Operating Principle of the Andrea Labyrinth Filter

1. What is an Andrea Labyrinth Filter

The **Andrea labyrinth filter** (also referred to as an *Andrea paint arrestor filter*) is a **mechanical separation filter** designed for the **capture of paint overspray** in spray booths, coating lines, and industrial ventilation systems.

Unlike surface filtration systems, the Andrea filter operates on the basis of **inertial and gravitational separation**, achieved through **multiple directional changes of the airflow**.

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2. Filter Construction

The filter consists of:

- **Profiled, corrugated channels (lamellas)** forming a labyrinth structure,
- Typically manufactured from:
  - impregnated cardboard,
  - plastic materials,
  - less frequently aluminum or steel,
- Installed in a **vertical or inclined orientation** relative to the airflow direction.

The geometry of the lamellas forces the air stream to follow a complex, non-linear path.

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3. Operating Principle – Step by Step

Step 1: Intake of paint-laden air

Air extracted from the spray booth contains:

- paint droplets,
- pigments and binders,
- solvent particles.

This air stream enters the labyrinth filter directly.

Step 2: Rapid changes in airflow direction

Inside the labyrinth:

- the airflow is forced to **change direction multiple times**,
- light gaseous components follow the airflow,
- heavier paint particles cannot adapt to the sudden directional changes due to **inertia**.

Step 3: Inertial separation

Paint particles:

- impact the lamella surfaces,
- lose kinetic energy,
- merge into larger droplets through **coalescence**.

This is the core separation mechanism of the Andrea filter.

Step 4: Gravitational drainage of paint

The condensed paint:

- flows downward by gravity,
- is collected in a drainage channel or collection tray.

As a result:

- the filter does not clog on the surface,
- airflow remains stable over long operating periods.

Step 5: Cleaned air discharge

After passing through the labyrinth:

- the air is largely free of paint overspray,
- it is then directed to:
    - secondary filters (e.g. fiber or panel filters),
    - exhaust fans,
    - or further ducting systems.

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4. Efficiency and Performance Parameters

Typical values:

- **Overspray separation efficiency:**
  approx. **85–95%** (depending on paint viscosity and air velocity),
- **Very low pressure drop:** typically 20–50 Pa,
- High paint-holding capacity,
- Stable airflow characteristics over time.

5. Key Advantages

- No surface clogging,
- Low pressure loss and reduced energy consumption,
- Long service life,
- Suitable for continuous operation,
- Excellent performance with liquid coatings and high overspray loads,
- Reduced maintenance compared to traditional fiber filters.

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6. Limitations and Operating Conditions

- Does not remove odors or VOCs,
- Not a HEPA filter – not intended for submicron particles,
- Requires:
    - correct airflow velocity (typically 0.3–0.5 m/s),
    - proper vertical installation,
    - periodic cleaning of the drainage system.

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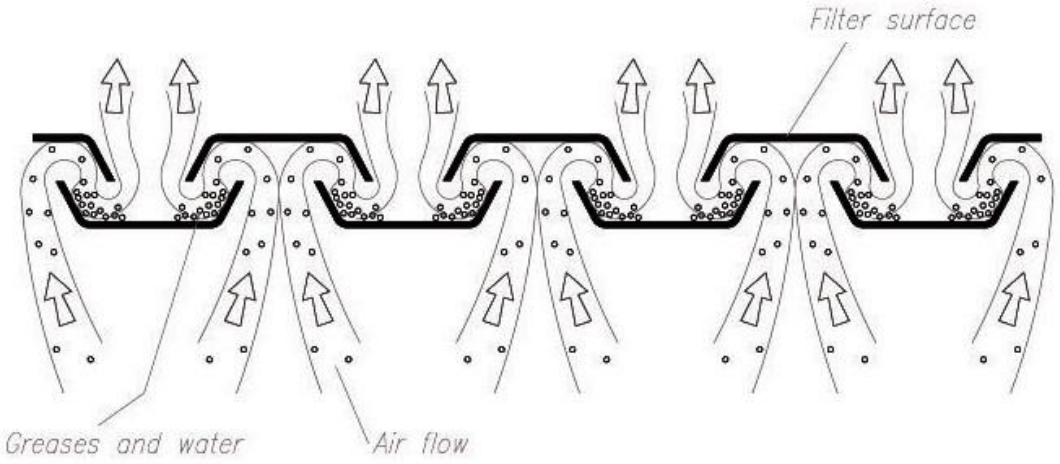
7. Typical Applications

- Wet spray booths,
- Industrial coating and painting lines,
- Liquid paint application processes,
- Systems where **low pressure drop and high durability** are critical.


Filter surface
Greases and water
Air flow


andreae
FILTERS
FILTRE COLLECTEUR DE BROUILLARD DE PEINTURE
PAINT OVERSPRAY COLLECTION FILTER
FARBNEBEL ABSCHEIDER
H 90cm

Paint Stop G4 Filter – Operating Principle and Technical Description

1. Overview

The **Paint Stop G4 filter** is a **high-efficiency depth filtration medium** designed for the **capture of paint overspray** in spray booths, coating lines, and industrial painting systems. It is classified according to **EN ISO 16890 / EN 779 (G4)** and is widely used as a **primary or secondary overspray filter**.

Unlike labyrinth filters, Paint Stop G4 operates by **progressive depth filtration**, ensuring high paint retention capacity and stable airflow characteristics.

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2. Filter Construction

The Paint Stop G4 filter is manufactured from:

- **multi-layered synthetic fiberglass media**,
- progressively structured from **coarse fibers on the air inlet side** to **finer fibers on the air outlet side**.

Key construction features:

- increasing fiber density in airflow direction,
- open structure on the inlet side for high paint loading,
- reinforced outlet layer to prevent fiber migration,
- supplied in rolls, pads, or cut-to-size panels.

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3. Operating Principle – Step by Step

Step 1: Intake of paint-laden air

Air extracted from the spray booth contains:

- liquid paint droplets,
- pigments and binders,
- solid and semi-solid overspray particles.

This air stream enters the **coarse fiber side** of the Paint Stop G4 filter.

Step 2: Progressive depth filtration

As air passes through the filter:

- larger paint particles are captured in the outer layers,
- finer particles penetrate deeper into the media,
- particles are retained throughout the entire thickness of the filter.

This **depth loading mechanism** prevents rapid surface clogging.

Step 3: Particle adhesion and retention

Paint particles:

- adhere to the fibers due to inertia and adhesive forces,
- accumulate uniformly across the filter depth,
- remain permanently trapped within the filter structure.

Step 4: Cleaned air discharge

After passing through all filtration layers:

- the air is high-grade purified from paint overspray,
- it is directed toward:
    - exhaust fans,
    - heat recovery units,
    - or further filtration stages.

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4. Filtration Efficiency and Performance

Typical performance parameters:

- **Overspray separation efficiency:** up to **98%**,
- **Filter class:** G4,
- **High paint holding capacity** due to depth filtration,
- **Stable pressure drop behavior** over the service life,
- Uniform airflow distribution across the filter surface.

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5. Key Advantages

- Very high overspray capture efficiency,
- Long service life compared to standard surface filters,
- Reduced frequency of filter replacement,
- Consistent airflow performance,
- Simple installation and replacement,
- Compatible with most spray booth designs.

6. Limitations and Operating Conditions

- Disposable filter – requires periodic replacement,
- Higher pressure drop than labyrinth filters,
- Does not remove VOCs or solvent vapors,
- Proper airflow direction must be respected (coarse → fine side).

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7. Typical Applications

- Dry spray booths,
- Wet and solvent-based painting processes,
- Powder coating pretreatment zones (liquid stages),
- Automotive, industrial, and metal coating lines,
- Secondary filtration stage behind labyrinth filters.

Polyester Filter G3 – 2 mm / 120 g/m²

Technical Description and Filtration Efficiency**

1. Application and Purpose

The **G3 polyester filter with a nominal thickness of 2 mm and a basis weight of 120 g/m²** is a dry filtration medium designed for use in **spray booths, painting zones, and industrial ventilation systems**.
It is intended for the **capture of paint overspray and coarse airborne particles** generated during liquid coating processes.

The filter is commonly used as:

- a **pre-filter**,
- a **primary overspray filter** in simple dry spray booths,
- a **protective filter** for exhaust fans and ductwork.

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2. Filter Construction

The filter is manufactured from:

- **synthetic polyester fiber media**,
- with a **uniform fiber distribution**,
- **nominal thickness: 2 mm**,
- **basis weight: 120 g/m²**.

Construction characteristics:

- homogeneous fiber structure,
- good mechanical stability,
- low material weight,
- supplied in **rolls or cut-to-size sheets**.

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3. Operating Principle

The filter operates on the principle of **mechanical depth filtration**:

1. Paint-laden air flows through the polyester fiber layer.
2. Overspray particles are captured by the fibers due to:
    - inertial impaction,
    - direct interception,
    - adhesion to the fiber matrix.
3. Contaminants are retained throughout the filter depth rather than only on the surface.
4. Cleaned air is discharged toward the exhaust system or subsequent filtration stages.

4. Filtration Class and Technical Parameters

- **Filtration class:** G3 (according to EN 779 / EN ISO 16890 – coarse filter)
- **Thickness:** 2 mm
- **Basis weight:** 120 g/m²
- **Initial pressure drop:** low
- **Airflow resistance:** suitable for energy-efficient ventilation systems

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5. Filtration Efficiency

The **G3 polyester filter (2 mm / 120 g/m²)** provides filtration efficiency typical of **coarse pre-filters**:

- **Approx. 60–80% efficiency** for particles **>10 µm**,
- high capture efficiency for **coarse paint overspray droplets**,
- limited effectiveness for fine particles below 5 µm.

Filtration efficiency depends on:

- airflow velocity,
- paint type and viscosity,
- filter loading level,
- correct installation without air bypass.

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6. Advantages

- very low pressure drop,
- stable airflow performance,
- easy installation and replacement,
- can be cut to size on site,
- cost-effective filtration solution,
- effective protection of fans and duct systems.

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7. Limitations

- disposable filter – periodic replacement required,
- lower paint holding capacity compared to Paint Stop or labyrinth filters,
- does not remove VOCs or odors,
- not suitable for fine or absolute filtration.

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8. Typical Applications

- dry spray booths,
- exhaust walls in painting areas,
- industrial process ventilation,
- pre-filtration upstream of:
    - Paint Stop G4 filters,
    - Andrea labyrinth filters,
    - exhaust fans.