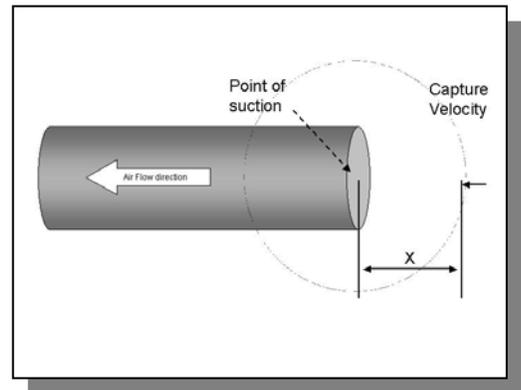


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1.0 Purpose/Scope

This procedure provides a standardized method for determining the effectiveness of a local exhaust ventilation system (LEV) in capturing a contaminant released outside of the ductwork, i.e., the capture efficiency. This procedure is used as part of the initial or periodic LEV system effectiveness test described in IH62400 or IH62410.

The "zone of capture" is visualized by releasing smoke from a smoke tube around the intake to the LEV.

At numerous points in the vicinity of the intake, velocity measurements are made.

2.0 Responsibilities

This procedure will be implemented through the SHSD Industrial Hygiene Group Leader or the RCD Facility Support Group Leader, or line management for the person conducting the measurement.

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3.0 Definitions

Area (A) - surface area of hood opening or duct, measured as:

round duct: $A = 3.14 \times (\text{radius})^2$

rectangular duct: $A = \text{length} \times \text{width}$

Units: English- square feet (ft²), Metric- square meters (m²).

Velocity (V) - speed of air passing a point in space.

Units: English- feet per minute (fpm), Metric- meters per sec (m/s)

Capture velocity- air speed necessary to overcome opposing air currents and draw a contaminant into a hood or intake. Acceptable capture velocity depends on the mass of the particulate being captured, the prevailing air currents outside the hood, thermal properties of the contaminant (ex., hot fumes rise), and the velocity of the particulate or gas relative to the hood flow (ex. belt sander throwing dust into or away from exhaust line).

- A typical value is usually about 1000 fpm for tools like saws and belt sanders.
- May be less than 100 fpm for welding gases and fumes under a canopy hood.
- For more examples, see Attachment 9.1.

4.0 Prerequisites

- 4.1 Prior to testing a local exhaust system, verify the calibration and operability of the test equipment.
- 4.2 Observe area postings and obtain approval to enter the test area, as required.

5.0 Precautions

5.1 **Hazard Determination:**

- 5.1.1 This test may be done in areas where chemicals or radiological contamination is known or suspected to be present. These contaminants can have significant health effects and must receive a hazard evaluation by a cognizant ESH professional.
- 5.1.2 This operation may involve release of and exposure to hazardous chemical (smoke

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tubes). The gases, vapors, or aerosols that the exhaust systems are used to capture could cause exposure to the tester. Appropriate measures to minimize inhalation of gas contaminants must be made.

- 5.1.3 Air testing meters used in this procedure do not generate Hazardous Wastes.
- 5.1.4 The smoke testing equipment may generate a very low in airborne concentration that is not of environmental or personal exposure consequence under typical exposure levels. Do not intentionally breathe the mist from the smoke tube. Consult the MSDS for personnel precautions
- 5.1.5 The test equipment design does not cause significant ergonomic concerns in routine use.

5.2 Personal Protective Equipment

- 5.2.1 Eye: Safety Glasses with side shields are required.
- 5.2.2 Hand: Contact with work surfaces should be minimized as it could pose a health risk. Use of this operation in areas of known or suspected chemical or radiological contamination requires the use of disposable gloves. Exam-style, splash gloves are acceptable. Acceptable elastomers are: Nitrile, PVC, and Natural Rubber.
- 5.2.3 Body:
 - If contact of the body with contaminated surfaces is anticipated, a disposable suit should be used. Acceptable Chemical Protective Clothing (CPC) materials include: Tyvek®, KleenGuard®, and cotton. Disposable garments must be discarded as per Hazardous Waste Management Division instruction.
 - If contact with potentially contaminated surfaces is not expected, protective clothing is optional. However, if personal clothing items become contaminated, they must be surrendered for BNL cleaning or disposal.
- 5.2.4 Foot:
 - If contact of the feet is anticipated with contaminated surface, disposable shoe coverings, boots or booties should be used. Acceptable CPC material include: Tyvek®, KleenGuard®, and rubber.
 - If contact with potentially contaminated surfaces is not expected, shoe coverings are optional. However, if personal shoes become contaminated, they must be surrendered for BNL cleaning or disposal.
- 5.2.5 Respiratory: Under normal use, respiratory protection is not required. If chemical or radiological levels from contamination in the area cause the OSHA, ACGIH, or DOE standards to be exceeded, respirators are required.

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6.0 Procedure

6.1 Assemble Equipment:

6.1.1 Air velocity meter such as the Alnor® swinging vane anemometer or the TSI® thermal anemometer VelociCalc®. Follow the appropriate SHSD IH SOP on the operation of the meter.

6.1.2 Measuring ruler.



6.2 Pre-Testing Inspection of equipment

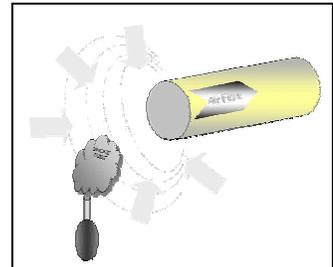
6.2.1 Verify that the exhaust ventilation system is operating.

6.2.2 Inspect the exhaust system and its associated ductwork and mechanical components for any obvious signs of damage (e.g., missing or damaged seals, breached ductwork, excessive rust, or unusually loud motor noise). Notify Plant Engineering and the system owner of these conditions. Do not test if the system is not operable or not of adequate integrity.

6.3 Evaluate and document the conditions surrounding the LEV system. Observe and record conditions in the work area, such as:

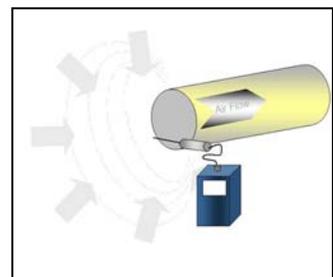
- Status of doors and windows: open or shut,
- Status of room HVAC system,
- Traffic and movement of people and equipment around the system, and
- Permanent or temporary storage of equipment around the system.

6.4 Smoke Tube: Release smoke tube vapor/fume into the air in the vicinity of the duct intake. Move the smoke release point to various locations around the duct opening until the zone of capture is visualized.



6.5 Initial Evaluation Velocity Measurements by ESH Professionals:

6.5.1 Determine appropriate sample locations to characterize the operation and LEV control of hazards.



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- 6.5.2 Place the velocity-measuring meter's probe at various locations around the duct opening until the zone of capture is measured.
 - 6.5.3 Record the reading at each point tested. Optimum results are obtained when a systematic sampling pattern, such as radii, grids, or other suitable techniques are used. Record the test results on a *LEV Capture Velocity* form (Attachment 9.2), or suitable alternative.
 - 6.5.4 Compare results with the needed control velocity from Attachment 9.1 or other suitable reference.
 - 6.5.5 Transfer the velocity values to the *LEV System Initial Evaluation Test Record* or *LEV System Periodic Validation Test Record*, if applicable.
- 6.6 Periodic Validation Velocity Measurements by ESH Professionals or Technicians:
- 6.6.1 Place the velocity-measuring meter's probe at location(s) specified based on the *LEV System Periodic Validation Test Record*.
 - 6.6.2 Record the reading at these point(s) tested.
 - 6.6.3 Record the test results on a *LEV Capture Velocity* form (Attachment 9.2), or equivalent.
 - 6.6.4 Transfer the velocity values to the *LEV System Periodic Validation Test Record*.
- 6.7 Post a label or tag on the LEV equipment noting the test date and name of tester.
- 6.8 Record-keeping: Provide a copy of the *LEV Capture Velocity* form to the Divisional Safety Coordinator, the Process/Operation and Exhaust system owner/management, and any other interested parties. The original test report is retained by the organization responsible for the testing in accordance with the BNL record keeping requirements. Send a copy of the record to the SHSD IH lab.

7.0 Implementation and Training

- 7.1 Tests shall be performed by persons who have demonstrated the competence to satisfactorily perform the tests as evidenced by experience and training.
 - 7.1.1 SHSD: Determination of qualification to use this procedure, testing of applicants, and documentation of qualification shall be set by the IH Group Leader, or designee.
 - 7.1.2 RCD: Determination of qualification to use this procedure, testing of applicants,

The only official copy is on-line at the SHSD IH Group website.
 Before using a printed copy, verify that it is current by checking the document issue date on the website.

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and documentation of qualification shall be set by the RCD Facility Support Group Leader, or designee.

8.0 References

- 8.1 American Conference of Governmental Industrial Hygienists (ACGIH). *Guidelines for Testing Ventilation Systems*; 1991.

9.0 Attachments

- 9.1 Capture Velocity Reference
- 9.2 BNL Exhaust Ventilation *Capture Velocity* form

10.0 Documentation

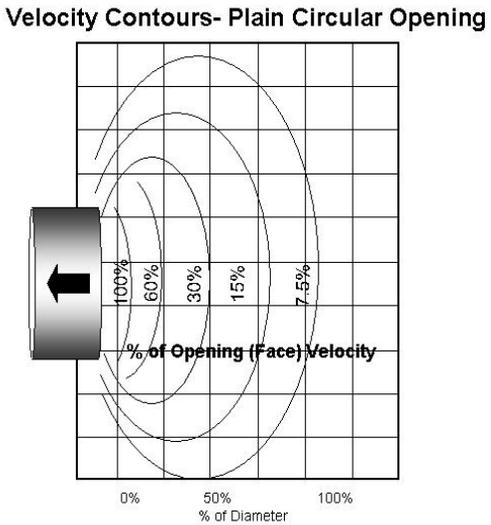
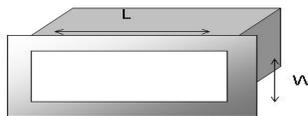
Document Review Tracking Sheet			
PREPARED BY: R. Selvey IH Group Leader Date 12/20/02	REVIEWED BY:		APPROVED BY: R. Selvey IH Group Leader Date 12/21/02
	C. Weilandics RCD Facility Support Date 11/20/02	J. Peters IH Group Date 11/20/02	
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Periodic Review Record		
Date of Review	Reviewer Signature and Date	Comments Attached

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Attachment 9.1 Reference on Capture Velocities

RANGE OF CAPTURE VELOCITIES		
Condition of Dispersion of Contaminant	Example	Capture Velocity (fpm)
Released with practically no velocity into quiet air	Evaporation from tanks, degreasing, etc.	50 - 100
Released at low velocity into moderately still air	Spray booths, intermittent container filling, low speed conveyors, welding, plating, pickling	100 - 200
Active generation into zone of rapid air motion	Spray painting in shallow booth, barrel filling, conveyor loading, crusher	200- 500
Released at high initial velocity into zone at very rapid air motion	Grinding, abrasive blasting, tumbling	500 - 2000

Hood Type	Description	Velocity Contours- Plain Circular Opening
Slot [W/L <0.2] Q = 3.7 LVX		
Flanged Slot Q = 2.6 LVX		
Plain Opening Q = V (10X²+A)		
Flanged Opening Q = 0.75 V(10X²+A)		

EXHAUST VENTILATION SURVEY FORM
Initial Evaluation of **CAPTURE VELOCITY**

DATE:	SURVEYOR(S):
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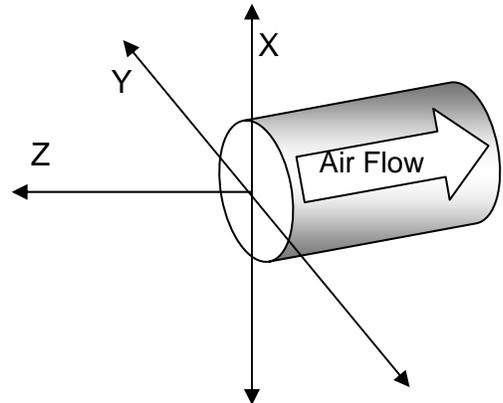
I. AREA INFORMATION				
DEPT:	BLDG:	ROOM:		
EXHAUST SYSTEM I.D.:				
EQUIPMENT EXHAUSTED:				
STATUS OF ROOM/AREA:	Windows: Open / Closed	Doors: Open / Closed	HVAC: On / Off	Other:

II. SURVEY INSTRUMENT INFORMATION	
INSTRUMENT:	CALIBRATION DATE:
MODEL:	SERIAL#:

III. RESULTS		
REQUIRED VELOCITY:	ACCEPTABLE VELOCITY RANGE:	SASH HEIGHT: (IF APPLICABLE)
HEIGHT:	WIDTH:	SURFACE AREA:
FLOW FORMULA: $Q = V \times A$	FLOW:	TEMPERATURE OF AIR STREAM:

SITE	X	Y	Z	FPM
A				
B				
C				
D				
E				
F				
G				
H				
I				
J				
K				
L				
M				
N				
O				
P				

Sample Locations



Sketch of System and Sample Location

Indicate

- Source
- Duct Face
- Operator