



Additive
Manufacturing

Air Handling Solutions for Additive Manufacturing

Extraction. Filtration. Persistence.



Complex products. Complex air pollution conditions.

Additive manufacturing (AM), often referred to as 3D printing, opens up the gates for innovative, complex products. This brings with it new and intricate issues with regards to air pollution, demanding the need for safe and efficient extraction and filtration

technology. Consistency of processed material and processes are equally as important. The processing of powders creates differing air pollution conditions compared that of liquids, fibres, or other solids.

The seven air pollutants in additive manufacturing and their potential hazards for humans, machines, and products

 Macro dust	Will be released during handling of powder materials and finishing of products (removal of supporting structures, grinding)	Damages the respiratory system; contaminates machines and products
 Nano dust	Emerges from melting processes during manufacture from powder particles	Risk of fire and explosion; damage to internal organs by passing the lung-blood-barrier; firmly adhering contaminants to machinery and products
 Solvent vapors	Will be released during outgassing of liquid synthetic resin and during cleaning of products	Eye damage; respiratory and nerve poison
 Noxious gases	Will be released when melting powder materials during manufacturing processes	Product damage due to contamination of powder materials and liquid synthetic resins
 Foreign particles	Dust particles in the air at the workplace	Product damage due to contamination of powder materials and liquid synthetic resins during manufacturing processes
 Oxygen in inert gases	Accumulates in the inert gas atmosphere during processes under protective gases (e.g. selective laser melting)	Damages products due to unwanted oxidation processes
 Air humidity	Normal side effect in non-air conditioned rooms	Impairs quality of stored material powders

Procedures utilizing powders with laser or electron beams are particularly hazardous. The released nano dusts may harm human health, machine conditions, and products.

What's more, metallic nano dusts are highly inflammable. The challenges to meet the hazards of additive manufacturing present extreme difficulties for air handling technologies. When working under inert gas atmosphere, argon or nitrogen is used

in a circulation process. They accumulate atmospheric oxygen and foreign particles to the detriment of products. Inert gas cleaning therefore is a mandatory task of air handling.

When considering the core manufacturing process, one additional aspect should not be forgotten: pre and post processing will also release air pollutants that must be removed.

Tasks of air handling during AM depend on procedure type

Procedure type	Processing of metal, plastic, and ceramics powders	Processing of plastic fibres and liquid synthetic resins
Procedure examples	 Selective laser melting	 Stereolithography
	<i>Further typical procedures:</i> Selective laser sintering Electron beam melting Laser deposition welding	<i>Further typical procedures:</i> Fused filament fabrication Liquid composite moulding
Process preparation	Keep away air humidity from material powders; Remove macro dust from the air	Remove solvent vapors from the air
Additive manufacturing	Remove nano dust from the air and deposit it safely; Remove noxious gases from the air; Keep away foreign particles from powders; Keep process gas atmosphere free of oxygen	Remove solvent vapors and gases from the air; Keep foreign particles away from molten mass or liquid resin
Process follow-up	Remove macro dust and solvent vapors from the air	Remove macro dust and solvent vapors from the air

Complete air handling.

ULT offers complete air handling solutions for additive manufacturing: for all procedures and all materials. These solutions have been developed taking into consideration all aspects of the complex conditions relating to air pollution.

For years, ULT AG has been accompanying the development of additive manufacturing methods through intensive research. ULT is a member of the AGENT-3D research consortium and is actively involved in relevant projects of universities and research institutes. Moreover, ULT has years of experience in cleaning industrial gases.

AMF series

Based on these prerequisites, the AMF series of extraction and filtration technology has been developed. The devices are saturation filter units. Their filtration systems feature a complex structure and can be adapted to individual procedure and material specific air pollution conditions. In addition, the devices are designed to, with minimal adaptation expenditure, become an integral part of any manufacturing plant.

The series is structured by air capacity. Hence, a suitable extraction and filtration solution is available for each manufacturing plant. This applies also to plants in continuous operation, where long-term reliability is mandatory. Even large open air volumes can be reliably extracted.

Renowned manufacturers of plants for additive manufacturing have already gained experience on the use of this extraction and filtration technology.

Handling of nano dust

ULT has all the knowledge to safely handle nano dusts, especially metallic dusts, gener-

Performance class	Max. volume flow (m³/h)
ULT JUMBO Filtertrolley 2.0 AMF	170
AMF 160	170
AMF 200	220
AMF 300	400
AMF 300 Ex	400
AMF 1200	1,500
AMF 1200 Ex	1,500

ated in additive manufacturing environments. Capturing elements, pipes, hoses, and filter cartridges are particularly designed to prevent deposits and spontaneous combustion. Special safety devices are available to assist filter exchanges.

For pre-processing and follow-up

Pre-processing of materials and follow-up treatment of products is spatially separated from the manufacturing plants. Accordingly, extra air handling solutions are required. Material powders must be stored in a very dry environment. While conventional drying technology reaches its limits, the sorption drying concept ULT Dry-Tec® provides for a highly effective dehumidification of the process air. An additional extraction and filtration device of the ASD series (dust and smoke) will capture macro dust, which is released during classification and mixing of material powders.

While handling liquid resins before the additive process, a unit of the ACD series (odors, gases, and vapors) is recommended. Units from both series can also be used during cleaning and mechanical finishing of the products.

ULT's comprehensive air handling offers for additive manufacturing

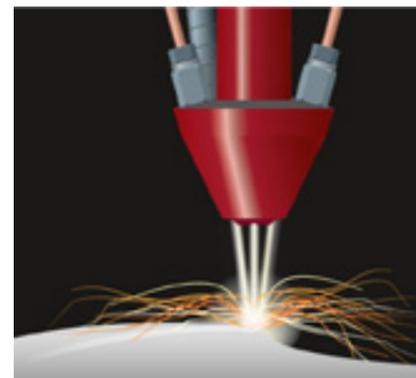
1. Process preparation



ULT Dry-Tec®:
extreme drying of material powders

Extraction and filtration technology: ACD series for odors, gases, and vapors, or ASD series for dust and smoke

2. Additive manufacturing



AMF series:
extraction and filtration technology for additive manufacturing processes



3. Process follow-up



Extraction and filtration technology: ACD series for odors, gases, and vapors, or ASD series for dust and smoke

Made to suit the customer's needs.

For ULT, air handling for additive manufacturing means individual consultation and project planning. The result is not just a configuration of extraction and filtration technology units for additive manufacturing, but a complete air handling solution for the entire manufacturing process – coordinated in every detail.

Check list for air handling technology

- » Which manufacturing method?
- » What sort of material?
- » Which manufacturing machine?
- » How many manufacturing machines?
- » Operation under inert gas?
- » Quantity of items to produce?
- » Automated continuous operation?
- » What kind of follow-up finishing work?

Tailored solutions from compact to large

ULT has them all: compact solutions for individual work places or collective solutions covering several machines and plants. The units are designed to suit applications with restricted space. Many devices are designed with mobility in mind.

Particularly user friendly

Air handling technology from ULT features low noise levels and minimum energy consumption.

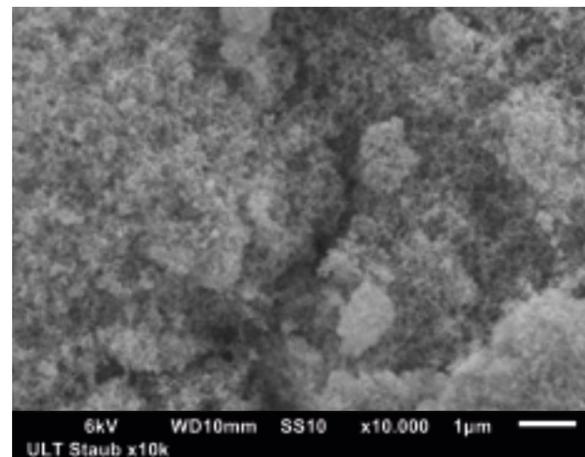
Operation and maintenance are very easy.

Open to special requirements

The units can be shipped in ESD or ATEX compliant designs. Casings are optionally made of corrosion resistant steel. Customers may choose special voltages and frequencies as well as a digital control to maintain constant pressure, timer function, filter analysis, and interfaces for external control. A web server solution allows for remote monitoring and control of the units.

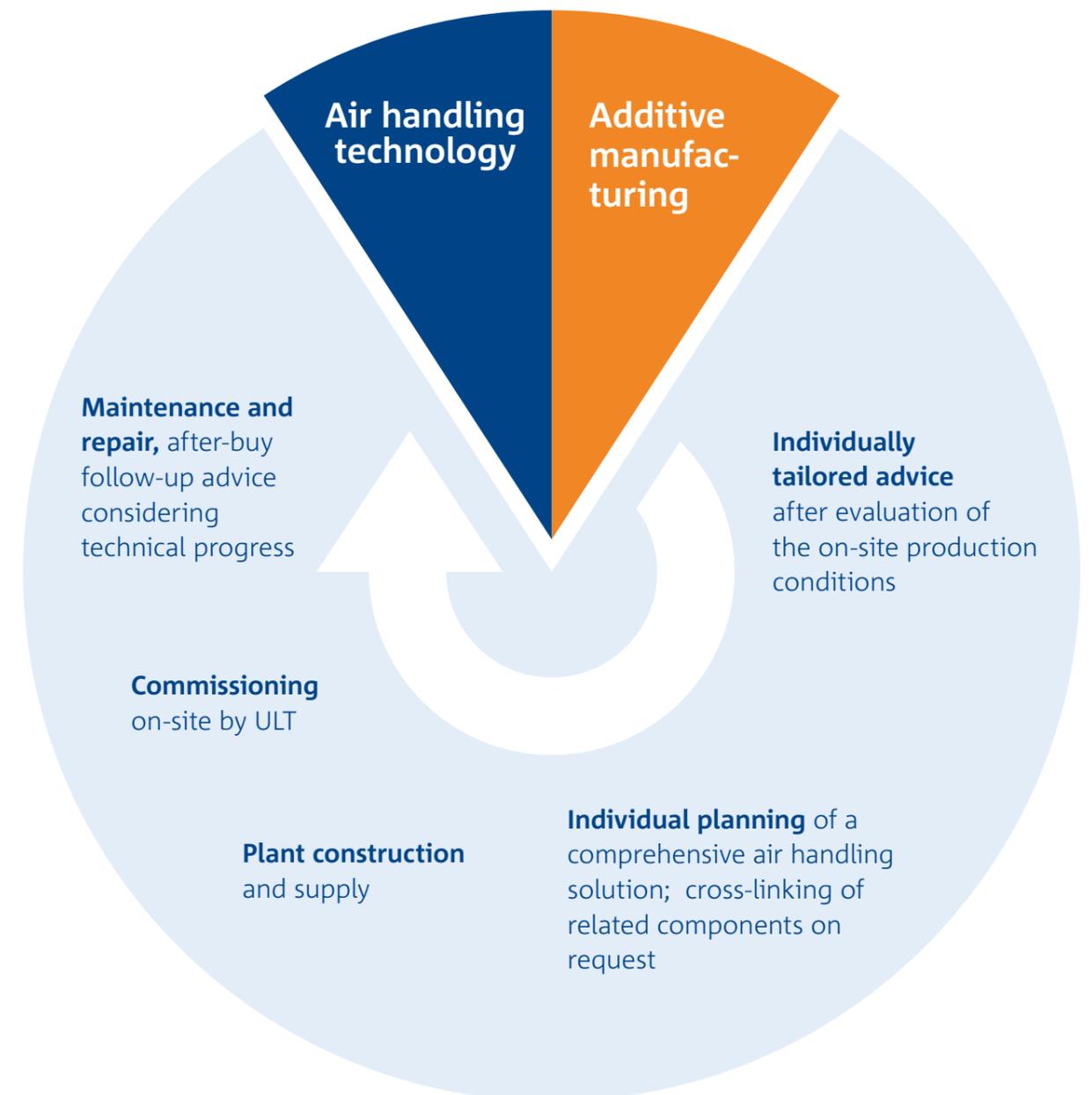
Exceptional scope of services

On-site installation and commissioning will be performed by ULT. The company's after sales service extends beyond maintenance and repair. Considering the technological progress, ULT advises its customers regarding suitable upgrades, both on the additive manufacturing and the air handling side.



Selective laser melting – a powder bed type of additive manufacturing – releases nano particles (SEM picture, ULT)

Regarding air handling technologies for additive manufacturing, excellent series products are only one element of the whole picture: ULT's range of services



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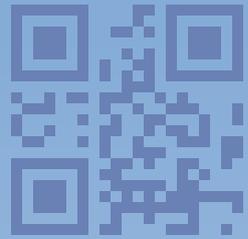
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ULT is certified according to ISO 9001:2008. The plants are designed meeting international standards. If required, they will be certified according to ATEX and W3 and tested to meet H requirements.

In addition, the plants always comply with current EC directives on energy efficiency (ErP directive: Total energy efficiency of ready-to-use ventilation systems or minimum energy efficiency of electric motors).

Detailed technical information can be found on device specific data sheets or on our website. All technical data is general and not binding and does not guarantee the suitability of a product for a specific application.

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