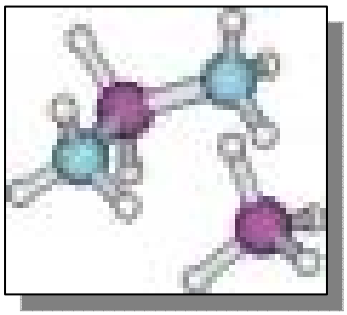
SUBJECT:

Exhaust Sorbent Efficiency Testing

Contents



1.0 Purpose/Scope

This procedure provides methods for the in-place efficiency testing of exhaust chemical sorbent systems at BNL (adsorbent or absorbent units).

The test described in this SOP involves an organic chemicals being injected into an absorber/adsorber exhaust ventilation system during testing. Penetration of this challenge agent through the sorbent is measured downstream of the injection site and adsorber.

Absorbers/Adsorbers are important components of many air pollution control systems. Sorbent are sometimes used on laboratory fume hood and glove box systems to remove potentially hazardous chemicals.

Upon installation and use in the field, absorber/adsorbers may need to be periodically evaluated to verify that saturation of the sorbent has not occurred. This evaluation is known as "in-place" testing and is designed to measure the removal efficiency of the sorbent. The criteria for the acceptance of an in-place test is a removal efficiency of >/= 99.97%, (i.e., a change in downstream airborne concentration of >/= 99.97% from upstream concentration).

However, if the facility being tested has its own BNL approved performance specification, that specification will be used.

2.0 Responsibilities

2.1 This procedure will be implemented through the SHSD Industrial Hygiene Group.
2.2 Personnel from the SHSD Industrial Hygiene Group (Level 1 Tester) will perform sorbent system testing and evaluation for BNL. Communication with, and cooperation from, RCD Facility Support Group and division ESH Coordinators will also be needed to coordinate this activity.
2.3 Tests shall be performed by a Industrial Hygiene Group *Level 1 Tester* who has demonstrated the competence to satisfactorily perform the tests as evidenced by experience and training.
2.4 In areas with radiological contamination, the *Level 2 Assistant* should be from RCD so as to provide Health Physics *Radiological Work Permit* coverage.

3.0 Definitions

Level 1 Tester: A BNL defined title for the highest level of competency in qualified employees. The qualification requirements for this position are defined in the *Implementation and Training* portion of this SOP.

Level 2 Assistant: A BNL defined title for the lower level of competency for employees. These employees serve a role as a fully supervised assistant in field-testing. This position often represents a temporary assignment of very short duration (1-3 days). The qualification requirements for this position are defined in the *Implementation and Training* portion of this SOP.

Surveillance Tests: Tests that monitor the condition of systems that have previously passed an *Acceptance Test*.

4.0 Prerequisites

4.1 Prior to testing an absorber/adsorber system, verify the calibration and operability of the test equipment.

4.2 Prior to testing an absorber/adsorber system, the Level 1 Tester contacts the appropriate RCD Facility Support Representative or Technician to obtain approval and clearance to enter the test area. This is to include RCD coverage for health physics issues as required by RCD.

4.3 Prior to testing an absorber/adsorber system, the Level 1 Tester or RCD contacts the System Owner to ensure that the ventilation system operating but that introduction of radiological/chemical hazards is not in active use to avoid inadvertent contamination of equipment and exposure to personnel.

4.4 **Hazard Determination:**

4.4.1 By its very nature, a test may be done in areas where chemicals or radiation contamination is known or suspected to be present. Inhalation of these contaminants can have significant health effects. These hazards must receive a hazard evaluation by a cognizant ESH professional.

4.4.2 The operation of this meter involves exposure to a potentially hazardous chemical that could pose an exposure risk.

4.4.3 The meter design does not cause significant ergonomic concerns in routine use.

4.4.4 PPE is needed to perform this test. See Section 4.5.

4.5 **Personal Protective Equipment**

4.5.1 Hand: Contact with challenge chemical could pose a health risk, and exposure control measures are necessary. Use of this meter 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.

4.5.2 Body:

- If contact of the body with contaminated surfaces is anticipated, a disposable suit is to be used. Acceptable CPC materials include: Tyvek®, KleenGuard®, and cotton. Disposable garments must be discarded as hazardous waste if contact with contamination has occurred.
- If contact with potentially contaminated surfaces is not expected, body covering is optional. However, if personal clothing items become contaminated, they must be surrendered for BNL cleaning or disposal.

4.5.3 Foot:

- If contact of the feet is anticipated with a contaminated surface, disposable shoe coverings, boots or booties are to 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.

4.5.4 Respiratory: Under normal use, respiratory protection is not required. If chemical or radiological levels from contamination in the area exceed the OSHA, ACGIH, or DOE standards, respirators are required. A half face or full face APR or PAPR respirator with appropriate cartridge or an air line respirators may be used up to assigned protection factor listed in the BNL's Respiratory Protection Selection and Issuance SOPs.

4.5.5 Eye: Safety Glasses with side shields are required.

4.6 **Environmental Management and Waste Disposal:**

4.6.1 The operation converts all the challenge chemicals into a vapor. In a test of a passing adsorber, the vapor is trapped on the adsorber. In a system with a leaking adsorber, some or all of the vapor is discharged to the environment up the exhaust stack. The concentration of vapor in the exhaust air has negligible environmental consequences.

4.6.2 If needed, unused portion of the chemical challenge agent is to be disposed of as a hazardous liquid via ESWMD.

5.0 Precautions

Exhaust ventilation systems are very likely to have radiological or chemical contamination. Do not perform work described in this SOP until you

- contact persons knowledgeable with the system
- have been informed of the hazards of the equipment and
- have been informed of measures to avoid inadvertent contamination of equipment and exposure to personnel.

Follow the Prerequisite in Section 4. Have the chemical test meter surveyed for radiological contamination before handling internal parts.

6.0 Procedure

6.1 Summary: Adsorber efficiency is determined by challenging the adsorber with an chemical vapor and measuring the vapor concentration both upstream and downstream to calculate the percentage removed by the adsorber system.

6.2 Equipment:

- An organic chemical (use of an OSHA/ACGIH carcinogen is prohibited).
- Chemical vapor detector (Miran SapphIRe or TVA 1000)
- Sampling train (Tygon/teflon tubing and probes)

6.3 Prior to testing an absorber/adsorber system, contact:

- RCD Facility Support Representative or FS Technician to obtain approval and clearance to enter the test area
- System Owner to ensure that the ventilation system is not in active use.

6.4 Identify the vapor release and sampling point locations. The upstream adsorber sampling point should be at least 10 duct diameters from the vapor release/system entry point to provide for a well-mixed suspension in the air mass. Similarly, the downstream sampling point should be located at least 10 duct diameters downstream from the adsorber housing. Where sampling points cannot be located at these distances due to the physical configuration of the ductwork, efforts should be made to maximize these distances to the greatest possible extent.

6.5 Activate the ventilation system or otherwise verify that the ventilation system is operating.

6.6 Inspect the external surface of adsorber system and its associated ductwork and mechanical components for any obvious signs of damage, e.g., missing or damaged seals, breached ductwork, excessive rust, unusually loud motor noise. Notify Plant Engineering and the RCD Facility Support Representative of these conditions.

6.7 Attach sample collection tubing to the detector and warm-up the chemical test meter as per the SOP for operation of the meter. Calibrate and zero the instrument according to manufacturer's procedures.

6.8 Insert sample probes into the duct centerline at both the upstream and downstream sampling points. For sampling locations with existing sampling ports or nozzles,

insert the sampling probe as appropriate.

6.9 Assemble the vapor generator system. Place the chemical vapor generator nozzle into air stream, upstream of adsorber, at a point as described above. For laboratory hood systems, it is often most expedient to release the challenge vapor directly into the fume hood.

6.10 On the chemical meter, measure the vapor concentration in the ventilation system until a stable measurement is obtained.

6.11 Measure upstream and downstream vapor concentrations as follows:

a. Record static pressure drop across adsorber(s) if a gauge is present
b. Measure upstream vapor concentration
c. Return to "clear" mode and re-zero instrument if necessary
d. Measure downstream vapor concentration
e. Return to "clear" mode and re-zero instrument if necessary
f. Repeat steps b - e until sequential upstream and downstream readings are within ±5% of their previous readings
g. Record upstream and downstream concentrations.

6.12 Calculate vapor removal efficiency of the adsorber as follows:

$$\text{Removal Efficiency (\%)} = \frac{C_u - C_d}{C_u} \text{ X } 100$$

Where: C_d = downstream vapor concentration
C_u = upstream vapor concentration

6.13 Record data and findings on test report form (see Attachment 9.2). Unless otherwise specified in the SBMS Subject Area: *Exhaust Ventilation* or the equipment operating specifications, the acceptable absorber/adsorber removal efficiency results are >/= 99.97%.

6.14 Affix results sticker at test location, fume hood face, or other appropriate location.

6.15 Absorber/Adsorber systems shall be tested at the frequency determined by the SBMS

Subject Area *Exhaust Ventilation*, or as required by other facility-specific specifications.

6.16 Record-keeping: A copy of the sorbent test report shall be provided to the ESH Coordinator, the RCD Facility Support Representative, Safety & Health Representative, and any other interested parties. The original test report will be retained by SHSD in accordance with the record keeping requirements of ESH&Q procedures.

6.17 If the detection meter has been used on a radiological exhaust system(s), at the end of sampling, have a Facility Support Representative survey the equipment for radiological contamination.

7.0 Implementation and training

7.1 *Level 1 Tester* has the highest level of competency in qualified employees. The qualification requirements for this position are defined in Attachment 9.3 Job Performance Measure.

7.2 *Level 2 Assistant has a* lower level of competency in this method. These employees serve a role as a fully supervised assistant in field-testing. This position often represents a temporary assignment of very short duration (1-3 days). There are no formal qualification requirements necessary for this position as they follow the directions of the Level 1 tester. The role in this SOP is limited to the actions requested and directed by the Level 1 tester.

8.0 References

8.1 American Conference of Governmental Industrial Hygienists (ACGIH). Industrial Ventilation: A Manual of Recommended Practice (current edition).

8.2 SBMS Subject Area: *Exhaust Ventilation*

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure: Field Procedure	NUMBER **IH62390** REVISION **FINAL Rev0**
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9.0 Attachments

9.1 Absorber/Adsorber System Test Results Sticker/Label

9.2 In-Place Absorber/Adsorber Test Report

9.3 Job Performance Measure

10.0 Documentation

Document Development and Revision Control Tracking			
PREPARED BY: **R. Selvey** **CIH** **Date 04/21/06**	**REVIEWED BY:** **R. Wilson** **Level 1 tester** **Date 04/21/06**	 **J. Peters** **CIH** **Date 04/21/06**	**APPROVED BY:** **R. Selvey** **IH Group Manager** **Date 04/24/06**
ESH Coordinator/ Date: *none*	Work Coordinator/ Date: *none*		SHSD Manager / Date *none*
QA Representative / Date: *none*	Training Coordinator / Date: *none*		Filing Code: **IH52**
Facility Support Rep. / Date: *none*	Environ. Compliance Rep. / Date: *none*		Effective Date: **04/24/06**
ISM Review - Hazard Categorization ☐ High ☒ Moderate ☐ Low/Skill of the craft	Validation: ☐ Formal Walkthrough ☐ Desk Top Review ☒ SME Review Name / Date:		Implementation: Training Completed: Tracked in BTMS Procedure posted on Web: 04/24/06 Hard Copy files updated: 04/24/06

Revision Log		
Purpose: ☐ Temporary Change ☐ Change in Scope ☐ Periodic review ☐ Clarify/enhance procedural controls Changed resulting from: ☐ Environmental impacts ☐ Federal, State and/or Local requirements ☐ Corrective/preventive actions to non-conformances ☒ none of the above Section/page and Description of change:		
(signature/date on file) SME Reviewer/Date:	SME Reviewer/Date:	SME Reviewer/Date:

ATTACHMENT 9.1

Adsorber/Absorber System Test Results Sticker/Label

In-Place Adsorber/Absorber test			
Date	**Efficiency (%)**	**Pass/Fail?**	**Tester**
Report any problem to: **Safety & Health Services Division ext. 3900**			

IH62390 ATTACHMENT 9.2
IN-PLACE SORBENT TEST REPORT

BROOKHAVEN NATIONAL LABORATORY
Safety & Health Services Division
INDUSTRIAL HYGIENE GROUP

DATABASE RECORD ID#	SHSD UNIT ID#	

DIVISION	BUILDING	ROOM/AREA
BLDG MANAGER	FS REP/TECH	OTHER CONTACT
SYSTEM DESCRIPTION		
SYSTEM TYPE □ FIXED IN-PLACE □ PORTABLE HANDLR	MANUFACTURER	SORBER NUMBER
SITE OF ADSORBER		

GENERATOR METHOD & VAPOR	
DETECTOR	DETECTOR SN
DETECTOR CALIB. DATE	COMMENTS

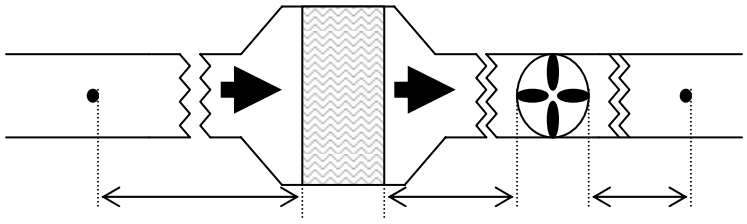
LEVEL 1 TESTER	SIGNATURE	TEST DATE

Sorbent Unit/ Room Number	**ΔP**	**Upstream Reading**	**Downstream Reading**	**Removal Efficiency[1]**	**Comments**

[1]Based upon formula:

$$\text{Removal Efficiency}(\%) = \frac{C_u - Cd}{C_u} \times 100$$

Where: C_d = downstream vapor concentration
C_u = upstream vapor concentration



BROOKHAVEN NATIONAL LABORATORY

HP-IHP- 62390

Environmental, Safety, Health & Quality Directorate
SHSD Industrial Hygiene

Exhaust Ventilation Sorbent Level 1 tester
Job Performance Measure (JPM) Completion Certificate

Candidate's Name	Life Number:

Practical Skill Evaluation: Demonstration of Evaluation Methodology by Oral Exam

Criteria	Qualifying Performance Standard	Unsat.	Recov.	Satisf.
1. Hazard Analysis	Understands the need to perform a hazard analysis of the area and potential exposure to the self as sampler and workers in the area.			
2. Personal Protective Equipment	Understands the need to be aware of the potential surface contamination, airborne levels of contaminants, radiological hazards, and noise hazard. Knows how to determine the need for PPE.			
3. Sampling Equipment	Knows where equipment needed for the procedure is located and how to properly sign it out.			
4. Pre-Testing Inspection	Verifies the system to be monitored is operational and represents typical operation. Makes notation in sampling record if the operating conditions are atypical.			
5. Measurement of hazard	Knows how to properly measure the challenge agent concentration levels. Knows the proper meter to use.			
6. Operating Parameters	Knows the theory to establish operating parameters (safety envelope) for the equipment. Make drawing or photo.			
7. Documentation	Demonstrates correctly filling out IH monitoring 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: