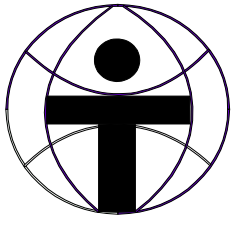
National Institutes of Health
Office of Research Services
Division of Occupational Health and Safety

Local Exhaust Ventilation Testing Protocols



Technical Assistance Branch

Reviewed June 2011

National Institutes of Health
Office of Research Services
Division of Occupational Health and Safety

LOCAL EXHAUST VENTILATION TESTING PROTOCOLS

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LOCAL EXHAUST VENTILATION TESTING PROTOCOLS

1.0 DOWNDRAFT SINKS FOR SMALL ANIMAL SURGERY

1.1 Introduction

The Office of Research Services, Division of Occupational Health and Safety (DOHS), established this protocol for the routine performance testing of downdraft sinks where the work area does not exceed three square feet.

1.2 Performance Testing

Performance testing of downdraft sinks is divided into two parts. The first part is the measurement of the uniformity of air velocities and a determination of the average air velocity. The second part of the test is a visual inspection of the smoke capturing ability of the downdraft sink.

1.2.1 Air Velocity Measurement

The measurement of air velocities is to be done using a calibrated thermoanemometer. For measurement purposes, the work surface of the downdraft sink is to be divided into an imaginary grid of four-inch squares. The air velocity measurements shall be taken at multiple points over the entire work surface on a grid with the points approximately four inches apart and at a height of five inches above the work surface. Measurements along the perimeter of the table should be taken at least one inch onto the work surface.

The air velocity measurements, when taken on an unobstructed downdraft sink, should have a calculated average velocity of 50-100 fpm. No single measurement point should be below 40 fpm, nor should any point exceed 125 fpm.

1.2.2 Smoke Test

Smoke is to be used to visually evaluate airflow direction and to identify any turbulence in the inward movement of air violent enough to affect the capture of the majority of the generated smoke. Smoke should be released for capture by the downdraft table at a height of five inches.

1.2.3 Recording Results

After testing of each downdraft sink, a section of the "Downdraft Sink Survey Report" is to be completely filled out, including comments. A copy of the Report is included as Attachment 1. The Technical Assistance Branch (TAB) will enter the results into a computer database for record keeping and performance tracking of the downdraft sink.

1.3 Certification of Performance

Downdraft sinks that meet the performance testing criteria identified in part II of the test are considered to be acceptable for use in small animal surgery, necropsy and other procedures where volatile anesthetics and other chemicals posing a potential human exposure are used. A green sticker will be affixed to the table near, but not on, the work surface. The sticker will indicate that the downdraft sink is approved for work, and will identify the date the sink was tested, who tested it, and include a telephone number to call if there are any questions.

Downdraft sinks failing the test criteria will have a red sticker affixed to them, which will read that the sink is not suitable for work and include a telephone number to call if there are questions. Sinks failing to meet the acceptable performance criteria will be identified to maintenance for repair. After repair, the sink will be rechecked and, if it meets the performance testing criteria, passed.

1.4 Frequency of Performance Testing

Downdraft sinks at the NIH will be tested on a routine basis at least once a year. If adjustments or modifications are made to the exhaust system that serves the downdraft sink, the table is to be re-tested when the changes are completed.

2.0 DOWNDRAFT TABLES FOR SMALL ANIMAL SURGERY

2.1 Introduction

The Office of Research Services, DOHS, established this protocol for the routine performance testing of small downdraft tables where the work area does not exceed three square feet.

2.2 Performance Testing

Performance testing of a downdraft table is divided into two parts. The first part is the measurement of the uniformity of air velocities and a determination of the average air velocity. The second part of the test is a visual inspection of the smoke capturing ability of the downdraft table.

2.2.1 Air Velocity Measurement

To ensure a representative air velocity measurement, disruptive cross drafts that may be created by excessive traffic and overhead supply diffusers must be avoided. Air velocity measurement is to be done using a calibrated thermoanemometer. For measurement purposes, the work surface of the downdraft table is to be divided into an imaginary grid of four-inch squares. The air velocity measurements shall be taken at multiple points over the entire work surface on a grid with the points approximately four inches apart and at a height of five inches above the work surface. Measurements along the perimeter of the table should be taken at least one inch onto the work surface.

The air velocity measurements, when taken on an unobstructed downdraft table, should have a calculated minimum average velocity of 50-100 fpm. No single measurement point should be below 40 fpm, nor should any point exceed 125 fpm.

2.2.2 Smoke Test

Smoke is to be used to visually evaluate airflow direction and to identify any turbulence in the inward movement of air violent enough to affect the capture of the majority of the generated smoke. Smoke should be released for capture by the downdraft table at a height of five inches.

2.2.3 Recording Results

After testing of each downdraft table, a section of the "Downdraft Table Survey Report" is to be completely filled out, including comments. A copy of the Report is included as Attachment 2. The TAB will enter the results into a computer database for record keeping and performance tracking of the downdraft table.

2.3 Certification of Performance

Downdraft tables that meet the performance testing criteria identified in part II of the test are considered to be acceptable for use in small animal surgery, necropsy and other procedures where volatile anesthetics and other chemicals posing a potential human exposure are used. A green sticker will be affixed to the table near, but not on, the work surface. The sticker will indicate that the downdraft table is approved for work, and will identify the date the table was tested, who tested it, and include a telephone number to call if there are any questions.

Downdraft tables failing the test criteria will have a red sticker affixed to them, which will read that the table is not suitable for work and include a telephone number to call if there are questions. Hoods failing to meet the acceptable performance criteria will be identified to maintenance for repair. After repair, the table will be rechecked and, if it meets the performance testing criteria, passed.

2.4 Frequency of Performance Testing

Downdraft tables at the NIH will be tested on a routine basis at least once a year. If adjustments or modifications are made to the exhaust system that serves the downdraft table, the table is to be re-tested when the changes are completed.

3.0 SLOT HOODS USED FOR LOCAL VENTILATION

3.1 Introduction

The Office of Research Services, DOHS, established this protocol for the routine performance testing of slot hoods used for local ventilation. The testing of slot hoods is divided into two parts, preliminary evaluation and routine performance testing.

3.2 Preliminary Evaluation

A preliminary evaluation conducted according to this protocol will be performed on each slot hood to determine the average slot velocity required to obtain an estimated capture velocity of at least 50 feet/minute (fpm) at the point of contaminant generation. Staff of the TAB will conduct the preliminary evaluation prior to any routine performance testing. The required average slot velocity to obtain 50 fpm at

the point of contaminant generation can be estimated based on the width, and length of the slot, the existing slot velocity and the distance from the slot face to the farthest point of contaminant release.

The volumetric air flow (Q) in cubic feet/minute (cfm) of each slot hood can be determined by the formula:

$Q = (V_{slot})(A)$

where:

V_{slot} = average slot air velocity, fpm

A = area of slot, sq. ft.

This does not give the capture velocity at the site of contamination generation. The capture velocity must be estimated using the formula:

$V = Q/2.6(LX)$

where:

V = capture velocity at distance X, fpm

L = length of slot, ft.

X = distance from slot face to contaminant release, ft.

(This formula only applies for slot hoods where the aspect ratio of the slot [W/L] is 0.2 or less).

If the estimated capture velocity at the point of contaminant release is less then 50 fpm, the slot velocity must be increased. With the data gathered above in accordance with the procedure outlined in 3.3 Performance Testing, the slot velocity required to give 50 fpm capture velocity at the point of contaminant generation can be calculated and the system adjusted accordingly. With the required slot velocity known for each individual slot hood, future checks of the slot hood would only have to measure the average slot velocity to determine that it meets the minimum slot velocity set in the original evaluation. This assumes that there have been no changes in the system or the area since the original evaluation.

A sketch of the slot hood and the area surrounding it must be made, noting locations of air vents, doorways and anything that might obstruct or deflect the air movement into the slot hood. The slot hood should be tested with smoke to help verify the movement of air toward the slot hood and to visualize the effects that any of the items listed above might have on the capture of the smoke by the slot hood. In addition, tape is to be placed across the work surface indicating the point where the 50 fpm capture velocity is determined to be.

3.3 Performance Testing

Performance testing of the slot hoods is divided into two parts. The first part is the measurement of the

slot velocities and a determination of the average slot velocity. The second part of the test is a visual inspection of the smoke capturing ability of the slot hood.

3.3.1 Air Velocity Measurement

The measurement of air velocities is to be done using a calibrated thermoanemometer. Air velocity readings should be measured at the face of the slot and taken every 6 inches along the entire length of the slot and the average slot velocity calculated. The average slot velocity measured should be compared with the required minimum slot velocity determined in the original evaluation. If the measured average slot velocity is less than the minimum slot velocity for that slot hood, the hood fails.

3.3.2 Smoke Test

Smoke is to be used to visually evaluate airflow direction and to identify any turbulence or cross drafts in the movement of air violent enough to affect the capture of the majority of the generated smoke. Smoke should be released for capture by the slot hood at the farthest distance from the slot hood where contaminant release will likely occur.

3.3.3 Recording Results

After the testing of each slot hood is completed, a copy of the "Slot Hood Survey Report" is to be completely filled out, including comments. A copy of the Report is included as Attachment 3. The TAB will enter the results into a computer database for record keeping and performance tracking of the slot hood.

3.4 Certification of Performance

Slot hoods that meet the performance testing criteria identified in 3.3, Performance Testing, are considered to be acceptable for use with known low toxicity materials. A green sticker will be affixed to the slot hood near, but not on, the work surface. The sticker will indicate that the slot hood is approved for work, and will identify the distance from the hood where the 50 fpm capture velocity is determined to be, the date the slot hood was tested, who tested it, and include a telephone number to call if there are any questions.

Slot hoods failing the test criteria will have a red sticker affixed to them, which will read that the slot hood is not suitable for work and include a telephone number to call if there are questions. Slot hoods failing to meet the acceptable performance criteria will be identified to maintenance for repair. After repair, the slot hood will be rechecked and, if it meets the performance testing criteria set for that slot hood, passed.

3.5 Frequency of Performance Testing

Slot hoods at the NIH will be tested on a routine basis at least once a year. If adjustments or modifications are made to the exhaust system that serves the slot hood, the slot hood is to be re-tested when the changes are completed.

4.0 CANOPY HOODS USED FOR LOCAL VENTILATION

4.1 Introduction

The Office of Research Services, DOHS, established this protocol for the routine performance testing of canopy hoods used for local exhaust ventilation. The testing of canopy hoods is divided into two parts, preliminary evaluation and routine performance testing.

4.2 Preliminary Evaluation

A preliminary evaluation conducted according to this protocol will be performed on each canopy hood to determine the average velocity at the face required to obtain an estimated capture velocity of at least 50 feet/minute (fpm) at the point of contaminant generation. Staff of the TAB will perform the preliminary evaluation prior to any routine performance testing. The required average canopy face velocity to obtain 50 fpm at the point of contaminant generation (site of work) can be estimated based on the perimeter of the work surface, the height of the canopy above the work, and the existing canopy face velocity.

The volumetric air flow (Q) in cubic feet/minute (cfm) of each canopy hood can be determined by the formula:

$Q = (V)(A)$

where:

V = average air velocity at the canopy face, fpm

A = area of canopy, square ft.

This does not give the capture velocity at the site of contamination generation. The capture velocity must be estimated using the formula:

$V' = Q/1.4(PD)$

where:

V' = capture velocity at work site, fpm

D = height above work area, ft.

P = perimeter of work area, ft.

If the estimated capture velocity at the point of contaminant release (work) is less then 50 fpm, the canopy face velocity must be increased.

With the data gathered above, the velocity required to give 50 fpm capture velocity at the point of contaminant generation can be calculated and the system adjusted accordingly. With the required velocity known for each individual canopy hood, future checks of the canopy hood would only have to measure the average face velocity of the canopy to determine that it meets the minimum velocity set in the original

evaluation. This assumes that there have been no changes in the system or the area since the original evaluation.

A sketch of the canopy hood and the area surrounding it must be made, noting locations of air vents, doorways and anything that might obstruct or deflect the air movement into the canopy hood. The canopy hood should be tested with smoke to help verify the movement of air toward the canopy hood and to visualize the effects that any of the items listed above might have on the capture of the smoke by the canopy hood.

4.3 Performance Testing

Performance testing of the canopy hoods is divided into four parts: a) the measurement of air velocities for calculation of the average capture velocity at the canopy; b) a visual inspection of the smoke capturing ability of the canopy hood; c) verification of the physical operating parameters of the canopy; and d) Recording of the results.

4.3.1 Air Velocity Measurement

The measurement of air velocities is to be done using a calibrated thermoanemometer. Air velocity readings should be measured at the face of the canopy and taken in a grid pattern over the entire open area of the canopy, and the average canopy capture velocity calculated. The same number of testing points should be used as was used in the original evaluation. The average capture velocity measured should be compared with the required minimum velocity determined in the original evaluation. If the measured average velocity is less than the minimum velocity for that canopy hood, the hood fails.

4.3.2 Smoke Test

Smoke is to be used to visually evaluate airflow direction and to identify any turbulence or cross drafts in the movement of air violent enough to affect the capture of the majority of the generated smoke. Smoke should be released for capture by the canopy hood at the work site where contaminant release will likely occur.

4.3.3 Operating Parameter Check

Following completion of the smoke test of the canopy, the physical operating parameters of the canopy will be checked to verify that the parameters have not been changed since the first survey. The operating parameters to be checked are the dimensions of the canopy, perimeter of work area, and the height of the canopy above the work area. Any alterations in these parameters are to be noted and an re-evaluation of the canopy may be necessary.

4.3.4 Recording Results

After the testing of each canopy hood is completed, a copy of the "Canopy Hood Survey Report" is to be completely filled out, including comments. A copy of the Report is included as Attachment 4. The TAB will enter the results into a computer database for record keeping and performance tracking of the canopy hood.

4.4 Certification of Performance

Canopy hoods that meet the performance testing criteria identified in Part 4.3, Performance Testing, are considered to be acceptable for use with known low toxicity materials. A green sticker will be affixed to the canopy hood. The sticker will indicate that the canopy hood is approved for work, and will identify the date the hood was tested, who tested it, and include a telephone number to call if there are any questions.

Canopy hoods failing the test criteria will have a red sticker affixed to them, which will read that the hood is not suitable for work and include a telephone number to call if there are questions. Canopy hoods failing to meet the acceptable performance criteria will be identified to building maintenance section for repair. After repair, the hood will be rechecked and, if it meets the performance testing criteria set for that canopy hood, passed

4.5 Frequency of Performance Testing

Canopy hoods at the NIH will be tested on a routine basis at least once a year. If adjustments or modifications are made to the exhaust system that serves the canopy hood, the canopy hood is to be re-tested when the changes are completed.

5.0 MISCELLANEOUS LOCAL EXHAUST VENTILATION DEVICES

5.1 Introduction

The Office of Research Services, DOHS, established this protocol for the routine performance testing of LEV (the acronym LEV would be referring to all types of local exhaust ventilation mentioned in this protocol). LEVs currently included on the miscellaneous list are movable exhaust hoods, soldering and welding benches, welding trunk hoods, enclosed canopies, large necropsy tables, and simple hoods. The testing of LEV hoods is divided into two parts, preliminary evaluation and routine performance testing.

5.2 Preliminary Evaluation

A preliminary evaluation conducted according to this protocol will be performed on each LEV hood to determine the average velocity required to obtain an adequate capture velocity at the point of contaminant generation. Staff of the TAB will perform the preliminary evaluation prior to any routine performance testing. The required average velocity to obtain the required fpm at the point of contaminant generation (site of work) will be determined as per the specific LEV.

The volumetric air flow (Q) in cubic feet/minute (cfm) of each LEV can be determined by the formula:

$Q = (V)(A)$

where:

V = average air velocity at the point of measurement, fpm

A = area of LEV monitored, square ft.

This may not give the capture velocity at the site of contamination generation. The capture velocity may be estimated using a relevant formula. The respective formula will be adapted from the most recent edition of the American Conference of Governmental and Industrial Hygienists (ACGIH), Industrial Ventilation: A Manual of Recommended Practice.

If the estimated or measured capture velocity at the point of contaminant release (work) is less than 50 fpm, the LEV face velocity must be increased. With the data gathered above, the velocity required to give 50 fpm capture velocity at the point of contaminant generation can be calculated and the system adjusted accordingly. With the required velocity known for each individual LEV, future checks of the LEV would only have to measure the velocity of the LEV at the point(s) indicated to determine that it meets the minimum velocity set in the original evaluation. This assumes that there have been no changes in the system or the area since the original evaluation.

A sketch of the LEV and the area surrounding it must be made, noting locations of air vents, doorways and anything that might obstruct or deflect the air movement into the LEV. The LEV should be tested with smoke to help verify the movement of air toward the LEV and to visualize the effects that any of the items listed above might have on smoke capture.

5.3 Performance Testing

Performance testing of the LEV is divided into four parts: a) the measurement of air velocities for calculation of the average capture velocity at the LEV; b) a visual inspection of the smoke capturing ability, c) verification of the physical operating parameters of the LEV; and d) recording of the results.

5.3.1 Air Velocity Measurement

The measurement of air velocities is to be done using a calibrated thermoanemometer. Air velocity readings should be measured at the point(s) indicated for each type of LEV and taken in a grid pattern over the entire open area of the LEV, and the average capture velocity calculated. The same number of testing points as was used in the original evaluation should be used in this test. The average capture velocity measured should be compared with the required minimum acceptable velocity determined in the original evaluation. If the measured average velocity is less than the minimum acceptable velocity for that LEV, it fails.

5.3.2 Smoke Test

Smoke is to be used to visually evaluate airflow direction and to identify any turbulence or cross drafts in the movement of air violent enough to affect the capture of the majority of the generated smoke. Smoke should be released for capture by the LEV at the work site where contaminant release will likely occur.

5.3.3 Operating Parameter Check

Following completion of the smoke test of the LEV, the physical operating parameters will be checked to verify they have not changed since the last survey. Any alterations in these parameters are to be noted and a re-evaluation of the LEV may be necessary.

5.3.4 Recording Results

After the testing of each LEV is completed, a copy of the Miscellaneous LEV Survey Report is to be completely filled out, including comments. A copy of the Report is included as Attachment 5. The TAB will enter the results into a computer database for record keeping and performance tracking of the LEV.

5.4 Certification of Performance

LEVs that meet the performance testing criteria identified in 5.3, Performance Testing, are considered to be acceptable for use with known low toxicity materials. A green sticker will be affixed to the LEV. The sticker will indicate that the LEV is approved for work, and will identify the date the LEV was tested, who tested it and include a telephone number to call if there are any questions.

LEVs failing the test criteria will have a red sticker affixed to them, which will read that the LEV is not suitable for work and include a telephone number to call if there are questions. Those LEVs failing to meet an acceptable performance criterion will be identified to building maintenance section for repair. After repair, the LEV will be rechecked and, if it meets the performance testing criteria set for that LEV, passed.

5.5 Frequency of Performance Testing

LEVs at the NIH will be routinely tested at least once a year. If adjustments or modifications are made to the exhaust system that serves the LEV, the LEV must be re-tested when the changes are completed.

ATTACHMENT 1: DOWNDRAFT SINK SURVEY REPORT

(Measure air velocity at 5 inches above table surface.)

Date
Bldg/Rm ICD Telephone #
Sink Dim. (in.) x Area (sq. ft.) Avg. fpm Hi fpm Low fpm
Total Volume cfm Smoke Test 5" above table surface: Pass/Fail
Comments

Date
Bldg/Rm ICD Telephone #
Sink Dim. (in.) x Area (sq. ft.) Avg. fpm Hi fpm Low fpm
Total Volume cfm Smoke Test 5" above table surface: Pass/Fail
Comments

Date
Bldg/Rm ICD Telephone #
Sink Dim. (in.) x Area (sq. ft.) Avg. fpm Hi fpm Low fpm
Total Volume cfm Smoke Test 5" above table surface: Pass/Fail
Comments

Date
Bldg/Rm ICD Telephone #
Sink Dim. (in.) x Area (sq. ft.) Avg. fpm Hi fpm Low fpm
Total Volume cfm Smoke Test 5" above table surface: Pass/Fail
Comments

Date
Bldg/Rm ICD Telephone #
Sink Dim. (in.) x Area (sq. ft.) Avg. fpm Hi fpm Low fpm
Total Volume cfm Smoke Test 5" above table surface: Pass/Fail
Comments

ATTACHMENT 2: DOWNDRAFT TABLE SURVEY REPORT

(Measure air velocity at 5 inches above table surface.)

Date
Bldg/Rm ICD Telephone #
Sink Dim. (in.) x Area (sq. ft.) Avg. fpm Hi fpm Low fpm
Total Volume cfm Smoke Test 5" above table surface: Pass/Fail
Comments

Date
Bldg/Rm ICD Telephone #
Sink Dim. (in.) x Area (sq. ft.) Avg. fpm Hi fpm Low fpm
Total Volume cfm Smoke Test 5" above table surface: Pass/Fail
Comments

Date
Bldg/Rm ICD Telephone #
Sink Dim. (in.) x Area (sq. ft.) Avg. fpm Hi fpm Low fpm
Total Volume cfm Smoke Test 5" above table surface: Pass/Fail
Comments

Date
Bldg/Rm ICD Telephone #
Sink Dim. (in.) x Area (sq. ft.) Avg. fpm Hi fpm Low fpm
Total Volume cfm Smoke Test 5" above table surface: Pass/Fail
Comments

Date
Bldg/Rm ICD Telephone #
Sink Dim. (in.) x Area (sq. ft.) Avg. fpm Hi fpm Low fpm
Total Volume cfm Smoke Test 5" above table surface: Pass/Fail
Comments

ATTACHMENT 3: SLOT HOOD SURVEY REPORT

I. Original Evaluation

Date of Original Evaluation:
Bldg/Rm ICD Telephone #
Dimensions of slot (ft) length x width
Aspect Ratio (W/L) Area (sq. ft.)
Distance to farthest point of contaminant generation (ft.) Avg. slot velocity fpm
Hi fpm Low fpm
Total Volume (Q) cfm Minimum Acceptable Velocity fpm
Calculated Capture Velocity Required: fpm Pass/Fail
Comments

Sketch of Slot Hood and Surrounding Area

II. Performance Testing

Date:

	Slot 1	Slot 2	Slot 3	Slot 4
Average				
Hi				
Low				

Total average slot velocity fpm *(Refer to Part I for minimal acceptable velocity)*

Smoke Test *(See taped location and/or indicated distance of contaminant generation)*

Pass/Fail

Comments

ATTACHMENT 4: CANOPY HOOD SURVEY REPORT

I. Original Evaluation

Date of Original Evaluation:
Bldg/Rm ICD Telephone #
Dimensions of Canopy (ft.) length width
Perimeter of Work Area (ft.) Area of Canopy (ft.)
Height above work (ft.) Number of Grid Sampling Points
Average Velocity fpm Hi fpm Low fpm
Total Volume (Q) cfm Minimum Calculated Capture Velocity Required fpm
Minimum Acceptable Face Velocity fpm
Smoke Test Comments

Sketch of Slot Hood and Surrounding Area

II. Performance Testing

Date
Average Velocity fpm Hi fpm Low fpm
(Refer to Part 1 for minimal acceptable face velocity, dimension of canopy, perimeter of work area, and height above work area).

Smoke Test Pass/Fail
Comments

ATTACHMENT 5: MISCELLANEOUS LEV SURVEY REPORT

I. Original Evaluation

Date of Original Evaluation:
Bldg/Rm ICD Telephone #
Dimensions of LEV (ft.) length width Area
Diameter of LEV opening (ft.) Area of Canopy (ft.)
Sampling Point Number of Sampling Points
Average Velocity fpm Hi fpm Low fpm
Total Volume (Q) cfm Minimum Acceptable Velocity
Minimum Capture Velocity Required fpm
Smoke Test: Adequate/Inadequate
Comments:

Sketch of Miscellaneous LEV and Surrounding Area Including Location of Grid Sampling Points:

II. Performance Testing

Date:
Average Velocity fpm Hi fpm Low fpm
(Refer to Part I for minimal acceptable velocity)

Smoke Test Pass/Fail
Comments