CRANDALL CORPORATION
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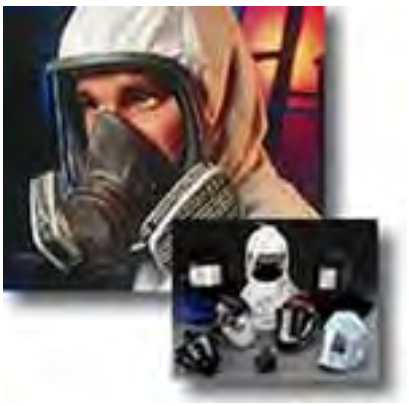
Compliance Headliner

Selecting the Appropriate Respiratory Protection for Isocyanates

Oftentimes during a Respiratory Protection Training session, the participants, usually automotive painters, will question the effectiveness of air-purifying respirators for isocyanates. In response, this article is intended to review the regulations, discuss the questions and provide recommendations for appropriate selection of respiratory protection.

First of all, let's **define isocyanates**… OSHA states that isocyanates react with compounds containing alcohol (hydroxyl) groups to produce polyurethane polymers, which are components of polyurethane foams, thermoplastic elastomers, spandex fibers, and polyurethane paints (www.osha.gov). For workers involved in automotive spray painting, their most probable exposure is to toluene-2,4-diisocyanate (TDI) and hexamethylene-1,6-diisocyanate. These chemicals can be found in clear coats and some paint hardeners.

The **health effects associated with isocyanates** should also be understood by managers and workers. Such effects include irritation of skin - rashes, blistering and reddening; irritation of the eyes – reddening and blurred vision; chest tightness and wheezing (www.osha.gov). Inhaling isocyanates may sensitize a person, causing an asthma-like reaction (www.gov.mb.ca/labour). High doses of toluene-2,4-diisocyanate through inhalation can cause a build-up of fluid in the lungs, known as pulmonary edema (www.state.nj.us/health/eoh/rtkweb/1869.pdf). Isocyanates are classified as potential human carcinogens and are *known* to cause cancer in animals.



A full facepiece air-purifying respirator equipped with an OV cartridge
Photograph Source: 3M

Numerous cases published by The National Institute of Occupational Safety and Health (NIOSH) have linked isocyanate exposure to asthma, cancer and even death. One **case study published by NIOSH automotive spray painter who "suffered isocyanate-induced asthma** that resulted in his **death** at the age of 37. He was admitted to the hospital with asthma symptoms [Fabbri et al. 1988] that had been present for approximately 5 years. He had been working in the same environment for more than 20 years, so the physician advised the worker to change his job or avoid the use of polyurethane paints. However, he continued to work as a car painter and used medications such as bronchodilators, cromolyn, and steroids to treat his asthma.

Six years later, he was wearing a mask and spraying a car with 2-component polyurethane paint when he developed severe, prolonged asthma. Despite medication, he remained symptomatic--especially at night. He returned to work, sprayed the polyurethane paint again, and developed severe asthma requiring emergency treatment. He died in the ambulance en-route to the hospital. The manufacturer reported that the paint contained small amounts of …*(continued on page 2)*

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toluene diisocyanates (TDI), and a chemical analysis confirmed the presence of TDI mixed with solvents" (www.cdc.gov/niosh/asthma.html).

Because of their dangerous properties, OSHA has established a **permissible exposure limit** (PEL) to TDI of .02 ppm as a ceiling limit [29 CFR 1910.1000]. The "ceiling limit" is the maximum concentration that a worker can be exposed to at any point during the workday. In 1989, OSHA decreased the PEL to .005 ppm (¼ the previous PEL)…however, this standard was rescinded by court order in 1992 (http://www.cdc.gov/niosh/asthma.html).

The PEL is one of the parameters used to **select the appropriate respiratory protection.** The type of contaminants and their (measured or estimated) concentration must also be known. The material safety data sheet (MSDS) can be reviewed to determine the PEL of the substance(s). If the product consists of several chemicals, for example, a polyurethane clear coat paint that contains methyl ethyl ketone, toluene, polyisocyanates as well as other substances, then the average PEL should be calculated. This can be done by multiplying the percentage of each substance by its established PEL; adding all of the PEL's and dividing by the total number of substances. Then, the (measured or estimated) concentration of contaminant in the air is divided by the calculated (average) PEL to determine the appropriate protection factor needed in a respirator. Ceiling limits and IDLH concentrations must also be considered for each individual chemical.

Protection factors range from 10 for a half-mask air-purifying (A-P) respirator up to 10,000 for a positive pressure self-contained breathing apparatus (SCBA). If an air-purifying respirator's protection factor is adequate, then the appropriate cartridge/filter must be selected, based on its ability to remove, absorb and/or neutralize the specific contaminant(s) as they pass through. Because exposure monitoring and the selection process can be expensive and time-consuming, most automotive body shops depend on paint suppliers, respiratory protection suppliers and/or consultants for guidance. The following table describes some common chemicals and the recommended respiratory protection:

Respirator	Cartridge/Filter	Color	Examples of contaminants
Fullface A-P	Organic Vapor	Black	*gasoline, paints*
Fullface A-P	Acid Gas	White	*sulfuric acid, hydrochloric acid*
Fullface A-P	OV/AG	Yellow	*paint strippers*
Fullface A-P	Ammonia/Methylamine	Green	*floor cleaners, industrial processes*
Fullface A-P	Formaldehyde	Gold	*laboratories, wood preservation*
Half-mask A-P	N95	White	*dust, dirt*
Half-mask A-P	P95	White	*paint overspray, fiberglass*
Half-mask A-P	P99	Yellow	*welding fumes, crystalline silica*
Half-mask A-P	P100	Pink	*asbestos*

Source: 3M 2003 Respirator Selection Guide

According to an article published by Occupational Hazards at www.occupationalhazards.com, OSHA issued an interpretation letter on July 18, 2000 clarifying the appropriate protection for workers who are exposed to common isocyanates. OSHA's states in this letter that **air-purifying respirators are adequate** as long as exposure monitoring indicates levels are below the protection factor offered by the respirator. Data collected by Crandall in 2002 during a limited study that measured exposure concentrations of automotive painters and waste paint handlers to polyisocyanates indicated that levels were actually below the permissible exposure limit for the specified isocyanates. Further information supporting the acceptance of air purifying respirators for isocyanates is the 2003 Respirator Selection Guide published by 3M, a leader in respiratory protection products and technical services. This guide **recommends a fullface air-purifying respirator equipped with an organic vapor cartridge and a N95 filter**. To print a copy of this guide, go to http://www.3m.com/occsafety/html/publications.html and click *3M Respirator Selection Guide - 2003.pdf*

It must be noted that there are NO KNOWN SAFE LEVELS to any suspected carcinogens. Therefore, to reduce exposure, engineering controls and **personal protective equipment** should be used. Anyone who handles products containing isocyanates should wear coveralls, gloves, goggles, a full face shield, and suitable respiratory equipment. A full face piece respirator may be worn to eliminate the need for goggles and a face shield. A dust mask will not protect against isocyanate vapors! *(Continued on page 3)*

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Workers should also apply **safe handling techniques** to reduce exposure, such as:

- Only mix isocyanate paints in an approved paint mixing room equipped with mechanical ventilation.
- The door to the mixing room should remain closed and the ventilation system should be turned 'ON' when the building is occupied. Ventilation equipment should be checked for adequate performance at least every 3 months.
- Containers of isocyanate paints should be tightly covered to prevent evaporation.
- Replace exhaust filters and intake filters routinely to increase natural flow of clean air through the booth.
- Replace respirator cartridges (or disposable respirators) frequently to prevent saturation and shorten the duration of use when humidity levels exceed 85%.

For more information, visit OSHA's website at www.osha.gov/SLTC/isocyanates/ or contact **Crandall at 800-248-4801**.

Occupational Fatality Report for Fourth Quarter 2004

Sewer Manhole - Confined Space Entry Resulting in Multiple Deaths

On November 12, 2003, the Houston Chronicle reported that two workers were killed in a sewer line manhole and a third worker was injured, due to toxic gas exposure. According to the report, one man descended approximately 18 feet below the land surface without protective equipment or rescue lines. Due to high levels of hydrogen sulfide and methane gas, the worker collapsed…soon after, the second worker went down in a rescue attempt. When the second worker collapsed, a third worker (and supervisor) entered the 36" manhole in a second rescue attempt. However, he became ill, evacuated the manhole and was unable to save the first two workers. Consistent with historical cases relating to confined space entry incidents, there were more "would-be" rescuers involved than original workers in the space. Fortunately, the third entrant was able to perform self-rescue, thus not aggravating the consequences further. For more on this story, see HoutsonChronicle.com – Sewer gases kill two workers in Valley manhole by James Pinkerton.

Occupational Fatalities in 2003 – National and Statewide Statistics

Georgia is ranked 41st in the nation for the number of occupational fatalities that occurred in 2003. There were 26 fatalities reported per 100,000 workers. SC ranked 48th with 34 fatalities reported per 100,000 workers. NC ranked 36th with 27 fatalities reported per 100,000 workers. Most fatalities occurred in the services industry, as shown in the Table 1 (Source: United Health Foundation, http://www.unitedhealthfoundation.org and Bureau of Labor Statistics).

Table 1. Comparisons between the National and State Ratios of Occupational Fatalities by Industry

Occupational Fatalities in U.S. in 2003				
Occupation	**National Average Ratio**	**# NC (Ratio)**	**# SC (Ratio)**	**# GA (Ratio)**
Agriculture, Forestry, Fishing	2 %	78 (16%)	25 (10%)	44 (10%)
Construction	10%	143 (30%)	75 (30%)	172 (38%)
Manufacturing	21%	84 (18%)	56 (22%)	72 (16%)
Transportation, Communications	9%	105 (22%)	49 (20%)	86 (19%)
Services	57.80%	66 (14%)	45 (18%)	84 (18%)

Crandall Now Provides First Aid and CPR Training

Crandall
Integrated Compliance Management

100 Rich-Lex Drive
Lexington, SC 29072

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Crandall can now offer Standard First Aid and CPR Training! Our authorized trainer is an active Emergency Medical Technician in the upstate of South Carolina with years of experience in emergency care giving. We will begin offering regional courses throughout SC, NC and GA in the second quarter of 2004…please notify your Account Manager if you are interested in participating. There will be a nominal fee for our Compliance Management Program clients and a competitive cost for other clients.

The 6-8 hour training program is designed to arm laypersons with the minimum knowledge and skills necessary to provide emergency care for injury or sudden illness during the brief interval between incident and EMS arrival. The following objectives will be met during the course:

- Understand the "Good Samaritan Law."
- Know how to obtain consent from a conscious victim.
- Understand what is meant by "Implied Consent."
- Understand the necessity of stated health precautions.
- Be familiar with the key roles and responsibilities of a first aid provider.
- Recognize an emergency.
- Assess scene for safety.
    - Identify appropriate "Personal Protection Equipment" (PPE) that can reduce risk of exposure.
    - Understand the need for emergency oxygen.
    - Understand the "Stop-Wash-Report" steps in the event of an exposure.
    - Explain the "Warning Signs and Symptoms" of Medical Problems.
    - Appreciate the emotional stress of providing emergency care.
    - Perform Emergency Action Steps.
    - Given an emergency scenario, select and wear the appropriate personal protective equipment.
- Assess victim(s) for responsiveness.
- Alert EMS.
- Perform a SAMPLE Assessment.
- Place victim in the recovery position.
- Open an adult's airway using the head-tilt, chin-lift and jaw-thrust.
- Assess an adult for breathing and provide rescue breaths.
- Determine if adult victim has signs of circulation.
- Perform adult external chest compressions.
- Care for the conscious adult choking victim.
- Operate an Automated External Defibrillator (AED).
- Integrate the AED into Adult CPR.
- Control External Bleeding.
- Care for Shock.
- Stabilize Suspected Spinal Injury.
- Care for a Dislocated, Broken, or Cracked Bone.

Crandall will be sending you information soon about the upcoming regional courses. If you have questions about the number of trained providers required for your company, please contact us at **800-248-4801**.