AIR DESIGN
AIR HANDLING | HEAT RECOVERY

LEGISLATION

ISO 16890 consists of the following parts, under the general title Air filters for general ventilation:

Part 1: Technical specifications, requirements and classification system based upon particulate matter efficiency (ePM).

Part 2: Measurement of fractional efficiency and air flow resistance.

Part 3: Determination of the gravimetric efficiency and the air flow resistance versus the mass of test dust captured.

Part 4: Conditioning method to determine the minimum fractional test efficiency.

ISO 16890-1:2016(en)
Air filters for general ventilation — Part 1: Technical specifications, requirements and classification system based upon particulate matter efficiency (ePM).

ISO 16890 defines four groups of filters. Group designations are "ISO coarse", "ISO ePM10", "ISO ePM2.5" and "ISO ePM1".

The effects of particulate matter (PM) on human health have been extensively studied in the past decades. The results are that fine dust can be a serious health hazard, contributing to or even causing respiratory and cardiovascular diseases. Different classes of particulate matter can be defined according to the particle size range. The most important ones are PM10, PM2.5 and PM1. The U.S. Environmental Protection Agency (EPA), the World Health Organization (WHO) and the European Union define PM10 as particulate matter which passes through a size-selective inlet with a 50 % efficiency cut-off at 10 μm aerodynamic diameter. PM2.5 and PM1 are similarly defined.

As the precise definition of PM10, PM2.5 and PM1 is quite complex and not simple to measure, public authorities, like the U.S. EPA or the German Federal Environmental Agency (Umweltbundesamt), increasingly use in their publications the more simple denotation of PM10 as being the particle size fraction less or equal to 10 μm. Since this deviation to the above mentioned complex "official" definition does not have a significant impact on a filter element's particle removal efficiency, the ISO 16890 series refers to this simplified definition of PM10, PM2.5 and PM1.

Particulate matter in the context of the ISO 16890 series describes a size fraction of the natural aerosol (liquid and solid particles) suspended in ambient air. The symbol ePMx describes the efficiency of an air cleaning device to particles with an optical diameter between 0,3 μm and x μm. The following particle size ranges are used in the ISO 16890 series for the listed efficiency values.

Table 1 Optical particle diameter size ranges for the definition of the efficiencies, ePMx.

Efficiency	Size range, μm
ePM10	0.3 ≤ × ≤10
ePM2.5	0.3 ≤ × ≤2.5
ePM1	0.3 ≤ × ≤1

Particulate matter (PM) - solid and/or liquid particles suspended in ambient air.

PM10 Particulate matter which passes through a size-selective inlet with a 50 % efficiency cut-off at 10 μm aerodynamic diameter.

PM2.5 Particulate matter which passes through a size-selective inlet with a 50 % efficiency cut-off at 2.5 μm aerodynamic diameter.

PM1 Particulate matter which passes through a size-selective inlet with a 50% efficiency cut-off at 1 μm aerodynamic diameter.

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LEGISLATION

The standard was in place as from the 12th December 2016 with an 18 month grace period. Actual effective date will be the June 2018.

For coarse filters the new standard will include filters that capture less than 50% of particles in the PM10 range – these will be known as "ISO Coarse" and will detail their PM10 performance i.e. "PM Coarse 45%".

Where airborne particulate go

Particle Size microns	Effect
5.5 - 9.2	Lodges in nose and throat
3.3 - 5.5	Main breathing passages
2.0 - 3.3	Small breathing passages
1.0 - 2.0	Bronchi
0.3 - 1.0	Air Sacs
PM10 refers to particulate matter that is less than 10microns in size	

Human Health and Particle Facts
Indoor air is up to 50 times more polluted than outdoor air and we spend approx 90% of our life indoors. We breathe on average 25kg of air a day, with every breath having approximately 25million particles.

Human Hair 75 microns
Course particles visible course dust and sand, leaves and other large organic particles.

Pollen 10 - 100 microns
PM10 smoke, dust, dirt and pollen. Coarser fine dust and bigger organic particles.

Spores 1 - 10 microns
PM2.5 bigger spores and other organic particles.

Nano Particles 0.1 - 1 micron
PM1 very fine dust, combustion particles, bacteria, viruses and smaller spores.

Classification			Coarse
PM1	PM2.5	PM10	
ePM1 (95%)	ePM2.5 (95%)	ePM10 (95%)	Arrestance reported in full 10%
ePM1 (90%)	ePM2.5 (90%)	ePM10 (90%)	
ePM1 (85%)	ePM2.5 (85%)	ePM10 (85%)	
ePM1 (80%)	ePM2.5 (80%)	ePM10 (80%)	
ePM1 (75%)	ePM2.5 (75%)	ePM10 (75%)	
ePM1 (70%)	ePM2.5 (70%)	ePM10 (70%)	
ePM1 (65%)	ePM2.5 (65%)	ePM10 (65%)	
ePM1 (60%)	ePM2.5 (60%)	ePM10 (60%)	
ePM1 (55%)	ePM2.5 (55%)	ePM10 (55%)	
ePM1 (50%)	ePM2.5 (50%)	ePM10 (50%)	
Requirement > 50% initial eff > 50% discharged eff	**Requirement** > 50% initial eff > 50% discharged eff	**Requirement** > 50% initial eff No discharge requirement	**No discharge requirement**
Table 4: The filter classification according to EN ISO 16890-1:2016			

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BUILDING REGULATIONS

The following information is relevant to the selection of fans for Ventilation Systems, indicating the maximum specific fan powers allowed under Part L (Refer to the Non-domestic Building Services Compliance Guide: 2013 Edition for further details).

The SFP for the entire system (including both supply & extract fans) shall be less than that allowed by these figures. The following tables are the maximum values allowed under Building Regulations when finally commissioned.

Air Distribution System	Specific fan power (W/(L/s))	
	New Buildings	Existing Buildings
Central balanced mechanical ventilation system with heating and cooling	1.6	2.2
Central balanced mechanical ventilation system with heating only	1.5	1.8
All other central balanced mechanical ventilation systems	1.1	1.6
Zonal supply system where the fan is remote from the zone, such as ceiling void or roof mounted units	1.1	1.4
Zonal extract system where fan is remote from zone	0.5	0.5
Zonal supply and extract ventilation system such as ceiling void or roof units serving a single room or zone with heating and heat recovery	1.9	1.9
Local balanced supply and extract ventilation system / such as wall roof units serving a single area with heating and heat recovery	1.6	1.6
Local supply or extract ventilation units such as window / wall / roof units serving a single area (e.g. toilet extract)	0.3	0.4
Other local ventilation supply or extract units	0.5	0.5
Fan assisted terminal (VAV) unit	1.1	1.1
Fan coil units (rating weighted average*)	0.5	0.5
Kitchen extract, fan remote from zone with grease filter	1.0	1.0

*Note: The weighted average is calculated by the following formula:

$$\frac{P_{mains,1}{}^{SFP}1 + P_{mains,2}{}^{SFP}2 + P_{mains,3}{}^{SFP}3 + ..}{P_{mains,1} + P_{mains,2} + P_{mains,3} + ...}$$

Where P_{mains} is useful power supplied from the mains in W.

Extending SFP for additional components in new and existing buildings

Component	SFP (W/(L/s))
Additional return filter for heat recovery	+0.1
HEPA filter	+1.0
Heat recovery - thermal wheel system	+0.3
Heat recovery - other systems	+0.3
Humidifier / dehumidifier (air conditioning system)	+0.1

Example: For a central mechanical ventilation system with heating and cooling, and heat recovery via a plate heat exchanger plus return filter:

SFP = 1.6 + 0.3 + 0.1 W/(L/s)
= 2.0 W/(L/s)

Recommended minimum dry heat recovery efficiency for heat exchangers in new and existing buildings

Heat exchanger type	Dry Heat recovery efficiency
Plate heat exchanger	50%
Heat pipes	60%
Thermal wheel	65%
Run around coil	45%

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BUILDING REGULATIONS

SECTION 6 (2015 EDITION)

Permissible maximum specific fan power and pressure drop in air distribution systems.

Maximum specific fan powers in air distribution systems new and existing buildings.

System Type	Specific fan power (W/(L/s))	
	New Buildings	Existing Buildings
Central balanced mechanical ventilation system with heating and cooling	1.6	2.2
Central balanced mechanical ventilation system with heating only	1.5	1.8
All other central balanced mechanical ventilation systems	1.1	1.6
Zonal supply system where fan is remote from the zone, such as ceiling void or roof mounted units	1.1	1.4
Zonal extract system where fan is remote from zone	0.5	0.5
Zonal supply and extract ventilation units, such as ceiling void or roof units serving single room or zone with heating and heat recovery	1.9	1.9
Local balanced supply and extract ventilation system such as wall/ roof units serving single area with heat recovery	1.6	1.6
Local supply or extract ventilation units such as window/ wall/ roof units serving single area (e.g. toilet extract)	0.3	0.4
Other local ventilation supply or extract units	0.5	0.5
Fan assisted terminal VAV unit	1.1	1.1
Fan coil unit (rating weighted average*)	0.5	0.5
Kitchen extract, fan remote from zone with grease filter	1.0	1.0

*Note: The weighted average is calculated by the following formula:

$$\frac{{}^{P}\text{mains},1^{.SFP}1 + {}^{P}\text{mains},2^{.SFP}2 + {}^{P}\text{mains},3^{.SFP}3 + ..}{{}^{P}\text{mains},1 + {}^{P}\text{mains},2 + {}^{P}\text{mains},3 + ...}$$

Where ^{P}mains is useful power supplied from the mains in W.

Extending SFP for additional components in new and existing buildings

Component	SFP (W/(L/s))
Additional return filter for heat recovery	+0.1
HEPA filter	+1.0
Heat recovery – thermal wheel system	+0.3
Heat recovery – other systems	+0.3
Humidifier/ dehumidifier (air conditioning system)	+0.1

Recommended minimum dry heat recovery efficiency for heat exchangers in new and existing buildings

Heat exchanger type	Dry heat recovery efficiency
Plate heat exchanger	50%
Heat pipes	60%
Thermal wheel	65%
Run around coil	45%

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