# White Paper : Vortex Issues in Esco's Laminar Flow Cabinets (Physical Test)

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*This paper serves to investigate and establish the airflow pattern in one of ESCO's Laminar Flow Cabinets when a common laboratory equipment is placed in the cabinet. The objective is to determine if with the equipment placed inside the cabinet, how much turbulent flow would be generated. The cabinet that is being used for this study is a LHC-4A1 2005-10357. Dräger CH 216 smoke tubes are used to obtain airflow visualizations.*

*Figure 1: Smoke flowing out smoothly away from the cabinet away from object*

## Establishing Normal Airflow

Before the experiment is started, the airflows of the cabinet is tested and adjusted to achieve the desired average nominal airflow velocity of 0.45 m/s. Smoke tubes are used to establish the regular airflow pattern without any objects or obstructions in the cabinet that might disrupt the airflow. This airflow pattern would serve as a reference when objects are placed.



*Figure 2: Serious vortices formed behind the microscope*

## Object 1: Microscope

With the cabinet running at the nominal airflow velocity, a common laboratory equipment, a microscope is placed in the cabinet centrally lengthwise and with the base near to the edge of the cabinet. This is to simulate the position of the microscope when it is used by the operators in a laminar flow cabinet.

Smoke tubes are used to determine the smoke pattern behind the microscope as shown in figure 2.

From the smoke patterns, we can observe vortices being formed at the face of the microscope that is away from the filter. The smoke did not flow away from the cabinet as shown previously but got drawn back into the cabinet. This is repeated a few times and the flow pattern remained unchanged.



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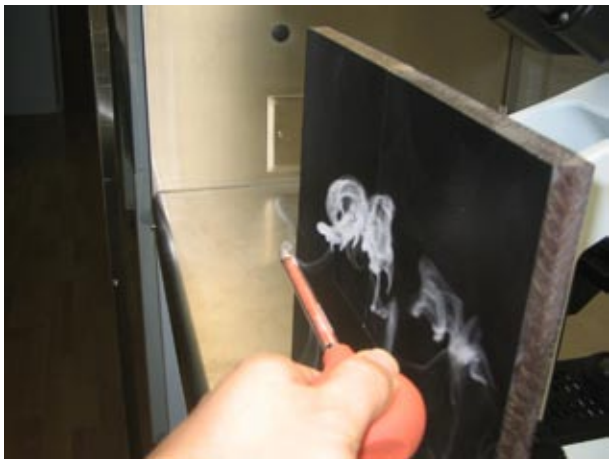

*Figure 3: Vortices formed behind the microscope even with a board being placed.*

*Figure 4: Smoke pattern in a vertical laminar flow cabinet*



## Object 2: Microscope with screen

This test was conducted in view of the serious vortices formed. It was deduced that one of the possible reasons for this is the jagged structure of the microscope which the initially laminar airflow was not able to conform and hence transit to turbulent flow to generate the vortices. Therefore a piece of board is placed behind the microscope to determine if any shielding done would help to improve the airflows and reduce the vortex.

With the board in place, the smoke tubes are used again as per previous test to determine the airflow pattern.

From the smoke pattern, we can see that the vortices generated is still very significant.

## Conclusion

It is concluded from these tests that airflows from a horizontal laminar flow cabinet would give rise to inward air being drawn into the cabinet due to vortex flows when objects are being placed in the cabinet. Even with the use of a board as a shield, the airflows were still not satisfactory. Therefore alternatives have to be explored.

One of the ways to improve this situation is to have the equipments placed in a vertical flow cabinets instead of horizontal flow cabinets. Similar tests are therefore conducted on a vertical flow cabinet to determine the feasibility of this alternative arrangement. An ESCO's LVC-4A1 2005-9787 was used for this test. Likewise, airflow measurements are conducted to achieve the desired average airflow velocity of 0.45 m/s before proceeding with the tests.

As can be seen from figure 4, the same microscope that was used in previous tests did not show any vortex flows being formed in the same areas as when a horizontal laminar flow cabinet was used. The airflows outside the cabinet was very consistent and outward flowing with no inflow of air into the cabinet. It is therefore much effective to use a vertical laminar flow cabinet than a horizontal flow cabinet.