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ROC No. 198400165W

Dust Introduction Test to determine ULPA Filter Loading Characteristics in Class II Biosafety Cabinets

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INTRODUCTION

One of the most important component in any biosafety cabinet is the filter as it removes the bioagents that may be introduced in the course of work inside the biosafety cabinet. An efficient and properly installed filter helps to ensure the safety of the personnels and reduce the number of laboratory-acquired infections.

For a typical Class II biosafety cabinet, there would be 2 filters , usually a HEPA or ULPA filter installed in the cabinet. One filter (exhaust filter) would be used to filter the air before it is discharged to the surroundings. The other filter (downflow filter) would be used to filter the air before it is to be blown down to the work area as downflow. The diagram below shows the airflow patterns of an ESCO Labculture Class II Type A2 cabinet.

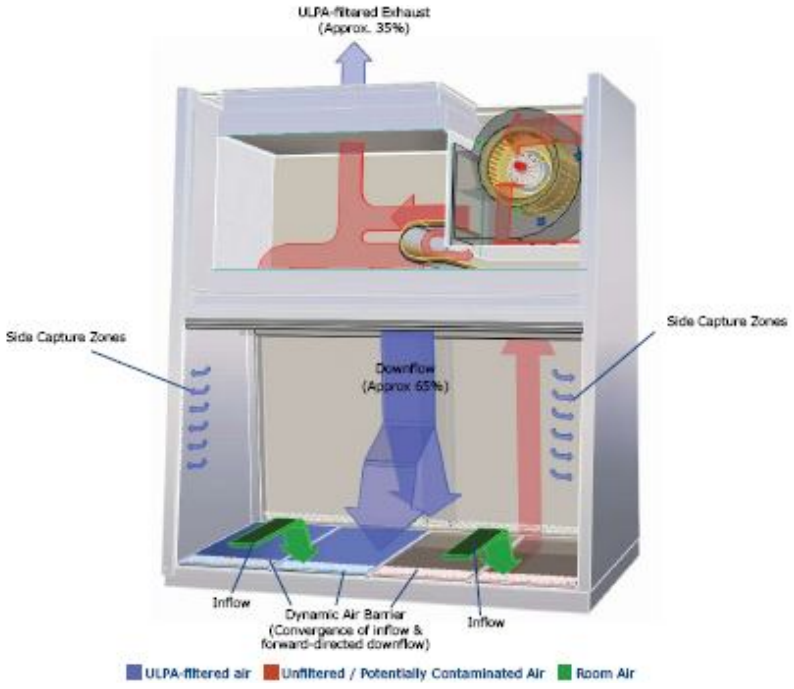

Figure 1: Airflow Distribution Pattern in an LA2-4A1

With continuous use of the cabinet, the filter would get more loaded with time. It would come to a point in which the cabinet blower may not be strong enough to overcome the pressure drop across the loaded filter to provide good airflow velocities for operator protection. Therefore, this paper serves to investigate the filter loading patterns of a Class II Type A2 cabinet. How the loading of the filters would affect the airflow velocities and how the downflow distribution changes across the face of the entire filter.

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PURPOSE OF STUDY

The purpose of this study is to investigate how the downflow filter behave as it gets loaded with time. This would help manufacturers to have a better understanding of the airflow patterns and hence provide a more accurate gauge of the performance of their cabinets and improve the design of their cabinets for optimum life and performance. By understanding how the filter loads and the change in the airflow distribution, the design of the cabinets can be improved to optimize the use of the filters. Another purpose of this study is that it also would allow the manufacturers to determine the best location to place their airflow sensors so as to provide a more dynamic and accurate reflection in the cabinet display.

METHODOLO GY

An ESCO Labculture Class II Type A2 with serial number 2004-7328 has been selected for this filter loading test. In order to carry out a good and accelerated loading of the filter, an artificial dust is used for this study. The dust that was used is **12103-1 A1 Ultrafine Test Dust** from **Powder Technology Incorporated (PTI)**. Besides the dust, other measurement instruments are also used for this test. Below is a list of instruments used:

No.	Measurement Parameter	Test Equipment	Model Number	Manufacturer
1.	Volumetric Inflow	Flow Hood Airdata Flowmeter	ADM-870C	Shortridge
2.	Downflow velocity	Velocicalc Plus Portable Air Velocity Meter	8385-M-GB	TSI Incorporated
3.	Light Intensity	Light Meter	407026	Extech Instruments
4.	Noise Level	Sound Level Meter	1900	Quest Technologies
5.	Vibration Level	Vibration Integrator	VI-90	Quest Technologies
6.	Filter Integrity	Aerosol Generator Aerosol Photometer	TDA-4B TDA-2G	ATI ATI
7.	Motor Blower Voltage	Digital Multimeter	110	Fluke
8.	Powder Weighing	Weighing Balance	Spider 2 / Floor	Mettler Toledo

Table 1: List of instruments used for tests

Before the dust introduction test is started, a series of initial tests are also conducted on the cabinet with new filters fitted to ensure the cabinet is operating under acceptable conditions. The tests that are conducted include:

1. Inflow Velocity Test
2. Downflow Velocity Test
3. Light Intensity Test
4. Vibration Level Test
5. Noise Level Test
6. Filter Integrity Test
7. Motor Blower Performance

All these tests were conducted according to the requirements of NSF 49:2002.

After the tests have been completed and the cabinet is deemed to be operating in satisfactory conditions, artificial dust is being introduced into the cabinet. Dust is weighed and introduced into the air inlet of the blower in the cabinet. As the blower blows, the air would carry the test dust to both the downflow and exhaust filters which would then be captured by the filters. The entire test is carried out over a period of 1 month on the following dates and amounts:

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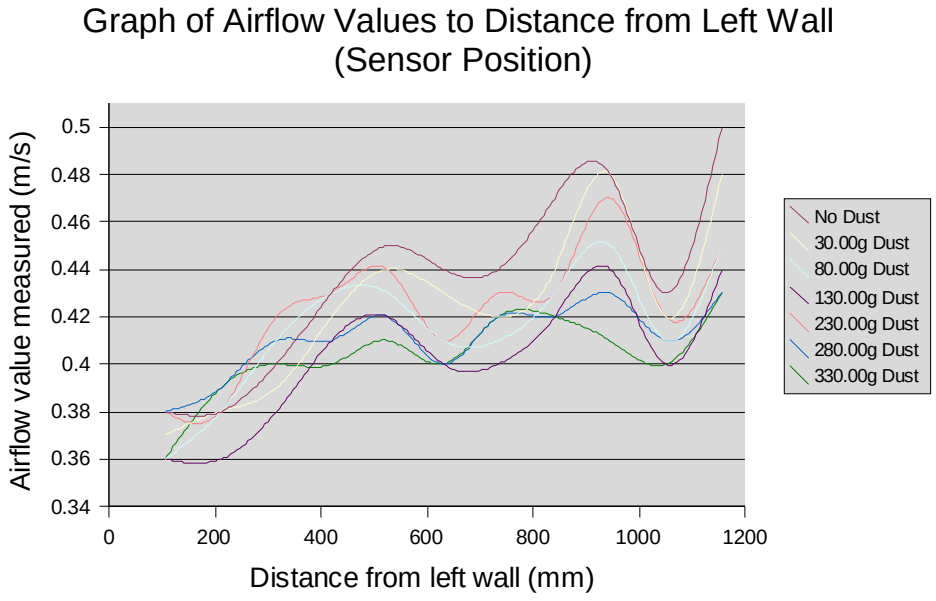
No.	Date	Amount of Dust
1	29. Dec. 2005	Initial Tests / 30.00g
2	30. Dec. 2005	50.00g
3	3. Jan. 2006	50.00g
4	6. Jan. 2006	50.00g
5	12. Jan. 2006	50.00g 50.00g
6	23. Jan. 2006	50.00g
		Total: 330.00g

Table 2: Date of test and amount of dust introduced

During each run of the test, airflow measurements are made at different locations as well as possible sensor locations within the workzone of the cabinet. The airflow measurements are taken as according to the requirements of NSF 49:2002

RESULTS AND DISCUSSIONS

The data acquired from each run of the test is compiled and analyzed. The following samples of graphs show how downflow changes with increasing amount of dust introduced.



Graph 1: Change in downflow values at possible sensor locations

For Graph 1, the measurements are taken at a distance of 145mm from the diffuser, 60mm from the backwall, 105mm from the side walls and 105mm apart, left to right. As can be seen from the graphs, the range of airflow values at any given point increases as the measurement points are increasingly further away from the left wall. This means that for points that are nearer to the right wall of the cabinet, the downflow is more sensitive to changes to filter loading.

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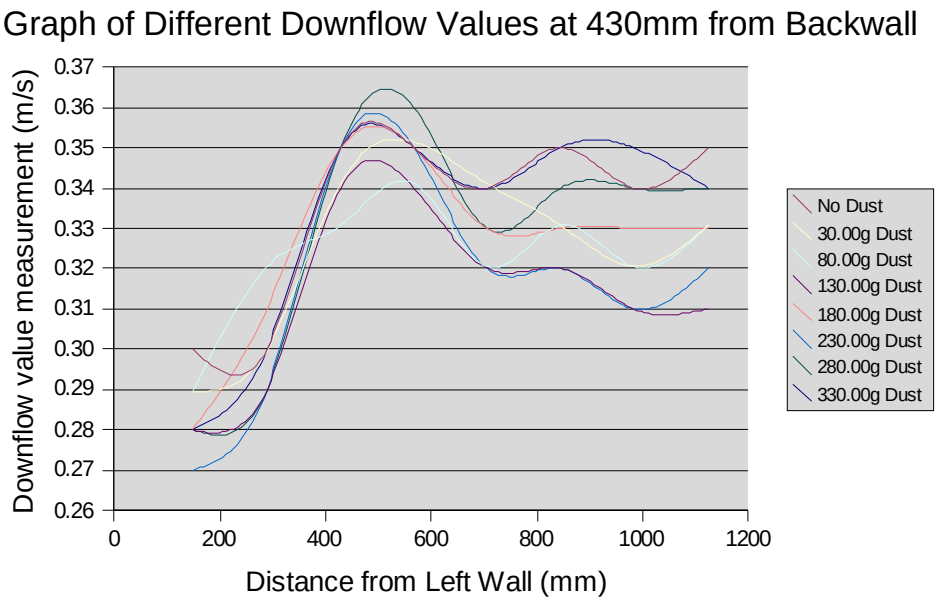

Graph 2: Change in downflow values at 1st row of measurement points on NSF grid

Graph 2 shows how downflow changes for the measurement points on the NSF downflow measurement grid. The points are defined as 430mm from the back wall, 100mm above the lower edge of the sash window, 150mm from the walls and 139mm apart. Likewise as can be seen from this graph, the change in downflow is not as significant for points on the left of the cabinet.

Besides analyzing the downflow for points left to right, studies are also made to determine the change in downflow for points from front to back as the filter is loaded.

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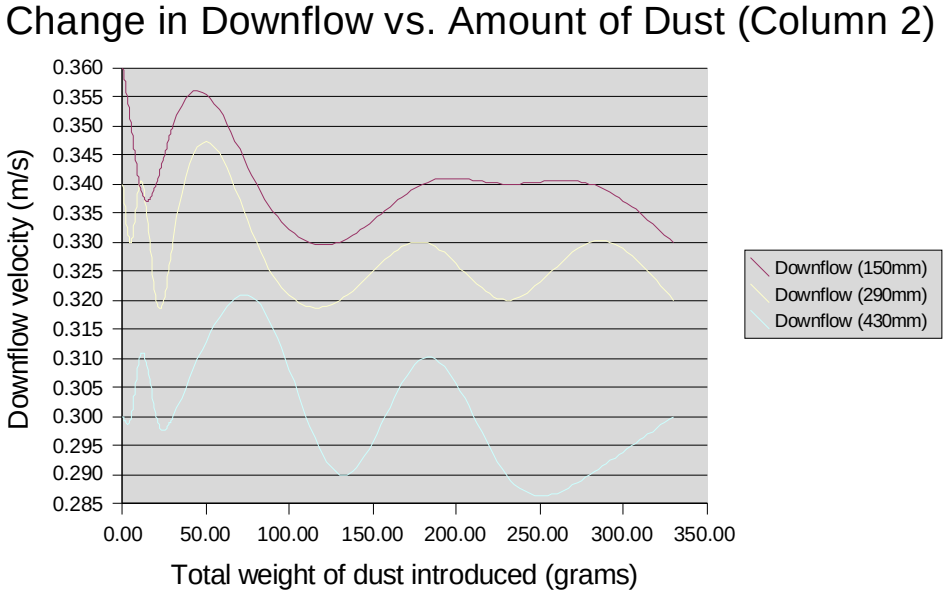

Graph 3: Change in downflow at 2nd column of measurement points on NSF grid

Overall, the following points are observed from this dust introduction test:

- It is observed that the nearer the downflow is to the backwall, the more uniform the downflow becomes as the filter is loaded.
- At different stages of the dust introduction, there would be different trends in the downflow distribution. There is no particular trend in which the downflow would change.
- Generally, the measurement points on the right side of the cabinet show greater airflow changes compared to the left side for the same amount of dust introduced.
- There is a better correlation between the actual downflow measurements and the cabinet's LCD display than for inflow measurements. At the end of 330.00g, the average downflow measured is 0.34m/s and inflow of 0.49m/s. The values displayed by LCD is downflow 0.34m/s and inflow of 0.51m/s.
- With a total of 330.00g of artificial dust introduced, the downflow decreased by 5.56% from 0.36m/s and inflow decreased by 7.55% from 0.53m/s.

However, as the change in airflows result is still relatively insignificant, no conclusive remarks can be made as this point and larger amounts of dust has to be introduced.