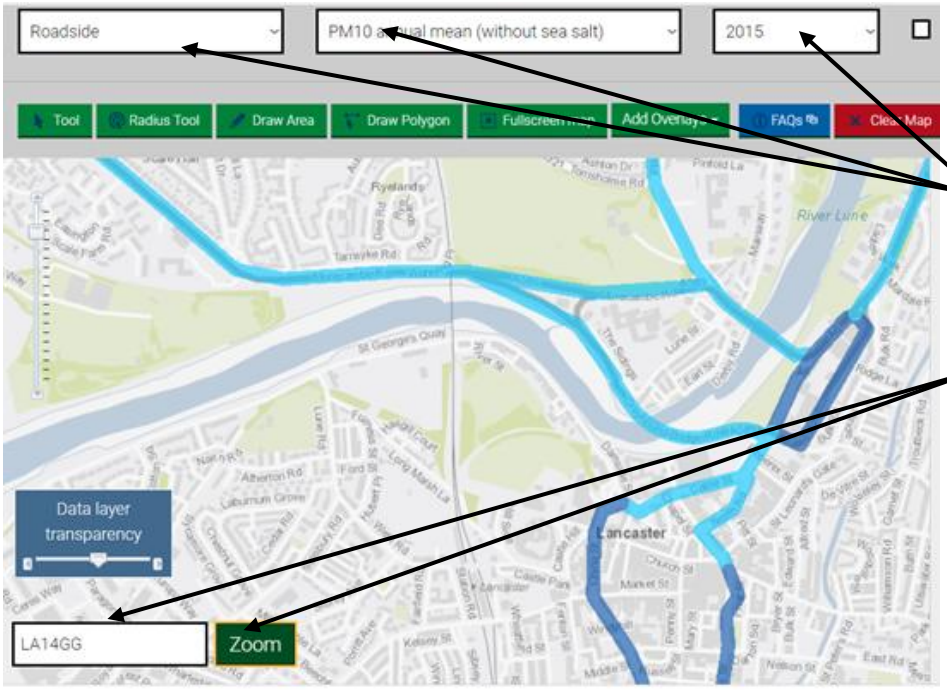
Definitions

IAQ - Indoor Air Quality
AHU – Air Handling Unit
ODA – Outdoor Air Quality
PM – Particulate Matter
ePM*x* - Particulate Matter Filter efficiency (Where "x" represents particle size 1, 2·5, or 10µm).
WHO – World Health Organisation
DHC – Air Filter Dust Holding Capacity
SUP – Supply Air category
UCV - Ultra Clean Ventilation
HEPA - High Efficiency Particulate Air (filter)

Step 1

Determination of Outdoor Air Quality (ODA)

On the Internet go to https://uk-air.defra.gov.uk/data/gis-mapping



Enter Postcode, zoom until you find your location and identify the colour code

Select Roadside, PM10 (without sea salt), for the last available year

PM_{10} excluding sea salt roadside concentration

Annual mean (µg m^{-3})

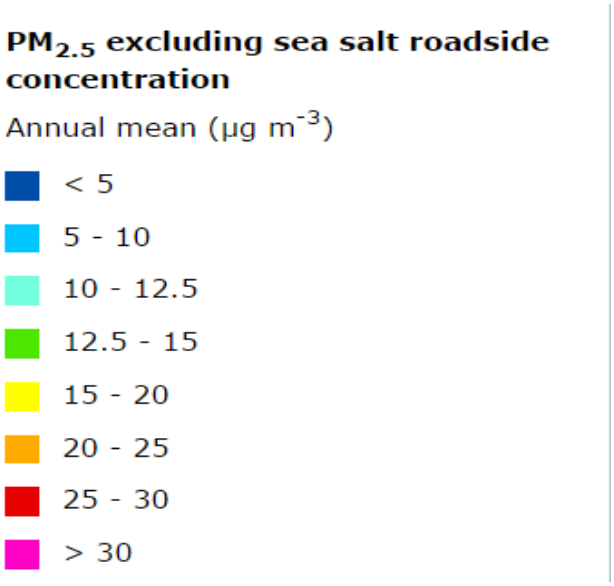
- < 13
- 13 - 17
- 17 - 20
- 20 - 25
- 25 - 30
- 30 - 31.5
- 31.5 - 40
- > 40

The colour coding of the roads correspond to an annual mean

PM 10 concentration

ODA 1	ODA 2	ODA3
< 13	20 - 25	30 - 31.5
13 - 17	25 - 30	31.5 - 40
17 - 20		> 40

Next enter PM2·5 annual mean (without sea salt) and press zoom again



The colour coding of the roads correspond to an annual mean PM 2·5 concentration

ODA 1	ODA 2	ODA3
< 5	10 - 12.5	15 - 20
5 - 10	12.5 - 15	20 - 25
		25 - 30
		> 30

The highest of both groups determines your ODA class, as the thresholds for PM 10 and PM 2·5 are not the same.

Step 2

Determination of pre-filter and second filter stage in the AHU. (Please note HEPA filtration is not covered by the BS EN normal definitions).

Second Filter stage

The BS EN 16798-3:2017 defines 5 supply air categories.

Eurovent interprets the BS EN for all supply air in hospitals as SUP1. The SVH Society does not concur with that view but considers a more specific classification as tabled below.

SVHSoc. Advice.

SUP1 Applications with high hygienic demands *(*Note additional HEPA filters may be required)*	**SUP2** Rooms with permanent occupation	**SUP3** Rooms with temporary occupation	**SUP4** Rooms with short -term occupation	**SUP5** Unoccupied Rooms
Isolation rooms ICU, CCU, SCBU, Burns Neutropeanic patient wards e.g. Oncology & Transplant Pharmacy Aseptic suites	Everything else not specified in SUP1,3,4 and 5 e.g.operating theatres, treatment rooms, general wards, offices, etc.	Decentralised Clean utilities Endoscopy clean & store Server rooms	Toilets Changing rooms Storage rooms	Underground car parks Rubbish rooms Charging stations

* Patients particularly vulnerable to airborne infection will be protected by additional HEPA filtration as required in NHS issued specific guidance, e.g. UCV Theatres and Neutropeanic isolation rooms.

The following table shows the recommended **Second Filter** stage with a Pre-filter of ePM10≥50% based on BS EN 16798

	Second Filter Stage				
Outdoor Air	**SUP1** PM2·5≤2·5µg/m³ PM10≤ 5·0µg/m³	**SUP2** PM2·5≤5·0µg/m³ PM10≤10 µg/m³	**SUP3** PM2·5≤7·5µg/m³ PM10≤ 15µg/m³	**SUP4** PM2·5≤10µg/m³ PM10≤ 20µg/m³	**SUP5** PM2·5≤15µg/m³ PM10≤ 30µg/m³
Category	ePM1	ePM1	ePM2·5	ePM10	ePM10
ODA 1	50%	50%	50%	50%	50%
ODA 2	60%	50%	50%	60%	50%
ODA 3	80%	60%	60%	80%	60%

Most common filter classes for majority of Healthcare premises

A simple 'translation' from EN779:2012 to BS EN 16890:2016 fails because of the very different measurement and assessment methods. There is no standard table available, so the following gives approximate equivalence for filters held in stock.

Approximate Classification Chart (May vary slightly between different suppliers)							
PM1		PM2·5		PM10		Coarse	
ISO ePM1 95%	F9	ISO ePM2·5 95%	F7	ISO ePM10 95%	M6	ISO Coarse 95%	G4
ISO ePM1 90%		ISO ePM2·5 90%		ISO ePM10 90%		ISO Coarse 90%	
ISO ePM1 85%		ISO ePM2·5 85%		ISO ePM10 85%		ISO Coarse 85%	
ISO ePM1 80%		ISO ePM2·5 80%		ISO ePM10 80%		ISO Coarse 80%	
ISO ePM1 75%	F8	ISO ePM2·5 75%		ISO ePM10 75%		ISO Coarse 75%	
ISO ePM1 70%		ISO ePM2·5 70%		ISO ePM10 70%		ISO Coarse 70%	
ISO ePM1 65%	F7	ISO ePM2·5 65%		ISO ePM10 65%		ISO Coarse 65%	
ISO ePM1 60%		ISO ePM2·5 60%	M6	ISO ePM10 60%	M5	ISO Coarse 60%	
ISO ePM1 55%		ISO ePM2·5 55%		ISO ePM10 55%		ISO Coarse 55%	G3
ISO ePM1 50%		ISO ePM2·5 50%		ISO ePM10 50%		ISO Coarse 50%	
						ISO Coarse 45%	
						ISO Coarse 40%	G2
						ISO Coarse 35%	
						ISO Coarse 30%	
Fine Filter		Medium Filter				Coarse Filter	

We strongly advise asking your supplier for their new filter test certificates!

N.B:- In times of renovation works or major building projects in, or adjacent to an occupied Healthcare facility, we recommend **during that period only** to fit an ePM1 ≥ 80% to limit the risk of Aspergillus spread.

First Filter stage (Pre-Filter)

In accordance with the Eurovent recommendations we advise that the first filter stage (pre-filter) for Air Handling Units (AHU's) delivered after 1 January 2016 should be a filter of PM10 efficiency ≥ 50%

However, for AHU delivered before that date it might be only possible to use Coarse filters with an efficiency ≥ 60% due to system pressure losses and fan capacity. (see table above).

Gas-Filters

It might be necessary to add Gas Filters (GF) [Activated carbon filters], not for odour control but for the elimination of high concentrations of gases such as NOX, O^3 and SOX.

Please see table below for Outdoor Air Quality (ODA) and Supply Air Quality (SUP) Categorisation.

	Supply Air Quality		
Outdoor Air	**SUP1**	**SUP2**	**SUP3**
ODA 1	GF recommended		
ODA 2	GF required	GF recommended	
ODA 3	GF required	GF required	GF recommended

To accommodate space problems in AHU's gas filters can be purchase as combined filters with the second filter stage.

Dust Holding Capacity

Filter performance is not only to be considered by filtration efficiency but also by dust holding capacity (DHC) and associated pressure drop (clean & dirty).

Easy way to compare for AHU's can be calculated as following:

Reference pressure drop (∆p clean + ∆p dirty)/2 for units delivered after the 1 January 2016.

For older units the recommendation of the BSEN 13053:2006 + Part A1:2011 (G4 = 150Pa, F7= 250Pa) are still valid.

∆p dirty is not the recommended filter pressure drop but the maximum supportable pressure drop for a filter.

Dust holding capacity curves can be obtained from filter suppliers. The crossing point between air volume and reference pressure drop gives the DHC; the higher the better.

Examples of ODA and filter class determination

1) Central London Hospital, Post code SW10 9NH
   AHU for Operating theatre suite delivered before 1 January 2016

   a) On Defra web site colour code for PM 10 = medium to dark green (= ODA 1-2)
   b) On Defra web site colour code for PM 2·5 = medium to dark green (= ODA 2)
   c) Outdoor air quality ODA 2 / Supply Air Category SUP 2
      ∴ Pre-filter Coarse filter ≥ 60%
      ∴ Second filter stage PM1 ≥ 50%
   d) Gas filter not required (only recommended)

2) Northern General Hospital, Post code LA14 4LF
   Isolation Room, AHU delivered after 1 January 2016

a) On Defra web site colour code for PM 10 = medium blue (= ODA 1)
b) On Defra web site colour code for PM 2·5 = medium blue (= ODA 1
c) Outdoor air quality ODA 1 / Supply Air Category SUP 1
   ∴ Pre-filter PM10 ≥ 50%
   ∴ Second filter stage PM1 ≥ 50%
d) Gas filter not required (only recommended)

Filter Replacement

There is an associated cost of filter replacement which includes labour and material costs. Our recommendation is to change filters using information from the differential pressure across the filters and to change when the filters are dirty.

There are two different approaches, depending of the age of the AHU:

1) AHU older than 1 January 2016
   a) Filter change by pressure drop is the preferred method
      ➔ Lowest clean filter pressure drop that can be installed in the existing frame
      ➔ Determine filter alarm X Pa lower than max. economical pressure drop per filter stage;
         Pre-filter: X ≈ 50 Pa
         Second filter: X ≈100 Pa
         This allows time to order filters and plan intervention

   b) Filter change by fixed time interval only in case of technical impossibility of a)
      ➔ Take the least expensive filter available in accordance with the efficiency needed due to ODA category and SUP class

2) AHU installed after 1 January 2016
   Filter change by pressure drop
   ➔ Clean filter pressure drop is mostly not an issue as filter surface is oversized anyway
   ➔ Determine filter alarm about 50 -100Pa lower than max. economical pressure drop per filter stage; this allows time to order filters and plan intervention

Appendix 1

BS EN 16890-2016 (Replaces BS EN 779 – 2012)

The BS EN defines the filtration performance for general ventilation. It has an efficiency classification system based upon particulate matter (PM) which is a more realistic test criterion.

What is different?

The new BS EN 16890 standard air filter efficiencies are based on testing particulate matter size ranges PM1, PM2·5 and PM10 (the filter classifications are ePM1, ePM2·5 and ePM10), which are also used as evaluation parameters by the WHO (World Health Organization) and other authorities.

BS EN 16890 – The new group classification

The new BS EN 16890 standard divides air filters into four groups (Coarse, ePM10, ePM2·5 & ePM1). A prerequisite for each group is that a filter captures at least 50% of the appropriate particle size range. If a filter, for example, captures more than 50% of PM1 particles, it will be grouped as an ePM1 filter. The respective efficiency is then reported, rounded in 5% increments.

Alongside fine dust filters, the new BS EN standard also evaluates coarse dust filters as BS EN coarse: that is, filters that capture less than 50% PM10. Note: Coarse classification is a gravimetric arrestance test covered by BS EN 16890-3:2016

What does PM1 mean?

PM1 means all Particulate Matter with size 1-micron diameter (equivalent) and below (µ)m - a thousandth of a millimetre.

1µm= 0·001mm (=PM1)
2·5µm= 0·0025mm (=PM2·5)
10µm= 0·01mm (=PM10)

With the introduction of the new BS EN 16890:2016 standard, actual operating conditions will be more effectively taken into account. Instead of considering only the particle size dia. 0·4 microns (EN779:2012), as previously, a broad range between 0·3 microns and 10 microns will be used to determine separation efficiencies for particulate matter fractions PM10, PM2·5 and PM1 (BS EN 16890). For an air filter to be rated to PM1 or any of the other PM sizes, it will need to demonstrate a minimum efficiency of 50% and this will be recorded incrementally to the closest 5% – so an air filter performing at 66% to PM1 particles will be rated at ePM1 65%.

For coarse filters the new standard will include filters that capture less than 50% of particles in the PM10 range, known as “BS EN Coarse”.

Note: BS EN Coarse testing has a different gravimetric test procedure covered by BS EN 16890-3:2016

WHO guidelines for particulate matter (PM) for outdoor air quality				
$PM_{2·5}$	10 ug/m^3 annual mean		$PM_{10·0}$	20 ug/m^3 annual mean
	25 ug/m^3 24 hour mean			50 ug/m^3 24 hour mean

Appendix 2

BS EN16798-3:2017 (Replaces EN13779:2007)

Outdoor Air quality (ODA) definitions

ODA 1 – Where WHO guidelines (2005) and any national air quality standards are fulfilled (PM2·5 ≤ 10μg/m^3 PM10 ≤ 20μg/m^3)

ODA 2 – Where WHO guidelines (2005) and any national air quality standards are exceeded by up to 1·5 times (PM2·5 ≤ 15μg/m^3 PM10 ≤ 30μg/m^3)

ODA 3 – Where WHO guidelines (2005) and any national air quality standards are exceeded by more than 1·5 times (PM2·5 ≥ 15μg/m^3 PM10 ≥ 30μg/m^3)

Supply Air (SUP) definitions

SUP 1 Refers to supply air with concentrations of particulate matter which fulfilled the WHO (2005) guidelines limit values multiplied by a factor x 0·25
(annual mean for PM2·5 ≤ 2·5 μg/m^3 and PM10 ≤ 5 μg/m^3).

SUP 2 Refers to supply air with concentrations of particulate matter which fulfilled the WHO (2005) guidelines limit values multiplied by a factor x 0·5
(annual mean for PM2·5 ≤ 5 μg/m^3 and PM10 ≤ 10 μg/m^3).

SUP 3 Refers to supply air with concentrations of particulate matter which fulfilled the WHO (2005) guidelines limit values multiplied by a factor x 0·75
(annual mean for PM2·5 ≤ 7·5 μg/m^3 and PM10 ≤ 15 μg/m^3).

SUP 4 Refers to supply air with concentrations of particulate matter which fulfilled the WHO (2005) guidelines limit values
(annual mean for PM2·5 ≤ 10 μg/m^3 and PM10 ≤ 20 μg/m^3).

SUP 5 Refers to supply air with concentrations of particulate matter which fulfilled the WHO (2005) guidelines limit values multiplied by factor x 1·5
(annual mean for PM2·5 ≤ 15 μg/m^3 and PM10 ≤ 30 μg/m^3).