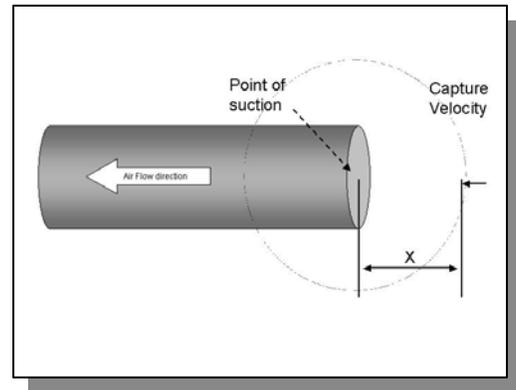


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Capture Velocity Measurements	

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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) that capture 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 to be made.

2.0 Responsibilities

This procedure will be implemented through the SHSD Industrial Hygiene Group Leader. Other BNL organizations conducting the measurement (for example, RCD Facility Support Group) are responsible to implement similar programs for this type of engineering control surveillance.

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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 The test equipment design does not cause significant ergonomic concerns in routine use.

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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.

5.3 **Environmental Impact:** This operation may involve release of and exposure to hazardous chemical (smoke 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.

5.3.1 Air testing meters used in this procedure do not generate Hazardous Wastes.

5.3.2 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

5.4 **Work Planning:** All requirements of work permits and work planning system reviews

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must be met in performing this procedure.

- 5.5 **Job Risk Assessment:** Consult the *Job Risk Assessment* [SHSD-JRA-02](#) for the risk analysis of this operation based on the hazards and controls of this SOP.

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.



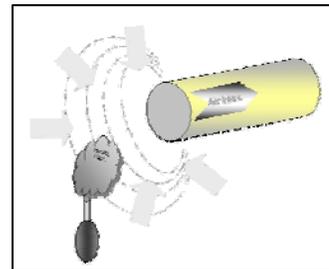
6.2 Pre-Testing Inspection of equipment

6.2.1 Verify that the exhaust ventilation system is operating.

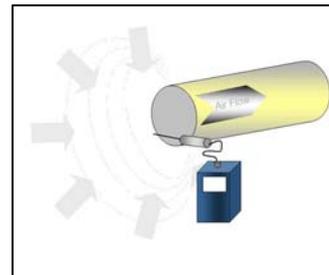
6.2.2 Inspect the exhaust system and its associated ductwork and mechanical components for any obvious signs of damage (e.g., missing or damaged seals, breached ductwork, excessive rust, or unusually loud motor noise). Notify Plant Engineering and the system owner of these conditions. Do not test if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

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Professionals:

- 6.5.1 Determine appropriate sample locations to characterize the operation and LEV control of hazards.
 - 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 ESH 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. All persons must have met the qualification criteria set in *IH50300 BNL IH Program and IH Group Training & Qualification Matrix*. Qualification is to be documented on

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Attachment 9.3 Job Performance Measure.

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
 9.3 *Job Performance Measure*

10 Documentation

Document Development and Revision Control Tracking		
PREPARED BY: R. Selvey IH Group Leader Date 12/20/02	REVIEWED BY: J. Peters IH Group Date 11/20/02	APPROVED BY: R. Selvey IH Group Leader Date 12/21/02
ESH Coordinator/ Date: <i>none</i>	Work Coordinator/ Date: <i>none</i>	SHSD Manager / Date <i>none</i>
QA Representative / Date: <i>none</i>	Training Coordinator / Date: <i>none</i>	Filing Code: IH52
Facility Support Rep. / Date: C. Weilandics; RCD Facility Support; Date 11/20/03	Environ. Compliance Rep. / Date: <i>none</i>	Effective Date: 12/21/02
ISM Review - Hazard Categorization <input type="checkbox"/> High <input checked="" type="checkbox"/> Moderate <input type="checkbox"/> Low/Skill of the craft	Validation: <input type="checkbox"/> Formal Walkthrough <input checked="" type="checkbox"/> Desk Top Review <input type="checkbox"/> SME Review Name / Date:	Implementation: Training Completed: Tracked in BTMS Procedure posted on Web: 05/31/07 Hard Copy files updated: 05/31/07 Document Control: 05/31/07

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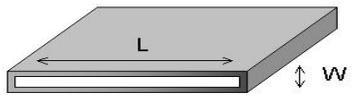
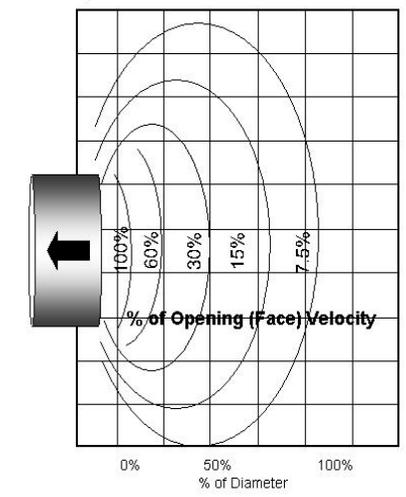
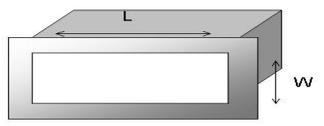
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Revision Log		
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input checked="" type="checkbox"/> Periodic review <input checked="" type="checkbox"/> Clarify/enhance procedural controls		
Changed resulting from: <input type="checkbox"/> Environmental impacts <input type="checkbox"/> Federal, State and/or Local requirements <input type="checkbox"/> Corrective/preventive actions to non-conformances <input checked="" type="checkbox"/> none of the above		
Section/page and Description of change: Revised Section 7 training requirements. Updated Section 10 to new format. Added Attachment 9.3 JPM.		
<i>(signature on file) R. Selvey 10/31/05</i> SME Reviewer/Date:	SME Reviewer/Date:	SME Reviewer/Date:
Purpose: <input type="checkbox"/> Temporary Change <input type="checkbox"/> Change in Scope <input type="checkbox"/> Periodic review <input checked="" type="checkbox"/> Clarify/enhance procedural controls		
Changed resulting from: <input type="checkbox"/> Environmental impacts <input type="checkbox"/> Federal, State and/or Local requirements <input type="checkbox"/> Corrective/preventive actions to non-conformances <input checked="" type="checkbox"/> none of the above		
Section/page and Description of change: Minor text changes to Section 1 for clarity. Section 2 updated to reflect responsibilities of non-SHSD organizations. Section 5 re-ordered for clarity and added the JRA. Document Control Rev dates added to Attachments 9.2 and 9.3.		
<i>(signature/date on file) R. Selvey 05/31/07</i> SME Reviewer/Date:	Reviewer/Date:	Reviewer/Date:

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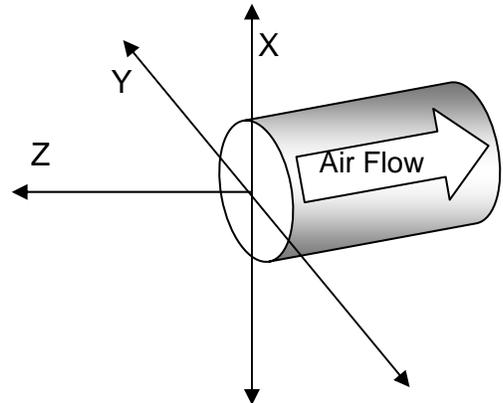
I. AREA INFORMATION				
DEPT:	BLDG:	ROOM:		
EXHAUST SYSTEM I.D.:				
EQUIPMENT EXHAUSTED:				
STATUS OF ROOM/AREA:	Windows: Open / Closed	Doors: Open / Closed	HVAC: On / Off	Other:

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	

Local Exhaust Ventilation- Capture Velocity Measurements Job Performance Measure (JPM) Completion Certificate

Candidate's Name	Life Number:	Qualification Number: HP-IHP- 62480
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Practical Skill Evaluation: Demonstration of Evaluation Methodology by Oral Exam

Criteria	Qualifying Performance Standard	Unsat.	Recov.	Satisf.
5.1 Hazard Analysis	Understands the need to perform a hazard analysis of the sampling area and potential exposure to the sampler.			
5.2 Personal Protective Equipment	Understands the need to be aware of the potential surface contamination and airborne levels of contaminants and knows how to determine the need for PPE.			
6.1 Sampling Equipment	Knows where equipment needed for the procedure is located and how to properly sign it out.			
6.2 Pre-Testing Inspection	Verifies the system is operational, intact, and represents typical operation.			
6.5 Operating Parameters	Knows the theory to establish operating parameters (safety envelope) for the equipment. Make drawing or photo. Measure.			

IH 62480 Capture Velocity Practical Skill Evaluation: Demonstration of Methodology

Criteria	Qualifying Performance Standard	Unsat.	Recov.	Satisf.
6.4 Smoke tube test	Demonstrates how to appropriately release smoke and observes pattern.			
6.5 Locate Sampling Points	Demonstrates knowledge in theory of sample location.			
6.5 Measurement of capture velocity	Knows the appropriate meter(s) that can be used to make the needed measurements.			
6.5 Measurement of capture velocity	Knows the method to measure the distance and velocity measurement - tape measure, rulers, probe.			
6.7 Documentation	Demonstrates correctly filling out IH62480 forms and transfer of appropriate info to IH62400 and IH62410 forms.			

I accept the responsibility for performing this task as demonstrated within this JPM and the corresponding SOP.

Candidate Signature:	Date:
----------------------	-------

I certify the candidate has satisfactorily performed each of the above listed steps and is capable of performing the task unsupervised.

Evaluator Signature:	Date:
----------------------	-------