Special Note: The next annual **Respirator Selection & Cartridge Change Out Schedule Workshop** will be held **February 23-24**, 2010 in Salt Lake City.

Respiratory Protection Newsletter from Dr. McKay. January, 2010

Test Your Respirator Knowledge:
Test your skill against this question. Or, if the person at your company with responsibility for selecting respiratory protection also conducts hazard assessments, see how they do.

Two employees are working in a room when one drops a flask containing 8 ml of "Dimethyl Nasty" onto the floor (refer to spill location "A" on the diagram). The flask breaks and the liquid spills onto the floor. Immediately, both employee leave the room and close the door. The room measures 10' wide x 20' long x 8' high. Although there is a window in the door, it is not possible to view the spill since the line of sight is obstructed by a workbench. A spill team is notified, but unavailable to clean the spill until later in the day. After approximately one hour, a third employee insists he must enter the room and work approximately 20 minutes at location "B" (located approximately 15 feet from the spill). One of the employees states that exposures levels have not been measured, therefore, a full-face pressure demand SCBA or full-face pressure demand supplied air respirator with an escape bottle should be worn. You are called to resolve this respirator selection problem.

The following information is retrieved from the MSDS:

Chemical name:	Dimethyl Nasty
Physical appearance:	Clear liquid
Molecular wt:	106
Vapor pressure:	9 mmHg
Liquid density:	0.86
Boiling point:	139 °C
Vapor density:	3.7 (Air = 1)
Room temp.:	23°C
Barometric pressure:	760 mmHg
Room changes:	at least 5 per hour
Exposure limit - TWA:	150 ppm
Ceiling/STEL:	375 ppm
IDLH:	1,000 ppm
Warning properties:	None below established exposure limits.

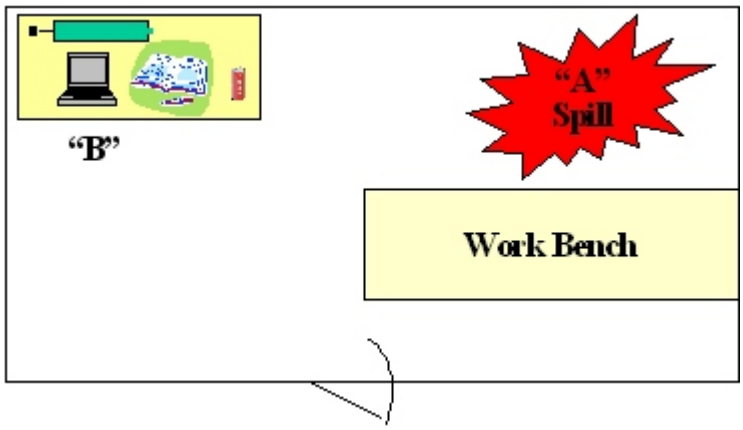
Exposure limits are based upon kidney and liver abnormalities. IDLH is based upon neurologic (CNS) toxicity. Eye irritation has not been reported at concentrations below 375 ppm.

Respirator info: Organic vapor cartridges effectively remove the contaminant.

Based upon this information, what level of respiratory protection do you recommend?

A. Respiratory protection is not needed.
B. Negative pressure air purifying respirator.
C. Full facepiece pressure-demand SCBA or full-face pressure demand supplied air respirator with an escape bottle (since exposure levels have not been measured).

Answer appears in "Training Opportunities" towards the end of this newsletter.



OSHA Releases Best Practices for Protecting EMS Responders:
In December of 2009, OSHA released a guidance document for employers of EMS responders who provide assistance during a hazardous substance release. The guide discusses comprehensive measures that should be taken (including PPE and respiratory protection) to protect EMS responders from becoming additional victims. The guide

includes OSHA's rationale for hazard assessment, PPE & respirator selection, and guidance on reasonably anticipated worst-case scenarios. Appendix J includes a summary of respirator types and selection information. The term EMS Responder refers to all levels of emergency medical personnel involved in incident response (e.g., emergency medical technicians [EMTs], paramedics, and other who perform similar duties. OSHA's recommendations for minimum training and PPE generally follow the regulatory requirements in paragraph (q) of HAZWOPER standard 1910.120. The guide provides examples of best practice procedures for EMS responders in a variety of different situations. To obtain a copy, go to the OSHA web page (www.OSHA.gov) and search for publication 3370-11. The title is: Best Practices for Protecting EMS Responders during Treatment and Transport of Victims of Hazardous Substance Releases. The cover photo which appeared on the OSHA publication was provided to OSHA courtesy of Dr. John Hicks.

OSHA Issues Flu Compliance Directive:
On November 9, 2009 OSHA released a compliance directive (CPL-02-02-075) to assist compliance officers with inspection of healthcare facilities where workers have high risk to influenza virus. This directive is, therefore, specifically designed to assist their staff with enforcement of occupational exposure to the 2009 H1N1 Influenza. As such, it provides uniform procedures when conducting inspections to minimize high to very high occupational exposure risk to the virus identified as 2009 H1N1 influenza to workers whose occupational activities involve contact with patients or contaminated material in a healthcare or clinical laboratory setting. The directive closely follows the Centers for Disease Control and Prevention's "Interim Guidance on Infection Control Measures for 2009 H1N1 Influenza in Healthcare Settings, Including Protection of Healthcare Personnel.". OSHA also maintains a web site (http://www.osha.gov/h1n1/index.html) to help employers and workers get up-to-date information for decision making and planning. The compliance directive applies OSHA-wide.

Points to Ponder:

Fit Testing Frequency. Is Anyone Ever Satisfied?
In the United States fit testing is conducted at least annually, in large part to comply with OSHA requirements. One reason for this requirement is the fact that many respirator users simply forget how to correctly put their respirators on. Fit testing provides an opportunity to verify that the user can properly don their respirator and achieve an acceptable seal. Not everyone shares this same philosophy. For example, some health care administrators don't see the value of repeat fit testing. Consequently, those who don't share the value of repeat fit testing battle to change the current regulation to something different. Outside North America, repeat fit testing is frequently not required. However, in these regions many are proposing to require repeat fit testing. Apparently, the correct approach depends on where you live. But wherever you live, there are others who wish to change it!

Use of Surgical Masks:
If a surgical mask wasn't designed to protect the wearer, why do some people wear surgical masks to protect themselves from potentially hazardous airborne exposures?

> That said, it is also important to recognize that there are significant differences in performance and fitting characteristics between different make and model surgical masks. Therefore, a generic statement such as the one above, is not equally applicable to all surgical masks or apply equally to those who choose to wear them for protection.

Respirator Approvals Revoked:
While reviewing a list of respirator approvals revoked by NIOSH, I was curious as to how frequently this may happen. The answer varies considerably from one month or year to another. None the less, during a recent 34 day period spanning May 29 through July 1, 2009, NIOSH revoked respirator approvals for 24 respirators. Respirator approvals are revoked either at the request of the approval holder (such as the manufacturer), or by NIOSH for some specific cause. Depending upon the reason for the revocation, a respirator User Notice may or may not be issued. Once revoked, the NIOSH approval number is no longer listed in their Certified Equipment List (CEL), or on any of the NIOSH web pages that list approved respirators.

Reader Questions

Note: Due to time restrictions, Dr. McKay may not respond to all reader questions. However, selected questions and answers will be published in future newsletters.

Do Powered Air Purifying Respirators (PAPRs) require fit testing?

The answer depends upon the type of facepiece used with the PAPR. Any facepiece (including PAPRs) that form a tight seal to the wearer's face, such as half-masks and full facepiece respirators must be fit tested regardless of the mode of operation in which they are used. When conducting the fit test, the blower unit for the PAPR must be turned off.

Loose fitting respirators, such as PAPRs whose hood or helmet are designed to form only a partial seal with the wearer's face or hoods which seal loosely around the wearer's neck or shoulders, do not require fit testing.

Respirator Selection - Maximum Use Concentration Question:
Test your respirator knowledge with this basic respirator selection question.

Based upon the following information, would a half mask, air purifying respirator provide an acceptable level of protection? Assume an APF of 10 and an acceptable gas/vapor cartridge is available.

	Workplace concentration (ppm)	Exposure Limit (ppm)	IDLH (ppm)	Target organs that formed basis of exposure limit
Solvent "A"	750	100	2000	Central Nervous System & Liver
Solvent "B"	200	100	700	Kidney, Liver, Respiratory
Solvent "C"	200	150	1000	Liver & Peripheral Nervous System

Answer appears in "Training Opportunities" towards the end of this newsletter.

Filtering Facepieces with Exhalation Valves : Are they any cooler and more comfortable?
Traditional thinking (perhaps influenced by marketing practices) would suggest that a filtering facepiece with an exhalation valve would be cooler and likely more comfortable to wear, than a similar filtering facepiece without an exhalation valve. However, traditional thinking may not agree with recent experimental findings published in the *Journal of the International Society for Respiratory Protection* (Volume 26, pages 12-19, 2009) by W. D. Monaghan and colleagues. In this study, two different style N95 filtering facepiece respirators were evaluated. Each was available with and without exhalation vales. Using infrared thermal imaging cameras to monitor surface temperatures of filtering facepiece respirators attached to a breathing mannequin (breathing was simulated using an automated breathing and metabolic simulator set to deliver 100% humidified air at 33°C), no statistical difference in temperature was observed. In fact, the surface temperatures for respirators with exhalation

valves was actually slightly higher. These results appear to be opposite traditional thinking, because one would normally expect less exhalation resistence and movement of warm, humidified air out of the exhalation valve. However, the researchers observed that the exhalation valves were not activated at the sedentary breathing volumes used in this study (10 liters/minute set to represent 14 breaths/minute with a 714 ml tidal volume). If the valves don't open, they may actually decrease the available surface area for exhaled breath to exit the respirator. The authors conclude that the more costly N95 filtering facepiece respirators with exhalation valves may not offer any significant advantages with respect to heat dissipation and comfort than less costly filtering facepiece respirators without exhalation valves. It is important to recognize that these studies were conducted at sedentary breathing rates. While these may be representative of some job titles, such as clerical staff and those conducting work in non-physically demanding environments, the results may differ with more physically demanding work. The researchers recommend confirmation of their findings with studies of human subjects. I suspect differences begin when minute volumes are sufficiently high enough to activate opening of the exhalation valve. Therefore, the benefit of the exhalation valve may not be recognized until the level of physical exertion exceeds a minimum threshold for the wearer.

Medical Complications from Respirator Use:
OSHA requires respirator medical clearance for persons required to wear respiratory protection. Typically the physician or licensed health care professional with this responsibility receives training on medical disorders which may affect safe respirator use. Researchers at the University of Cincinnati are investigating other approaches. Specifically we are collecting information on persons who: 1) developed a medical complication while wearing a respirator, and 2) what medical condition was causally related to the complication that developed.

If you have information (published or un-published) that established a link between a specific medical condition(s) and a complication that developed as a result from wearing a respirator, please share this information with us. We are particularly interested in cases where a medical complication was induced by respirator use. Information such as the specific type of respirator worn, work environment, duration of use, level of physical exertion, underlying medical conditions that contributed to the complication, etc., is needed. You can send this information to Roy@DrMcKay.com

Particulate Filter or Gas/Vapor Cartridge?

Given the following information, which would you recommend attaching to the respirator facepiece?

a. Particulate filter
b. Gas/Vapor cartridge
c. Combination particulate filter - gas/vapor cartridge
d. Respiratory protection is not required

The following information is retrieved from the MSDS:

Chemical name:	ABC powder
Physical appearance:	Flake-like crystal odorless solid, white
Molecular wt:	71.1
Vapor pressure:	0.007mmHg at 68 °F
Boiling point:	347-572 °F (Decomposes)
Melting point:	184 °F
Room temp.:	68°F
Barometric pressure:	760 mmHg
Room changes:	at least 5 per hour
Workplace concentration:	0.06 mg/m^3
Exposure limit - TWA:	0.03 mg/m^3
Ceiling/STEL:	Not applicable
IDLH:	Not applicable
Target Organs:	Multiple target organs

Answer appears in "Training Opportunities" towards the end of this newsletter.

Kudos to University of Cincinnati Respirator Researchers - Recent Publications:

A selected sampling of presentations, awards, and publications from University of Cincinnati researchers.

UC Publications:

Sergey A. Grinshpun, Hiroki Haruta, Robert M. Eninger, Tiina Reponen, Roy McKay, and Shu-An Lee. Performance of an N95 Filtering Facepiece Particulate Respirator and a Surgical Mask during Human Breathing: Two Pathways for Particle

Penetration. *Journal of Occupational & Environmental Hygiene*, 6:593-603, 2009.

This October 2009 publication reported on the relative contribution of particles in the size range of 0.03 to 1.0 um to pass through respirator faceseal leaks and filters under actual breathing conditions. This study on filtering facepiece respirators (N95s) was unique because most studies are conducted with constant flow, yet this is not the mode by which particles enter respirators during actual use. The study found that the number of particles passing through face seal leaks far exceeded the number of particles passing through the filter medium. For the N95 respirator, the excess was on average about an order of magnitude higher. It also increased with an increase in particle size. Facial and body movements were found to have a pronounced effect on the relative contribution of the two pathways. Surgical masks were also studied. As reported by others, surgical masks had significantly greater filter penetration and leakage through the face to facepiece sealing surface. For additional information, go to the source!

Share Your Respirator Experience:
Here's an opportunity to contribute your knowledge and experience to others. If you have an interesting respirator selection or other challenging respirator problem (and solution), please submit it to Roy@DrMcKay.com. I'll use your problem to train students in our graduate and continuing education programs in respiratory protection. This transfer of information will benefit others, maybe even your children or grandchildren.

Respirator Training Courses:

The University of Cincinnati is pleased to announce the following programs on Respiratory Protection and Fit Testing that may be of interest to your staff. They are:

1. **Respirator Selection & Change Out Schedule Workshop**.
   February 23-24, 2010 in Salt Lake City, Utah. Register now, before the deadline.
2. **Overview of Respiratory Protection**
   January 19, May 11, and October 12, 2010
3. **Fit Testing Workshop** (2-Days):
   January 20-21 and October 13-14, 2010
4. **Quantitative Fit Testing Workshop** (1 Day):
   May 12, 2010

All courses are held in Cincinnati, unless noted otherwise. On-site training is available.

Respirator Selection & Change Out Schedules
This workshop provides guidance on respirator selection and the development of OSHA compliant change out schedules for cartridges and filters. A combination of lecture with practice problem sessions is used. The course is designed to teach students how to select a respirator based on workplace conditions (exposure level, type of contaminant, length of time to be worn, etc.). The selection process goes beyond the typical "use a NIOSH approved air purifying respirator". Students will learn how to select a specific respirator as well as a specific filter/cartridge (when appropriate). More than a dozen guidelines for development of an OSHA compliant cartridge/filter change out policy will also be taught, including common computer models and how to use them.

Partial Listing of Topics

Respirator Selection

* Review of facepiece definitions and modes of operation.
* Practical and theoretical basis for respirator selection based upon.
  Assigned Protection Factors (APF)
  - MUC's, HR's, IDLH, etc.
* OSHA guidelines for respirator selection.
  - IDLH and non-IDLH atmospheres.
* Selection steps and information gathering procedures.
* Minimum respiratory protection versus practical alternatives.
* Filter selection issues
  - How to select an N, R, or P filter.
  - Why filter selection is influence by exposures below the exposure limit.
  - How to choose a 95 versus 100 filter.
* Practical methods for handling unknown concentrations without defaulting to an SCBA.
* Calculating MUC's for mixtures.
* Saturated Vapor Concentrations (SVC's) and selection concerns.
* When a particulate filter may be needed for organic solvents.
* Equilibrium Vapor Concentrations.
* Selection Workshop
  - Practical problems and solutions.

Development of Cartridge & Filter Change Out Schedules

* OSHA recommendations for a change out policy.

* Factors that affect cartridge service life.
* Learn how to develop an OSHA compliant change out schedule.
* Understanding the breakthrough curve.
* Common methods used to define breakthrough.
* What level of breakthrough should be used?
* Work rate tables.
* Effect of high relative humidity.
* Methods for determining service life (use, limitations, and practice problems)
  - OSHA recommendations
  - Rules of thumb
  - Using laboratory data
  - Using math models
  - Using computer (software) models
  - Cartridge testing methods (3 methods) Combining methods
* Learn how to develop a change schedule when computer models are not available.
* Recommendations for mixtures:
  - OSHA compliance method
  - mole fraction method
  - multi vapor model
* How to confirm your change-out schedule.
* Storage and migration concerns.
* Gain confidence that your current procedure is correct!

Former students have found this information to be extremely valuable. Even experienced students find the material useful as a way to verify their current procedures. Next dates are: **February 23 & 24**, 2010 in Salt Lake City.

Answer to Respirator Spill Selection Question:
From page #1.
Based upon this information, what level of respiratory protection do you recommend?

A. Respiratory protection is not needed.
Using a variety of exposure models, the anticipated levels of workplace exposure are expected to be well below applicable occupational exposure limits, therefore, respiratory protection is **not** necessary. Despite the limitations of simple models used to predict exposure levels and the fact that they commonly underestimate actual measured levels of exposure, respiratory protection is not needed in this situation even if we assume a generous error in our predicted exposure levels. If the program administrator still has doubt, he/she could recommend a negative pressure air purifying respirator to further increase the level of confidence that the employee would not be over-exposed. A properly fitted and properly worn half mask respirator would provide another 10-fold reduction in exposure and a full facepiece would increase the level of protection even further. The important point is that a full face, pressure-demand SCBA or full-facepiece pressure demand supplied air respirator with an escape bottle is not necessary simply because measured exposure levels are not available.

Overview of Respiratory Protection:
This one day course provides a practical overview of respirators, standards, guidelines, use, limitations and fit testing requirements including changes to the OSHA Respirator Standard. Little or no prior formal training is required. The morning session includes lectures on the types, use, selection and limitations of respirators. The advantages and disadvantages of different respirator facepieces, filters (N, R, & P), cartridges, PAPR's, and the physiologic effects of wearing a respirator will also be discussed. Respirator standards and program requirements will be reviewed to help the student comply with OSHA regulations. Discussion of qualitative and quantitative fit testing, user seal checks, worker training, and respirator medical clearance requirements will be provided. This course is essential for individuals who oversee respirator users in their work place. This is also an excellent opportunity to touch, hold, and feel a wide variety of respirators, filters, cartridges and other equipment from a variety of manufacturers at one time.

Fit Testing Workshop:
This two (2) day workshop provides comprehensive lecture and "hands-on" training for students who need to learn how to conduct an OSHA accepted qualitative or quantitative respirator fit test. Each student will be provided a variety of respirators including filtering facepieces, half, & full facepieces for participation in fit testing workshops. A combination of lecture and "hands-on" testing in the presence of a trained and experienced instructor will be used to help participants learn how to conduct respirator fit testing to satisfy regulatory requirements. Hands-on fit testing will include qualitative and quantitative methods. The following types of fit testing equipment will be available: Saccharin (sweetener), Bitrex (bitter), TSI PortaCount, and the OHD Fit Tester 3000/QuantiFit.

Banana oil and irritant smoke fit testing kits are also available, depending upon class interest in these techniques. Class size will be limited to ensure a favorable faculty to student ratio. Students will learn how to set-up, operate, maintain, troubleshoot, analyze, and interpret fit test results. Where appropriate, students will learn how to calibrate testing equipment and record results. All course materials, supplies, equipment, and reference manuals will be provided.

Students will also learn how to disassemble, clean, reassemble, and inspect respirators for common problems. The workbook alone is a valuable reference for solving fit testing problems in the future.

This course uses a combination of lecture and small practicum groups to ensure students have ample time to practice and learn fit testing techniques. The second day provides students sufficient time to concentrate on the particular methods of interest to them. The "Hands-On" approach is emphasized in this course. Students will fit test several different make and model respirators, not just one.

Individuals who plan to attend the fit testing workshop, but have little or no experience with respiratory protection should take the one day overview class in addition to the 2-day fit testing workshop. The fit testing workshop provides an opportunity to see and experience all types of fit test methods (qualitative and quantitative). A substantial discount is given when both courses are taken.

Dr. McKay is the current chair of the ANSI Z88.10 Respirator Fit Testing sub-committee, a voting member of the full ANSI Z88 Respiratory Protection Committee, the AIHA Respiratory Protection Committee, and others.

Answer to Respirator Selection - Maximum Use Concentration Question: From page #3.
Would a half mask, air purifying respirator provide an acceptable level of protection?

No. A half mask respirator should **not** be used. Since all three solvents have a common target organ, the Maximum Use Concentration (MUC) for this respirator must be calculated as a mixture. As a mixture, the MUC value of 1.24 exceeds unity. Therefore, a half mask respirator does **not** provide an acceptable level of protection. Another, more protective style respirator should be selected.

Answer to Filter/Cartridge Respirator Selection Question: From page #4.
Given the following information, which would you recommend attaching to the respirator facepiece?

c. Combination particulate filter - gas/vapor cartridge

A combination particulate filter with gas/vapor cartridge is needed since this contaminant has a an elevated saturated vapor concentration to workplace exposure concentration ratio. The elevated ratio (>400) suggests a considerable vapor phase component.

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Thank you for your continuing support. Students attending our programs help support our graduate training programs and respirator research projects. We hope to see you at a future training course.

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