Content

1.0 Purpose/Scope

This document describes a field procedure for testing containers of liquid chemicals for the formation of peroxides. It uses is *WaterWorks*™ Peroxide testing strips, or equivalent. The test method is described in SBMS *Working with Chemicals*. That description is intended to be used by container owners for their periodic surveillance of containers. This procedure augments the SBMS Subject Area information with information to be used when SHSD personnel conduct self-assessments and other large scale surveillances of containers at the site.

2.0 Responsibilities

2.1 This program is implemented through the SHSD Industrial Hygiene Group Leader who may delegate authority to administer this program. Members of the SHSD Industrial Hygiene Group can be qualified to perform this test when they demonstrate competency in accordance with Section 7 of this procedure.

2.2 Hazard Analysis of the Sampling Task: It is the responsibility of the person using this method and his/her supervisor to ensure that the appropriate personal protective equipment is worn while performing this procedure.

2.3 The person performing this procedure and his/her supervisor are responsible to ensure that all required training and qualification for hazards that may be present in areas

where this procedure will be used (such as respiratory protection or radiation contamination) have been met.

2.4 The person performing this procedure and his/her line supervisor are responsible to comply with all work planning and work permit system requirements.

3.0 Definitions

Peroxide: a compound containing an oxygen-oxygen single bond, including Hydrogen Peroxide (H_2O_2). Organic peroxides can accidentally initiate explosive polymerization in materials with unsaturated chemical bonds. Many liquid ethers in the presence of air, light, and metal slowly (over a period of months) form ether peroxides (e.g., diethyl ether peroxide), which are extremely unstable. Triacetone triperoxide (TATP) and hexamethylene triperoxide diamine are explosive organic peroxide compounds. TATP may be formed accidentally as a waste product in some reactions.
Since peroxides can form spontaneously in some materials, use caution must with "peroxide-forming materials." Extreme care must be taken with samples showing signs of crystal growth or precipitates.

Peroxide-forming chemicals: a class of compounds that have the ability to form shock-sensitive explosive peroxide crystals. Many of the organic solvents commonly used in laboratories have the potential to form explosive peroxide crystals. SBMS *Working with Chemicals* list the suspect chemicals. Under normal storage conditions these materials listed have the potential to generate and accumulate peroxide crystal formations, which may violently detonate when subjected to thermal or mechanical shock. Peroxide-forming chemicals react with oxygen – even at low concentrations – to form peroxy compounds. The risk associated with peroxide formation increases if the peroxide crystallizes or becomes concentrated by evaporation or distillation. Factors that affect rate of peroxide formation include exposure to air, light and heat, moisture, and contamination from metals. Peroxide crystals may form on the container plug or the threads of the lid and detonate when the lid is twisted. Do not open a liquid organic peroxide or peroxide-forming chemical if crystals or a precipitate are present.

4.0 Prerequisites

4.1 **Training prior to using this procedure:**

4.1.1 Demonstration of proper operation of the procedure per Section 7 for qualification requirements.

4.1.2 Training for hazards may be needed for entry into restricted areas (check

with ESH Coordinator or FS Representative for the facility).

4.2 **Area Access**:

4.2.1 Verify with the appropriate Facility Support Representative or Technician if a Work Permit or Radiological Work Permit is needed or is in effect. If so, review and sign the permit.

4.2.2 Use appropriate PPE for area.

5.0 Precautions

5.1 **Personal Protective Equipment**:

Appropriate personal protective equipment to protect the person when implementing this procedure:

- Eye: Safety Glasses with side shields are required in laboratories, construction, and general industry areas.
- Hand: At a minimum, use disposable gloves when contacting the surface of containers. Recommended gloves are disposable Nitrile, Natural Latex Rubber, or PVC.
- Body: Wear a lab coat or disposable suit. Acceptable chemical protective equipment materials include: Tyvek®, KleenGuard®, and cotton. Disposable garments must be discarded as hazardous waste if contact with contamination has occurred. If personal clothing items become contaminated, they must be surrender for BNL cleaning or disposal.
- Foot: Wear fully enclosed shoes. If personal shoes become contaminated, they must be surrendered for BNL cleaning or disposal.
- Respiratory: Under normal use, respiratory protection is not required.

5.2 **Peroxide Hazard:** Crystals of peroxide pose an explosion hazard when disturbed. Peroxide crystals may form on the threads of the lid and detonate when the lid is twisted. Do not open a liquid organic peroxide or peroxide-forming chemical if crystals or a precipitate are present.

5.3 **Work Planning:** All requirements of work permits and work planning system reviews must be met in performing this procedure.

5.4 **Environmental Impact and Waste Disposal:** This technique has minimal adverse impact on the environment. The test strip used in this technique can be disposed of in the trash.

5.5 **Risk Assessment:** Consult the *Job Risk Assessment* SHSD-JRA-04 for the risk analysis of the similar operation of Perchlorate testing which also has an explosion hazard.

6.0 Procedure

Test Strips

6.1 Analysis Equipment

6.1.1 PPE listed in Section 5.1.

6.1.2 Water spray bottle

6.1.3 Test Strips

6.2 Container testing

Theory: The presence of organic peroxides in chemicals is tested with a simple indicator paper (test strip) which is sensitive to the formation of hydroperoxide, the principal hazard associated with peroxide-forming solvents. The test paper measures peroxide concentration up to 100 ppm. Low concentrations of peroxide present in chemicals turns the paper yellow; high concentration of peroxide turns the paper dark blue.

6.2.1 Don the PPE required in Section 5.1

6.2.2 Prior to handling the container, check it for crystals.

- **DO NO MOVE or open a container if crystals are present.**
- Inform container owner, staff in the area, and ESH Coordinator immediately.
- Have the container posted as a hazard not to be moved.

Hazardous Crystal Formation

6.2.3 If no crystal are present, using gloves, place the bottle into a laboratory hood with a safety sash.

6.2.4 Lower the hood sash so that the barrier is between the bottle opening and your body and face.

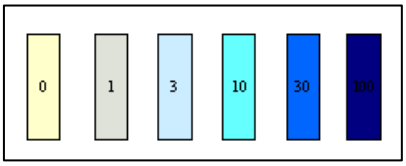
6.2.5 Using gloves, slowly open the sample container and remove the lid.

6.2.6 Immerse the end of the test strip in the chemical for about 1 second (wet the indicator portion of the strip).

6.2.7 Remove the test strip and allow the chemical to evaporate to dryness inside the hood.

6.2.8 Spray a small amount of water on the test strip from the sprayer (or breathe slowly on the test strip for 15 to 30 seconds as vapor in breathe provides water for the reaction to proceed).

6.2.9 Allow at least 1 minute until the color stabilizes on the test strip.

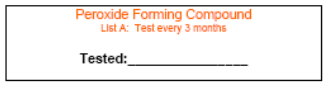


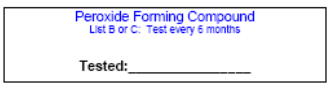
Color Scale

6.2.10 Determine the color of the test strip by comparing it to the color chart on the test strip bottle:

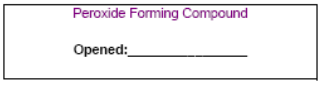
- No change or yellow to pale green-blue color indicates a low concentration of peroxide in the sample. Samples with a concentration of less than 100 ppm are considered negative for the risk of an explosion hazard. The container passes the test.
- **A blue color** indicates a high concentration. Samples with a concentration of **100 ppm** or more **FAIL** the test and are considered a risk of an explosion hazard.
- If results are 100 ppm or more (FAIL):
  - Examine the cap for crystals, if none, recap bottle and leave it in the hood.
  - Inform container owner, lab occupants and ESH Coordinator immediately.
  - Have the container posted as a hazard not to be moved. The container needs to be processed by trained explosive experts.

6.3 **Record sampling information:** Label the container with a "Date Tested" label from the SBMS Subject Area *Working with Chemicals* (either List A or List B or C label).





6.4 **Self assessments:** On the assessment checklist, record the "as found condition" of the container Labeling:



- Was a "Received date", "Opened date" or "Tested date" label on the bottle.
- Does the label indicate the correct time interval (3 months for List A; 6 months for List B and C chemicals as per the *Working with Chemicals* Subject area.)

7.0 Implementation and Training

7.1 **Qualification Criteria:** Only persons who have demonstrated competency in performing this test, to the satisfaction of the SHSD IH Group Leader or designee will be qualified to perform this test. The qualification criteria to perform this procedure are:

7.1.1 Lab Standard or HazCom training

7.1.2 Demonstrated competency in performing this test via:

- Visual observation of the sample technique.
- Knowledge of the appropriate personal protective equipment for the hazards of this particular type of sampling.

7.2 **Qualification Frequency & Record-keeping:** The SHSD IH Group Leader, or designee, will qualify SHSD IHG personnel to use this procedure. Personnel shall be re-qualified at a frequency not to exceed three years, provided there is no break in the work assignment that utilizes this procedure.

7.3 Personnel are to document their training using the Attachment 9.1 with its *Job Performance Measure Completion Certificate* for this meter. Qualification on this JPM is required on a 3 year basis.

8.0 References

8.1 BNL, SBMS, Subject Area: *Working with Chemicals.* Exhibit: *Storing Materials That Might Become Hazardous During Prolonged Storage*.

8.2 NFPA: NFPA 43B, *Code for the Storage of Organic Peroxide Formulations.*

8.3 Univ. of Illinois at Chicago: *Chemical Safety training- Peroxide-Forming Chemicals.*

8.4 Blair, D. and S. Zimber; Chemical Heath & Safety: Recognition and safe management of explosive chemicals; May/June 2000.

9.0 Attachments

9.1 Qualification: Job Performance Measure

BROOKHAVEN NATIONAL LABORATORY Safety & Health Services Division INDUSTRIAL HYGIENE GROUP Standard Operating Procedure	NUMBER **IH75225** REVISION **Final Rev0**
SUBJECT: **Peroxide Forming Chemical Testing with Indicator Strips**	DATE **07/23/08** PAGE **7** OF 8

10.0 Documentation

Document Development		
PREPARED BY: *(Signature and date on file)* R. Selvey Date 07/21/08	REVIEWED BY: *(Signature and date on file)* F. Horn 07/23/08 N. Chiu 07/23/08 A. Kim 07/23/08 M. Chuc 07/23/08	APPROVED BY: *(Signature and date on file)* R. Selvey, IH Manager Date 07/23/08
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: **07/23/08**
ISM Review - Hazard Categorization ☒ High ☐ Moderate ☐ Low/Skill of the craft	Validation: ☐ Formal Walkthrough ☒ Desk Top Review ☐ SME Review Name / Date: R. Selvey 07/23/08	Implementation: Training Completed: Tracked in BTMS Procedure posted on Web: 07/23/08 Hard Copy files updated: n/a Document Control: 07/23/08

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:
SME Reviewer/Date:

BROOKHAVEN NATIONAL LABORATORY

HP-IHP-75225

Environmental, Safety, Health & Quality Directorate
SHSD Industrial Hygiene

Peroxide Forming Chemical Testing Evaluator
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 hazard analysis of the peroxide use areas and potential exposure to the self as sampler and workers in the area to hazards other than peroxides. • Describe the hazards of a container in which peroxides have formed. • Knows the signs of peroxide formation.			
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 the correct PPE for peroxide testing.			
3. Sampling Equipment	• Knows where equipment needed for the procedure is located and how to properly sign it out.			
4. Measurement of hazard	• Knows how to properly test for peroxide in liquids. • Knows the acceptable limits.			
5. 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:**