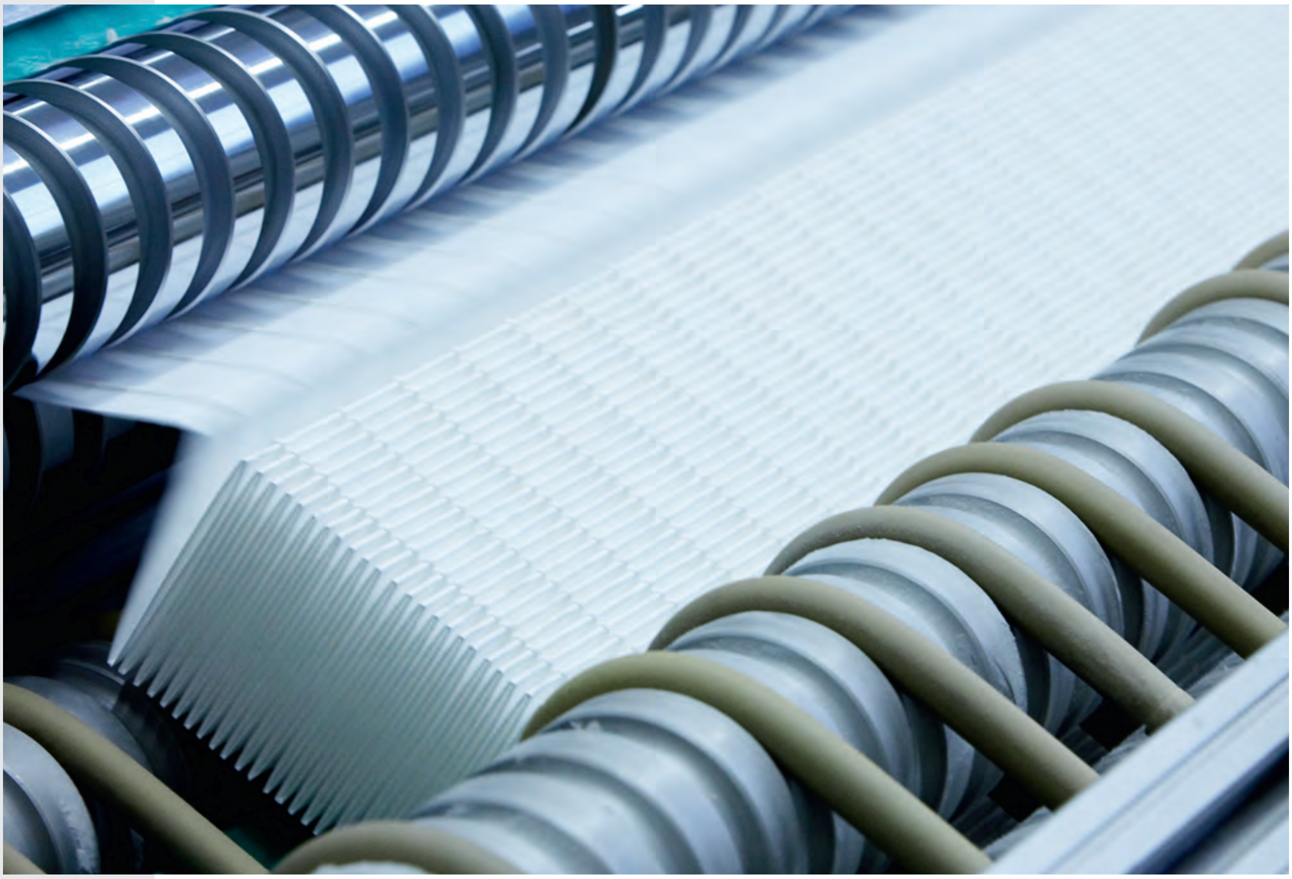


ISO 16890

The new standard for coarse dust and fine dust filters

TROX TECHNIK
The art of handling air

What is particulate matter, and why is it so dangerous?

PM10
Nasal cavity and throat

▼

PM2.5
Trachea and bronchial tubes

▼

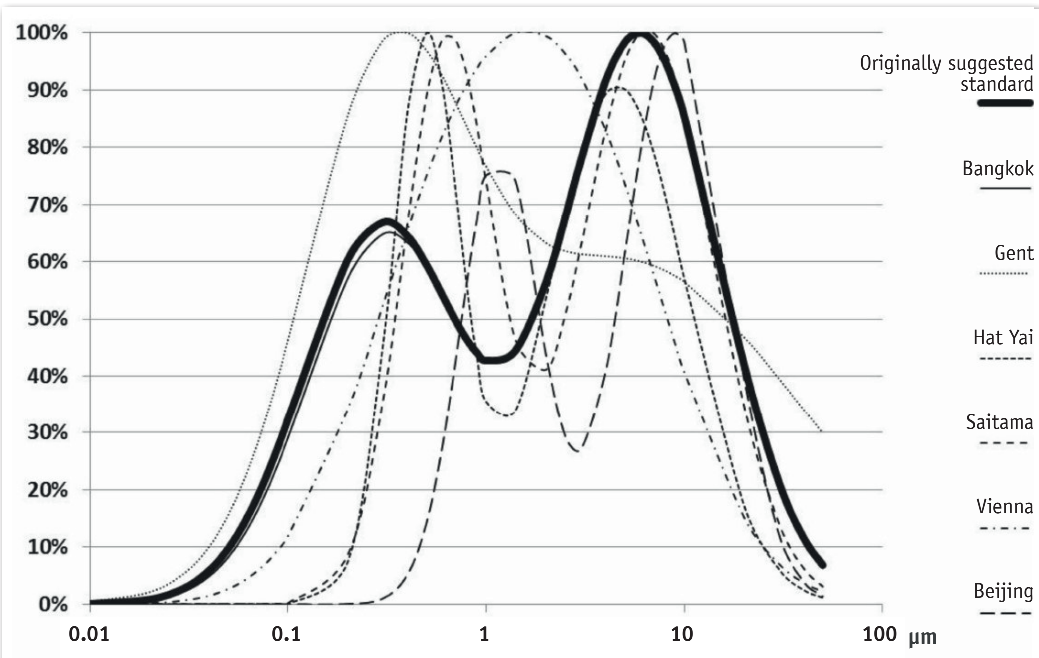
PM1
Lung tissue and alveoli

Fine dust consists of the tiniest solid and liquid particles, which are grouped into different particle size fractions. Particles with a diameter of up to 10 µm (PM10) are called particulate matter. Particles from 3 to 10 µm are deposited in the nose and throat. Particles of about 2.5 µm (PM2.5) are respirable. Particles that are smaller than 1 µm (PM1) enter the alveoli and eventually the bloodstream.

Adverse health effects include irritation and inflammation of the mucous membranes, damage to the alveoli, and increased plaque build-up in the arteries. According to the WHO, long-term exposure to particulate matter (PM2.5) can lead to arteriosclerosis, adverse birth outcomes and respiratory diseases in children. The German environment agency UBA estimates that 47,000 deaths a year are caused by particulate matter.

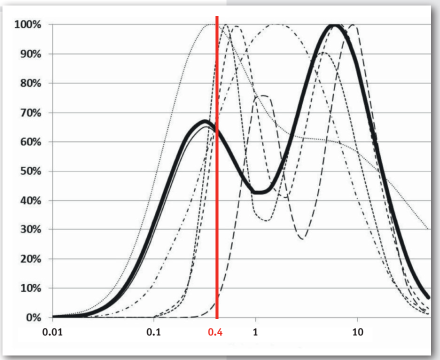
Sources of particulate matter are industrial combustion processes and vehicle emissions as well as traffic-generated dust from brake and tyre wear. It is mainly these primary particles that have a detrimental effect. In addition to these, the chemical reactions of gases in the air, such as ammonia (often from farms), sulphur dioxide and nitrogen oxides, can form the no less harmful secondary particles.

Find out about particulate matter concentration in your area:
http://www.umweltbundesamt.de/daten/luftbelastung/aktuelle-luftdaten#stations



Suggested standard and particulate matter in various large cities

Why is EN 779 obsolete?



EN 779 was last updated in 2012. It describes a test procedure that was developed roughly 40 years ago, where the efficiency of particulate filters is tested using a synthetic aerosol with a uniform particle size, namely 0.4 µm. The result is used to assign particulate filters to classes from M5 to F9. Coarse dust filters are classified based on a test procedure that uses a standard dust (ASHRAE).

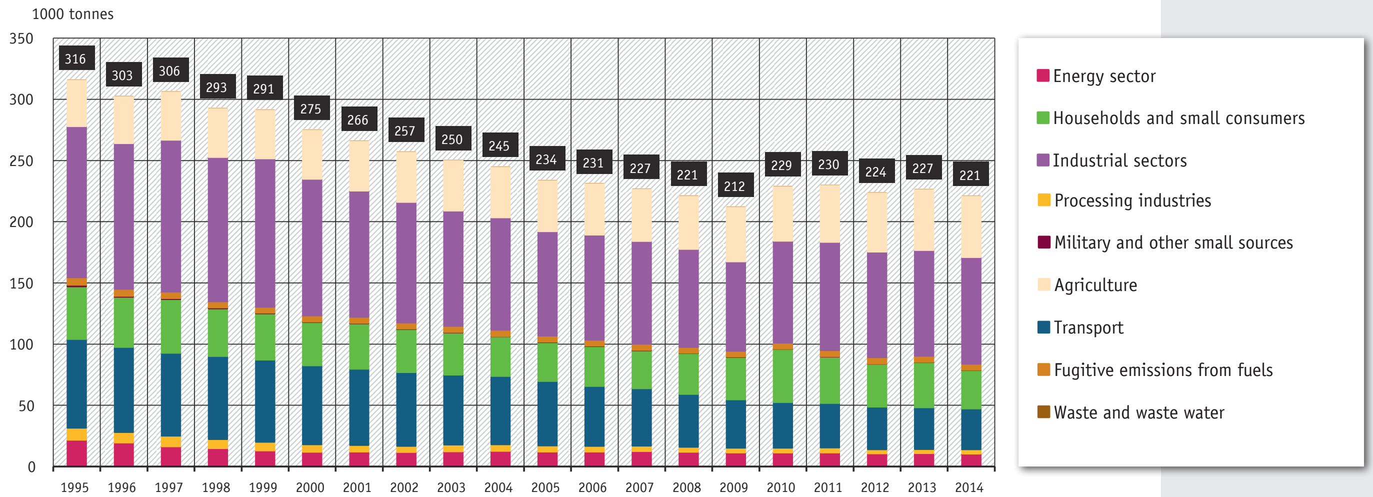
Since that test procedure was introduced, the air quality in many industrialised countries has noticeably improved. There has been a considerable reduction in coarse dust emitted from production processes as well as in emissions from industrial sectors. Yet concentrations of nitrogen dioxide and of particulate matter in the atmosphere continue to exceed EU limits. Now that there is a new test procedure for filters, however, filters can be selected based on the particle fraction prevalent in a location.

But air quality has improved, hasn't it?

Since 2001, particulate matter concentrations (PM10) in Germany have been measured and evaluated by numerous monitoring stations across the country. While emissions from households and traffic have continuously decreased, overall pollution levels have hardly changed over the past ten years.

Due to the harmful effect of ultrafine particles, new threshold values have been defined for air cleanliness. A threshold value (25 µg/m³) for ultrafine particles (PM2.5) was introduced on 1 January 2015, and it applies to all of Germany. It is hence important that filters in ventilation and air conditioning systems effectively retain particulate matter.

Particulate matter emissions (PM10) based on source



What is new about the new ISO 16890?

The new international ISO 16890 standard defines four new filter groups based on dust particle size.

- ISO Coarse (assessment of the separation of ISO A2 dust)
- ISO PM10: particle size ≤ 10 µm
- ISO PM2.5: particle size ≤ 2.5 µm
- ISO PM1: particle size ≤ 1 µm

ISO 16890 also describes the test procedures to determine the principal characteristics of air filters, and it will replace EN 779 after a transition period of 18 months in mid-2018.

In the past, filters were only exposed to size 0.4 µm particles for classification. Now, however, filter efficiency is measured with three different particle fractions, namely PM1, PM2.5 and PM10. This test scenario is a great help in selecting the best filter for a particular local particulate matter concentration, i.e. a filter that provides the required efficiency.

For measurements of the fractional efficiency and flow resistance, filters are no longer fed with synthetic ASHRAE dust. They are instead exposed to DEHS and KCI test aerosols, which are ideal for generating and measuring fine particles. The decisive factor is whether a filter can separate more than 50% of a particle size range.

Differences between EN 779:2012 and ISO 16890

	EN 779:2012	ISO 16890
Particle size for classification	• 0.4 µm	• 0.3 to 1 µm (PM1)
		• 0.3 to 2.5 µm (PM2.5)
		• 0.3 to 10 µm (PM10)
Test aerosol	DEHS (di-ethylhexyl sebacate)	DEHS for 0.3 to 1 µm
		KCl (potassium chloride) for 2.5 µm and 10 µm
Electrostatic discharge with IPA (isopropanol)	• Sample is fully immersed	• Sample (entire filter) is conditioned with IPA vapour
Efficiency of discharged filter	• Comparison of sample and filter	• Average efficiency of treated and untreated (conditioned) filter
Dust feed for classification	• Incremental dust feed	• Classification without dust feed
Test dust for ISO Coarse and energy efficiency	• ASHRAE	• ISO fine
Dust feed	• 70 mg/m^3	• 140 mg/m^3
Test final differential pressure	• G1, G2, G3, G4 = 250 Pa	• PM 10 $<$ 50% = 200 Pa
	• M5, M6, F7, F8, F9 = 450 Pa	• PM10 ≥ 50% = 300 Pa
Classification	• G1 to G4	• ISO Coarse
	• M5 to M6	• ISO ePM10
	• F7 to F9	• ISO ePM2.5
		• ISO ePM1

What are the advantages of the new standard?

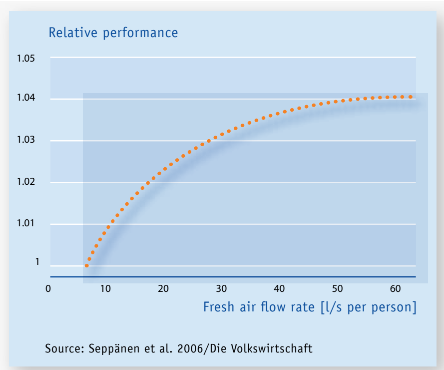
Filter classes PM10, PM2.5 and PM1 correspond to the particles that are harmful to health. This makes it easier to design filter systems in such a way that they can cope with the actual pollutants in a location.

Efficient system design will now include the air quality in a location, which can be measured with monitoring stations. The local air quality ultimately determines the filter. Individually selected, bespoke filters are the best protection against harmful particulate matter, while energy-efficient filters help to save costs in the long run.

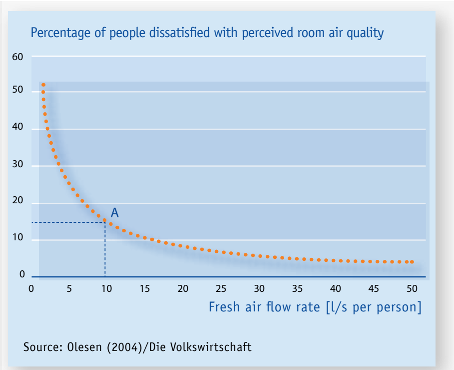
Why do we need good indoor air quality?

Good indoor air quality is obviously conducive to people's health and well-being. What is more, however, studies have shown that minimising particulate matter and increasing the supply air flow rate in offices may lead to an increase in performance levels by up to 4%.

Relation between office ventilation and employee performance



Percentage of dissatisfied employees based on ventilation rate



How to read the graphic: With a supply air flow rate of 10 l/s, 15% of people perceive the air quality as not satisfactory

The higher the supply air flow rate, the more people are satisfied, and then significantly – this is an immensely important aspect since motivation and well-being, but also the sick leave rates, correlate with employees' satisfaction.

What we gain

- Realistic filter classification, especially with regard to particulate matter
- Increased awareness of the health hazards of particulate matter
- Improved filter quality due to minimum standards for occupied zones
- Relevance to discussions of particulate matter and environmental awareness

Who developed the new standard?

The new classification allows for a better assessment of fine dust filters and for adapting them to specific applications. ISO 16890 was developed by WG 3 of ISO TC 142, the international standardisation committee of which TROX is also a member.

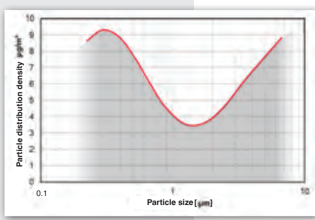
TROX develops and manufactures high-quality filters that combine maximum air cleanliness with maximum energy efficiency. Whether business or leisure time – the focus is always on people and their health.

EN 779 / ISO 16890 comparison, recommendation of the VDI-SWKO expert working group

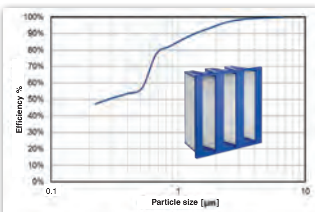
EN 779	ePM1 [%]	ePM2.5 [%]	ePM10 [%]
M5			ISO ePM10 (50%)
F7	ISO ePM1 (50%)	ISO ePM2.5 (65%)	
F9	ISO ePM1 (80%)		
A filter of at least **ISO ePM1 50%** is required for the **final filter stage.**			

Based on the particulate matter values measured in an area, the best, most efficient filter can be selected. This way it is possible to determine the indoor air quality that can be achieved.

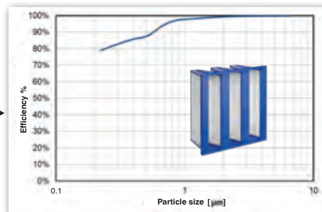
Fresh air quality



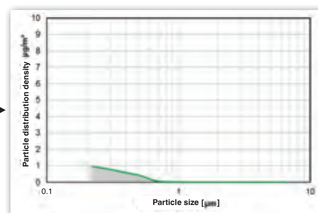
1st filter stage
Filter ePM1 55% (F7)



2nd filter stage
Filter ePM1 85% (F9)



Indoor air quality



Picture credits:
Page 2: Lung picture: Sebastian Kaulitzki - Fotolia
Page 3: Table: Umweltbundesamt, Nationale Trendtabellen für die deutsche Berichterstattung atmosphärischer Emissionen seit 1990, Emissionsentwicklung 1990 bis 2014 (Stand 03/2016) (German environment agency, National trend tables for German reporting on atmospheric emissions since 1990, emissions from 1990 to 2014, last updated 03/2016)
Page 3: 'Umwelt' zone picture: stockWERK - Fotolia
Page 5: Source: Seppänen et al. 2006/Die Volkswirtschaft
Page 5: Source: Olesen 2004/Die Volkswirtschaft

TROX filters for many applications

Nowhere in Germany are the measured values for particulate matter higher than in city centres, such as in Stuttgart, the capital of the south-western state of Baden-Württemberg. On up to 89 days per year, the particulate matter concentration exceeds 50 micrograms per cubic metre of air. This is why filter systems in buildings in Stuttgart city centre should be particularly effective.

With 86 shops and restaurants on three levels with a total area of 25,000 square metres, GERBER in Stuttgart city centre is a spacious shopping mall with a window front of nearly one kilometre.

Excellent air quality

A total of 30 X-CUBE air handling units are installed in the GERBER shopping centre. They provide treated supply air with volume flow rates of up to 33,000 m^3/h. An extended filter system ensures that particulate matter is separated effectively and efficiently. Clean air is essential for the well-being and the health of both visitors to the shopping centre and of the staff working there.

The German environment agency UBA has provided the data regarding the actual particulate matter concentration in that area. That was the basis on which TROX engineers designed a highly efficient filter system. Prefilters and main filters complement one another perfectly such that the utmost energy efficiency is achieved over the entire filter life.

TROX® TECHNIK
The art of handling air

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