Extraction and filtration solutions for laser fume and laser dust

ULT
air quality

Laser processes and applications

Laser technology has become standard in many industrial manufacturing processes, but it's also utilized in other fields like medical technology or research and development. Cutting, joining, surface treatment, marking, and modern production techniques like additive manufacturing all benefit from the wide range of advantages this technology offers. There isn't just one type of laser, as the variety of available technologies continues to grow.

Application fields

- Laser cutting
- Laser sintering
- Laser welding
- Laser marking
- Laser structuring
- Laser ablation
- Medical laser
- Laser printing
- Laser cleaning
- Laser melting
- Micro processing

Processes materials

- All metals
- Plastics and composite material
- Organic materials/ textiles
- Paper
- Wood
- Ceramics
- Rubber
- Glass

Laser wavelengths in the electromagnetic spectrum

INVISIBLE SPECTRUM (ULTRA VIOLET)

100 nm – 380 nm

VISIBLE SPECTRUM

380 nm – 780 nm

INVISIBLE SPECTRUM (NEAR INFRARED)

780 nm – 2,500 nm

INVISIBLE SPECTRUM (INFRARED)

2,500 nm – 1 mm

UV LASER
- 193 nm: Applications in medical technology, e. g. eye treatments
- 355 nm: Laser marking, cutting, structuring of e. g. copper, glass, ceramics
- 450 nm: UV laser for laser marking, cutting of plastics, wood

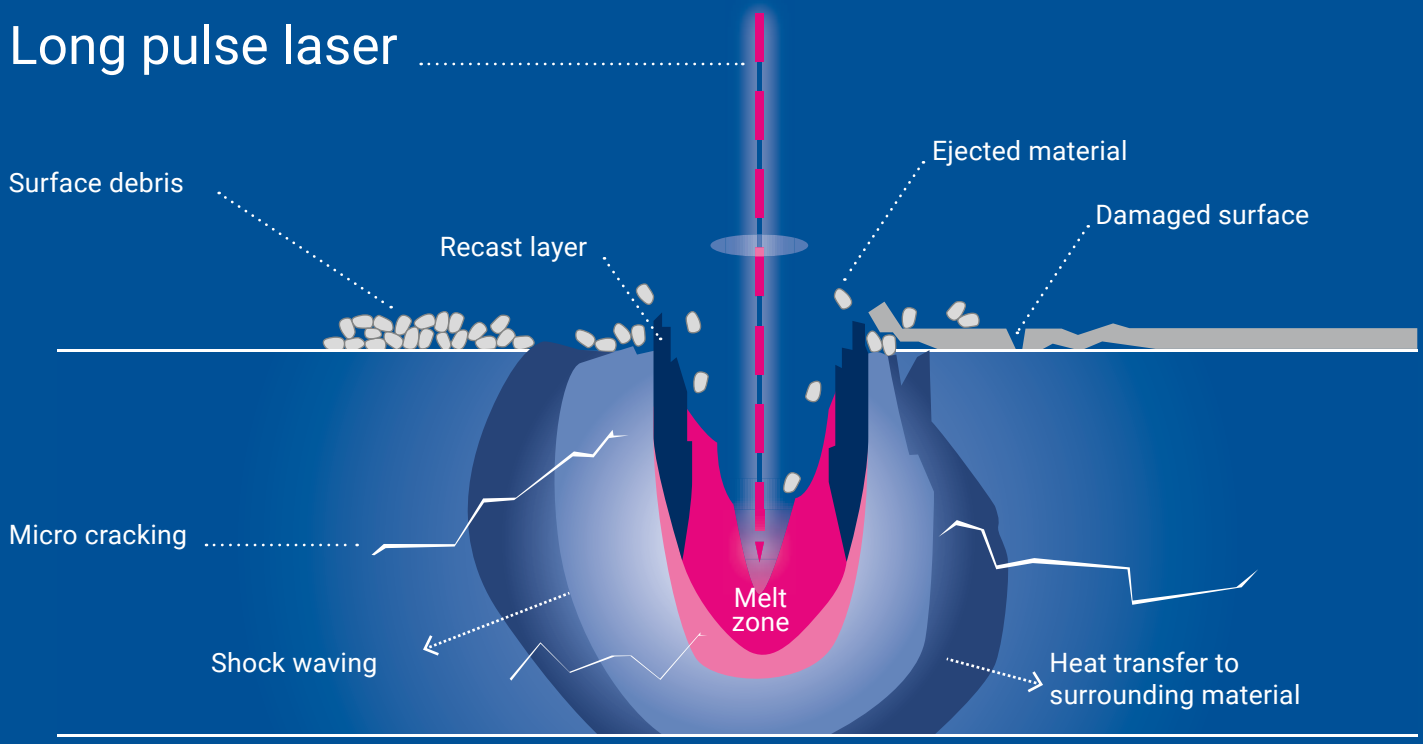
VISUAL LASER
- 532 nm: High-precision turning or cutting of a wide variety of materials, e. g. saphire, glass, and metal
- Melting, welding of copper and gold

NEAR INFRARED LASER
- 1,064 nm: Laser marking, cutting, welding, melting of all possible materials
- Available in different power classes up to >100 kW as well as ultrashort pulse lasers (ns, ps, fs)

INFRARED LASER (CO_2)
- 10.6 µm: Laser engraving and cutting of various materials, e. g. plastics, wood, rubber, leather, metals, textiles, and many more

Technologies and emissions

Long pulse laser

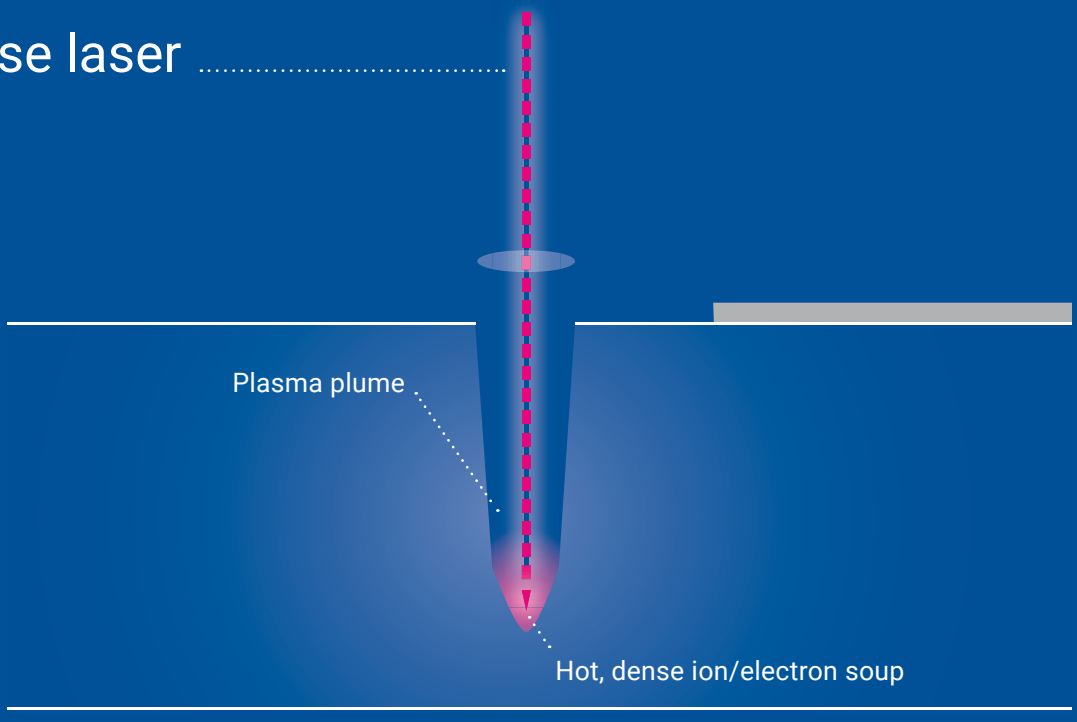


Ultra short pulse laser

No damaged surface

No debris

No recast layer



No micro cracking

No shock waving

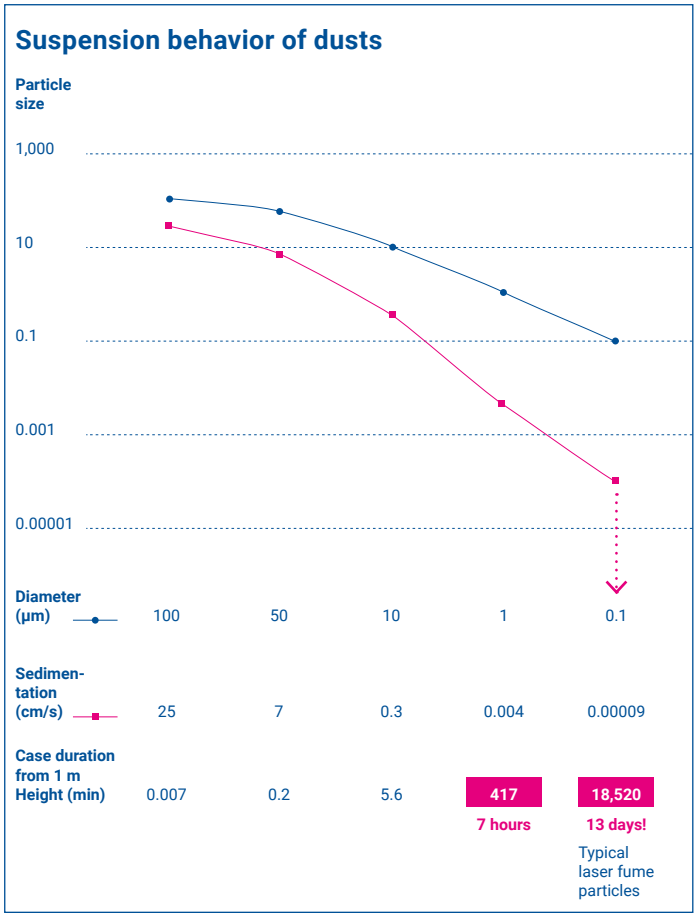
No melt zone

Depending on the laser technology used, all applications create airborne pollutants, commonly called laser fume, laser dust, or laser vapor. These emissions contain particles of different sizes and compositions. They can affect human health, manufacturing equipment, and product quality.

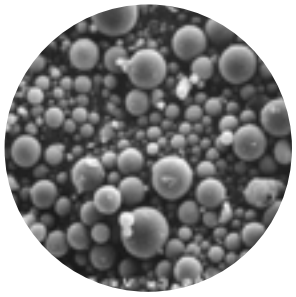
The type of contaminant released depends on the specific laser process.

Sedimentation behavior of airborne particles

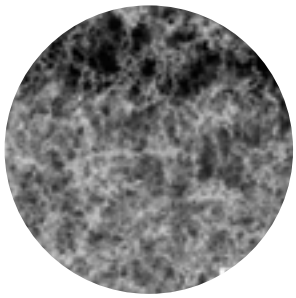
The finer the laser dust, or the smaller the particles produced, the longer it takes for them to fully settle out of the surrounding air – ignoring any possible air currents or temperature changes. That's why it's crucial to capture and remove pollutants directly at the source to stop them from getting into the air.



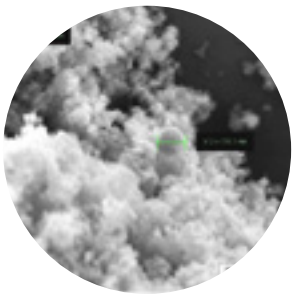
Particle shapes after processing with different laser techniques.



Continuous wave laser (cw)
Nanosecond pulse (ns)



Pikosecond pulse (ps)



Femtosecond pulse (fs)

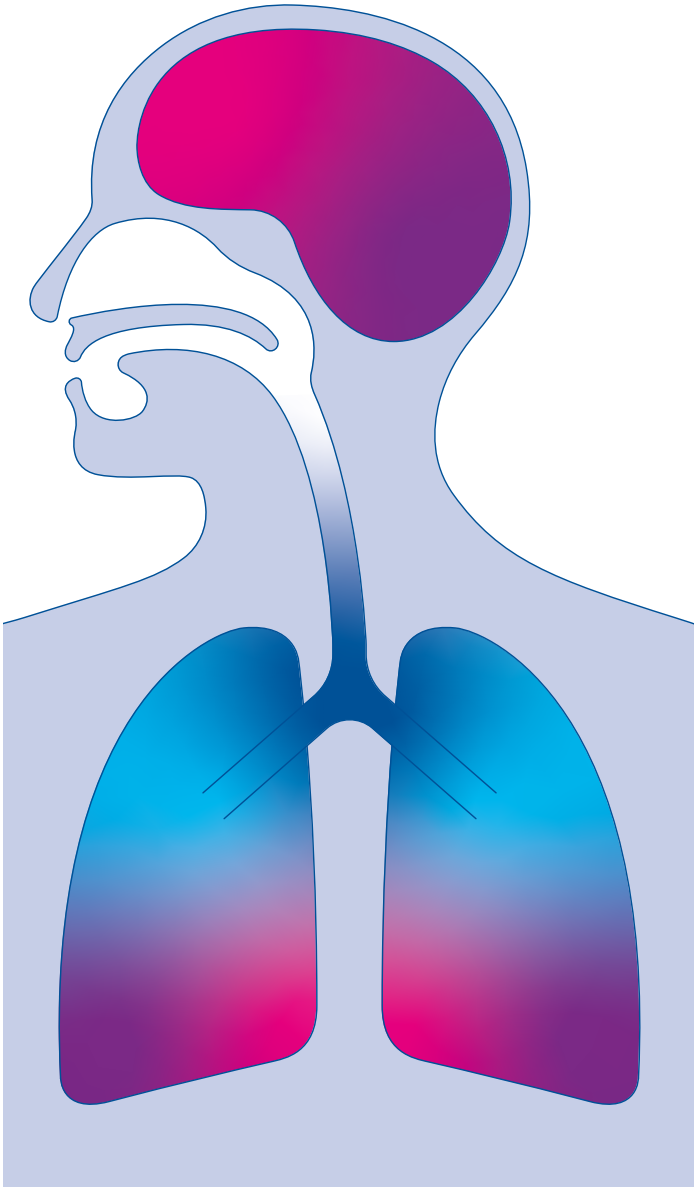
Particles can be highly combustible or even pyrophoric (self-igniting).

Health risks and legal basis

In North America, the primary federal agency responsible for workplace air quality is the Occupational Safety and Health Administration (OSHA). OSHA sets standards for permissible exposure limits (PELs) for various airborne contaminants. Additionally, the National Institute for Occupational Safety and Health (NIOSH) recommends exposure limits (RELs) that are often more protective than PELs.

These regulations often differentiate between substances based on their health risks, such as whether they harm the brain, nerves, or respiratory system, and whether they can be inhaled deeply into the lungs.

It's essential for businesses to comply with all applicable regulations to protect worker health and safety.



Material processing releases pollutants

Some laser fume compositions, like chromium-nickel compounds, require special handling because they fall under specific occupational safety regulations.

Utilizing professional extraction and filtration technology is crucial. Because laser fumes vary in composition, a thorough analysis and planning process is needed to determine the best collection, separation, and exhaust solution.

Pollutant capture

The filtration process starts with collecting

Air pollutants are captured before filtration, because only what's captured can be filtered. The amount captured determines the effectiveness of the subsequent filtration process. This directly impacts the overall system efficiency and the level of pollutants in the recirculated exhaust air.

Placing the collection element as close as possible to the pollutant source is crucial. Selecting the right collection element is also very important. ULT is here to help customers with this process.

Further information on the capture of airborne pollutants:

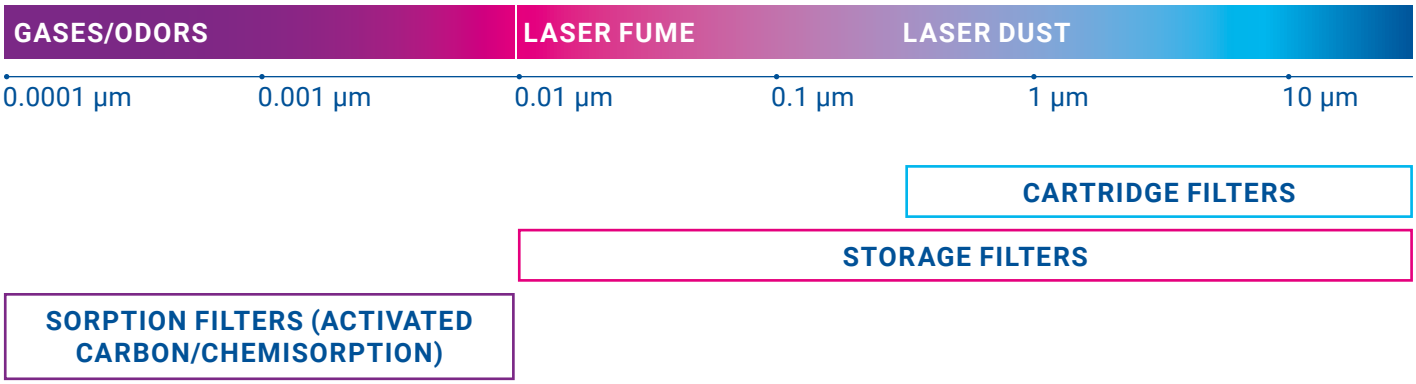
COMPETENCE BROCHURE ON POLLUTANT CAPTURE FROM ULT

CANADIAN CENTRE FOR OCCUPATIONAL HEALTH AND SAFETY

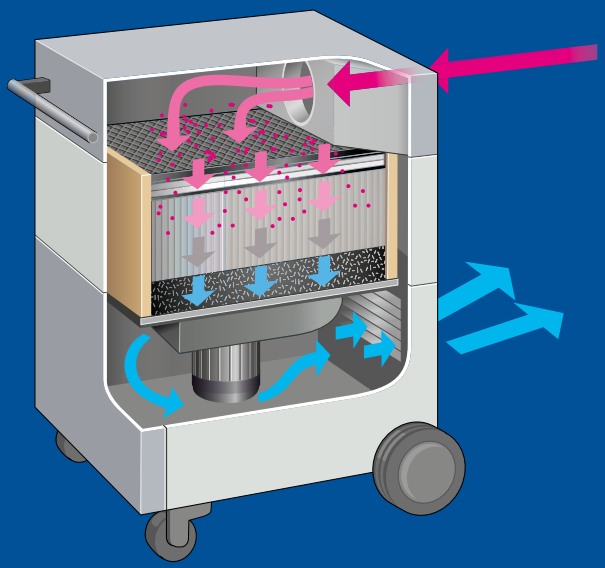
Rule of thumb: Doubling the distance between the collection point and the pollutant source quadruples the energy needed to run the filter system.

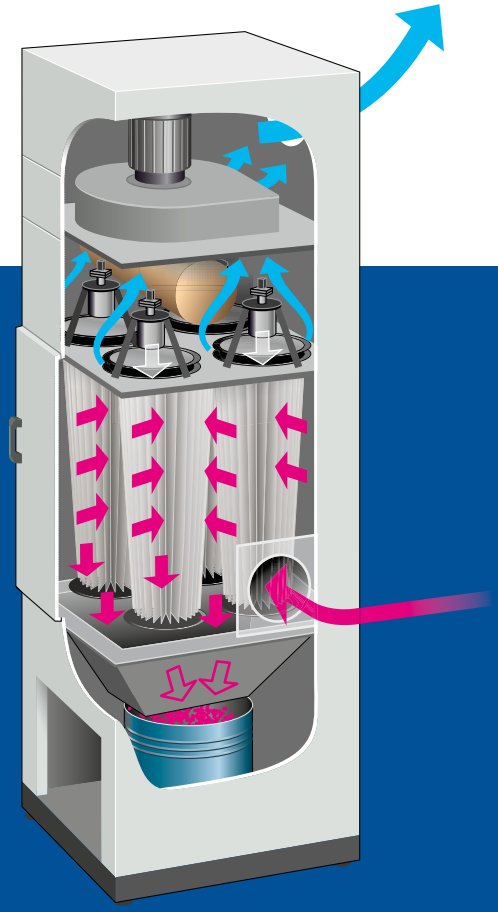
Typical capturing elements for laser fume and dust

Filter types and particle sizes



Filtration principles



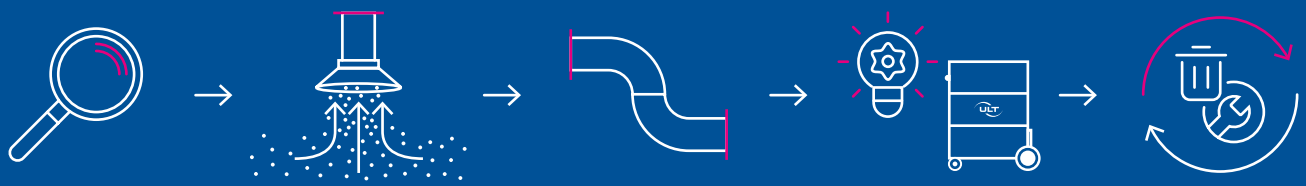


STORAGE FILTER
· For low laser fume concentration and occasional use
· Low investment costs
· High flexibility

CLEANABLE FILTER (CARTRIDGE)
· For higher laser dust levels and continuous use
· Low maintenance needs
· High operating point stability

Optimal system design for air pollution control

The system technology is sized based on a thorough analysis of the production process and pollutant levels. This analysis should be conducted by experts working together with the end-users.



1) ANALYSIS STAGE

2) CAPTURE DETERMINING

3) TRANSMIS-SION ELEMENT DETERMINING

4) DEVICE AND TECHNOLOGY DETERMINING

5) WASTE HAN-DLING AND MAINTENANCE

Utilization of additional technology

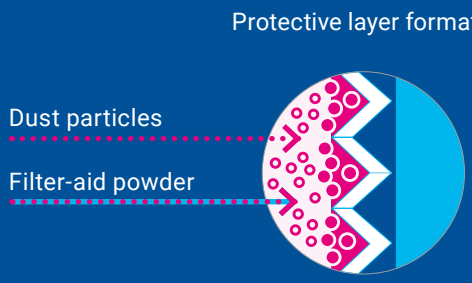
In some cases, a simple extraction and filter system isn't enough. For example, when dealing with moist laser dust from plastics or organic materials like paper or wood, a filter aid is almost always necessary. This helps improve the separation of particles and significantly extends filter life.

Additionally, laser processes often produce odors or gases that can be removed using adsorption methods (like activated carbon or chemisorption).

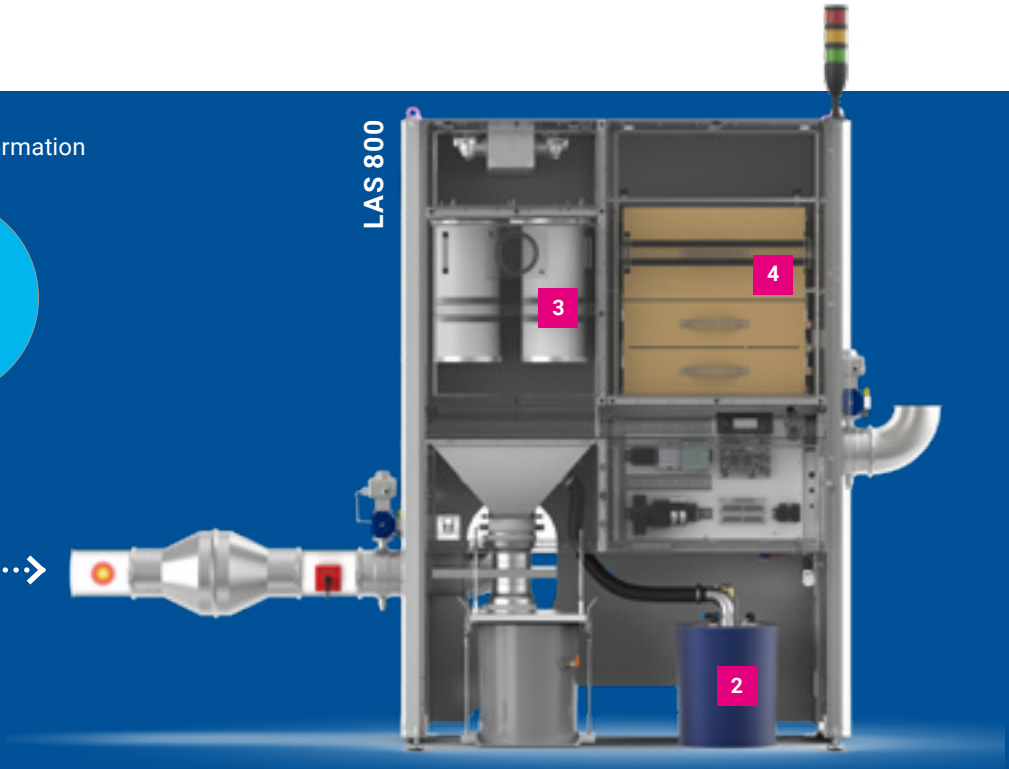
Ultrashort pulse lasers present a particular challenge because filters clog up quickly.

FILTER AID FOR PARTICLE SEPARATION

EXTRACTION AND FILTRATION OF STICKY LASER DUST



Pollutant source



1) EXTRACTION
Capturing of contaminated air including sticky particulates

2) METERED ADDITION
Sequential addition of filter-aid powder

3) PRE-FILTRATION
Cleanable filter unit for dust particle filtration

4) POST-FILTRATION
Storage filter unit for odor and gas filtration

Undesirable dangers — what should be considered?

Question:

What pollutants are produced? Information and knowledge about particles, including their physical and chemical properties, is critical.

PAPER ON PARTICLE CHARACTERIZATION

Based on hazardous material checklists and risk assessments, we develop a comprehensive concept for your ideal extraction and filtration solution.

Analysis stage and questions

Structural analysis
Functional analysis → Fault analysis → Action analysis and evaluation → Optimization

- Are the substances flammable or explosive?
- Which explosion protection zones are there?
- Are spark traps or filter aids necessary?
- What laws and guidelines must be followed?
- What are the parameters regarding flow rate, vacuum, hose lengths?
- Does the filtered air need to be vented outside?
- Which signals are important for a higher control system?
- What are the risks and where is prevention important?

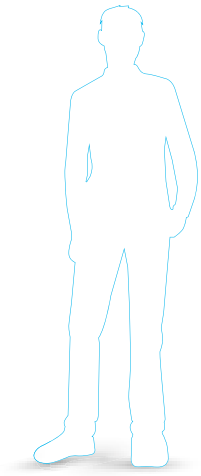
These and other questions need to be answered. ULT helps customers with hazard analysis and elimination, and provides custom solutions when needed.

ULT systems and their typical applications

The examples below showcase commonly used process technologies, but other methods like laser melting, laser ablation, or micro-processing are also possible with specialized system setups. We work closely with customers to develop tailored solutions for these applications.

Based on our extensive experience, we know that each process requires a specific analysis. Factors like laser power, dust amount, and the necessary flow rate are crucial to consider.

Storage filter systems



Typical applications	LAS 160.1	LAS 200.1	LAS 260.1	LAS 400.1	LAS 1200
Max. flow rate in m³/h	190	320	360	1,000	1,500
Laser cutting					X
Laser welding			X	X	X
Laser marking	X	X	X		
Laser ablation			X	X	X
Laser structuring	X	X	X	X	X
Laser cleaning		X	X	X	X
Laser drilling			X		X
Medical laser	X	X	X		

Cleanable filter systems

LAS 300	LAS 500	LAS 800	LAS 1500	LAS 2000	LAS 2500
900	400	1,620	3,240	4,000	3,250
X	X	X	X	X	X
X	X	X	X	X	X
X		X			
X	X	X	X	X	X
X	X	X	X	X	X
X	X	X	X	X	X
X		X			

Intelligent solutions for best air quality

ULT — air quality

Air quality is essential for work and production processes. As a full-service provider, ULT develops air purification solutions to meet the highest standards, protecting employees, equipment, products, and the environment.

Our reliable products support efficient manufacturing and customer profitability. Because we understand our customers' processes and needs, we can create tailored solutions ranging from standard products to custom systems.

Our in-house research and development team, along with partnerships with industry associations, academic institutions, and businesses, drives continuous improvement in our ventilation systems and air quality solutions for the future.

ULT

ULT headquarters
in Löbau/Germany

Solutions — unique and customer-focused

What makes our solutions for laser fume extraction so special:

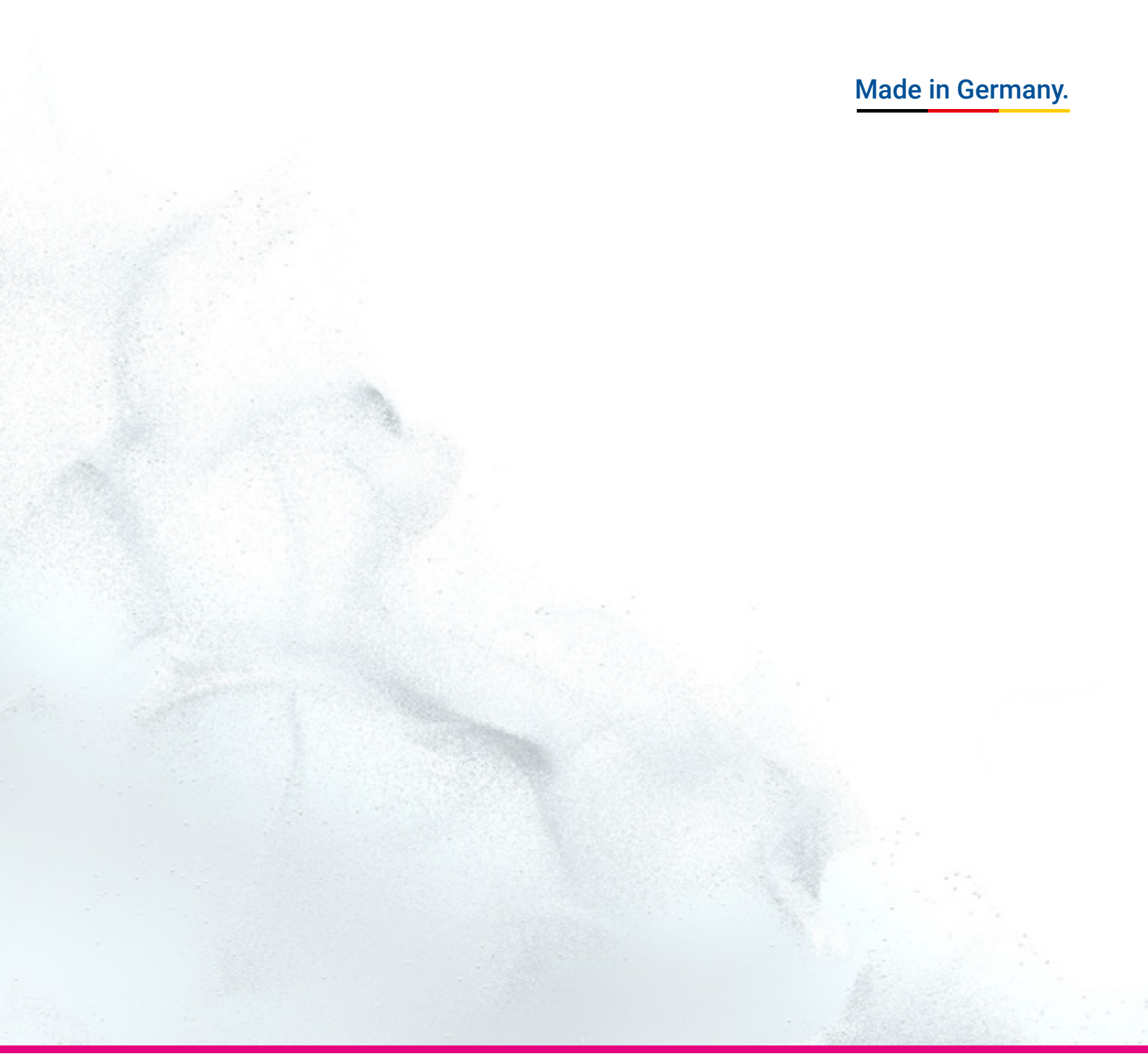
- Complete system solutions: We offer a wide range of filter types, safety features, and accessories.
- Quiet operation: Our systems are designed to be quiet.
- Low operating costs: Our solutions help you save money.

What sets ULT apart?

- One-stop shop: We provide products, system solutions, and installation services.
- Customizable systems: We can create a unique system based on your needs using our modular design.
- Expert advice: Our team offers high-level consulting services.

EXTRACTION AND FILTRATION SOLUTIONS FOR LASER FUME AND DUST

Made in Germany.



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ULT Canada Sales Inc.
64111 – 393 Avenue East Suite 57
T1S0L1 Okotoks
Canada

Phone: +866-694-1131
E-Mail: office@ult-na.com
Web: www.ult-na.com