NATIONAL INSTITUTES OF HEALTH

FUME HOOD TESTING PROTOCOL

For

CONSTANT VOLUME FUME HOODS

PART I. GENERAL

Test identified below was created by Farhad Memarzadeh of the National Institutes of Health in 1997 and further revised by Memarzadeh and Brightbill in 1999.

1.01 DESCRIPTION OF WORK

A. The work of this section consists of testing the performance of constant volume chemical fume hoods.

B. On Site Testing of Fume Hoods shall be work of this Section

C. This section specifies procedures that are common to the scope of Section 11800 – Laboratory Hoods

1.02 SUBMITTALS

A. TESTING EQUIPMENT AND FACILITIES

1. Submit 3 copies of specification sheets on all equipment proposed for on site testing specified in Part III of this section.
2. Submit 3 copies of sample test reports for approval. Contractor shall demonstrate the ability to perform necessary calculations on site the day of the test for the on site testing requirements.
3. Submit 3 copies of layouts of the testing facility

1.03 CERTIFICATIONS

A. Submit test data attesting that each type of hood to be provided has been tested in accordance with the **Modified ANSI/ASHRAE 110-1999** and meets the requirements of this specification.

1.04 QUALITY ASSURANCE

A. Testing agency for On Site testing shall be independent of the fume hood control system manufacturer.

B. Independent testing agency shall be approved by the NIH project officer. Testing agency shall submit Statement of Qualifications demonstrating experience relating to fume hood testing. As a minimum testing agency shall:

1. Have a registered Professional Engineer or Industrial Hygienist executing the testing
2. Demonstrate prior execution of indicated tests and submit a sample of the test report

1.05 REFERENCE DOCUMENTS

A. American National Standard Institute

B. ANSI/ASHRAE 110-1999 Standard for testing performance of Fume hoods

C. National Fire Protection Association NFPA 45 - Fire Protecting for Laboratories Using Chemicals

D. ANSI/ASHRAE III Testing and Balancing

E. ANSI/AIHA Z9.5 Laboratory Ventilation Standard

PART II. PRODUCTS

2.01 TEST AND MEASUREMENT EQUIPMENT

A. Anemometers:

1. Accuracy: ±5% of reading
2. Internal Time Constant: <= 100ms

B. Tracer Gas Ejector in accordance with ANSI/ASHRAE 110

C. Tracer Gas (SF_6) Sensor:

1. Sensitivity: 0.01 to 100 ppm
2. Accuracy:
   a) Above 0.1 ppm: ±10% of reading
   b) Below 0.1 ppm: ±25% of reading

D. Data Acquisition System: minimum 6 channel system capable so simultaneous sampling at 10 hz or greater

PART III. EXECUTION

3.01 FUME HOOD CONTAINMENT TESTING (ON SITE)

A. **General**: Laboratory areas and Constant volume fume hoods shall be tested **as installed** to assess the level of containment. Testing shall be conducted as outlined below for 50% of the hoods provided in the project.

B. Testing shall be conducted in accordance with **ASHRAE 110 - Method of Testing Performance of Laboratory Fume Hoods** with the following modifications. This is primarily a test of the hood and laboratory configuration.

1. Hoods will be tested with simulated apparatus. This apparatus will consist of: two each 3.8 L round paint cans, one 300mm by 300mm by 300mm cardboard box, three

each 150mm by 150mm by 300mm cardboard boxes. These items will be positioned from 150mm to 250mm behind the sash, randomly distributed, and supported off the work surface by 50mm by 50mm blocks.

2. The test gas will have a 6 LPM flow rate.
3. The test will be conducted at the center position for the manikin only.
4. Each test duration will be 5 minutes.
5. Acceptable test results will be 0.05 **PPM** or better.
6. At the conclusion of each 5-minute test there will be three rapid walk-by at 300mm behind the manikin. Each walk-by will be spaced 30 seconds apart. If there is a rise in test gas concentration, it cannot exceed **0.10 ppm** and must return to 0.05 **ppm** within 15 seconds.
7. There will be a minimum of three and a maximum of five people in the test room during the test procedure.
8. Representatives of the NIH will witness the tests.

C. **Face velocity testing** shall be conducted to determine flow rates and turbulence at the face of the hood.

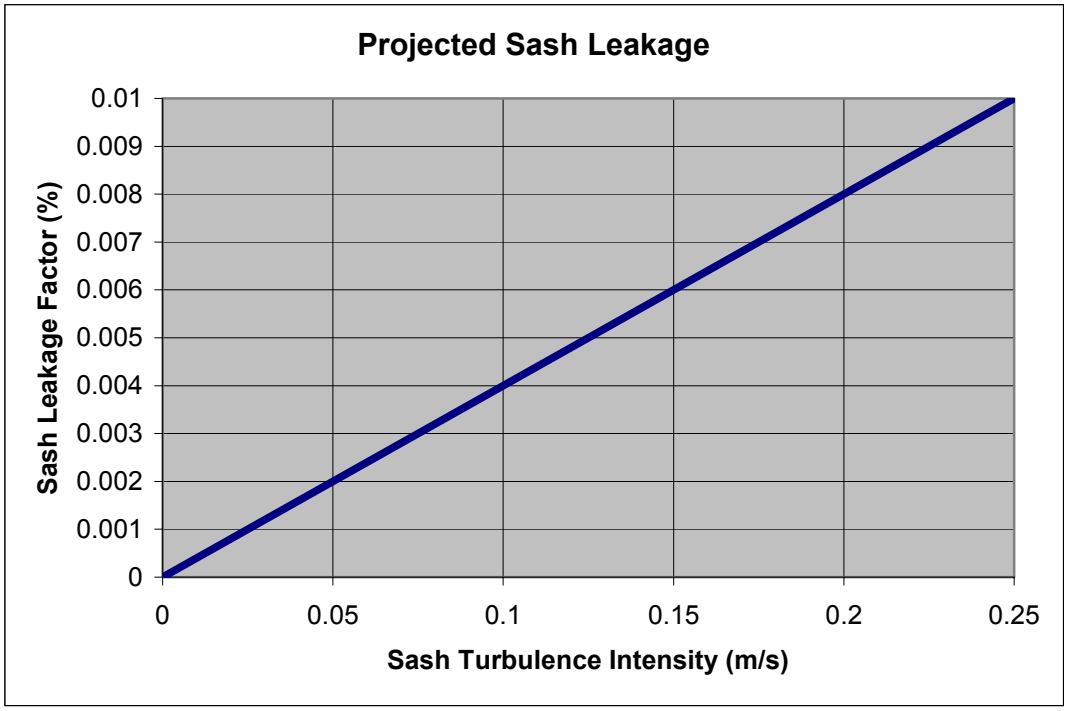
1. Face Velocity Parameters shall include:

   a) **Measured Face Velocity** (FVm expressed in m/s): Face velocity measured in the plane of the sash at three locations at any point in time. Samples for each sensor shall be recorded simultaneously at no less than 10 Hz. The sensors shall basically be point sensors located in the middle of 1' by 1' grid sectors. Move the three sensors to other sectors for subsequent testing periods. Averages shall be calculated for any point in time to assess overall measured face velocity, however individual sensor samples shall be used in calculating TI for each sensor. These face velocity measurements shall be made with sash(es) open and "closed". Open shall mean the sashes positioned to their maximum design position. (To sash stop typically 18" to 22"). Closed shall mean open to 6" for a vertical rising only sash and center panels open 6" on the horizontally sliding panels with the vertically rising sash closed.

   b) **Steady State Face Velocity** (SSFV): The average of all sampled face velocities for a 5 second period. Two SSFVs will be determined for both measured face velocity and calculated face velocity; one before the event (SSFVb) and one after (SSFVa). The SSFVa will start two seconds after the end of TSS. The second suffix of m for measured and c for calculated shall be used to indicated the type of assessment

   c) **Turbulence Intensity** (TI expressed in m/s): Calculated root mean square of the fluctuating face velocity determined using FVm, calculated as follows: $sqrt[Sum_{1-n}\{(FVm_1-SSFV)^2+...+(FVm_n-SSFV)^2\}/n]$ This value shall be calculated for each of the steady state conditions preceding and following each event. This shall be correlated to a "Box Leakage Factor" using the following graph of the installation using the **Methodology for Optimization of Laboratory Fume Hood Containment**" (MOLHC) by NIH Office of the Director, Farhad Memarzadeh principal investigator. While this value does not

have a pass/fail requirement, it is the fundamental indicator of containment and therefore shall be clearly reported.



D. Hood Static Pressure: Take traverse readings to measure exhaust rate and measure the hood static pressure two straight-line duct diameters downstream from the point of connection between the hood and the exhaust line. The readings shall be taken with a face velocity of .51 m/s ±.05 m/s at the full open sash position. (Open sash typically is 18" to 22").

E. Performance Parameter Requirements

1. **Tracer Gas Leakage per ANSI/ASHRAE – 110:** 4.00 AM 0.05
2. **Average Face Velocity**
   a) **Sash(es) open**:.51 m/s ± .05m/s (Open to sash stop typically 18" to 22").
   b) **Sash(es) Closed**: <1.53 m/s ± .15 m/s (exhaust rate shall not change)
3. **SSFV Deviation Across Face:** <15% of average face velocity
4. **Pressure Drop Through the Hood**: <= 13 mm water gage

F. **Test Execution**: Testing agency shall be equipped to execute the testing and assess all performance parameters on site the day of the test. Data acquisition of required parameters shall be simultaneous.

G. **Test Documentation**: All testing, calculated, and recorded parameters shall be presented in a report that shows the recorded parameters graphically and tabulates and summarizes all the results. Performance of the hood, the hood controls, and the laboratory in general shall be described and summarized.