



# PROCLEANROOM

BUILD YOUR EXPERTISE

## LAMINAR FLOW UNITS - DOWNFLOW VS. CROSSFLOW COMPARISON

### WHICH TYPE IS BEST FOR ME?



#### WHAT ARE LAMINAR FLOW UNITS AND HOW DO THEY WORK?

A laminar flow unit is a workplace in which critical actions or processes take place that require a low particle level. In the market a laminar flow unit is also known as clean bench, clean hood, LAF cabinet or laminar flow cabinet for example. It is equipped with a laminar airflow of filtered air which ensures a very clean environment. The users can sit or stand in front of the cabinet while carrying out work. This is in contrast to a cleanroom where people can move around.

The official naming of laminar flow is 'unidirectional airflow' and refers to an airflow in one direction at the same speed without interruption due to turbulence. In a LAF unit, air is drawn in from outside the cabinet through a pre-filter by means of a fan. The fan then pushes the air drawn in through the HEPA or ULPA absolute filter, leaving the filter surface in a unidirectional way. This can be a horizontal flow (crossflow) or vertical flow (downflow).

Any airborne particles that may be present or generated are flushed out of the cabinet. In addition, the positive airflow ensures that contamination from outside cannot enter the working area. The most critical work should preferably be carried out as close to the filter surface as possible and with minimal upstream obstructions. Objects in a flow unit are a risk of contamination because they cause turbulence. In addition, any particles from the object may precipitate on substrates or products placed downstream.

## WHAT ARE LAMINAR FLOW UNITS USED FOR?

For many industries and research institutes, laminar flow units are of great importance for controlling contamination caused by particles. They are a very important and indispensable tool for companies and research institutes for being able to manufacture and treat high-tech products. For decades, flow units have been widely used in various markets, including the protection of electronic and precision mechanical components or medical and pharmaceutical products.

In a cleanroom, air moves in a turbulent pattern, causing airborne particles to end up on surfaces at random. For the most critical processes a laminar flow environment offers a good solution. A laminar flow environment can be created in a cleanroom of any size; however, a laminar flow unit often offers sufficient space and is therefore a compact and cheaper local solution. This means that an investment in a more expensive complete cleanroom is often not necessary. A laminar flow unit is easy to install in a workshop, factory hall, warehouse, laboratory, office space or existing cleanroom.

## HOW ARE LAMINAR FLOW UNITS MADE?

ProCleanroom laminar flow units are manufactured and designed in-house. They are typically provided with a powder coated or stainless steel enclosure and plenum. Depending on the type, the filter system is installed either at the top or the rear. Side walls are often made of transparent plastic and the units can be equipped with connections for cables, wall outlets, connection for Ethernet, air, gas or vacuum.

All units are equipped with energy-efficient DC fan motors featuring zero heat load, minimal energy consumption and low vibration. Besides standard products customisation offers most flexibility in dimensions and configuration. The units can be placed on existing tables or free-standing in the room when combined with a matching table. In some cases, downflow units are suspended directly from the ceiling above a work table or process.

## WHAT TYPES OF LAMINAR FLOW UNITS ARE AVAILABLE?

Flow units can be configured for:

1. **Process/product protection** - *with an overpressure environment in which positive air flow leaves the unit at the front and/or bottom.*
2. **Operator/environmental protection** - *with a negative pressure environment in which outside air is drawn into the cabinet and exits it again via a filter or exhaust system.*
3. **Or a combination of 1 and 2** - *usually with a slightly negative pressure environment but with internal filtered airflow to combine product and operator protection.*

ProCleanroom provides solutions for process/product protection or operator/environmental protection. Besides the above-mentioned configurations there are two basic types;

**1. Horizontal flow units** - also known as **crossflow** units, with a horizontal unidirectional airflow (from rear to front over the work surface) See image 1.

**2. Vertical flow units** - also known as **downflow** units, with a vertical unidirectional airflow (from top to bottom over the work surface) See image 2.

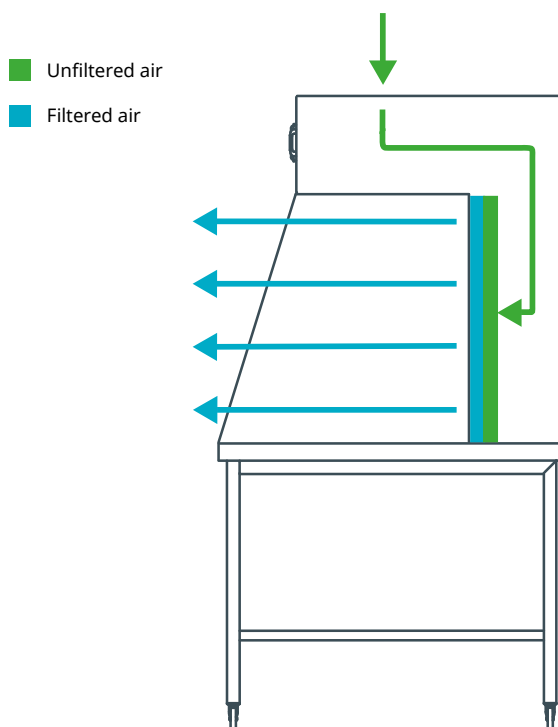


Image 1. Horizontal flow unit - Crossflow

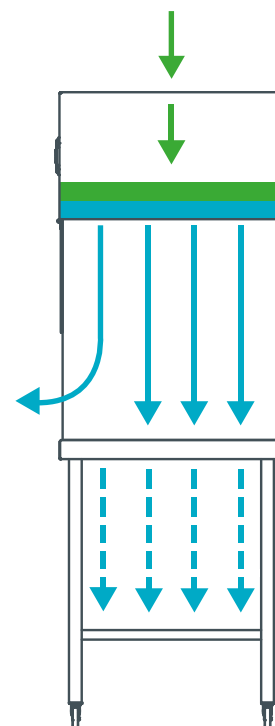


Image 2. Vertical flow unit (Downflow)

In horizontal flow units, the filtered air flows from the rear to the front through the work surface. The air then leaves the cabinet at the front. See image 1.

In vertical flow units, the filtered air flows from top to bottom toward the work surface. If a perforated worktop is used, the air flows through the cabinet completely vertically and then leaves the work environment via the work surface. In models with a solid work surface, the air moves from top to bottom and bends forward at the work surfaces, leaving the working space through an opening at the front. See image 2.

The cleanness of the air in both types is the same. Depending on the application and requirements, there are reasons for choosing a horizontal or vertical flow unit.

### WHICH TYPE IS IDEAL FOR ME?

Although both designs function effectively, in both cases airflow encounters obstructions. Choosing between horizontal or vertical flow is depending on the application and requirements.

In a vertical flow unit, the obvious obstacle is the working surface. A perforated or working surface made of bars ensures that the laminar air flow can leave the flow unit with minimal disturbance. These open work surfaces can be a problem when working with liquids or small parts. In that case, a solid work surface in the vertical flow unit or alternatively a horizontal flow unit is a better choice.

Much depends on the process and tools needed in the flow unit. It is necessary to analyse in which case the least dead spots and turbulence are caused. If there is a relatively large number of or larger equipment in the cabinet, a vertical flow unit is often the better choice. A horizontal flow unit finds too much obstruction on its way here, resulting in dead spots and turbulence. See image 3.

**Horizontal flow unit (crossflow)**

vs

**Vertical flow unit (downflow)**

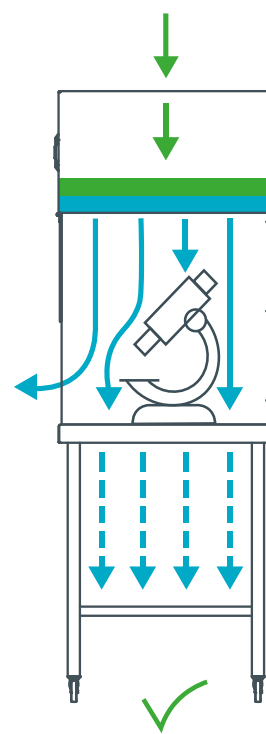
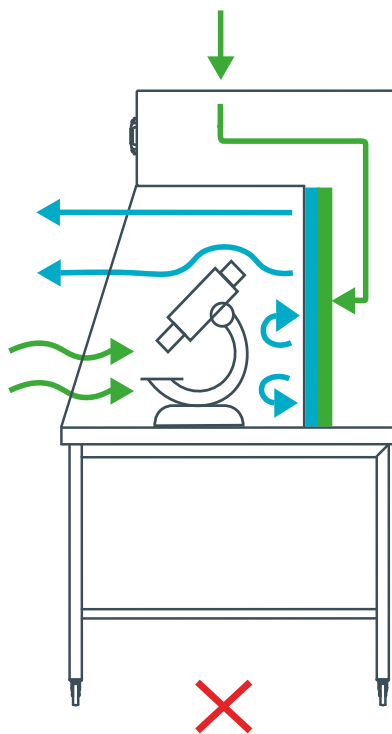


Image 3. Difference in airflow at larger equipment

■ Unfiltered air

■ Filtered air

### Horizontal flow unit (crossflow)

vs

### Vertical flow unit (downflow)

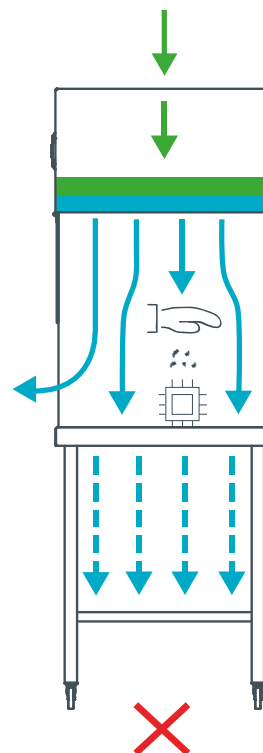
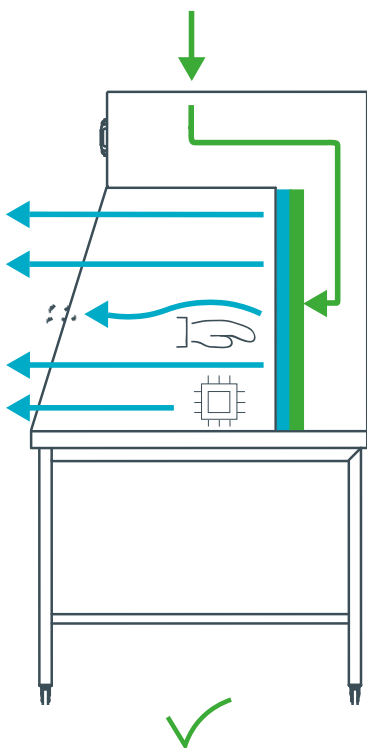


Image 4. Difference in airflow at action above product

■ Unfiltered air

■ Filtered air

In the case of larger flat products, a horizontal flow has the advantage that any contamination is flushed away parallel to the product. In this case, there is also an ideal positioning in the flow because the operator does not move between the clean airflow and the product.

Operations above a product increase the risk of contamination in a vertical flow unit because the operator moves between the clean airflow and the product. Horizontal flow certainly has advantages here. See image 4.

The air from a horizontal flow unit eventually ends up directly in the face of the user. Any unpleasant or harmful substances, such as gases or fine powders, may be blown into the operator's face. If this poses a health risk, a vertical flow may be the better choice, possibly combined with extraction.

A vertical flow unit is a preferred option if floor space is important. Because the technology is fully integrated at the top of the enclosure, a vertical flow unit takes approx. 25-30% less floor space than a horizontal flow unit. With a horizontal flow unit, much of the equipment is in a rear, which makes these units considerably deeper.

## THE PROS AND CONS OF BOTH TYPES

### Vertical laminar flow unit (Downflow)

| PROS                                                                                                                                 | CONS                                                                                                                                                          |
|--------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Geometry: has minimum depth and therefore requires less floor space.                                                                 | Free space at the top required. A ladder may be required to replace filters.                                                                                  |
| Safety: airflow not directly on the user. If equipped with a front screen, a barrier is present between the cabinet and the airflow. | Is less suitable for placing items on top of each other or working with hands over critical products due to obstruction of airflow and turbulence generation. |
| Maintenance: technique and filters placed at the top, making them more easily accessible.                                            | An increased turbulence at the worktop if not perforated. This may be a risk for some applications.                                                           |
| Less turbulent effect combined with large objects or equipment.                                                                      |                                                                                                                                                               |
| Less risk of cross-contamination of objects placed on the work surface.                                                              |                                                                                                                                                               |
| Possibilities for rear wall utilities (gas, electricity, etc.).                                                                      |                                                                                                                                                               |

### Horizontal laminar flow unit (Crossflow)

| PROS                                                                                                                      | CONS                                                                                                               |
|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|
| Hardly no turbulence at the work surface, because the flow moves parallel to the surface.                                 | Depending on the positioning, it maybe less accessible for maintenance.                                            |
| Normally not fitted with a front screen which makes it easier to install equipment, but air blows directly onto the user. | Large objects or equipment obstruct the clean airflow.                                                             |
| Activities above products are usually less polluting and risky because they occur downstream of the product.              | Air flows directly into face of user: not desired in case of vapours and/or powders.                               |
|                                                                                                                           | No possibilities for utilities in rear wall (gas, electricity, etc.) because the absolute filter is located there. |



## MAINTENANCE AND VALIDATION

Maintenance, periodic quality inspection and validation are essential for the flow units. Usually, inspection and revalidation are carried out once or twice a year in accordance with the international standard ISO14644. Pre-filters should be replaced every 3 to 12 months. The HEPA or ULPA absolute filters have a service life of at least 3 to 5 years with full continuous operation. The user must establish a maintenance and cleaning protocol for the flow unit. ProCleanroom offers the necessary support and basic documentation.

## ALTERNATIVE PRODUCTS:

- [Modular cleanrooms](#)
- [Validation of cleanrooms and laminar flow units](#)

## WHITE PAPERS

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Questions, comments or additions? Feel free to contact us via:

T. +31 (0)40 400 28 74  
[info@procleanroom.com](mailto:info@procleanroom.com)  
Attn. Niels Ferguson

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Author: Niels Ferguson – Director ProCleanroom  
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