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Airflow Study of Esco BC2-4S7 Biological Safety Cabinet at Various Temperatures

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1. Summary

Room temperature is the best environment for Biological Safety Cabinet (BSC) to work properly. Since the room temperature of laboratory can vary due to effect of the environmental temperature, this study was conducted to determine the work of BSC under various temperatures. Esco conducted this study by observing the airflow change at various temperatures. The results showed that Esco BC2-4S7 BSC still provides personnel and product protection at various temperatures.

2. Introduction

The main purpose of the Biological Safety Cabinet (BSC) is to protect personnel, product, and environment from biohazard. It is done by managing the airflow of the BSC. In the manufactured BSC, the airflow was set up by manufacture, which is termed as the 'nominal set point'. In this airflow set up, the BSC provides an optimal protection.

Airflow is the amount of air per unit of time that flows through a particular device. Because air is a gas, its volume will vary depending on the temperature (www.wikipedia.org). In a chamber, when the environment temperature rises, the volume of air inside the chamber will decrease and the air density will increase. It will trigger an environment air to flow inside the chamber (www.engineeringtoolbox.com). According to Lanthier (2007), temperature has a direct effect on air density and when the air is colder or heavier, the fan will have to move more and as the air warms and becomes lighter, the fan will slightly move to satisfy the demand.

Esco's customers have their different laboratory environment, where the BSC will be located. Since the temperature has an effect on the BSC, Esco conducted a study of the effect of various temperatures to the BSC's airflow. The test was done by measuring the airflow of BSC at different temperatures in the Environment Test Chamber.

3. Material and Method

3.1 Material

Material and equipment used in this study were:

1. Esco BSC; BC2-4S7 model, with 100 Volt 50/60 Hz power rating, 175 mm sash opening, 0.50 m/s nominal inflow, 0.30 m/s nominal downflow, and used Degree C Airflow sensor.
2. Environmental Test Chamber (Espec)
3. Thermo anemometer (TSI)
4. Flowhood with air data multimeter ADM -870 C (Shortridge Instruments)
5. Power Supply (APC)

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3.2 Method

Testing in Environmental Test Chamber

1. Place the BSC in the Environmental Test Chamber.
2. Set the Environmental Test Chamber to 25℃, and wait until stable.
3. Set the inflow and downflow at the nominal airflow set point and calibrate it.
4. Record the data.
5. Do the test in three replicates.
6. Set the Environmental Test Chamber to 35℃, measure the airflow, and record the airflow data.
7. Repeat the test at 5℃, 10℃, and 15℃.

Measure the inflow and downflow

1. Place the 'downflow grid' on the working area inside the cabinet.
2. Measure the sash opening at 175 mm.
3. Place the 'thermal anemometer' in the cabinet and turn it on.
4. Read the result of 'thermal anemometer' of each test spots and calculate the mean value of it.
5. Remove the 'thermal anemometer'.
6. Place the 'flow hood' in the middle of the ‘front opening’ of the cabinet. Seal by taping the device.
7. Close the rest of the ‘front opening’ area that is not covered with the 'flow hood'. Seal by taping the additional instrument.
8. Turn on the 'flow hood'.
9. Read the result of 'flow hood' instrument for ten (10) times and calculate the mean of that value.

4. Result

Airflow is the most important thing on the BSC, because it acts as a barrier of biohazard to come out from the BSC and contamination from environment to flow inside the BSC. Esco conducted this study to prove that our BSC cabinets still provide personnel and product protection even at various environmental temperatures.

This study was done using BC2-4S7 model with ECM (Electronically Commutated Motor) blower. The motor blower has benefits such as the following: more efficient, more precise, variable speed, and can maintain airflow during changes in the system (Regal-Beloit, 2007). Alteration of environmental temperature can push ahead the system change. When the environmental temperature decreases, the air density will increase. It triggers the blower to move faster to maintain an airflow supply. It is reflected in the observation results wherein the deviation of inflow and downflow is not more than 0.05 m/s. The results of this observation were shown in table 1.

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Table 1. Downflow and inflow reading at various temperature.

Temp (°C)	Airflow reading				
	Actual reading			Display	
	Downflow (m/s)	Inflow (m/s)	Inflow (l/s)	Downflow (m/s)	Inflow (m/s)
35	0.31±0.0036	0.53	113.00	0.31	0.51±0.0058
25	0.30±0.0029	0.50	107.00	0.30	0.50
15	0.29±0.0029	0.48±0.0027	102.67±0.5774	0.29	0.49±0.0058
10	0.28±0.0013	0.47±0.0027	99.67±0.5774	0.29	0.49
5	0.28±0.0025	0.45	97.00	0.29	0.49

Since this unit has the same design with Esco BSC AC2 Gen 3 model, we observe whether the alteration of airflow above is still in the safety range based on the Performance Envelope Test conducted by Sumaryati (2013) on AC2 Gen 3 model. Figure 1 showed that all the alteration of airflow in this study are still in the triangle area of performance envelope. It is demonstrated that even the environment temperature is different with the requirement temperature of manufacture (25℃), the unit still provides a protection to personnel and product being tested.

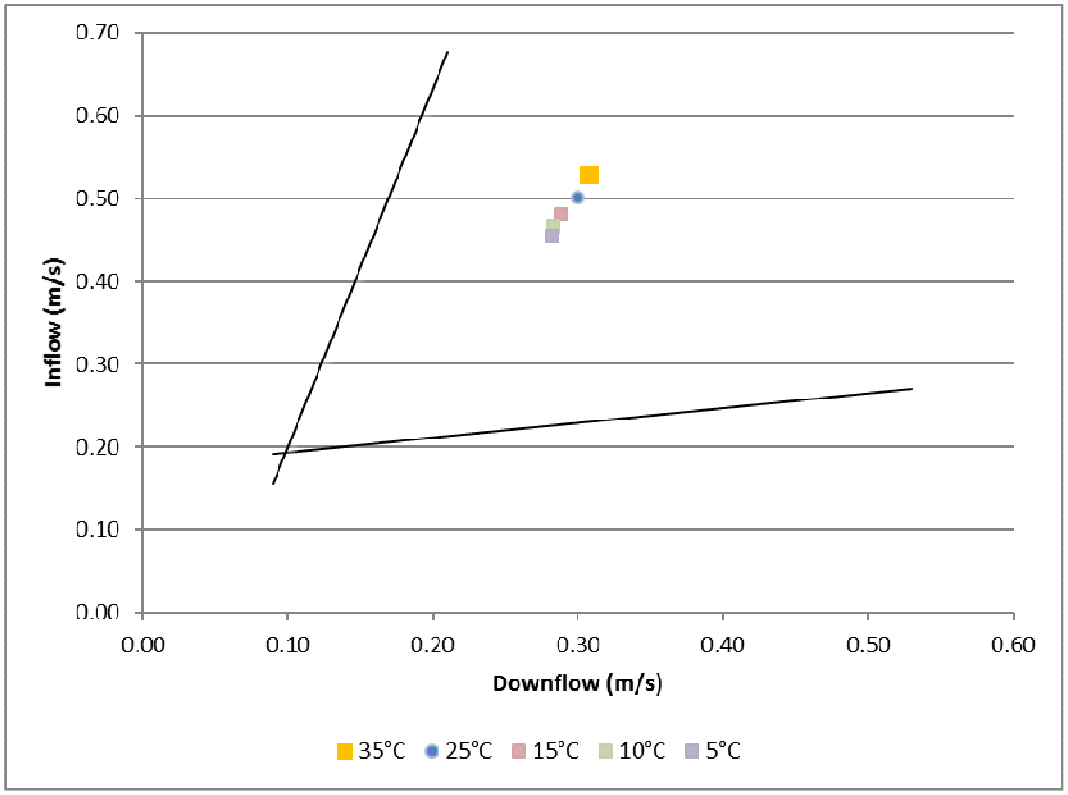

Figure 1. Airflow at various temperature in the Performance Envelope of AC2-4 Gen 3.

Table 1 also showed that there is an airflow difference ranging from 0.01-0.04 m/s between the actual reading and display. The airflow difference at temperature 10℃ to 35℃ is ranging from 0.01-0.02 m/s. It is in the range of airflow sensor accuracy (Esco internal data). Testing at temperature 5℃

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showed a difference of 0.04 m/s which is beyond the sensor accuracy range, indicating that at 5℃ this sensor isn't accurate anymore.

5. Conclusion

The Esco BC2-4S7 model of Biological Safety Cabinet still provides personnel and product protection even under alterations of airflow as a result of various environmental temperatures.

Reference

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