Extraction and filtration solutions for laser fume and laser dust

ULT
air quality

Laser processes and applications

The use of laser technology has become standard in many industrial manufacturing processes, but also in other areas such as medical technology or R&D. Cutting and joining processes, surface processing, marking or modern production technologies such as additive manufacturing benefit from the extensive advantages of this technology.

There is not "the" laser, because the range of possible technologies is also increasing.

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

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

VISIBLE SPECTRUM

380 nm – 780 nm

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

INVISIBLE SPECTRUM (NEAR INFRARED)

780 nm – 2,500 nm

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)

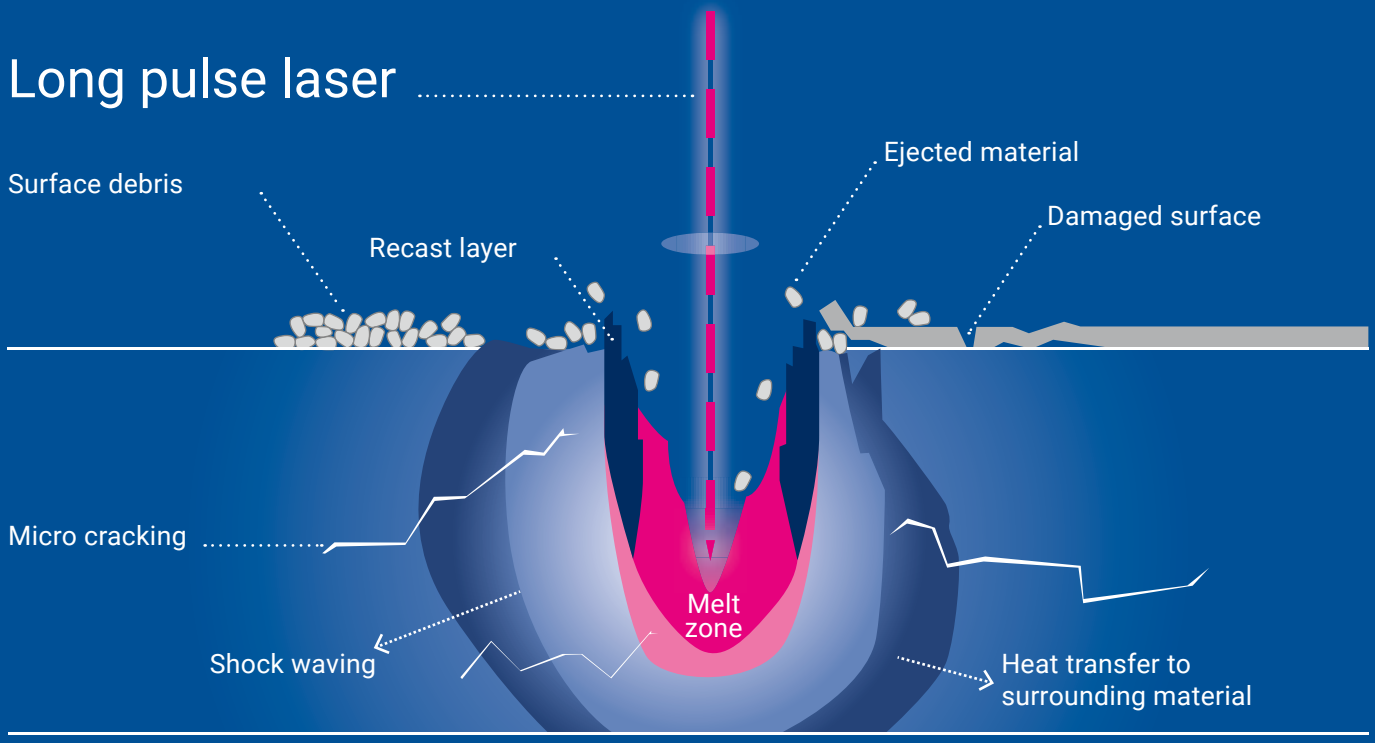
INVISIBLE SPECTRUM (INFRARED)

2,500 nm – 1 mm

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

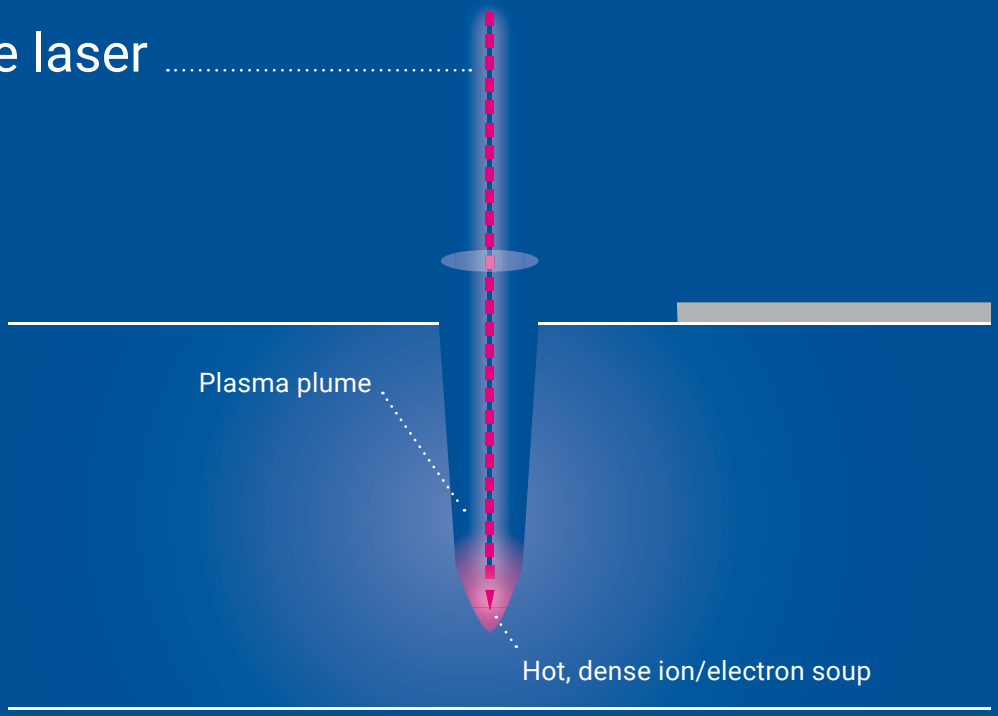


Ultra short pulse laser

No damaged surface

No debris

No recast layer



No micro cracking

No shock waving

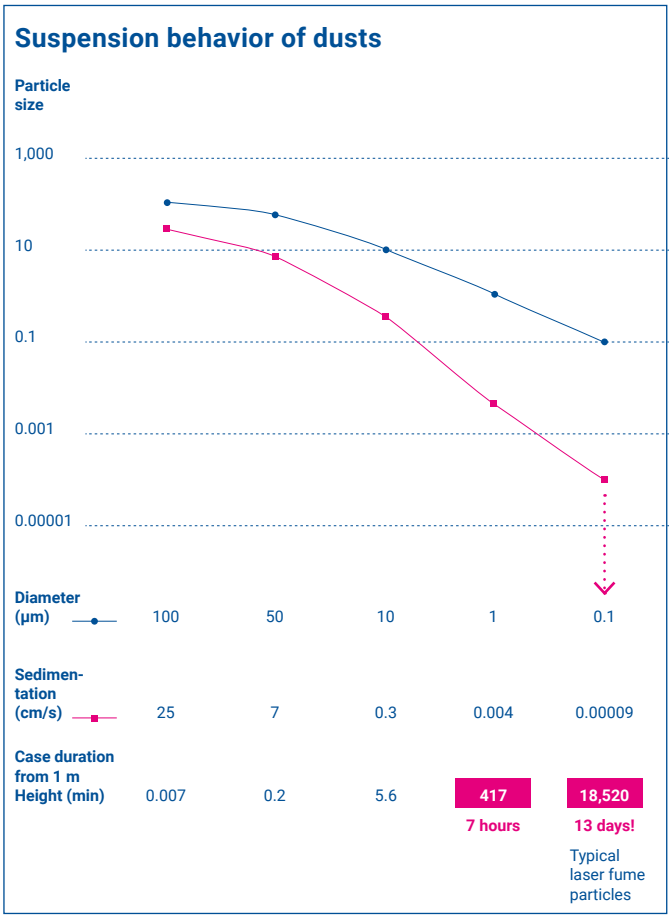
No melt zone

Depending on the laser technology, all applications produce airborne pollutants, classically referred to as laser fume, laser dust or laser vapor. These emissions consist of particles of different sizes and compositions. They may have impacts on the human organism, the manufacturing equipment, and the product quality.

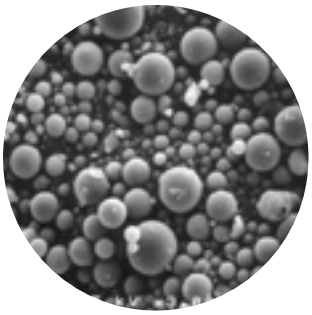
The type of contaminant emission depends on the respective laser process.

Sedimentation behavior of airborne particles

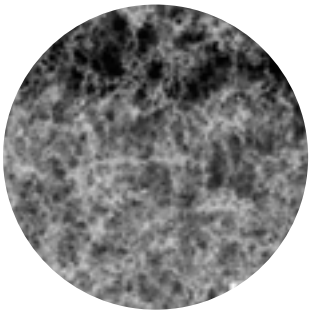
The finer the laser dust, i.e. the smaller the particles produced, the longer it takes for them to completely sink out of the ambient air – possible air movements and thermal influences are excluded. That's why it is highly important to capture and remove pollutant directly at the source to prevent it from entering the ambient air.



Particle shapes after processing with different laser techniques.



Continuous wave laser (cw)
Nanosecond pulse (ns)



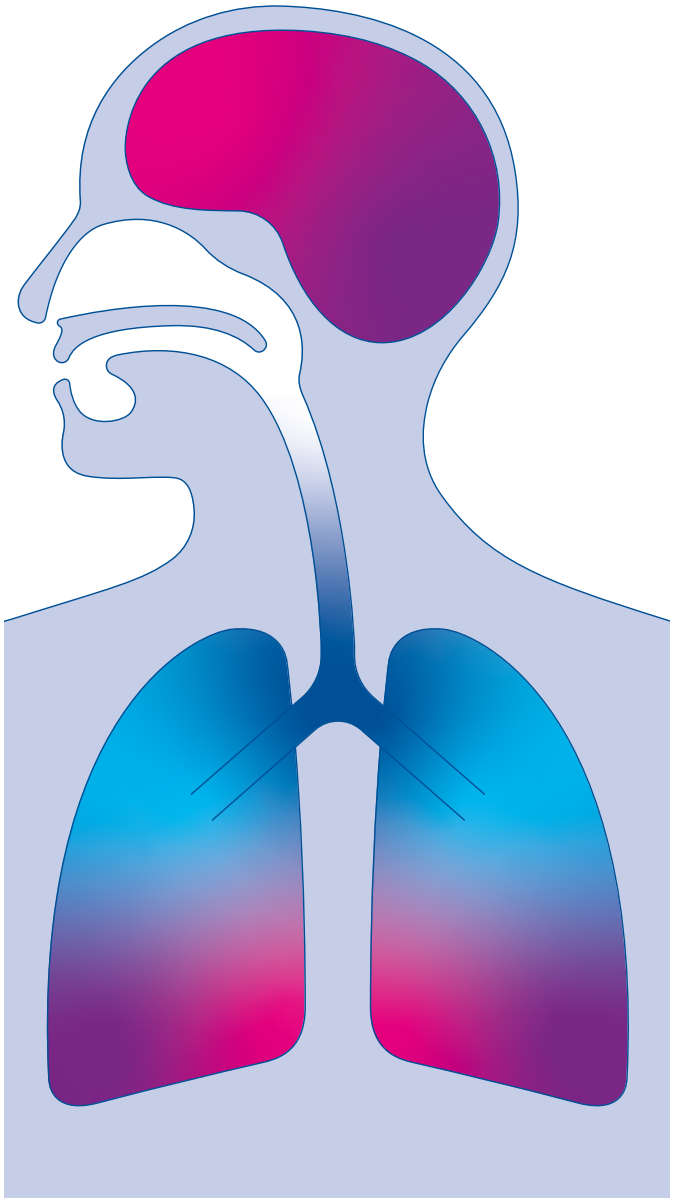
Pikosecond pulse (ps)

Femtosecond pulse (fs)

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

Health risks and legal basis

In many countries there is a number of legal regulations that prescribe how airborne pollutants in the process air must be removed. A distinction is made as to whether the substances are harmful to the brain, nerves or respiratory tract, or whether they are inhalable or alveolar.



Material processing releases pollutants

Some compositions of laser fume, e.g. chromium-nickel compounds, must be considered separately, as special occupational safety regulations apply to them.

The use of professional extraction and filtration technology is therefore imperative. Due to the different compositions of laser fume, a comprehensive analysis and implementation process is required to define the ideal collection, separation and exhaust solution.

Pollutant collection

The filtration process begins with the capture

Air pollutants are collected before filtration, because only what is captured can be filtered. The degree of capture forms the basis for the subsequent optimal filtration. Consequently, this results in the efficiency of the entire system and therefore the pollutant residues in the recirculated exhaust air.

The greatest proximity to the pollutant source is crucial here.

The selection of the best-suited collection element is also of great importance. ULT is at the customer's side to provide advice.

Further information on the capturing of airborne pollutants:

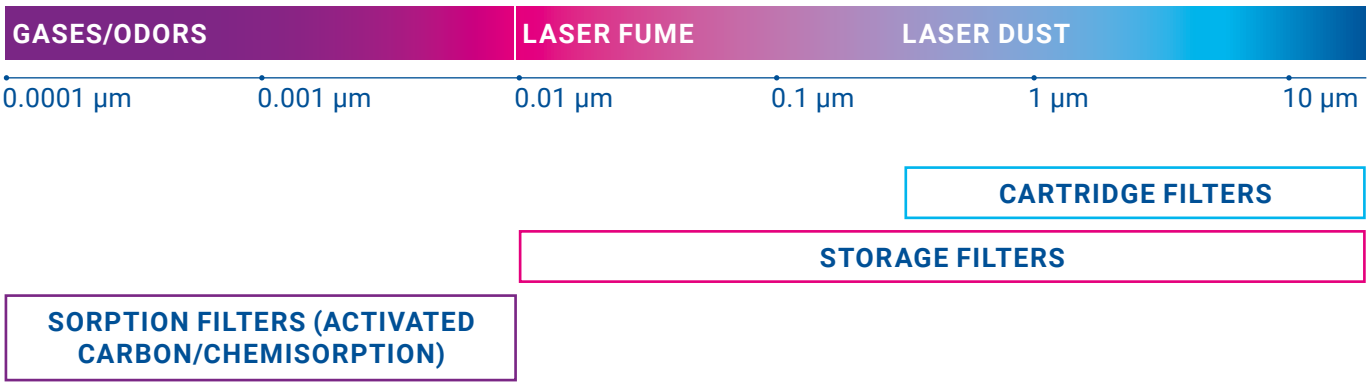
COMPETENCE BROCHURE ON POLLUTANT CAPTURING FROM ULT

BROCHURE BY THE GERMAN PROFESSIONAL ASSOCIATION VDMA

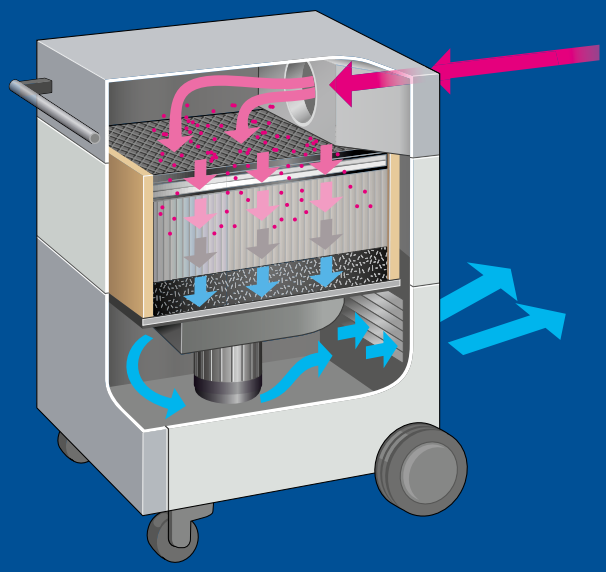
Rule of thumb: Doubling the distance between the collecting element and the pollutant source means quadrupling the energy requirement of the filter system.

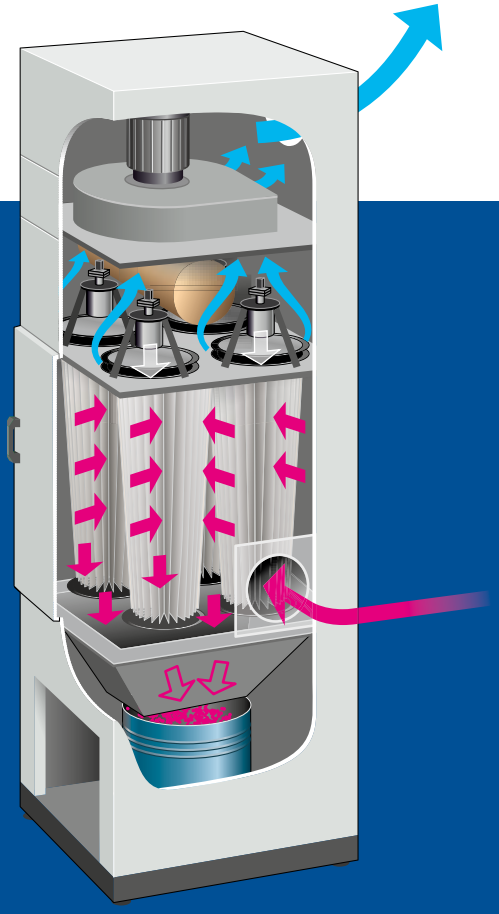
Typical capturing elements for laser fume and dust

Filter types and particle sizes



Filtration principles



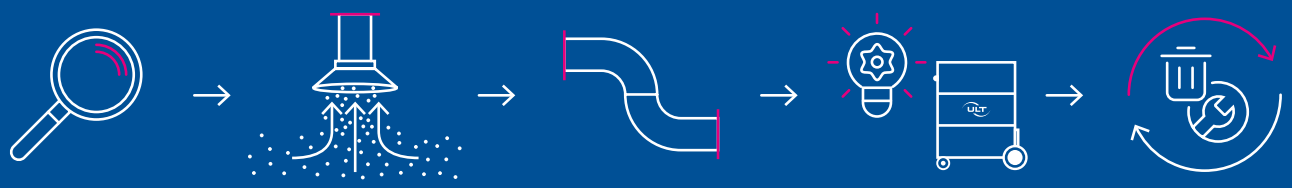


STORAGE FILTER
· For low laser fume concentration and sporadic use
· Low investment costs
· High flexibility

CARTRIDGE FILTER
· For higher laser dust concentrations and continuous use
· Low maintenance requirement
· High operating point stability

The right plant design for optimum air pollution control

The dimensioning of the plant technology is derived from a fundamental analysis of the production and pollutant situation. This should be prepared by experts together with the users



1) ANALYSIS STAGE

2) COLLECTION DETERMINING

3) TRANSMISSION ELEMENT DETERMINING

4) DEVICE AND TECHNOLOGY DETERMINING

5) WASTE HANDLING AND MAINTENANCE

Utilization of additional technology

In certain cases, a "simple" extraction and filter system is no longer sufficient.

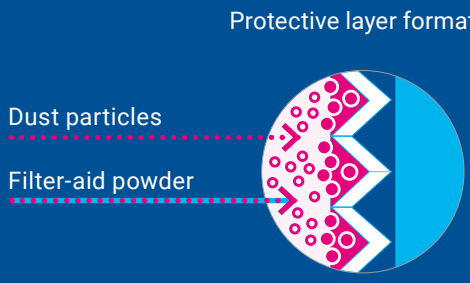
For example, in the case of moist laser dust from plastics or organic materials such as paper or wood, a filter aid additive is necessary in almost all cases. This supports and optimizes the separating process of the occurring particles and, hence, extends the filter life considerably.

In addition, laser processes almost always generate odors or gases, which can be removed by appropriate sorption processes (use of activated carbon or chemisorption).

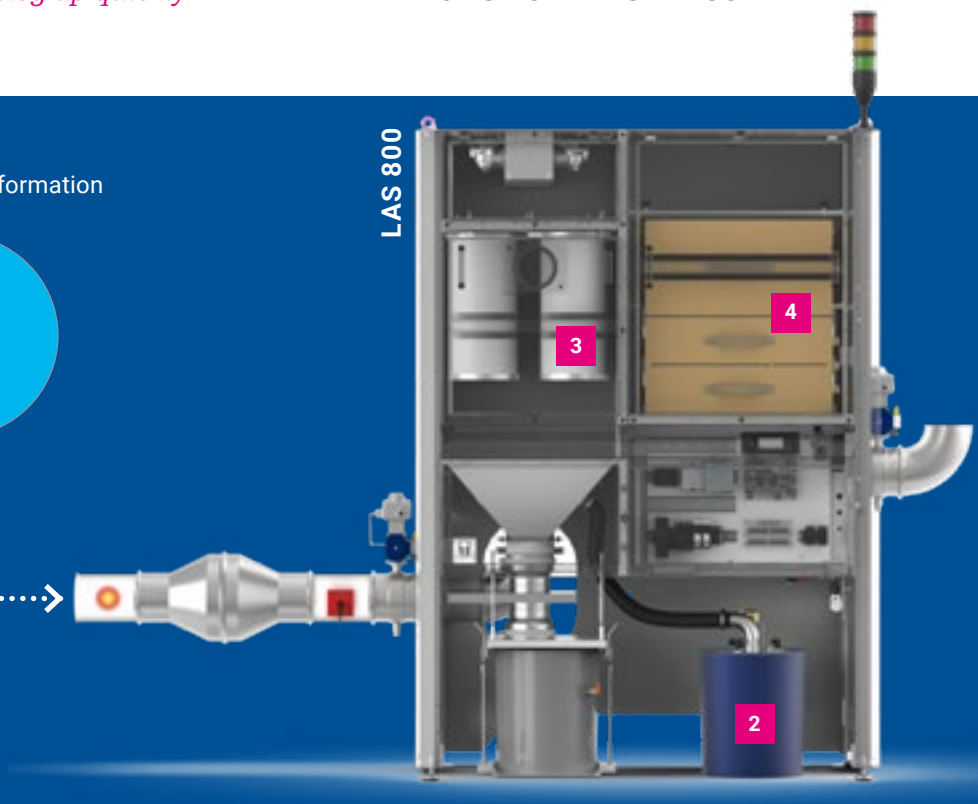
Particularly in terms of ultrashort pulse laser, there are major challenges as filters clog up quickly.

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
Cartridge 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? The Gestis database of the DGUV provides necessary information.

DGUV GESTIS DATABASE

Based on hazardous material check-lists 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 volume flow, vacuum, hose lengths?
- Does the filtered air have to be discharged to the 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 supports users in hazard analysis and elimination, and offers individual solutions if required.

ULT systems and their typical fields of application

The applications below are exemplary and show the currently common process technologies – others such as laser melting, laser ablation or micro-processing are also supported by partly special system configurations in consultation with users. For this purpose, ULT is there to advise its customers.

Based on extensive practical experience, we know that each process must be analyzed specifically. Parameters such as laser power, dust quantity and the amount of required air play decisive roles.

Storage filter systems

Typical fields of application	LAS 160.1	LAS 200.1	LAS 260	LAS 400.1	LAS 1200
Max. air flow in m³/h	190	320	635	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		

Cartiridge 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

Since the air quality is of fundamental importance for work and production processes, ULT, as a full-service provider, develops air purication solutions for the highest demands — to protect employees, equipment, products, and the environment.

The reliability of our products ensures manufacturing processes and the profitability of our customers.

The proximity of the ULT experts to the processes and requirements of our customers enables the development of tailor-made and needs-oriented solutions — from the standard product to the individual system.

Our own research and development department as well as numerous cooperations with professional associations, education institutions and industry form the basis for the permanent further development of our ventilation systems and solutions for the best air quality of tomorrow.

ULT AG

ULT headquarters in Löbau/Germany

Utilization of an LAS 800
laser fume extractor
for laser cutting

Solutions – unique and customer-oriented

What makes our solutions for laser fume extraction so special:

· Complete system solutions: filter types, safety technology, accessories
· Low-noise operation
· Low operating costs

What distinguishes a solution from ULT:

· One-stop shop for products, system solutions, installation
· Individual system configuration on basis of a modular device concept
· High professional competence in consulting

EXTRACTION AND FILTRATION SOLUTIONS FOR LASER FUME AND DUST

Made in Germany.

Version June 2023

ULT AG
Am Göpelteich 1
02708 Löbau
Germany

Phone: +49 3585 4128 0
Fax: +49 3585 4128 11
Email: ult@ult.de
Web: www.ult.de