INTRODUCTION TO LAMINAR FLOW CABINETS

In the 1960’s, due to the increased need for clean air in industry, laminar flow cabinets (also known as cleanbenches) were first developed to provide product protection for small-scale experimental procedures.

A laminar flow cabinet provides a controlled environment in which levels of particulates, microbes, and contamination of all kinds are regulated and kept to a minimum by constant air filtration with industrial-grade filters.

How Does a Laminar Flow Cabinet Work?

A laminar flow cabinet creates a particle-free working environment by taking air through a filtration system and exhausting it across a work surface in a laminar or unidirectional air stream.

Commonly, the filtration system compromises of a pre-filter and a HEPA filter. Because the air within the cabinet does not contain any airborne particles, it is also sterile.

The laminar flow cabinet is usually enclosed on the sides and kept under constant positive pressure in order to prevent the infiltration of contaminated room air.

Laminar Flow Cabinets and Cleanroom Technology

In order to further understand the technology behind laminar flow, it is helpful to consider that these cabinets were first developed as an adjunct to cleanroom technology. Just like the interior of a laminar flow cabinet, cleanrooms are also controlled “clean environments” used in many modern industries.

However, while industrial cleanrooms can span thousands of square metres, with sophisticated protocols, entry systems and working garments, a laminar flow cabinet provides a much more economically viable solution for smaller scale processes.

The only drawback of the laminar flow cabinet is its inability to accommodate extremely large pieces of equipment due to physical constraints within the working zone.

What Are Laminar Flow Cabinets Used For?

In industrial applications, laminar flow cabinets can be placed within a cleanroom to create an ultra-clean mini-environment. When a laminar flow cabinet rated at Class 10* or Class 100* levels is placed within a cleanroom rated at Class 1000* levels, the air within the cabinet can often meet Class 1* levels. This arrangement is usually very economical versus operating a full-sized Class 1* cleanroom.

However, the most common application of the laminar flow cabinet is using it to provide an individual clean air environment for small items not requiring a full-size cleanroom. In the laboratory, individual laminar flow cabinets are commonly used for specialized work such as tissue culture to eliminate airborne contamination would otherwise interfere with work processes.

* Particles of 0.5 microns in size per cubic foot of air
  The lower the cleanliness class, the cleaner the air

Above: Class 100 Laminar Flow System
Esco Single Laminar Flow Straddle Units

Above: Class 100 Laminar Flow System in a Cleanroom
Esco Double Laminar Flow Straddle Units

Above: Class 10,000 Industrial Cleanroom

Above: Class 100,000 Industrial Cleanroom
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What is Laminar Flow?

If air flows in straight, parallel paths throughout an enclosed space, the airflow is said to be laminar. In Esco Laminar Flow Cabinets, the “laminar flow” is a stream of clean air conditioned by a sophisticated industrial-grade filtration system.

Proprietary construction technology guarantees that the internal plenum of the cabinet is pressurized uniformly. This serves to increase filter life by evenly loading the filter. Most importantly, this also guarantees the uniformity of airflow within the working zone of the cabinet, which helps to enhance product protection.

Laminar airflow guarantees that air throughout the cabinet is replaced frequently and in a consistent fashion. This also ensures that particles generated in the cabinet due to normal work processes do not become trapped in dead air corners, where they may otherwise accumulate and cause product contamination.

Laminar Flow Cabinets Provide Product Protection

Product or sample protection is important in a wide variety of modern industries. This includes the pharmaceuticals industry, in which clean air is necessary for the sterile production of drugs.

In the semiconductors and microelectronics fields, a single dust particle can cause irreversible product damage during the manufacturing process, which is why clean air is necessary to protect sensitive components, without which the miniaturization of electronics would otherwise be impossible.

In the laboratory, airborne contamination can often influence experimental procedures and results, which is why processes should be carried out under controlled environment conditions.

In order to illustrate that ability of the laminar flow cabinet to protect your products and samples, consider that normal air may contain as much as 5 million suspended particles of contaminants per cubic foot and compare this value with those in the table to the left.

An Esco Laminar Flow Cabinet equipped with a state of the art filtration system can reduce airborne contamination levels greatly within the working area, depending on the filtration system of choice.

International Standards and Norms

The most common standard referred to by most manufacturers of laminar flow systems is the US Federal Standard 209E. It is important to understand that the 209E does not apply specifically to laminar flow cabinets and that is only applies in general to air cleanliness for cleanrooms.

The US Federal Standard 209E does not deal with general aspects of laminar flow cabinet construction. However, it deals with the most important aspect of cabinet performance which is the level of product protection provided (in other words the cleanliness of the air) within the working area of the laminar flow cabinet.

This is the reason that Esco specifically declares that the clean working area provided within our cabinet complies to the US Federal Standard 209E for Class 100 cleanliness. Other standards and norms similar to the US Federal Standard 209E (dealing with cleanrooms and clean air) are the BS 5295, AS 1386, VDI 2083 and the recently released ISO standard 14664.

<table>
<thead>
<tr>
<th>Particle Size</th>
<th>Standard HEPA Filter *</th>
<th>Optional ULPA Filter **</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 microns</td>
<td>&lt; 3500 particles</td>
<td>&lt; 350 particles</td>
</tr>
<tr>
<td>0.2 microns</td>
<td>&lt; 750 particles</td>
<td>&lt; 75 particles</td>
</tr>
<tr>
<td>0.3 microns</td>
<td>&lt; 300 particles</td>
<td>&lt; 30 particles</td>
</tr>
<tr>
<td>0.5 microns</td>
<td>&lt; 100 particles</td>
<td>&lt; 10 particles</td>
</tr>
</tbody>
</table>

Above: Number of Particles Per Cubic Foot of Air in the Interior of a Typical Esco Laminar Flow Cabinet

* Meets US Federal Standard 209E Class 100
** Meets US Federal Standard 209E Class 10

Esco is the only international manufacturer of laboratory laminar flow systems with core experience in industrial cleanroom engineering.
INTRODUCTION TO LAMINAR FLOW CABINETS

In selecting a laminar flow cabinet, users often encounter both horizontal and vertical flow models. Learn more about the differences between both systems in order to select an appropriate type for your specific application.

**Horizontal and Vertical Laminar Flow**

In horizontal laminar flow cabinets, air is usually taken in from above the cabinet, filtered, and exhausted across the work area in a horizontal laminar (unidirectional) air stream. In vertical laminar flow cabinets, air is usually taken in from above the cabinet, filtered, and exhausted downwards in a vertical laminar (unidirectional) air stream.

Both horizontal and vertical laminar flow cabinets provide protection in excess of Class 100 or Class 10 levels. There is no significant difference between a horizontal and a vertical laminar flow cabinet in terms of performance.

**Choosing Between Both Systems**

The use of a vertical or horizontal laminar flow cabinet is largely a matter of user preference. However, these are some minor differences to help you in your choice:

Horizontal laminar flow cabinets do not have surfaces that will cause the air stream to be deflected. In vertical laminar flow cabinets, the air stream effectively strikes the working surface, which will result in a certain degree of air turbulence.

Large pieces of equipment in a horizontal laminar flow cabinet will increase turbulence, whereas in a vertical laminar flow cabinet large pieces of equipment will have a relatively insignificant effect on airflow. However, it must be noted that some degree of turbulence has an insignificant effect on laminar flow cabinet performance.

Esco Vertical Laminar Flow Cabinets consume less power and cost less to operate than our horizontal laminar flow cabinets due to the higher efficiency of the blower system on our vertical laminar flow cabinets.

Even though our cabinets are already one of the most quiet in the world, Esco Vertical Laminar Flow cabinets tend to have higher sound levels during operation.

For applications utilising unusually large and tall pieces of apparatus, vertical laminar flow cabinets offer an larger internal working height than horizontal cabinets.

If necessary, Esco Vertical Laminar Flow Cabinets may also be customised at a relatively lower cost (as compared to horizontal laminar flow cabinets) to offer an increased internal working height.

Conventionally, vertical laminar flow cabinets have been the choice for industrial applications, whereas horizontal laminar flow cabinets have been more popular in smaller-scale laboratory settings.