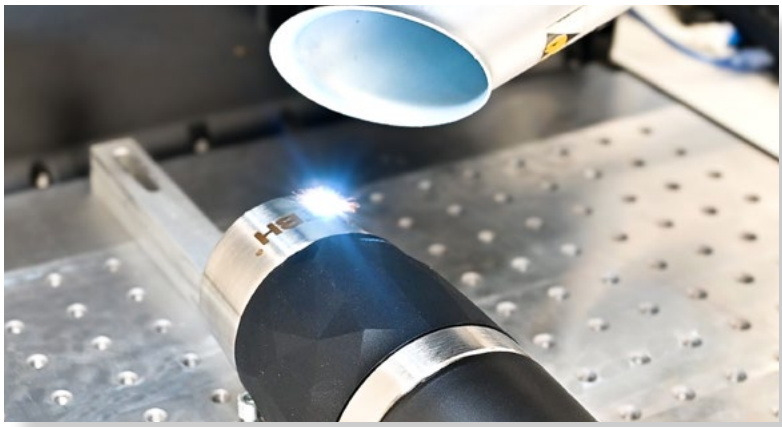
TBH®

Katalog výrobků

APPLICATIONS: PARTICULATE MATTER

Particulate extraction is essential for occupational safety, as particulate matter is considered a hazardous substance. Compliance with the dust limits defined by OSHA PELs in 29 CFR 1910.1000, (Respirable fraction: 5 mg/m³, Total dust: 10 mg/m³), and the German TRGS900 (A-dust: 1.25 mg/m³, E-dust: 10 mg/m³) prevents the penetration of micrometer-sized particles into the alveoli of the lungs. Particle extraction provides effective protection.

PARTICULATE MATTER



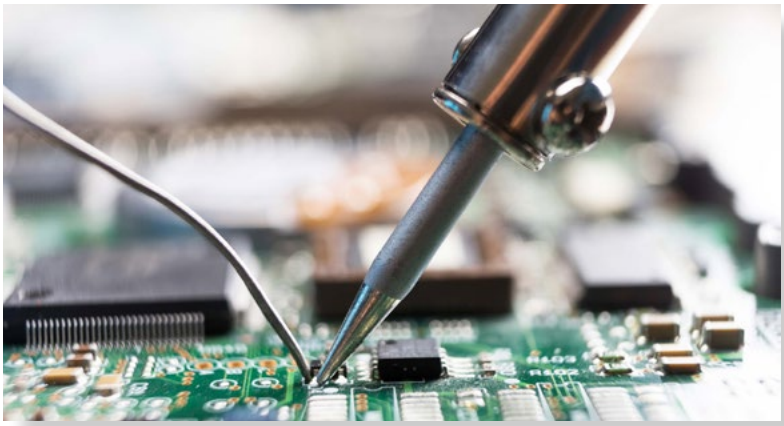
Laser applications

such as marking, engraving and cutting generate hazardous laser smoke that releases pollutants such as cobalt, nickel and chromium. Filter and extraction systems effectively protect the lungs and respiratory tract from these risks.

Automated welding

releases fine carcinogenic particles. TFS and LN/GL series extraction systems with W3 label and DGUV certification, tested in accordance with ISO 21904-1/-2 (formerly ISO 15012-1/-2), offer effective protection through certified filters and system design in accordance with the requirements of OSHA 29 CFR 1910.252 (TRGS528).

APPLICATIONS: PARTICULATE MATTER



Soldering fumes:

Contains health hazards such as tin, lead, colophony, amines, formaldehyde, phenol, hydrogen chloride and carbon monoxide. Although lead is used less frequently, it is still used in some areas. The particles in these fumes are harmful to health, especially if the TRGS 900 workplace limit is exceeded. Protective measure: Extraction.

Cleanroom:

Cleanrooms protect processes and products in industries such as food, automotive, biotechnology and pharmaceuticals. TBH filter and extraction systems remove particulate emissions and gases from processes as they occur. They ensure health protection and prevent contamination of the clean room.

Surface Treatment:

Surface pre-treatment plays a crucial role in many processes, ensuring process quality for subsequent painting, coating, welding, etc. The surfaces are cleaned from release agents and/or roughened by laser, plasma, abrasives, etc. The resulting gases and particles must be extracted.

APPLICATIONS: DUST & SWARF

The assessment of metalworking dusts considers both physical and toxic properties, with chippings, oil mists and vapors being produced. Work areas need to be cleaned and the health of workers protected. TBH filter and extraction systems, adapted to the specific requirements, protect both the work processes and the health of the employees.

DUST & SWARF

Metal Cutting:

Grinding, turning and milling processes generate carcinogenic and explosive dusts. TBH offers flexible protection for maintaining health in dry metalworking with mobile extraction technology.

Wet machining:

Grinding, turning and milling, for example of aluminum or copper, produces particles as well as cooling water, oil or emulsion mist that must be extracted and filtered to protect workers.

APPLICATIONS: DUST & SWARF

Grinding dust and dry dust:

Many industrial processes generate grinding and dry dust. Working in a dust-free environment or complying with the limit values is only possible with a filter and extraction system. Extract large quantities of dust with TBH filter and extraction technology.

Chip-forming plastics processing:

Requires efficient extraction systems and possibly pre-filters for the various chip and particle sizes. Choosing the right filter and extraction system is important to minimizing health and safety risks.

High industrial dust concentration

Extraction solutions for powder mixing and transfer reduce dust in the food, pharmaceutical and packaging industries, protecting employee health and meeting strict hygiene regulations.

APPLICATIONS: GASES-ODORS - VAPORS

Workplace exposure to gases, odors and solvent vapors from bonding, cleaning and plastic injection molding processes requires effective extraction. While solvent levels are low in gluing processes, they can be as high as 100% in injection mold cleaning. Minimizing outgassing and vaporized particles is crucial for health protection.

GASES - ODORS - VAPORS

Automated bonding processes:

Automated bonding processes generate solvent vapors, cyclic siloxanes, acrylates, dust, odors and sometimes smoke that are harmful to health and the environment. Efficient extraction, low-emission adhesives and protective measures are crucial for safety and environmental compliance.

Plastic Injection Molding Emissions:

In plastic injection molding, plastic granules are heated and pressed into molds, and the heat causes chemical additives to evaporate. These emissions, volatile organic compounds, are created by the combination of heat and pressure during molding and curing of the material.

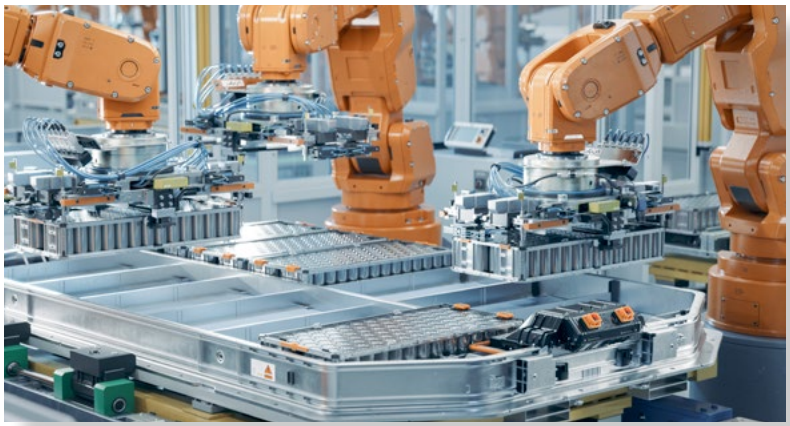
APPLICATIONS: GASES-ODORS - VAPORS

Solvent fumes extraction:

Industrial cleaning processes generate volatile organic compounds (VOCs), hydrocarbons and aldehydes from the evaporation of chemical cleaning agents. Efficient extraction and filtration technologies are essential to minimize workplace exposure, comply with emission limits and reduce environmental impact.

Plasma surface treatments:

Generate emissions such as ozone, nitrogen oxides, UV radiation and VOCs, depending on material and process gas. Industrial safety measures such as extraction systems and personal protective equipment (PPE) minimize exposure. Control of these emissions requires application-specific analysis.



Battery cell production:

The production of battery cells for electric vehicles generates vapors and gases such as hydrogen fluoride, sulfur dioxide, nitrogen oxides, and particulate matter. High-performance filters and HEPA extraction systems are crucial to effectively neutralize these emissions.

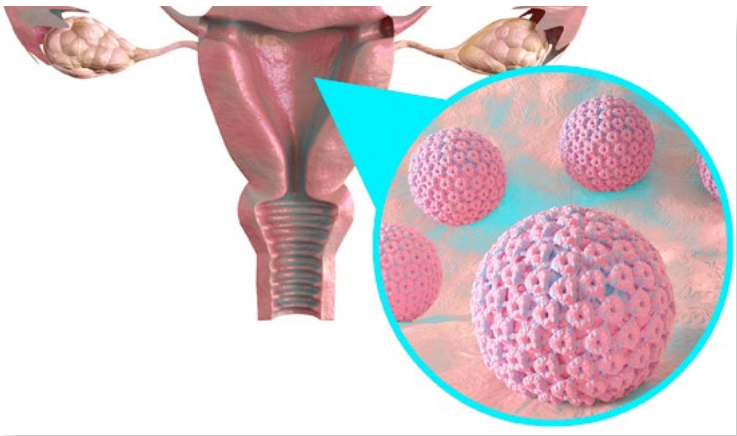
APPLICATIONS: MEDICAL & AESTHETICS

During medical and aesthetic procedures, smoke gases and virus-contaminated tissue are released. TBH filter and extraction systems effectively capture these potentially infectious particles to provide optimal protection for physicians, medical staff and patients.

EXPERTS' ADVICE

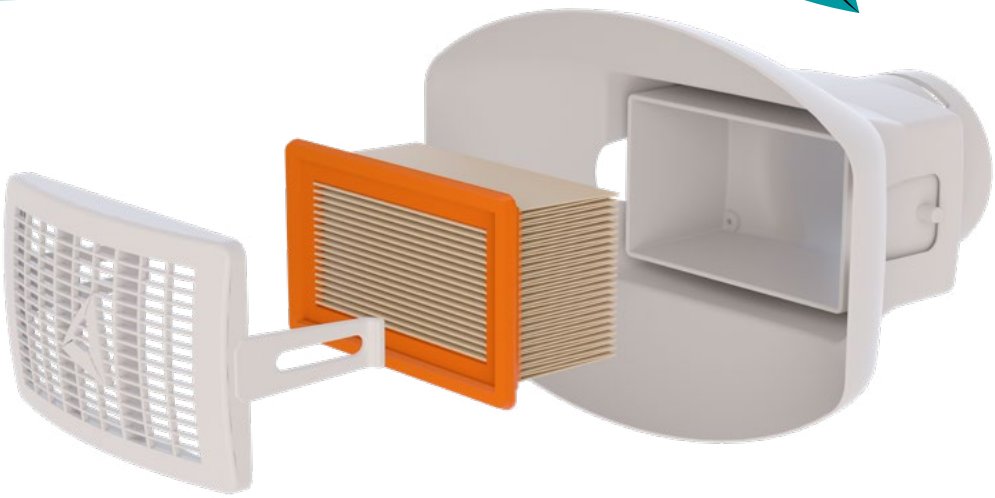
Laser lesion removal:

When removing benign melanocytic skin lesions with a laser, extraction is necessary to prevent inhalation of potentially infectious particles.



HPV Risks:

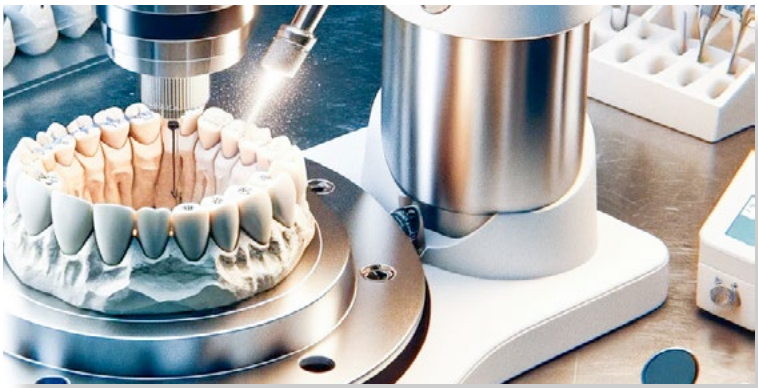
Medical personnel performing laser treatments in areas such as gynecology are at increased risk for HPV-related diseases such as laryngeal papillomatosis and oropharyngeal cancers. A properly adjusted and positioned extraction system is the most effective protective measure and is crucial to minimizing the risk of infection.



With the patented "InLine" pre-filter, the TBH Health Series is optimized for medical practices. HEPA H13/H14 and activated carbon filters provide clean air and reduce the incidence of illness. The InLine pre-filter minimizes internal contamination, reduces maintenance costs and extends the main filters' life.

Dental Aerosol Extraction:

Oral extractors remove only the coarsest particles during dental procedures. An extraction system effectively reduces the aerosol concentration to a safe level.



Dental laboratory:

Modern dental milling systems process a wide range of materials such as zirconium and plastics. They are easy to use and deliver high quality results. Efficient extraction is essential for processing quality, equipment life and cleaning

SATURATION FILTER SYSTEMS

Saturation filtration systems use a mesh to sieve or filter contaminants, with the appropriate filter media depending on the size, composition, and quantity of the particles. If the mesh is too large, particles will pass through; if it is too small, the airflow will be blocked too quickly. TBH uses a multi-stage filtration system for optimum extraction.

SATURATION FILTER SYSTEMS

BF Series: The entry-level model:

- The best entry-level model at the best price
- Compact and versatile
- Various motor and filter options
- Modular expandability
- Simple control electronics
- IFA-tested in accordance with ISO 21904-1/-2 (W3)
- Incl. DGUV certification (IFA positive list)
- Complies with the requirements of: OSHA 29 CFR 1910.252 (TRGS528)

LN 200 Series: Modular and flexible:

- High-performance turbines
- Effective, decentralized extraction
- Optimized for long extraction hoses
- Modularly expandable
- Can be configured with a wide range of accessories
- Ideal for soldering and laser processing
- IFA-tested in accordance with ISO 21904-1/-2 (W3)
- Incl. DGUV certification (IFA positive list)
- Complies with the requirements of: OSHA 29 CFR 1910.252 (TRGS528)

SATURATION FILTER SYSTEMS

GL Series: "Green Line":

- Eco-friendly, quiet and modular extraction
- Energy-efficient blowers
- Ideal for laboratories and practices (~55 dB(A))
- Modularly expandable
- IFA-tested in accordance with ISO 21904-1/-2 (W3)
- Incl. DGUV certification (IFA positive list)
- Complies with the requirements of: OSHA 29 CFR 1910.252 (TRGS528)

GL-Desk Series for space-saving laser setup:

- Panel size: 700 x 700 mm
- Suitable for compact lasers
- Saves up to 65% energy
- Quiet operation
- Environmentally friendly

SATURATION FILTER SYSTEMS

SATURATION FILTER SYSTEMS

TFS Series: Designed for laser smoke extraction:

- Low contamination filter change
- Individual filter monitoring
- HEPA H14 particle filter for ultra-fine particles (99.995% in accordance with DIN EN ISO 1822)
- TFS 500: Ideal for automation
- TFS 1000: Higher air capacity (1.4 kW)
- Available in standard and plus versions
- IFA-tested in accordance with ISO 21904-1/-2 (W3)
- Incl. DGUV certification (IFA positive list)
- Complies with the requirements of OSHA 29 CFR 1910.252 (TRGS528)

Options:

- Optional extraction arm for local extraction
- Optional spark separator
- Extends the system's application range
- System remains mobile and space-saving

SATURATION FILTER SYSTEMS

LN600 series:
High-performance extraction systems

- Maximum filter surface
- High turbine power for effective air cleaning
- Ideal for soldering and laser processing
- Handling of sticky dusts
- HEPA H14 particle filter for ultra-fine particles (99.995% in accordance with ISO 1822)

Versions:

- LN610: Multi-user extraction, automation integration
- LN615: Specific high vacuum applications

EXTRACTION CABINET & CLEAN ROOM

Effective extraction of gases, odors and solvent vapors. DT series: also suitable for ATEX zone 22/2. CR series: clean room filtration up to ISO class 5.

DT SERIES

DT series:
Specialized extraction cabinet

- For use in laboratories and workshops
- Ideal for painting and cleaning work
- Height-adjustable
- Adjustable protective screen
- Effective particle and gas extraction
- ATEX Directive 2014/34/EU
- ATEX-compliant for Zone 22/2

CCI – von Kahlden GmbH

CR series:
For highly sensitive manufacturing processes

- Contamination-free filter change: Up to ISO class 5 (DIN EN ISO 14644-1)
- Optimum air filtration: In cleanroom cabins (ISO 14644) and cleanrooms (VDA 19, ISO 16232)
- Efficiency and purity: For sensitive production environ ments
- Further information: See page 8

CLEAN ROOM

FILTER CARTRIDGE SYSTEMS

Effectively remove large amounts of dust. Precoat layer binds harmful particles, extends service life. Contact us for customized solutions.

FILTER CARTRIDGE SYSTEMS

FP 150 Series:
For large quantities of dry metal and ceramic dust

- Self-cleaning filter cartridge: by jet pulse
- Advanced filter options: HEPA H13 particulate filter and activated carbon filter
- Flexible operating modes for filter cleaning

FP 150 ATEX series:
For large quantities of dry, combustible dusts

- Minimum ignition energy: >10 mJ
- Filters easily ignitable or explosive dusts
- ATEX-Directive 2014/34/EU (equivalent to OSHA Publication 3073, § 1926.407 Hazardous (classified) locations, IEC 60079-10-2:2015 and National Electrical Code (NEC), NFPA 70 Standard)
- Area of application: Zone 21 extraction
- Extended filter options: particle filter and activated carbon filter
- Flexible operating modes for filter cleaning

FILTER CARTRIDGE SYSTEMS

FILTER CARTRIDGE SYSTEMS

FP 200 series: For industrial dust removal with low-contamination filter change

- Efficient cleaning: With jet pulses for long service life
- Models: FP 211 (3.0 kW) and FP 213 (1.8 kW)
- Patented low-contamination filters
- Filter options: HEPA H14 particle filter, activated carbon filter
- ATEX version (ATEX Directive 2014/34/EU) (equiva lent to OSHA Publication 3073, § 1926.407 Hazardous (classified) locations, IEC 60079-10-2:2015 and Natio nal Electrical Code (NEC), NFPA 70 Standard)

FILTER CHANGE

FULLY AUTOMATIC PRECOATING

PRECOTECH 300

Precotech 300: Fully automatic precoating

- Extends service life of filter cartridges
- High extraction quality, low operating costs
- No loss of extraction power during precoating
- Can be integrated into automated processes
- Reliable filling of filter aid

POWERFUL CONTROL UNIT

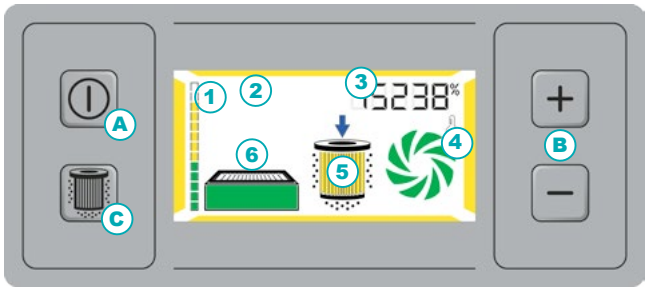
Application-optimized development: to increase performance and user-friendliness.

Display:

✓ Ergonomic color display, simple and intuitive operation

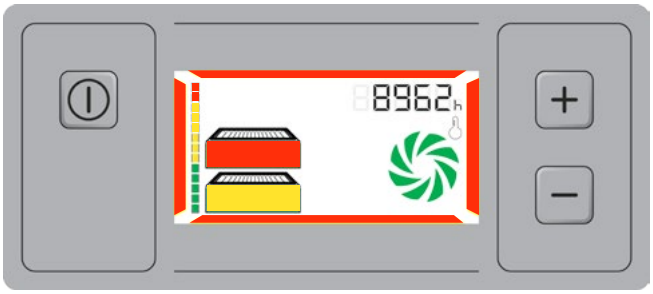
Functions:

- ✓ Parameterization of special functions
- ✓ Optimized message cache for customer service coordination
- ✓ Filter monitoring with status display
- ✓ Optional: monitoring particle filters
- ✓ Individually adjustable filter cartridge cleaning (FP series)



INSPIRE control units for cleanable filter cartridges

A Start / Stop button
B Manual power control
C Manual start Filter cartridge cleaning (FP series)
1 Filter saturation display
2 Display system status
3 Display power setting/operating hours counter
4 Display of temperature and turbine status
5 Display of filter status



INSPIRE control units for saturation filter systems

TBH-INTERFACE

Sub-D25

Harting Option

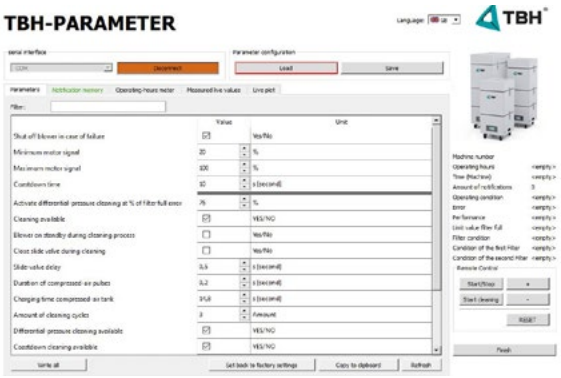
Control of filter and extraction system via RS232

e.g. with PLC or customer software

- ✓ Send start/stop command
- ✓ Show system status
- ✓ Show filter status
- ✓ Many other functions

Service Software:

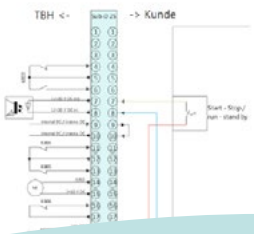
- ✓ Parameter adjustment: settings optimization
- ✓ Live data analysis: real-time operational monitoring.
- ✓ Message history: access to system messages.
- ✓ Troubleshooting: efficient diagnosis and fault correction.



Analog interface:
Control of filter and extraction system via analog inputs/outputs

e.g. with PLC

- ✓ Start / Stopp
- ✓ Filter saturated 75% / 100%
- ✓ Collective error
- ✓ Many other functions



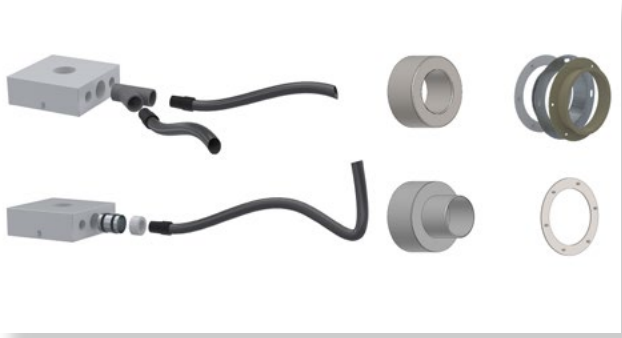
For more information, see

MANUALS, Chapter 9 "Operating the extraction system":

TBH-MANUALS

TBH ACCESSORIES

Our extensive range of accessories ensures optimal contaminant collection with suitable capture elements and extraction arms, supplemented by pre-separators, safety and connection components for TBH systems. Please contact us for custom solutions.



Connecting components:

TBH offers hoses, pipes, extraction and recirculation systems, including the Safe System with factory-mounted double-lip seals. Suitable for a wide range of applications, the Safe System meets the requirements of ASHRAE Standard, DIN EN 12237. Selecting the right hose diameter is crucial for system performance and efficiency.

Safety accessories:

Flow monitoring ensures extraction performance for hazardous substances. Spark extinguisher protects against sparks and fire. Filter rupture monitoring increases safety. Signal module for TBH systems with INSPIRE control unit (except BF series) available.

Passive separators:

Cyclone separator for dust and sparks in grinding/laser processes, coarse pre-separator for large particles. Activated carbon separator offers high efficiency.

Special extraction arms:

Special extraction arms for welding fumes and large air volume flows, type system 160. Wall mounting possible and can be connected directly to fixed piping. Other sizes and mounting options available. Contact us for more information.

TBH ACCESSORIES

Alsident® System A/S, the market leader in local extraction technology, offers specialized solutions for more than 30 industries. Our extensive product range includes flexible extraction arms and hoods that effectively capture pollutants at their points of origin. As Alsident's representative in Germany, we offer a complete range and individual advice, perfectly tailored to your needs.

TBH-ACCESSORIES

Alsident System AL:

For applications without special requirements for chemical resistance or conductivity.

Alsident System AS:

For applications with special conductivity requirements, e.g. in the ESD area of the electronics industry.

Alsident Arbeitskabinette:

They are versatile and suitable for a range of processes and provide efficient extraction for precise and safe work in a wide range of applications.

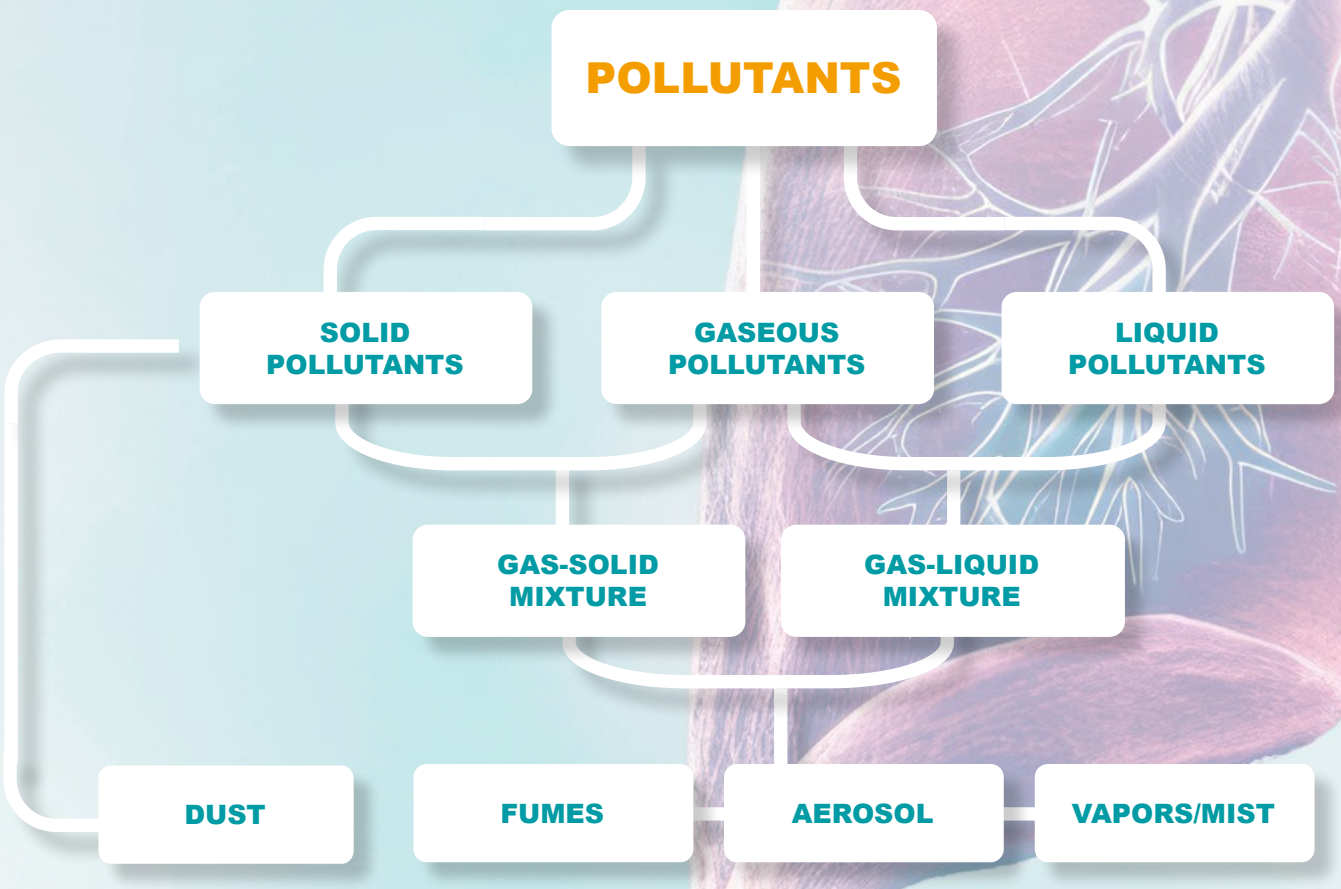
TBH ACADEMY: POLLUTANTS

When solids and liquids are mixed with gases, they can occur as airborne aerosols in form of vapor, mist, smoke or particulate matter.

These particles can remain in the air for several hours and spread far beyond their point of origin. These pollutants, including harmful gases, are particularly dangerous to people, the environment and machinery due to their long residence time. They not only affect work performance, but also employees' health, for example by contributing to the development of chronic lung diseases such as COPD.

TBH ACADEMY

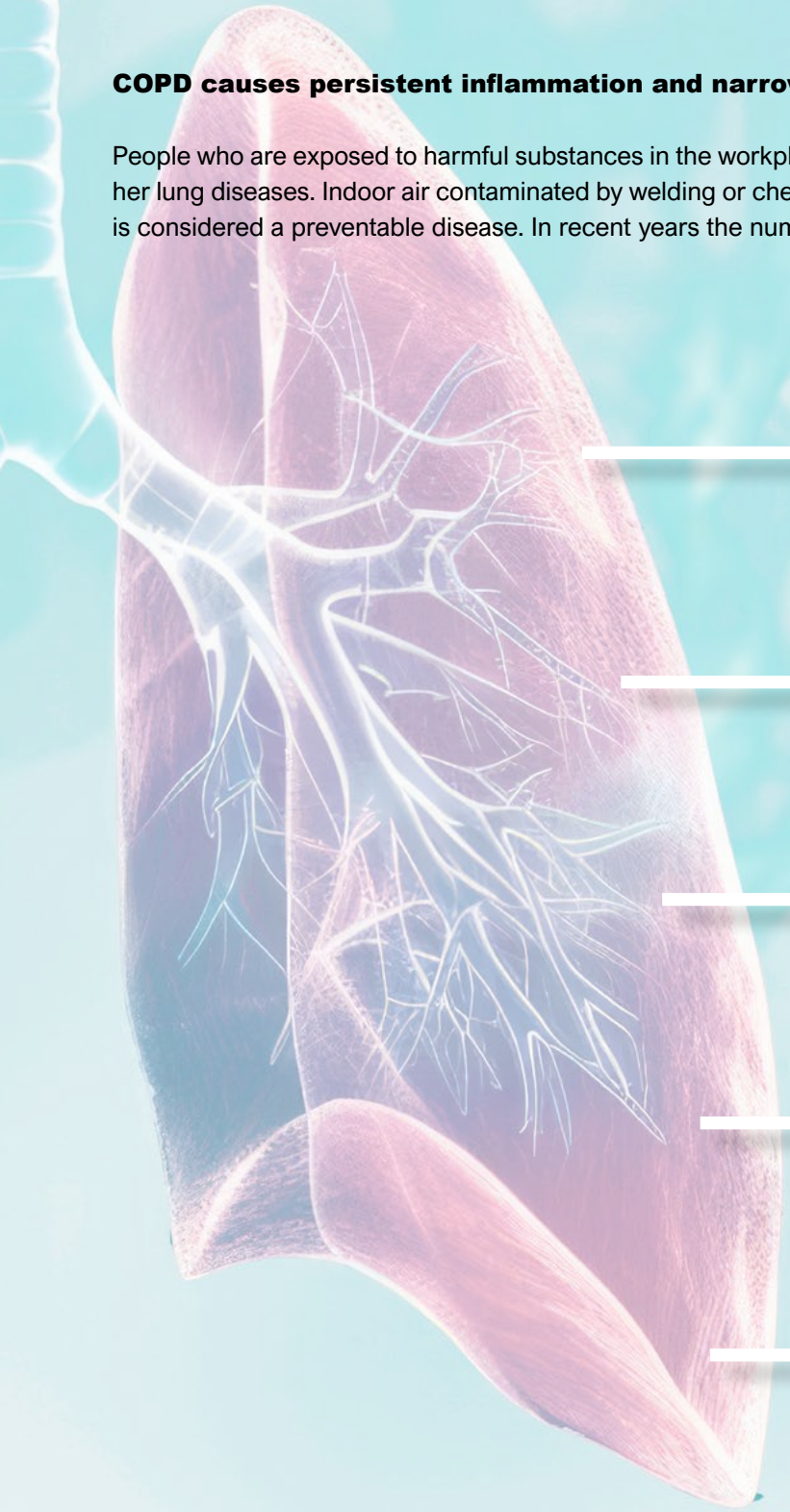
Overview of pollutant types and mixtures:



HEALTH EFFECTS

COPD causes persistent inflammation and narrowing of the airways.

People who are exposed to harmful substances in the workplace are disproportionately likely to develop COPD or other lung diseases. Indoor air contaminated by welding or chemical fumes is one of the biggest risk factors. Yet COPD is considered a preventable disease. In recent years the number of COPD cases has increased by 8 %.



- INFLAMMATION & CHANGES IN THE RESPIRATORY TISSUES
- TRIGGERING OR EXACERBATING ASTHMA AND ALLERGIES
- IMPAIRMENT OF LUNG FUNCTION
- DAMAGE TO SELF-PURIFICATION FUNCTION OF LUNGS
- INCREASED RISK OF LUNG CANCER

PARTICLE SIZES

Scanning Tunneling Electron Microscope

Scanning Electron Microscope

Optical Microscope

Visible to the naked eye

0,0001 µm

0,001 µm

0,01 µm

0,1 µm

1 µm

10 µm

100 µm

1000 µm

Nanoparticles
0,001-0,1 µm

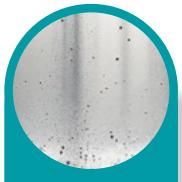
Gas molecule
0,0001-0,01 µm

Viruses
0,001-0,1 µm

Oil mist
0,01-1 µm

Tobacco smoke, Asbestos
0,01-5 µm

Bacteria
0,5-5 µm



Settling dusts
10-1000 µm

Industrial dust:
100-1000 µm

RESPIRABILITY

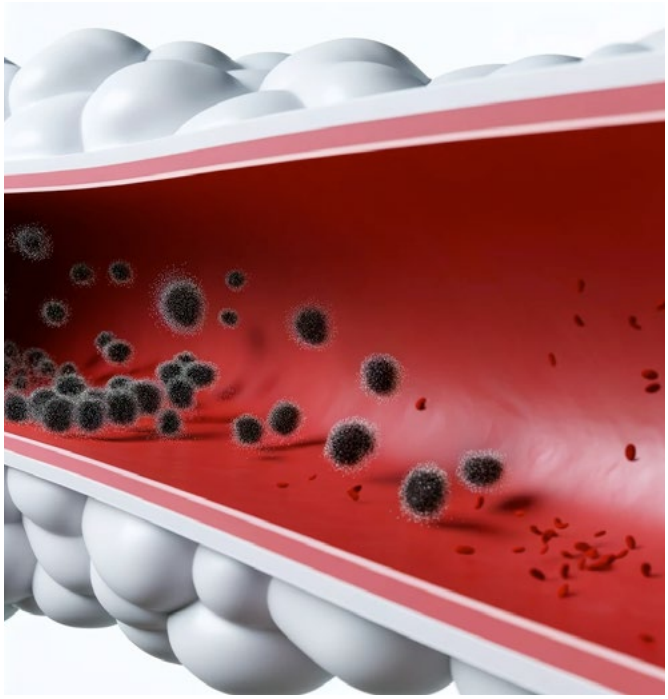
Which particles penetrate deep into the lungs?

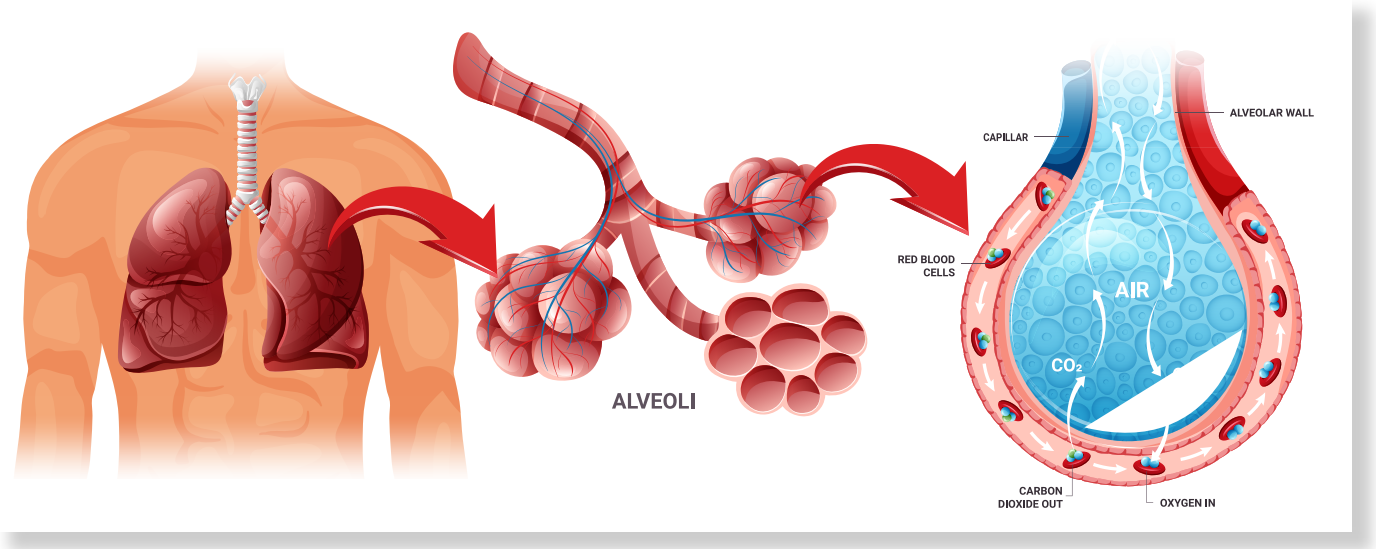
Particles are classified according to their size as PM10 (10µm), PM2.5 (2.5µm) and PM1 (1µm). They pose different health risks depending on their size, material and composition.

Alveolar penetration of particles is crucial for their health effects. Particles smaller than 10 µm, and especially those smaller than 1 µm, can penetrate deeply into the alveoli of the lungs and in some cases even into the bloodstream, posing a health risk.

Heavy industrial and metallurgical dusts are usually composed of larger particles, but their finer fractions below 1µm are also respirable. Laser particles or fine particles in general, gas molecules and nano dust with particle sizes below 1µm can easily reach the alveoli and potentially the bloodstream.

PM2.5 and PM1 particles are particularly problematic as their small size allows them to reach deep areas of the lungs and cause heart and lung problems (e.g. COPD).

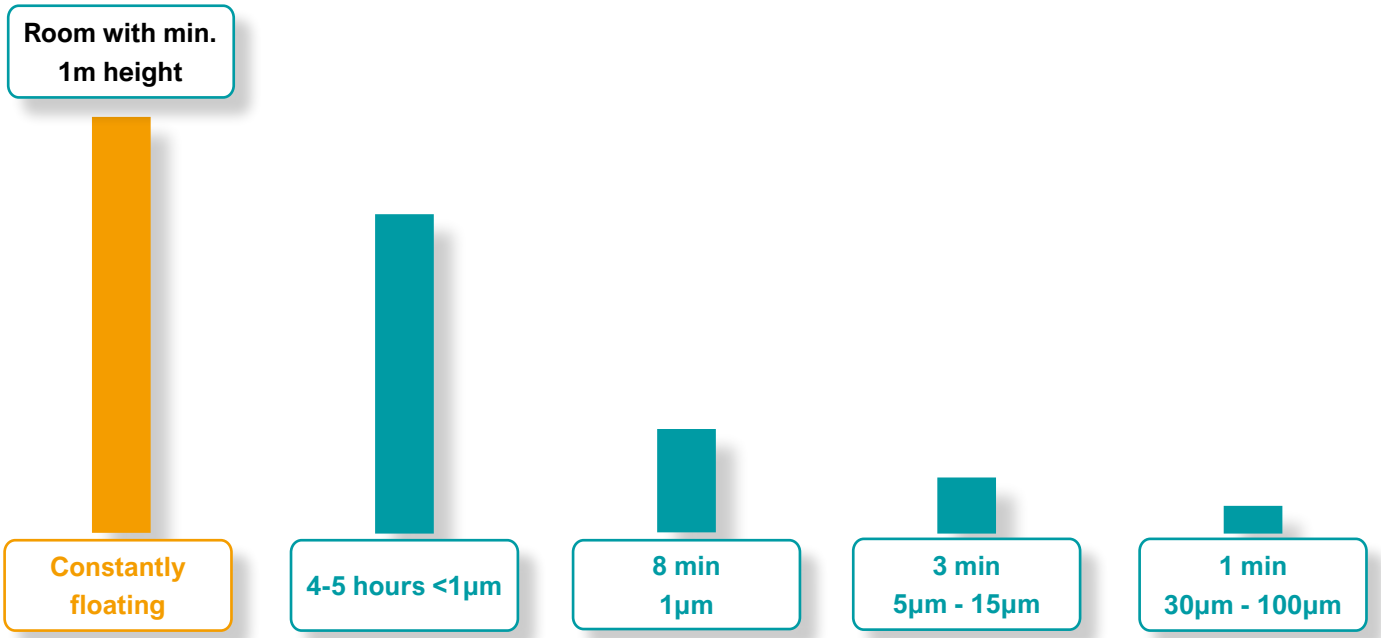




PARTICLE SIZES & SETTING TIMES

Particles 1 µm in diameter take 4 to 5 hours to settle. Even smaller particles remain in the air and do not settle.

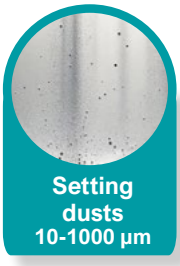
Airborne pollutants, especially harmful gases, are rarely removed by settling. They can travel long distances and exert their harmful effects at great distances from the production site.




Fine & nano dust
0,001-0,3 µm


Tobacco smoke
Asbestos
0,01-5 µm


Bacteria
0,5-5 µm


Setting dusts
10-1000 µm


Heavy industrial dust
ca.1.000 µm


Gas molecules
0,0001-0,01 µm


Oil mist
0,01-1 µm


Viruses
0,001-0,1 µm

FILTER TYPES & FILTER CLASSES

There is a wide range of terms for filter types, as shown in this overview below to main groups, designations and classes.

PRE-FILTER	
Saturation filter	
Coarse dust filter	Fine dust filter
New in accordance with ISO16890 -ePM$_{2,5}$- ePM$_{10}$ Filter class G1-G4 (EN779)	**New in accordance with ISO16890 ePM$_1$- ePM$_{2,5}$** Filter class M5-F9 (EN779)

Saturation or storage filters:

They capture particles up to the capacity limit. When saturation occurs, which reduces airflow, a filter change is required, except for molecular filters.

FILTER CARTRIDGE
Filter class
Dust class M (EN 60335-2-69 AA)
E10-E11 (EPA) - (EN1822)

Filter cartridges:

Filter cartridges can be cleaned with jet pulses to restore their performance. Filter cartridges are ideal for dry dusts.

TBH offers patented filter cartridges with an integrated disposal bag for low-contamination disposal of the filters and optimal health protection.

PARTICLE FILTERS
(Suspended Particle Filter) Saturation Filter
H13-H14 (HEPA)

Particle filters:

These are classified in accordance with EN 1822 for fine-pored particulate air filters such as EPA, HEPA and ULPA, with criteria such as initial and fractional separation efficiency.

FILTER TYPES & FILTER CLASSES

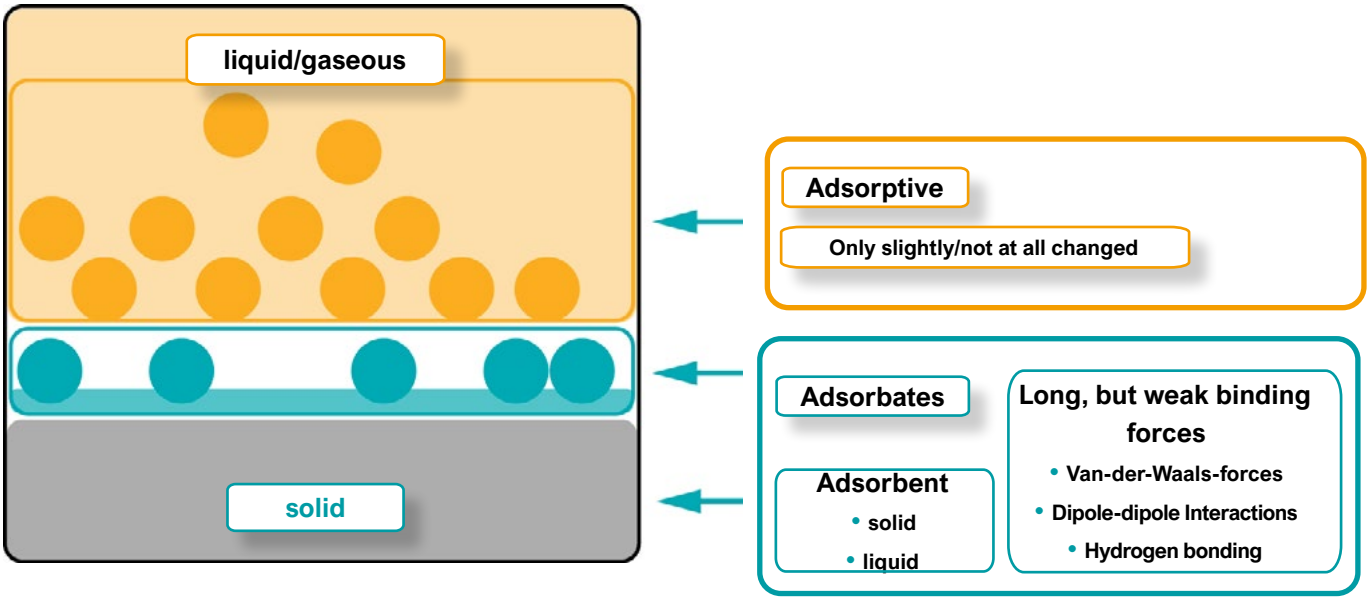
MOLECULAR FILTER	
Saturation filter	
Physical adsorption filter (activated carbon)	Chemical adsorption filter

Physical Adsorption:

Adsorption is generally a physical process in which substances attach to the surface of another material. Activated carbon, a popular filter media with a sponge-like microstructure, can bind large gas molecules to absorb unpleasant odors or harmful gases. It is made from organic materials such as coal, peat, and coconut shells. Its extremely fine pores give it a very large surface (up to 1700m²/g), resulting in high efficiency, storage capacity and long service life.

Chemical adsorption filter

In chemical adsorption, gas molecules are split and neutralized by a chemical reaction, as opposed to physical adsorption, which only captures them. TBH offers specialized consulting for customized applications.



STANDARDS

The table lists the applicable standards and classifications:

The initial separation rate:

The ratio between captured and supplied material for new filters.

The fractional separation rate:

Refers to the filter efficiency in separating particles of a specific size.

CURRENT STANDARDS				RELATED / OTHER STANDARDS	
ISO 29463-1	**EN 1822**	**EN 779**	**ISO 16890**	**US MIL-STD**	**DIN EN 60335**
EPA, HEPA, ULPA (replaces DIN EN 1822)	EPA, HEPA, ULPA Initial separation efficiency A DEHS, MPPS ca 0,1-0,3 µm	Fine dust filter with fractional separator A 0.4 µm final pressure difference 450 Pa	Fine dust filter with fractional separator, (replaces DIN EN 779) 0.3-10 µm	Particulate air filter Initial separation rate A DOP 0.3 µm	Particulate air filter Permeability D Paraffin oil 61% < 1 µm
	A (integral)> 85% **E10**	E>40% **M5**	**ISO ePM$_{10}$** > 50%	95%	D < 1% **L**
A (integral) ≥ 95% **ISO 15 E** A (integral) ≥ 99% **ISO 20 E**	A (integral)> 95% **E11**	E>60% **M6**	**ISO ePM$_{2,5}$** > 50-65% **ISO ePM$_{10}$** > 60%	99,97%	D < 0,1% **M**
A (integral) ≥ 99,5% **ISO 25 E** A (integral) ≥ 99,9% **ISO 30 E**	A (integral)> 95,5% **E12**	E>80% **F7**	**ISO ePM$_{1}$** > 50-65% **ISO ePM$_{2,5}$** > 65-80% **ISO ePM$_{10}$** > 65-85%	99,99%	D < 0,005% **H**
A (integral) ≥ 95;95% **ISO 35 H** A (integral) ≥ 95;99% **ISO 40 H**	A (integral)> 99,95% **H13**	E>90% **F8**	**ISO ePM$_{1}$** > 65-80% **ISO ePM$_{2,5}$** > 80% **ISO ePM$_{10}$** > 90%	99,999%	
A (integral) ≥ 95;995% **ISO 45 H** A (integral) ≥ 95;999% **ISO 50 U**	A (integral)> 99,995% **H14** A (lokal)> 99,75%	E>95% **F9**	**ISO ePM$_{1}$** > 80% **ISO ePM$_{2,5}$** > 95% **ISO ePM$_{10}$** > 95%		
A (integral) ≥ 95,9995% **ISO 55 U** A (integral) ≥ 95,9999% **ISO 60 U**	A (integral)> 99,9995% **U15** A (lokal)> 99,9975%				
A (integral) ≥ 99,99995% **ISO 65 U** A (integral) ≥ 99,99999% **ISO 70 U**	A (integral)> 99,99995% **U16** A (lokal)> 99,99975%				
A (integral) ≥ 99,999995% **ISO 75 U**	A (integral)> 99,999995% **U17** A(lokal)> 99,9999%				

ATEX STANDARDS

ATEX-Directive 2014/34/EU

ATEX

ATEX, short for "Atmosphère EXplosible", refers to the EU directives for explosion protection. There are currently two main documents: the Equipment Directive 2014/34/EU (equivalent to OSHA Publication 3073, § 1926.407 Hazardous (classified) locations, IEC 60079-10-2:2015 and National Electrical Code (NEC), NFPA 70 Standard) and the Workplace Directive 2007/30/EC (equivalent to Occupational Safety and Health Administration (OSHA) and National Fire Protection Association (NFPA), OSHA 29 CFR 1910.307, NFPA 70 (National Electrical Code) and NFPA 497). These directives aim to provide protection against the risks of an explosive atmosphere, defined as a mixture with air of flammable substances such as gases, vapors, fumes or dusts in which ignition may cause combustion of the entire mixture.

Classification of products in accordance with the ATEX Equipment Directive 2014/34/EU:

SYSTEM GROUP II

SYSTEMS FOR OTHER HAZARDOUS LOCATIONS					
CATEGORY 1		CATEGORY 2		CATEGORY 3	
continuously, frequently or over a long period		occasionally		rarely and for a short time	
very high safety		high safety		normal safety	
Zone 0	Zone 20	Zone 1	Zone 21	Zone 2	Zone 22
G	D	G	D	G	D
G= gas, D= dust					

ATEX Workplace Directive 2007/30/EC

The ATEX Directive classifies potentially explosive atmospheres into specific zones, requiring employers to prepare an explosion protection document for the relevant workplaces and to define the zones accordingly.

We ensure that our customers have the correct filters and extraction systems to capture dust from potentially explosive environments. Our systems comply with the ATEX 2014/34/EU and DIN EN 1127-1:2019-10.
(equivalent to OSHA Publication 3073, § 1926.407 Hazardous (classified) locations, IEC 60079-10-2:2015 and National Electrical Code (NEC), NFPA 70 Standard) and DIN EN 1127-1:2019-10 (equivalent to OSHA 29 CFR 1910.307, NFPA 70 (National Electrical Code) and NFPA 497 and UL 1203).

CLASSIFICATION OF HAZARDOUS LOCATIONS			
Gases	**Zone 0** is an area in which a potentially explosive atmosphere consisting of a mixture of air and flammable gases, vapors or fumes is present continuously, for long periods or frequently.	**Zone 1** is an area in which an explosive atmosphere consisting of a mixture of air and flammable gases, vapors or fumes may occasionally occur during normal operation.	**Zone 2** is an area in which a dangerous explosive atmosphere consisting of a mixture of air and flammable gases, vapors or fumes does not normally occur or occurs only during normal operation.
Dust	**Zone 20** is an area in which an explosive atmosphere in the form of a cloud of combustible dust is present continuously, for long periods or frequently.	**Zone 21** is an area in which an explosive atmosphere in the form of a cloud of combustible dust is likely to occur in normal operation occasionally.	**Zone 22** is an area in which an explosive atmosphere in the form of a cloud of dust in the air does not normally occur or only for a short time during normal operation.

CLEANROOM CLASSES

Assessing air quality using international standards

ISO 14644-1 defines cleanroom classes by specifying maximum particle concentrations per m³ of air, with Class 1 being the most stringent and Class 9 being the least stringent. In special sectors such as food processing and pharmaceuticals, air purity is also assessed by microorganism concentrations. In the pharmaceutical industry, EU-GMP Annex 1 is applied. Standardized measurement procedures ensure compliance with these classes and allow air quality to be assessed in accordance with the standard.

CLEANROOM CLASS	ISO 14644-1						EU-GMP ANNEX 1		REVIDIERTE NORM	
	Cn = maximum number of particles per m³ and particle diameter						Room classification	Colony-forming units CFU/m²	US FEDERAL STANDARD 209E	
	0,1 µm/m³	0,2 µm/m³	0,3 µm/m³	0,5 µm/m³	1,0 µm/m³	5,0 µm/m³			English unit ft³	Metric SI unit tm³
ISO 1	10	2								
ISO 2	100	24	10	4						
ISO 3	100	237	102	35	8				1	M 1,5
ISO 4	1000	2370	1020	352	83				10	M 2,5
ISO 5	10000	23700	10200	3520	832	29	A / B	< 1	100	M 3,5
ISO 6	100000	237000	102000	35200	8320	293	(B)	10	1000	M 4,5
ISO 7				352000	83200	2930	C	100	10000	M 5,5
ISO 8				3520000	832000	29300	(C) / D / E / F	200	100000	M 6,5
ISO 9				35200000	8320000	293000	with employees			

The table shows a comparison of the ISO cleanroom classes, the EU GMP requirements for germ counts and the US Federal Standard 209E, which was valid until 2001.

SYSTEM DESIGN

Important principles for your filter and extraction system to ensure high efficiency in capturing contaminants:

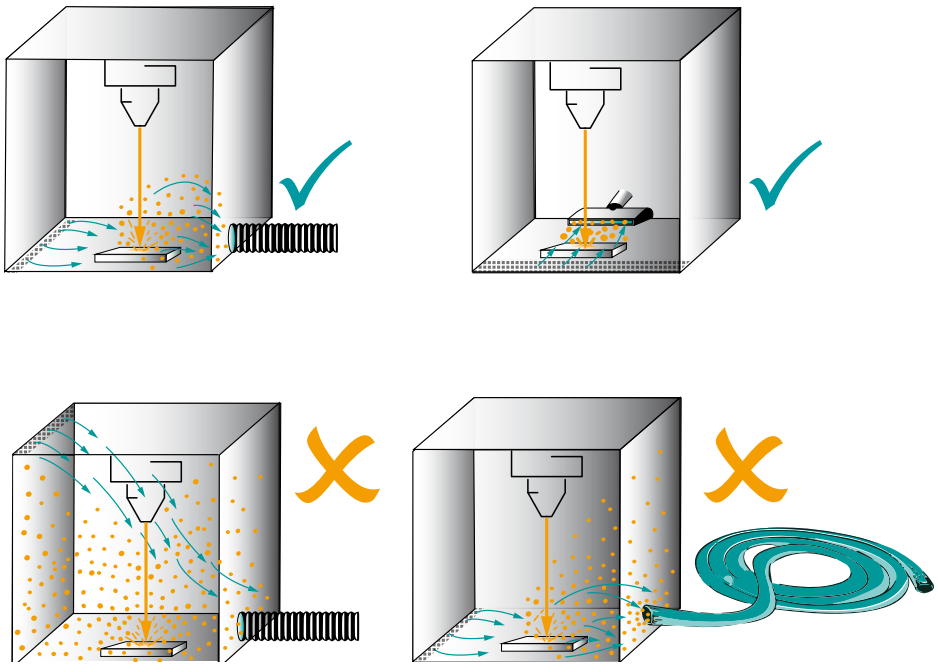
- Extraction systems filter solid and gaseous contaminants.
- Air velocity is relevant to:
    1. Particle size and weight
    2. Distance from the contaminant's point of origin
    3. Room design
    4. Influence of distance

Positioning Optimization:

- Capture is optimal when the air flows over a smooth surface.
- Accurate positioning of the capture units is critical.
- Simple solutions, such as an extraction pipe at the workstation, are often not sufficient. More effective adjustments are needed, such as: flat screens on the pipes, protection from external currents.
- For enclosures, provide an air supply, if possible, opposite the capture.
- According to our experience, the air speed is usually optimal at 1 diameter of the capture from the point of origin (or calculate the required air flow).
- Ensure hose is without loops: Shorten hose to optimum length: Adjust hose diameter and length to suit system conditions.

Common errors:

- Using pneumatic hoses, rolled and uncut, without adapting it to the required diameter or standard length (e.g., 5 m).
- Air supply in the wrong place.



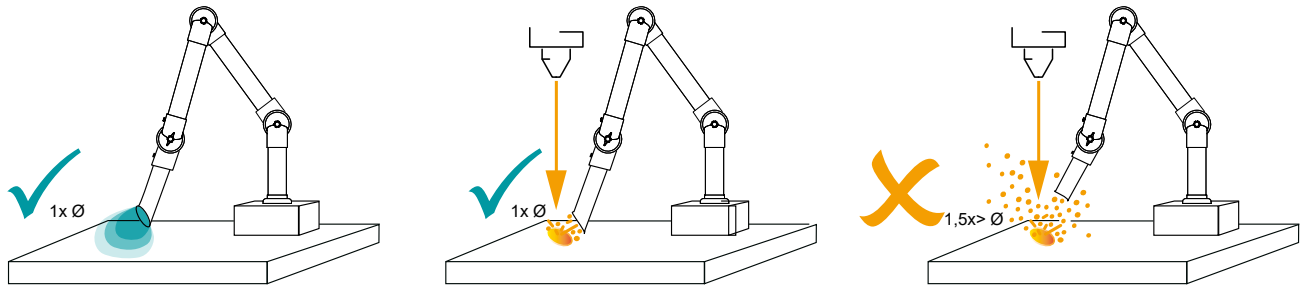
SYSTEM DESIGN

Open concepts are prone to failure: pay particular attention to air velocities at the contaminant's point of origin!

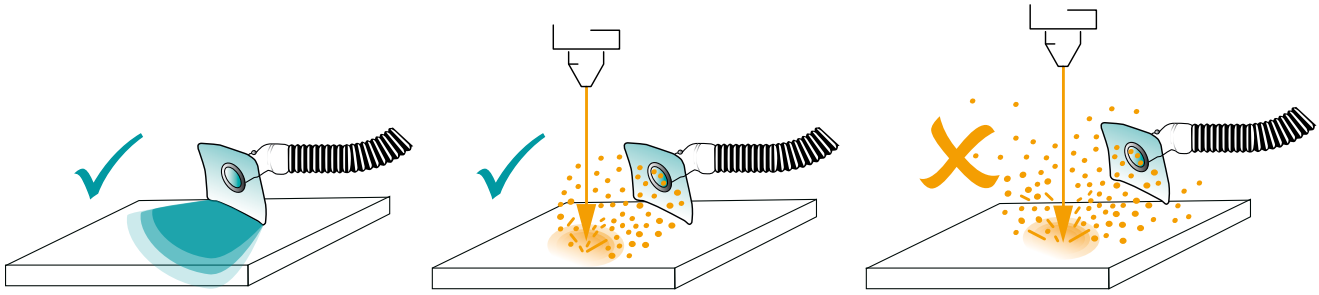
- Positioning the capture unit on the same surface as the workstation (e.g. table) takes advantage of the Coandă effect, improving efficiency by reducing turbulence.
- Avoid placing the extraction system above the workstation, as this creates non-directional and turbulent air currents that reduce efficiency.
- Use discharge pulses: For rotating tools, incorporate the discharge pulse to increase efficiency.

Frequent sources of poor capture results:

- Sub-optimal positioning of capture and air supply.
- Jet pulse for cleaning or open housings/glass interfere with capture.
- Suction nozzles and air inlets located too far from the point of origin:
  Most open capture systems work by creating a flow in a limited capture field.
- Capturing equipment (open design) should be placed as close as possible to the material:
  Even at one pipe diameter, the suction velocity is only 7.5% of the velocity at the suction point.



Max. 1 pipe diameter distance



As close as possible, max. 20 cm

REQUIRED AIR VELOCITIES

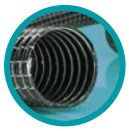
Capture of solid and gaseous contaminants depends on particle size and weight.

- Calculate the airflow using the following formula: **V = A · c**

  V: Effective air volume flow V [m³/h]; A: Area of extraction pipe A [m²]; c: Air velocity [m/s].

- Influence of the capturing equipment: The required airflow increases with the diameter of the extraction hose.

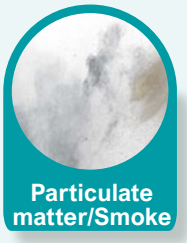
REQUIRED AIR VELOCITY



At the inlet of the extraction pipe / hose for:

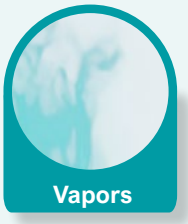
In origin area of certain processes

≥ 10 m/s

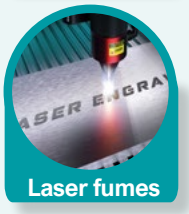


14-18 m/s

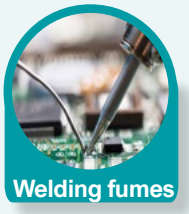
≥ 20 m/s



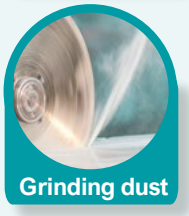
0,1 – 0,2 m/s



0,2 – 0,4 m/s



0,3 – 0,5 m/s



0,3 – 1,0 m/s

AIRFLOW OPTIMIZATION

- **Effect on filter area:**
  The required effective airflow affects the required filter area.

- **Impact on system size and price:**
  Higher airflow will result in larger systems and higher costs.

- **Choosing the optimal diameter:**
  The filter and extraction system must be chosen to optimally match the selected diameter.

- **Dependencies:**
  The table shows the relationships between the diameter of the extraction hose/pipe and the effective airflow required to achieve the desired air velocities for efficient particle collection.

SUCTION / TUBE DIAMETER (mm)	INDUSTRIAL DUST > 20 m/s	FINE DUST / FUMES 16 m/s	GAS MOLECULES >10 m/s
50	140 m³/h	115 m³/h	70 m³/h
63	225 m³/h	180 m³/h	110 m³/h
80	360 m³/h	290 m³/h	180 m³/h
100	565 m³/h	450 m³/h	280 m³/h
125	880 m³/h	710 m³/h	440 m³/h
160	1450 m³/h	1160 m³/h	720 m³/h
200	2260 m³/h	1810 m³/h	1130 m³/h
250	3530 m³/h	2830 m³/h	1770 m³/h
Do not fall below the recommended air volumes for the specified pipe diameters.			

Example calculation for particulate matter extraction:

With a pipe diameter of 80 mm, the air velocity should be 15 m/s to effectively extract particulate matter.
Target value for air velocity: ^{C}should be = 15 m/s
The calculation of the required air volume flow is as follows:

- 1- Cross-sectional area of pipe:

$$A = \frac{d^2 \cdot \pi}{4} = (0{,}08m)^2 \cdot 3{,}14 / 4 = 0{,}005m^2$$

- 2- Air volume flow:

$$V = A \cdot c = 0{,}005\ m^2 \cdot 15\ m/s = 0{,}075\ m^3/s$$

- 3- Conversion to m³/h: V:

$$V = A \cdot c = 0{,}075\ m^3/s \cdot 3600\ s/h = \mathbf{271\ m^3/h^*}$$

* + 20-30% for filter saturation

WORKING POINT & AIR-PERFORMANCE

OF THE EXTRACTION AND FILTER SYSTEM

Comparing: Turbine, Radial Blower, Fan:

- The efficiency of an extraction and filter system depends primarily on the engine and its technology.
- Turbines and radial blowers achieve similar air flows, but differ in key characteristics such as static pressure, which is crucial for overcoming air resistance.
- On page 47, we explain the dependencies between airflow and pressure drop.
  The table illustrates the technical differences and application areas of different motor types based on average values:

TECHNICAL DATA	TURBINE	BLOWER	HIGH PERFOR-MANCE BLOWER	FAN
Maximum speed	25 000	8 000	8 000	2 800
Maximum static pressure	15 000 - 20 000 Pa	6 000 Pa	5 500 Pa	1 500 - 2 000 Pa
Guaranteed runtime	Brushed motor 600h Brushless motor. 5 000h	Brushless motor 10 000h	Brushless motor. 10 000h	Brushless motor 10 000h
Expected service life	20 000h	40 000h	20 000h	15 000h
Noise level	< 60 dB (A)	< 53 dB (A)	< 63 dB (A)	< 74 dB (A)
Engine power	1-2 kW	0,2-0,7 kW	2,0-3,0 kW	0,3-7,0 kW
Minimum pipe diameter	32 mm	80 mm	160 mm	160 mm
TBH - device series	LN 230-265, 615, FP 150, 213, OEN 150, 155, BF 9, 100/200, 1000/1200	GL DESK 20-30 GL 230-265, BF 5, 10	LN 610 OEN 710 FP 211	Special solutions DT 100-DT 150

CHARACTERISTIC CURVE

FOR FANS & WORKING POINT

- **Free-blowing operation:**
  A free-standing fan provides high air volume flow.

- **System operation:**
  When connected to a system, additional flow resistances such as filters and air diverters must be overcome, which requires a pressure increase and reduces the air volume flow.

- **Characteristic Curve:**
  The characteristic curve for fans, Figure (A), describes the interdependence between air volume flow and pressure rise. The intercept with the device characteristic (internal flow resistances) defines the effective air volume flow.

- **Manufacturer Information:**
  Technical documents often only provide the free-standing airflow rate for fans, which is higher than the actual effective air volume flow in a system.

- **Motor variety:**
  Figure (B) shows differences in air volume flow depending on motor design; essential for realistic performance comparisons and avoiding design errors.

- **Consider Pressure Losses:**
  Pressure losses in the suction line, which are influenced by the pipe's length and diameter as well as the capturing equipment, are crucial in determining the operating point, Figure (C).

- **Result:**
  The combination of pressure gains and losses determines the operating performance and air velocity for capturing pollutants.

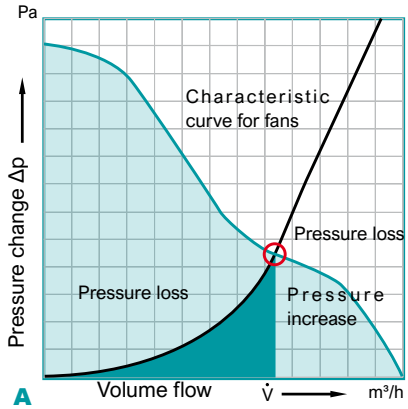


Fig. A: Characteristic curve for fans

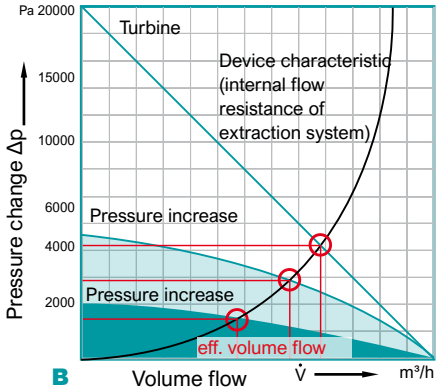


Fig. B: Comparison of different motor designs with the same free-blowing air volume flow.

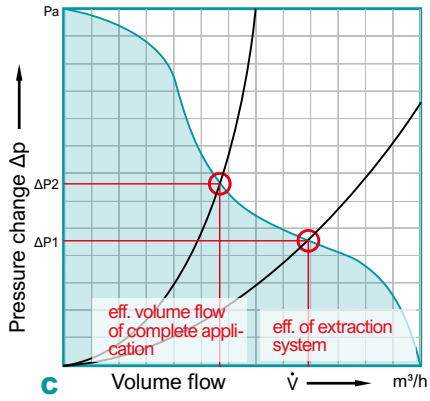


Fig. C: Determining the operating point by combining pressure increases and losses.

TBH®

TBH Czech and Slovakia

JVB Engineering s.r.o.
Komenského 1173
40801 Rumburk - CZ

Tel.: +420 412 333 291
E-mail: info@jvb.eu

www.tbh-czech.cz