

Technical Paper : Lowered Mannequin, Lowered Face Velocity Challenge on EFD-4B1 (Customized ASHRAE Test)

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INTRODUCTION

ASHRAE 110-1995 is one of the widely used standard for testing fume hood containment performance. In tracer gas containment test, a mannequin with clothing is used to simulate the actual human in front of the hood. Detector probe is located at breathing zone of mannequin to capture leakage of sulfur hexafluoride, simulating in actual operation the possibility of escaping fumes from the work chamber.

Actual mannequin height in standard ASHRAE testing is set to be 1.70 m and breathing zone shall be 26 inches away from the worktop. In actual condition, operators' breathing zone might be lower than the mannequin's. Possibility of breathing-in escaped fumes will increase in this condition.

To prove that our Esco fume hood is actually safe in all conditions, we reseted the mannequin height, by adjusting the mannequin breathing zone from 26 inches to parallel with full sash opening - 18 inches from the work surface. Containment test procedure is same as the ASHRAE 110 test standard.

TEST PROCEDURES

1. Fume hood face velocity setting and cross draft measurement

Face velocity is expressed in m/s or fpm. Face velocity at sash full opening shall be adjusted to 0.5 m/s, 0.4 m/s and 0.3 m/s respectively. Tracer gas containment test is conducted individually under different face velocity.

Cross draft at the center position and 5 feet in front of the fume hood and reading shall not exceed 0.15 m/s.

2. Tracer gas containment test

Tracer gas containment test is a quantitative test to measure the hood's containment ability. Tracer gas containment test will be

compared between the results of standard mannequin height as ASHRAE testing standard used, and adjusted mannequin height.

Standard mannequin breathing zone height shall be 26 inches height from the work surface, and the height shall be lowered to 18 inches to simulate normal operator's height. By releasing heavy tracer gas sulfur hexafluoride(SF6) at a rate of 4.0 LPM at 150 mm behind the sash opening, it simulates a fume hood under harsh usage. Tracer gas detector shall be able to capture any leakage of SF6 at a range of 0.01 ppm during the experiment.

a. Static test

Test is carried out in 3 positions: center, 300 mm from the left wall and 300 mm from the right wall for each sash opening. Mannequin shall be centrally located in front of tracer gas ejector. Gas is released and detector is monitored for 5 minutes for tracer gas leakage. The test is repeated with sash opening of 100%, 50% and 25% for each ejector location.

The maximum SF6 leakage shall not exceed 0.10 ppm.

b. Sash movement effect

Test is carried out in 3 positions: center, 300 mm from the left wall and 300 mm from the right wall for each sash opening. Mannequin shall be centrally located in front of the tracer gas ejector. Sash is moved from 0% to 100% sash opening position, paused for 2 minutes then moved to 0% sash opening position again. The test is repeated 3 times and maximum SF6 leakage shall be recorded.

The maximum SF6 leakage shall not exceed 1.0 ppm.

RESULTS & DISCUSSIONS

1. Comparison of results between standard mannequin height and adjusted mannequin height

Maximum SF6 Leakage Detected (in ppm)								
Method	Ejector Position	Sash Opening	0.5 m/s		0.4 m/s		0.3 m/s	
			26"	18"	26"	18"	26"	18"
Static Test	Center	100%	0	0	0	0	0.03	0
		50%	0	0	0	0	0	0
		25%	0	0	0	0	0	0
	Left	100%	0	0	0	0	0	0
		50%	0	0	0	0	0	0
		25%	0	0	0	0	0	0
	Right	100%	0	0	0	0	0.03	0
		50%	0	0	0	0	0	0
		25%	0	0	0	0	0	0
Sash Movement Effect	Center	0 - 100%	0	0	0	0	0	0.02
		100 - 0%	0	0	0	0	0	0
	Left	0 - 100%	0	0	0	0.02	0	0
		100 - 0%	0	0	0	0	0	0
	Right	0 - 100%	0	0	0	0	0	0
		100 - 0%	0	0	0	0	0	0

Table above showed the results of SF6 leakage detected while conducting tracer gas containment test. No leakage is detected in all static tests and sash movement test in a face velocity of 0.5m/s. Minor leakage were observed in sash movement test, however much lower than standard maximum leakage limit of 1.0 ppm.

Conclusion

Esco always concerns the operators' safety while conducting experiment. Esco fume hood not only passes the Standard ASHRAE 110 testing, it also passed the test when lowering the mannequin's breathing zone to a height of 18 inches. The results obtained from testing proves that Esco fume hood ables to ensure operators' safety if their breathing zone nearby or parallel to the top opening edge of face hood surface. Even though in lower face velocity, the hood still working efficiently.



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