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## Identifying Chemical and Biological Hazards in Washington State's Workplaces: A survey of labor groups, business associations, and health & safety professionals

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## **List of Definitions and Acronyms**

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ACGIH.....	American Conference of Governmental Industrial Hygienists
AIHA.....	American Industrial Hygiene Association
ANSI.....	American National Standards Institute
BLS.....	U.S. Department of Labor’s Bureau of Labor Statistics
CFOI.....	Census of Fatal Occupational Injuries
DOH.....	Washington State Department of Health
DOL.....	U.S. Department of Labor
IH.....	Industrial Hygienist
L&I.....	Washington State Department of Labor and Industries
NIOSH.....	National Institute for Occupational Safety and Health
NOES.....	National Occupational Exposure Survey
OIICS.....	Occupational Injury/Illness Coding System
OSHA.....	Occupational Safety and Health Administration
PNS-AIHA.....	Pacific Northwest Section of the American Industrial Hygiene Association
PPE.....	Personal Protective Equipment
SHARP.....	Safety & Health Assessment & Research for Prevention
SIC.....	Standard Industrial Classification
WAC.....	Washington Administrative Code
WCRS.....	Workplace Chemical Ranking System
WISHA.....	Washington Industrial Safety and Health Act – Washington’s state OSHA program
WSLC.....	Washington State Labor Council



## **Executive Summary**

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The aim of this study was to identify the principal chemical and biological hazards in Washington's workplaces. To this end, the Safety & Health Assessment & Research for Prevention (SHARP) Program developed and distributed a survey instrument to a total of 1880 health & safety professionals, labor organizations, and business associations across Washington State.

The principal hazards identified by survey respondents were: silica, paints, isocyanates, welding fumes, carbon monoxide, molds, asphalt, bodily fluids, solvents, and asbestos. Construction was the most frequently mentioned industry. Although the harmful effects of many of these hazards have been recognized for decades, there is a critical need for health & safety professionals to address these exposures, including the development of effective exposure controls that do not rely on workers' use of personal protective equipment.

The low response rate to the survey (4 percent) means that the information gathered cannot be regarded as representative. However, these data are a useful first-step towards identifying hazards of concern in Washington's workplaces and setting occupational health research, education, and outreach priorities in Washington State.

Readers interested in discussing the hazards identified in this study are encouraged to contact the SHARP Program at 1-888-66-SHARP.





## **Introduction**

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Washington State's workplaces contain numerous chemical and biological hazards that have the potential to cause adverse health effects, like cancer, asthma, and skin problems. However, targeting prevention efforts to address chemical and biological exposures is a complex process, because attributing work-related illness to workplace exposures is fraught with difficulties.

The Safety & Health Assessment & Research for Prevention (SHARP) Program administers several occupational disease and injury surveillance systems that have proven extremely useful for targeting occupational injury and illness prevention activities. Several of SHARP's systems rely, at least in part, on Washington State's Workers' Compensation data. These systems include those designed to track work-related musculoskeletal disorders (Silverstein & Kalat 2002), workplace violence (Foley 2002), traumatic head and brain injuries (Cohen et al. 1999), dermatitis (Sama et al. 1998), occupational asthma (Baggs et al. 2000; DOH 2002a), and hospitalized burns (Baggs et al. 2000, 2002). The Fatality Assessment and Control Evaluation (FACE) program collects work-related traumatic fatality data from the Department of Labor & Industries' (L&I's) Bureau of Labor Statistics (BLS) group, the Washington Industrial Safety and Health Act (WISHA) Program, the Washington State Department of Health, public safety officials, newspapers, medical examiners/coroners, and other sources (DOH 2002b). In addition, blood lead level data for Washington State's Occupational Lead Exposure Registry originates from reports submitted by blood lead testing laboratories (Whittaker & Curwick 2001).

Although there has been substantial progress in the development of occupational disease and injury surveillance methods, systems for hazard surveillance are much less well developed. Hazard surveillance could serve as the basis for the primary prevention of work-related morbidity and mortality because it is directed at earlier recognition of risks than are systems that record injuries and illnesses once they have occurred (NIOSH 1996a). The SHARP Program has evaluated several hazard surveillance systems in an attempt to identify the principal workplace chemical exposures of concern in Washington State (Drozdowsky 2000). SHARP developed a Workplace Chemical Ranking System (WCRS), which combined exposure data from the National Occupational Exposure Survey (NOES) (NIOSH 1988, 1989a, 1989b) with Washington State employment statistics, and chemical toxicity data to yield relative risks associated with specific workplace chemicals (Drozdowsky 2000). However, the usefulness of the WCRS proved to be limited by uncertainties associated with the NOES database (Drozdowsky 2000; Greife et al. 1995) and enumerating exposed workers in Washington workplaces, in addition to the lack of toxicity data for numerous workplace chemicals. It should be noted that the difficulties associated with

identifying and quantifying potential chemical exposures were not unique to the WCRS; they are common to many hazard surveillance systems.

In order to avoid the limitations inherent in many hazard surveillance systems, SHARP developed a “Chemical and Biological Hazards Survey” to help identify the most serious chemical and biological hazards in Washington workplaces and the workers who are exposed to them. The survey was distributed to three principal stakeholder groups in Washington State: Labor Organizations, Business Associations, and Health & Safety Professionals. The results of this survey will be used to help set occupational health research, education, and outreach priorities in Washington State.

# Methods

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## Identification of Survey Recipients

Five sources of information were used to generate a “master mailing list”. These data sources were accessed in September of 2001. Where appropriate, permission to use membership rosters was requested from the administrators of the following databases:

1. The membership directory for the American Industrial Hygiene Association (AIHA).
2. The membership roster of the Pacific Northwest Section of the American Industrial Hygiene Association (PNS-AIHA).
3. The online membership directory for the American Conference of Governmental Industrial Hygienists (ACGIH).
4. The directory of labor unions affiliated with the Washington State Labor Council (WSLC).
5. The Public Affairs Stakeholder List administered by L&I. This Microsoft Access™ database contains contact information for business associations. Organizations judged to be relevant to the survey were selected for inclusion.

Organization members with Washington State mailing addresses were included. Data from these five sources were combined in a custom Microsoft Access™ database and duplicate records were eliminated to generate the master mailing list.

The survey was also distributed via e-mail using the distribution list for Industrial Hygienists (IHS) associated with L&I’s WISHA Services. In addition, the survey and instructions were posted on SHARP’s web site at [www.lni.wa.gov/sharp/hazchem](http://www.lni.wa.gov/sharp/hazchem).

## Survey Strategy

The survey package (Appendix A) was distributed to Labor Groups and Health & Safety Professionals in October 2001. The package for Business Associations was mailed in January 2002. The following items were included in the package:

- A cover letter describing the purpose of the survey. The letter was customized for the three stakeholder groups – Labor Organizations, Business Associations, and Health & Safety Professionals;
- An example of a completed survey;

- The survey instrument; and
- A postage-paid return envelope (for mailed surveys).

Recipients were provided a deadline of three weeks to complete and return the survey. Four weeks after the initial distribution (i.e., one week after the specified deadline expired), either a reminder postcard was mailed or an e-mail was sent, as appropriate.

## **Survey Instrument**

Recipients (or their representatives) were asked to select from a list of occupations that best described their position. Although recipients were provided the opportunity to return their mail surveys anonymously, they were encouraged to provide contact information in order to further discuss their selection(s) or receive a copy of the results. Recipients were assured that their name and affiliation would not be shared with anyone outside of the SHARP Program.

Survey recipients were asked to describe up to three chemical or biological hazards (ranked in order of concern) that they believed to be the most significant problems in Washington workplaces. “Chemical hazards” were defined as any form (solid, liquid, or gas) of a hazardous chemical substance (including dusts, vapors, mists, fumes, etc.). “Biological hazards” were defined as animal tissues (e.g., meats), bodily fluids (like blood, urine, or feces), bacteria, viruses, molds, or fungi.

For each hazard identified, recipients were asked to provide the following information:

- The physical form of the hazard;
- The industry/business where exposure occurs;
- The job titles of the exposed workers and the tasks they perform;
- Why the hazard is of concern (ranked); and
- Actions required to reduce or eliminate exposures (ranked).

The recipients were also encouraged to provide open-ended comments.

## **Data Entry, Coding, and Analysis**

Survey data were key-entered into a custom Microsoft Access™ database.

The hazards reported by respondents were categorized according to the Source of Injury/Illness from the Occupational Injury/Illness Coding System (OIICS). This classification system was developed by the U.S. Department of Labor's (DOL's) Bureau of Labor Statistics (BLS), and is used to code the case characteristics of injuries and illnesses by Occupational Safety and Health Administration (OSHA) and the Census of Fatal Occupational Injuries (CFOI) program.

Standard Industrial Classification (SIC) codes (1987 revision) were applied to the industries/businesses specified by respondents. SIC codes are four-digit numbers used by the Bureau of Census to categorize business activities conducted in the United States. The first two digits of the code represent the major industry group and the second two digits represent the specific subset of that group.

Descriptive analyses were performed by querying the Microsoft Access™ database and exporting data to Microsoft Excel™.



# Results

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## Survey Response Rate

The number of surveys distributed by stakeholder group is presented in Table 1.

<b>Stakeholder Group</b>	<b>Number of Surveys</b>
Labor Groups (mailed) <sup>a</sup>	815
Health & Safety Professionals (mailed) <sup>b</sup>	736
WISHA Industrial Hygienists (e-mailed) <sup>c</sup>	80
Business Associations (mailed) <sup>d</sup>	249
<b>TOTAL</b>	<b>1880</b>
<sup>a</sup> From WSLC affiliates mailing list <sup>b</sup> From AIHA, PNS-AIHA, and ACGIH membership lists <sup>c</sup> From WISHA's e-mail distribution list <sup>d</sup> From L&I's Public Affairs Stakeholder List	

Completed surveys were received from 75 of the 1880 individuals or organizations to whom the survey was distributed, yielding a crude response rate of 4 percent. It was not possible to stratify the response rate by stakeholder group (identified from the master mailing list) because 21 percent of respondents (16 individuals) provided anonymous survey responses and could not be matched to the source of mailing information. However, responses by self-identified occupation are described below.

## Respondent Occupation

The number of surveys returned by self-reported respondent occupation is presented in Table 2. The greatest number of surveys was returned by Labor Representatives (37.3 percent), followed by Government Agency Health & Safety Professionals (20.0 percent), Workers (12.0 percent), and IH Consultants (10.7 percent). These four occupations combined represented 80 percent of the total surveys returned.

<b>Table 2. Number of Respondents by Self-Reported Occupation</b>	
<b>Occupation</b>	<b>Number of Respondents (%)</b>
Academic IH or researcher	2 (2.7%)
Corporate health & safety professional	3 (4.0%)
Employer	1 (1.3%)
Government agency health & safety professional	15 (20.0%)
IH Consultant (private company)	8 (10.7%)
Labor representative	28 (37.3%)
Plant or facility health & safety professional	1 (1.3%)
Worker	9 (12.0%)
Other	6 (8.0%)
Occupation not provided	2 (2.7%)
<b>TOTAL</b>	<b>75</b>

## **Correction and Modification of Responses**

When specifying the physical form of the hazard, respondents occasionally selected forms that were not appropriate for their hazard. For example, when describing paints, several respondents selected “fumes” as a physical form. In these cases, the respondents’ selections were recorded in the database, but a question mark (?) was added to denote a questionable response.

Any references to specific individuals, employers, or workplaces were removed during preparation of summary tables.

Occasionally, respondents failed to rank their responses to the questions “Why the hazard is of concern?” and “Actions required to reduce or eliminate exposures?” Respondents occasionally provided a check mark, rather than placing numerical values next to their selections. In these cases, every checked option was ranked as their highest priority. Other errors introduced by respondents when ranking their responses were corrected prior to data entry.



## Hazards Identified

The hazards identified by the survey respondents are presented in Appendix B. A total of 84 different hazards were identified; several were mentioned by multiple respondents (the 84 hazards were mentioned a total of 147 times). The hazards fell into 18 OIICS Source categories; those containing 10 or more “hazard mentions” were:

1. Other Chemicals (28 hazard mentions);
2. Chemical Products – General (27 hazard mentions);
3. Non Metallic Minerals, Except Fuel (18 hazard mentions);
4. Infectious and Parasitic Agents (14 hazard mentions);
5. Metallic Particulates, Trace Elements, Dusts, Powders, Fumes (12 hazard mentions); and
6. Chemicals and Chemical Products, Unspecified (10 hazard mentions).

The ten most frequently mentioned hazards are summarized in Table 3. The remaining discussion will focus on these ten hazards, which were mentioned a total of 60 times.

<b>Table 3. Most Frequently Mentioned Hazards</b>				
<b>Hazard</b>	<b>Number of Mentions as:</b>			<b>Total Mentions</b>
	<b>Hazard Rank #1</b>	<b>Hazard Rank #2</b>	<b>Hazard Rank #3</b>	
Silica (including abrasive blasting, silica dusts, and “fibrous siliceous dusts”)	8	3	1	12
Paints (including “fumes” and coatings)	4	2	1	7
Isocyanates (including TDI, MDI, polyisocyanate liquid, and urethanes)		2	5	7
Welding fumes	4	2		6
Carbon monoxide (including vehicle exhaust and exhaust gases)	4		1	5
Molds	2	3		5
Asphalt (including fumes)	2	3		5
Bodily fluids	4	1		5
Solvents	3		1	4
Asbestos	3	1		4

## **Silica**

Silica (including abrasive blasting, silica dusts, and “fibrous siliceous dusts”) was mentioned 12 times, and was the highest ranked hazard for eight respondents (see Table 4). Exposure to silica dust was reported to be a hazard primarily for construction workers who sandblast, cut, drill, and sweep silica-containing materials.

The top concern associated with silica was the “potential for exceeding the workplace exposure limit” (the highest-ranked concern for seven respondents), followed by “large number of exposed workers” (the highest-ranked concern for five respondents). The top actions suggested to reduce or eliminate exposure were “education and training of employers”, “personal protective equipment”, and “engineering controls” (considered the highest-ranked actions by four respondents).

## **Paints**

Paints were mentioned seven times, and were the highest ranked hazard for four respondents (see Table 5). Workers who mix, apply, and cleanup paints were mentioned most frequently, although welders, production workers, machine operators, driver/forklift operators, and other workers were also mentioned.

The top concern associated with paints was the “potential for exceeding the workplace exposure limit” (the highest-ranked concern for all seven respondents). The top actions suggested to reduce or eliminate exposure were “education and training of employers” and “personal protective equipment” (the highest-ranked actions for two respondents).

**Table 4. Survey Responses for Silica**

Respondent Occupation	Hazard Rank	Physical Form of Hazard	Industry/Business where Exposure Occurs (Comments)	Job Title of Exposed Workers	Tasks Performed by Exposed Workers	Top Reasons for Concern (Ranked)	Top Actions Necessary (Ranked)
Labor representative	1	Dust	Construction	Laborers	<ul style="list-style-type: none"> <li>Chipping, grinding, breaking</li> <li>Dry sack and patching</li> <li>Shoveling</li> </ul>	<ol style="list-style-type: none"> <li>Potential for exceeding workplace exposure limit</li> <li>Large number of exposed workers</li> <li>Health effects described in the literature</li> </ol>	<ol style="list-style-type: none"> <li>Engineering Controls</li> <li>Personal Protective Equipment</li> <li>Enforcement of regulations</li> </ol>
Government agency health & safety professional	1	Dust	Construction/Fixed industry/Agriculture	Masons	<ul style="list-style-type: none"> <li>Tuck pointing - masonry restoration</li> <li>Cutting brick/block dry</li> </ul>	<ol style="list-style-type: none"> <li>Potential for exceeding workplace exposure limit</li> <li>Health effects described in the literature</li> <li>Lack of commercially available useful engineering controls</li> </ol>	<ol style="list-style-type: none"> <li>Personal Protective Equipment</li> <li>Engineering Controls</li> <li>Education and training of employers</li> </ol>
				Sandblasters	<ul style="list-style-type: none"> <li>Blasting concrete with silica sand</li> <li>Blasting other substrate with silica sand</li> </ul>		
				Concrete finishers	<ul style="list-style-type: none"> <li>Sanding/patching concrete (Dry grinding)</li> </ul>		
Corporate health & safety professional	1	Dust	Hard rock mining	Underground miners	<ul style="list-style-type: none"> <li>Operating drilling machine</li> <li>Operating loader</li> </ul>	<ol style="list-style-type: none"> <li>Large number of exposed workers</li> <li>Potential for exceeding workplace exposure limit</li> <li>Illness/symptoms observed in workers</li> </ol>	<ol style="list-style-type: none"> <li>Engineering Controls</li> <li>Personal Protective Equipment</li> <li>Administrative Controls</li> </ol>
				Processing technicians	<ul style="list-style-type: none"> <li>Clean-up</li> <li>Checking equipment</li> </ul>		

**Table 4. Survey Responses for Silica**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Government agency health & safety professional	1	Dust	Construction, masonry, restoration retrofitting, earthquake retrofitting, brick work (concrete, bricks, & mortar)	Hod carriers	<ul style="list-style-type: none"> <li>• Installs new mortar</li> <li>• May cut out mistakes when mortar dries, sweep dust</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>2. Large number of exposed workers</li> <li>3. Health effects described in the literature</li> </ol>	<ol style="list-style-type: none"> <li>1. Education and training of workers</li> <li>2. Education and training of employers</li> <li>3. Engineering Controls</li> </ol>
				Masonry retrofitters	<ul style="list-style-type: none"> <li>• Cuts brick</li> <li>• Sweeps dust</li> </ul>		
				General contractors	<ul style="list-style-type: none"> <li>• In area of retrofitting</li> </ul>		
IH Consultant (private company)	1	Dust	Construction/ demolition	Demolition workers	<ul style="list-style-type: none"> <li>• Demolition of building materials</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>2. Large number of exposed workers</li> <li>3. Health effects described in the literature</li> </ol>	<ol style="list-style-type: none"> <li>1. Enforcement of workplace regulations</li> <li>2. Education and training of employers</li> <li>2. Personal Protective Equipment</li> <li>2. Engineering Controls</li> </ol>
				Supervisors	<ul style="list-style-type: none"> <li>• Supervision of demolition workers</li> </ul>		
				Other trades	<ul style="list-style-type: none"> <li>• Present during demolition</li> </ul>		
Labor representative	1	Dust	Mechanical application repair insulation stripping etc. commercial, industrial, marine ("Fibrous siliceous dusts")	Insulators	<ul style="list-style-type: none"> <li>• Application of insulation materials</li> <li>• Reworking insulation during repair</li> <li>• Insulation removal for demo or remodel</li> </ul>	<ol style="list-style-type: none"> <li>1. Large number of exposed workers</li> <li>2. Potential for exceeding workplace exposure limit</li> <li>3. Health effects described in the literature</li> </ol>	<ol style="list-style-type: none"> <li>1. Personal Protective Equipment</li> <li>2. Education and training of employers</li> <li>3. Engineering Controls</li> </ol>
				Insulator helpers	<ul style="list-style-type: none"> <li>• Jobsite cleanup-sweeping</li> <li>• Jobsite cleanup-boxing</li> <li>• Material distribution</li> </ul>		

**Table 4. Survey Responses for Silica**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Worker	1	Dust	Construction/maintenance	Journeyman electricians	<ul style="list-style-type: none"> <li>• Exposure to dust of concrete worker</li> <li>• Drilling into concrete</li> <li>• Demolition and concrete removal</li> </ul>	<ol style="list-style-type: none"> <li>1. Large number of exposed workers</li> <li>2. Exposure can be all over the job for hours or days</li> <li>3. Potential for exceeding workplace exposure limit</li> </ol>	<ol style="list-style-type: none"> <li>1. Education and training of employers</li> <li>2. Engineering Controls</li> <li>3. Administrative Controls</li> </ol>
				Apprentice electricians	<ul style="list-style-type: none"> <li>• Exposure to dust of concrete worker</li> <li>• Drill into concrete</li> <li>• Demolition and concrete removal</li> </ul>		
				Foreman electricians	<ul style="list-style-type: none"> <li>• Exposure to dust of concrete worker</li> <li>• Drill into concrete</li> <li>• Demolition and concrete removal</li> </ul>		

**Table 4. Survey Responses for Silica**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Government agency health & safety professional	1	Dust	Construction	Various	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>1. Large number of exposed workers</li> <li>3. Illness/symptoms observed in workers</li> <li>3. Health effects described in the literature</li> <li>3. Lack of available exposure or health information</li> </ol>	<ol style="list-style-type: none"> <li>1. Education and training of employers</li> <li>1. Engineering Controls</li> <li>3. Education and training of workers</li> <li>3. Enforcement of workplace regulations</li> <li>3. Medical surveillance</li> <li>3. Personal Protective Equipment</li> <li>3. Administrative Controls</li> </ol>
Government agency health & safety professional	2	Dust	Construction/ highway contract work/painting activities (Respirable crystalline quartz)	Highway contractors	<ul style="list-style-type: none"> <li>• Use of compressed air for cleaning radial pavement cuts</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>1. Illness/symptoms observed in workers</li> <li>1. Health effects described in the literature</li> </ol>	<ol style="list-style-type: none"> <li>1. Development of a silica standard</li> <li>1. Education and training of employers</li> <li>1. Education and training of workers</li> <li>1. Enforcement of workplace regulations</li> <li>1. Medical surveillance</li> <li>1. Personal Protective Equipment</li> <li>1. Engineering Controls</li> </ol>
				Sandblasters	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>		
				Rock polishers (concrete fab. products)	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>		

**Table 4. Survey Responses for Silica**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>					
Labor representative	2	Solid?, Dust	Abrasive blasting	Sandblasters	<ul style="list-style-type: none"> <li>• Preparing equipment for blast</li> <li>• Blasting of surfaces</li> <li>• Monitoring and cleanup of blast</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>2. Lack of available exposure or health information</li> <li>3. Large number of exposed workers</li> </ol>	<ol style="list-style-type: none"> <li>1. Personal Protective Equipment</li> <li>2. Education and training of workers</li> <li>3. Education and training of employers</li> </ol>					
Labor representative	2	Dust	Mine site construction	Rodman	<ul style="list-style-type: none"> <li>• Reinforcing steel assembly</li> <li>• Cutting/burning steel</li> </ul>	<ol style="list-style-type: none"> <li>1. Health effects described in the literature</li> <li>2. Potential for exceeding workplace exposure limit</li> <li>3. Large number of exposed workers</li> </ol>	<ol style="list-style-type: none"> <li>1. Education and training of workers</li> <li>2. Personal Protective Equipment</li> <li>3. Education and training of employers</li> </ol>					
Labor representative	3	Dust	Apparatus repair (Grinding/sanding taking place where all employees are affected. Dusts contain various insulations (mica, micarta, silica)	<table border="1"> <tr> <td>Electricians</td> <td>• Not specified</td> </tr> <tr> <td>Machinists</td> <td>• Not specified</td> </tr> <tr> <td>Mechanics</td> <td>• Not specified</td> </tr> </table>	Electricians	• Not specified	Machinists	• Not specified	Mechanics	• Not specified	<ol style="list-style-type: none"> <li>1. Large number of exposed workers</li> <li>2. Lack of available exposure or health information</li> <li>3. Potential for exceeding workplace exposure limit</li> </ol>	<ol style="list-style-type: none"> <li>1. Education and training of employers</li> <li>2. Education and training of workers</li> <li>3. Personal Protective Equipment</li> </ol>
Electricians	• Not specified											
Machinists	• Not specified											
Mechanics	• Not specified											

**Table 5. Survey Responses for Paints**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Labor representative	1	Fume?	Construction (Paint fumes)	All crafts	<ul style="list-style-type: none"> <li>• Construction</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>2. Large number of exposed workers</li> <li>3. Lack of available exposure or health information</li> </ol>	<ol style="list-style-type: none"> <li>1. Engineering Controls</li> <li>2. Administrative Controls</li> <li>3. Personal Protective Equipment</li> </ol>
Worker	1	Liquid Vapor Fume? Mist	Hydro projects – dams (paint and solvents)	Painter	<ul style="list-style-type: none"> <li>• Mixing paints</li> <li>• Spraying or applying paints</li> <li>• Clean up of equipment</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>2. Health effects described in the literature</li> <li>3. Large number of exposed workers</li> </ol>	<ol style="list-style-type: none"> <li>1. Education and training of workers</li> <li>2. Education and training of employers</li> <li>3. Enforcement of workplace regulations</li> </ol>
				Hydro-mechanics	<ul style="list-style-type: none"> <li>• Mixing paints</li> <li>• Spraying or applying paints</li> <li>• Clean up of equipment</li> </ul>		
Labor representative	1	Dust Vapor Fume? Mist	Metal fabrication (Industrial paints, coatings, and preservatives for bridge girders and large fab production.)	Welders	<ul style="list-style-type: none"> <li>• Welding and fitting metal parts</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>1. Health effects described in the literature</li> <li>1. Lack of available exposure or health information</li> </ol>	<ol style="list-style-type: none"> <li>1. Education and training of employers</li> <li>2. Medical surveillance</li> <li>3. Education and training of workers</li> </ol>
				Production workers	<ul style="list-style-type: none"> <li>• Grinding</li> <li>• Forklift</li> <li>• Crane operation</li> </ul>		
				Machine operators	<ul style="list-style-type: none"> <li>• Sawing</li> <li>• Cutting</li> <li>• Forming</li> </ul>		



**Table 5. Survey Responses for Paints**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Labor representative	1	Liquid Vapor Fume?	Industrial & commercial painting (Solvent-based paint coatings)	Coating applicator	<ul style="list-style-type: none"> <li>Mixing products</li> <li>Application of products</li> <li>Cleanup of product and equipment</li> </ul>	<ol style="list-style-type: none"> <li>Potential for exceeding workplace exposure limit</li> <li>Large number of exposed workers</li> <li>Illness/symptoms observed in workers</li> </ol>	<ol style="list-style-type: none"> <li>Education and training of employers</li> <li>Education and training of workers</li> <li>Personal Protective Equipment</li> </ol>
				Apprentice painter	<ul style="list-style-type: none"> <li>Mask and prepare for application</li> <li>Tend to equipment</li> <li>Cleanup of equipment</li> </ul>		
IH Consultant (private company)	2	Solid Vapor Mist	Aerospace. Trucks, Auto repair (Painting with chromates and isocyanates)	Painters	<ul style="list-style-type: none"> <li>Not specified</li> </ul>	<ol style="list-style-type: none"> <li>Potential for exceeding workplace exposure limit</li> <li>Need new limits and sampling &amp; analysis</li> <li>Lack of available exposure or health information</li> </ol>	<ol style="list-style-type: none"> <li>Enforcement of workplace regulations</li> <li>Education and training of employers</li> <li>Medical surveillance</li> </ol>
Labor representative	2	Solid Dust Liquid Vapor Fume? Mist Gas?	Ship repair	Driver/ Forklift operator	<ul style="list-style-type: none"> <li>Delivery of paint and chemicals</li> </ul>	<ol style="list-style-type: none"> <li>Potential for exceeding workplace exposure limit</li> <li>Lack of available exposure or health information</li> <li>Health effects described in the literature</li> </ol>	<ol style="list-style-type: none"> <li>Personal Protective Equipment</li> <li>Administrative Controls</li> <li>Education and training of employers</li> </ol>

**Table 5. Survey Responses for Paints**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Government agency health & safety professional	3	Liquid Vapor Mist	Vehicle fabrication/repair (Vehicle painting and coating)	Painter	<ul style="list-style-type: none"> <li>• Apply coatings</li> <li>• Mix coatings</li> <li>• Clean equipment</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>2. Lack of available exposure or health information</li> <li>3. Health effects described in the literature</li> </ol>	<ol style="list-style-type: none"> <li>1. Personal Protective Equipment</li> <li>2. Engineering Controls</li> <li>3. Education and training of workers</li> </ol>
				Vehicle maintenance	<ul style="list-style-type: none"> <li>• Apply coatings</li> <li>• Clean equipment</li> </ul>		
				Supervisor	<ul style="list-style-type: none"> <li>• Inspect vehicles</li> </ul>		

### **Isocyanates**

Isocyanates were mentioned seven times, and were the second-highest ranked hazard for two respondents and the third-highest ranked for five respondents (see Table 6). Workers who mix, apply, and cleanup isocyanate-containing products were identified as being at risk for isocyanate exposure. However, isocyanates were also mentioned by a respondent who expressed concerned about paints (see the fifth entry in Table 5).

The top concern associated with isocyanates was “health effects described in the literature” (the highest-ranked concern for four respondents), followed by “illness/symptoms observed in workers” and “potential for exceeding workplace exposure limit” (both considered the highest-ranked concern for three respondents). The top actions suggested to reduce or eliminate exposure were “engineering controls” (the highest-ranked action for four respondents), followed by “education and training of employers” and “personal protective equipment” (both considered the highest-ranked action for three respondents).

### **Welding Fumes**

Welding fumes were mentioned six times, and were the highest ranked hazard for four respondents (see Table 7). Workers identified specifically as welders were of primary concern; welding was identified as taking place while repairing boilers, fabricating and repairing vehicles, during construction, and maintaining equipment and machinery.

The top concern associated with welding fumes was the “potential for exceeding the workplace exposure limit” (the highest-ranked concern for four respondents). The top actions suggested to reduce or eliminate exposure were “education and training of employers” and “personal protective equipment” (both considered the highest-ranked actions for three respondents).

**Table 6. Survey Responses for Isocyanates (including TDI, MDI, polyisocyanate liquid, and urethane)**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Government agency health & safety professional	2	Vapor	Autobody repair	Painter	<ul style="list-style-type: none"> <li>Spray painter</li> </ul>	<ol style="list-style-type: none"> <li>Illness/symptoms observed in workers</li> <li>Large number of exposed workers</li> <li>Health effects described in the literature</li> </ol>	<ol style="list-style-type: none"> <li>Engineering controls</li> <li>Personal Protective Equipment</li> <li>Education and training of employers</li> </ol>
Labor representative	2	Vapor Mist	Roofing (Polyisocyanate liquid)	Roofer	<ul style="list-style-type: none"> <li>Washing rubber roofing surfaces</li> <li>Opening can</li> <li>Storing cans</li> </ul>	<ol style="list-style-type: none"> <li>Potential for exceeding workplace exposure limit</li> <li>Health effects described in the literature</li> <li>Large number of exposed workers</li> </ol>	<ol style="list-style-type: none"> <li>Education and training of employers</li> <li>Education and training of workers</li> <li>Medical surveillance</li> </ol>
Government agency health & safety professional	3	Vapor Mist	Not specified	Auto painting truck	<ul style="list-style-type: none"> <li>Spray finishing</li> </ul>	<ol style="list-style-type: none"> <li>Health effects described in the literature</li> <li>Illness/symptoms observed in workers</li> <li>Large number of exposed workers</li> </ol>	<ol style="list-style-type: none"> <li>Personal Protective Equipment</li> <li>Education and training of workers</li> <li>Education and training of employers</li> </ol>
				Metal parts painting	<ul style="list-style-type: none"> <li>Spray finishing</li> <li>Mixing</li> </ul>		
				Spray foam insulating	<ul style="list-style-type: none"> <li>Spray foam applicator-fixed site</li> <li>Spray foam applicator-construction</li> <li>Insulation installation</li> </ul>		

**Table 6. Survey Responses for Isocyanates (including TDI, MDI, polyisocyanate liquid, and urethane)**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Labor representative	3	Solid Dust Liquid Vapor Fume? Mist	Not specified (Catalyzed materials - lacquers, epoxies, and urethanes)	Production workers	<ul style="list-style-type: none"> <li>• Mixing materials</li> <li>• Applying coatings</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> </ol>	<ol style="list-style-type: none"> <li>1. Education and training of employers</li> <li>1. Education and training of workers</li> <li>1. Medical surveillance</li> <li>1. Personal Protective Equipment</li> </ol>
				Painters	<ul style="list-style-type: none"> <li>• Mixing materials</li> <li>• Spraying coatings</li> </ul>	<ol style="list-style-type: none"> <li>1. Illness/symptoms observed in workers</li> <li>1. Health effects described in the literature</li> <li>1. Lack of available exposure or health information</li> <li>1. Large number of exposed workers</li> </ol>	
Government agency health & safety professional	3	Vapor Mist	Autobody shops (Solvents/Isocyanates)	Paint spray finisher	<ul style="list-style-type: none"> <li>• Auto vehicle</li> </ul>	<ol style="list-style-type: none"> <li>1. Illness/symptoms observed in workers</li> <li>1. Health effects described in the literature</li> <li>1. Large number of exposed workers</li> </ol>	<ol style="list-style-type: none"> <li>1. Education and training of employers</li> <li>1. Education and training of workers</li> <li>1. Enforcement of workplace regulations</li> <li>1. Medical surveillance</li> <li>1. Personal Protective Equipment</li> <li>1. Engineering Controls</li> </ol>

**Table 6. Survey Responses for Isocyanates (including TDI, MDI, polyisocyanate liquid, and urethane)**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
IH Consultant (private company)	3	Liquid Vapor Mist	Aircraft manufacturing/autobody repair (TDI & MDI)	Spray painter	<ul style="list-style-type: none"> <li>• Mixing polyurethane paints</li> <li>• Spraying polyurethane paint</li> <li>• Cleaning spraying and mixing equip.</li> </ul>	<ol style="list-style-type: none"> <li>1. Health effects described in the literature</li> <li>2. Potential for exceeding workplace exposure limit</li> <li>3. Large number of exposed workers</li> </ol>	<ol style="list-style-type: none"> <li>1. Engineering Controls</li> <li>2. Personal Protective Equipment</li> <li>3. Enforcement of workplace regulations</li> </ol>
				Foam insulation installer	<ul style="list-style-type: none"> <li>• Mixing polyurethane resin with catalyst</li> <li>• Applying foam insulation</li> <li>• Cleaning foam mixing equipment</li> </ul>		
QA/Safety Officer	3	Liquid	Boat manufacturing (Toluene di isocyanate - TDI)	All workers	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>2. Illness/symptoms observed in workers</li> <li>3. Health effects described in the literature</li> </ol>	<ol style="list-style-type: none"> <li>1. Engineering Controls</li> <li>2. Education and training of workers</li> <li>3. Enforcement of workplace regulations</li> </ol>

**Table 7. Survey Responses for Welding Fumes**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Not specified	1	Vapor Fume Gas	Boiler repair	Boilermaker	<ul style="list-style-type: none"> <li>• Welding Steel Galvanized</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>1. Illness/symptoms observed in workers</li> <li>1. Health effects described in the literature</li> </ol>	<ol style="list-style-type: none"> <li>1. Education and training of employers</li> <li>1. Enforcement of workplace regulations</li> <li>1. Medical surveillance</li> <li>1. Personal Protective Equipment</li> </ol>
Government agency health & safety professional	1	Fume	Vehicle fabrication/repair	Welder	<ul style="list-style-type: none"> <li>• Welding-large scale, all types</li> <li>• Acetylene torch cutting</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>2. Illness/symptoms observed in workers</li> <li>3. Health effects described in the literature</li> </ol>	<ol style="list-style-type: none"> <li>1. Engineering Controls</li> <li>2. Education and training of workers</li> <li>3. Education and training of employers</li> </ol>
				Vehicle maintenance	<ul style="list-style-type: none"> <li>• Small scale welding</li> </ul>		

**Table 7. Survey Responses for Welding Fumes**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
IH Consultant (private company)	1	Fume	Construction	Welder	<ul style="list-style-type: none"> <li>• Welding pipe</li> <li>• Torch cutting metal</li> <li>• Welding steel plate</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>2. Health effects described in the literature</li> <li>3. Large number of exposed workers</li> </ol>	<ol style="list-style-type: none"> <li>1. Education and training of employers</li> <li>2. Education and training of workers</li> <li>3. Engineering Controls</li> </ol>
				Steel worker	<ul style="list-style-type: none"> <li>• Welding structural steel</li> <li>• Torch cutting steel</li> <li>• Torch cutting painted surface</li> </ul>		
				Demolition worker	<ul style="list-style-type: none"> <li>• Torch cutting structural steel</li> <li>• Torch cutting painted surface</li> </ul>		
Labor representative	1	Fume	Not specified	Welder	<ul style="list-style-type: none"> <li>• Consuming welding electrode</li> </ul>	<ol style="list-style-type: none"> <li>1. Lack of available exposure or health information</li> <li>2. Illness/symptoms observed in workers</li> <li>3. Health effects described in the literature</li> </ol>	<ol style="list-style-type: none"> <li>1. Personal Protective Equipment</li> <li>2. Education and training of workers</li> <li>3. Education and training of employers</li> </ol>



**Table 7. Survey Responses for Welding Fumes**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Labor representative	2	Dust Fume Gas	Industrial/paper and pulp mills (Electric arc welding)	Boilermaker welder	<ul style="list-style-type: none"> <li>• Replace boiler tubes</li> <li>• Repair smoke stack and flue duct</li> <li>• Welding/grinding</li> </ul>	<ol style="list-style-type: none"> <li>1. Lack of available exposure or health information</li> <li>2. Illness/symptoms observed in workers</li> <li>3. Potential for exceeding workplace exposure limit</li> </ol>	<ol style="list-style-type: none"> <li>1. Administrative Controls</li> <li>2. Personal Protective Equipment</li> <li>3. Engineering Controls</li> </ol>
				Boilermaker mech.	<ul style="list-style-type: none"> <li>• Oxy/act cutting on dirty metal</li> <li>• Working around exhaust gas and smoke</li> <li>• Working in and around dust collection systems</li> </ul>		
				Boilermaker mech.	<ul style="list-style-type: none"> <li>• Replacement of bags in dust collection systems</li> <li>• Replacement of collector plates in precipitator</li> <li>• Confined space entry pressure vessels, etc.</li> </ul>		
Airport Manager	2	Vapor Fume	Airport maintenance (This element of the job is exercised infrequently. No real concern.)	Maintenance worker	<ul style="list-style-type: none"> <li>• Welding equipment and machinery</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>1. Illness/symptoms observed in workers</li> <li>1. Health effects described in the literature</li> <li>1. Large number of exposed workers</li> </ol>	<ol style="list-style-type: none"> <li>1. Education and training of employers</li> <li>1. Education and training of workers</li> <li>1. Enforcement of workplace regulations</li> <li>1. Personal Protective Equipment</li> </ol>

### **Carbon monoxide**

Carbon monoxide was mentioned five times, and was the highest ranked hazard for four respondents (see Table 8). Forklift operators, warehouse workers, production workers, office workers, vehicle maintenance technicians, and construction workers were identified as being at risk from carbon monoxide poisoning.

The top concern associated with carbon monoxide was the “potential for exceeding the workplace exposure limit” (the highest-ranked concern for all five respondents). The top action suggested to reduce or eliminate exposure was “engineering controls” (the highest-ranked action for four respondents).

### **Molds**

Molds were mentioned five times, and was the highest ranked hazard for two respondents (see Table 9). Workers located in any building, cable technicians, construction workers, and other workers entering confined spaces were identified as being at risk from mold exposure.

The top concerns associated with molds were the “lack of exposure or health information” and “large number of exposed workers” (both considered the highest-ranked concern for two respondents). The top action suggested to reduce or eliminate exposure was “personal protective equipment” (the highest-ranked action for three respondents).

### **Asphalt**

Asphalt was mentioned five times, and was the highest ranked hazard for two respondents (see Table 10). Workers involved in road paving and roofing were identified as being at risk from asphalt exposure.

The top concern associated with asphalt was the “potential for exceeding the workplace exposure limit” (the highest-ranked concern for three respondents). The top actions suggested to reduce or eliminate exposure were “personal protective equipment” and “education and training of workers” (both considered the highest-ranked action for three respondents).

**Table 8. Survey Responses for Carbon monoxide (including vehicle exhaust and exhaust gases)**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Government agency health & safety professional	1	Gas	Packaging/warehousing operations	Warehouse workers	<ul style="list-style-type: none"> <li>• Fish processing</li> <li>• Food processing</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>1. Illness/symptoms observed in workers</li> <li>1. Health effects described in the literature</li> <li>1. Large number of exposed workers</li> </ol>	<ol style="list-style-type: none"> <li>1. Direct read instrumentation</li> <li>1. Enforcement of workplace regulations</li> <li>1. Engineering controls</li> </ol>
				Production workers	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>		
				Forklift operators	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>		
Government agency health & safety professional	1	Gas	Fruit packing / warehouse / truck loading / cold storage	Forklift driver	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>2. Illness/symptoms observed in workers</li> <li>3. Health effects described in the literature</li> </ol>	<ol style="list-style-type: none"> <li>1. Engineering controls</li> <li>2. Education and training of employers</li> <li>3. Enforcement of workplace regulations</li> </ol>

**Table 8. Survey Responses for Carbon monoxide (including vehicle exhaust and exhaust gases)**

Respondent Occupation	Hazard Rank	Physical Form of Hazard	Industry/Business where Exposure Occurs (Comments)	Job Title of Exposed Workers	Tasks Performed by Exposed Workers	Top Reasons for Concern (Ranked)	Top Actions Necessary (Ranked)
Government agency health & safety professional	1	Gas	Fruit packing/vegetable packing	Forklift operators	<ul style="list-style-type: none"> <li>Moving produce/loading CA rooms</li> <li>Unloading/loading trucks</li> </ul>	<ol style="list-style-type: none"> <li>Health effects reported by chronic exposures (i.e., central nervous system and cardiac muscle)</li> <li>Potential for exceeding workplace exposure limit</li> <li>Health effects described in the literature</li> <li>Large number of exposed workers</li> </ol>	1. Engineering controls
				Fruit sorters/packers	<ul style="list-style-type: none"> <li>Packing fruit/sorting fruit</li> <li>Inspecting fruits</li> </ul>		
				Office workers	<ul style="list-style-type: none"> <li>Management/human resource and other office</li> </ul>		
Worker	1	Fume? Gas	Vehicle storage and worksites (exhaust gases/gasoline and diesel fumes)	Maintenance Techs.	<ul style="list-style-type: none"> <li>Vehicle startup</li> <li>Equipment operation-job site</li> </ul>	<ol style="list-style-type: none"> <li>Potential for exceeding workplace exposure limit</li> <li>Lack of available exposure or health information</li> <li>Health effects described in the literature</li> </ol>	<ol style="list-style-type: none"> <li>Engineering controls</li> <li>Education and training of workers</li> <li>Education and training of employers</li> </ol>

**Table 8. Survey Responses for Carbon monoxide (including vehicle exhaust and exhaust gases)**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Labor representative	3	Fume?	Not specified (Vehicle Exhaust/ Exhaust fossil fuel)	All crafts	<ul style="list-style-type: none"> <li>• Construction</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>2. Large number of exposed workers</li> <li>3. Lack of available exposure or health information</li> </ol>	<ol style="list-style-type: none"> <li>1. Scheduling</li> <li>2. Engineering controls</li> <li>3. Administrative controls</li> </ol>

**Table 9. Survey Responses for Molds**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
IH Consultant (private company)	1	Not specified	All	Not specified	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>	<ol style="list-style-type: none"> <li>1. Lack of available exposure or health information</li> </ol>	<ol style="list-style-type: none"> <li>1. Engineering controls</li> <li>2. Personal Protective Equipment</li> <li>3. Education and training of employers</li> </ol>
Not specified	1	Biological	All building based businesses (This is by far the most frequent problem I dealt with as a consultant. Some employees experience real discomfort and or illness, while others in the area become adversely affected by fear concern.)	Not specified	<ul style="list-style-type: none"> <li>• Not specified</li> </ul>	<ol style="list-style-type: none"> <li>1. Employees may overreact and the hazard is actually more stress-related</li> <li>1. Illness/symptoms observed in workers</li> <li>1. Large number of exposed workers</li> <li>3. Potential for exceeding workplace exposure limit</li> <li>3. Health effects described in the literature</li> <li>3. Lack of available exposure or health information</li> </ol>	<ol style="list-style-type: none"> <li>1. Proper building and maintenance procedures and prompt response to water leaks or standing water on roofs.</li> <li>2. Engineering controls</li> <li>3. Education and training of employers</li> </ol>

**Table 9. Survey Responses for Molds**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Labor representative	2	Liquids Molds or fungi	Not specified (Waste water/molds and fungi in underground vaults and in manholes)	Cable technician	<ul style="list-style-type: none"> <li>Placing underground cable</li> </ul>	<ol style="list-style-type: none"> <li>Potential for exceeding workplace exposure limit</li> <li>Lack of available exposure or health information</li> <li>Large number of exposed workers</li> </ol>	<ol style="list-style-type: none"> <li>Personal Protective Equipment</li> <li>Education and training of employers</li> <li>Education and training of workers</li> </ol>
				Cable splicer	<ul style="list-style-type: none"> <li>Splicing cables/moves and changes</li> </ul>		
IH Consultant (private company)	2	Solid Dust Vapor? Mist	Construction trades	Demolition	<ul style="list-style-type: none"> <li>Not specified</li> </ul>	<ol style="list-style-type: none"> <li>Lack of available exposure or health information</li> <li>Illness/symptoms observed in workers</li> <li>Health effects described in the literature</li> </ol>	<ol style="list-style-type: none"> <li>Developing accepted mold/microbial contaminant standards</li> <li>Education and training of workers</li> <li>Personal Protective Equipment</li> </ol>
				Reconstruction	<ul style="list-style-type: none"> <li>Not specified</li> </ul>		
				Other trades/building occupants	<ul style="list-style-type: none"> <li>Not specified</li> </ul>		
IH Consultant (private company)	2	Aerosolized/airborne spores	Most industries	Entry workers (confined spaces)	<ul style="list-style-type: none"> <li>Entering sump pump pits sewer lines</li> <li>Entering storm drain vaults cisterns, water meter</li> <li>Crawl spaces under buildings</li> </ul>	<ol style="list-style-type: none"> <li>Large number of exposed workers</li> <li>Lack of available exposure or health information</li> <li>Illness/symptoms observed in workers</li> </ol>	<ol style="list-style-type: none"> <li>Personal Protective Equipment</li> <li>Education and training of employers</li> <li>Education and training of workers</li> </ol>

**Table 10. Survey Responses for Asphalt (including fumes)**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Labor representative	1	Liquid Vapor Fume	Asphalt industry (Asphalt antistrip and chevron 7022 oil. There have been some exposures to some kind of toxic fumes from a new mix that is on the market now. With this mix design the contractor had to batch at a very high temperature to get compaction with this high temp. The mix gave off very toxic fumes. The operators and laborers complained of sore eyes, nose, and throat and also felt nausea. L&I was contacted.	Topside operator	<ul style="list-style-type: none"> <li>• Operate topside</li> <li>• Operate spreader, screedman</li> <li>• Operate rollers</li> </ul>	<ol style="list-style-type: none"> <li>1. Illness/symptoms observed in workers</li> <li>2. Lack of available exposure or health information</li> <li>3. Potential for exceeding workplace exposure limit</li> </ol>	<ol style="list-style-type: none"> <li>1. Personal Protective Equipment</li> <li>2. Engineering controls</li> <li>3. Administrative controls</li> </ol>
				Batch plant operator	<ul style="list-style-type: none"> <li>• Batch asphalt</li> <li>• Check oil inventories</li> </ul>		
IH Consultant (private company)	1	Dust Vapor Fume Mist Gas	Road paving	Road paver	<ul style="list-style-type: none"> <li>• Exposure to PAHs while pouring asphalt</li> <li>• Asphalt</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>1. Lack of available exposure or health information</li> </ol>	<ol style="list-style-type: none"> <li>1. Education and training of employers</li> <li>1. Education and training of workers</li> <li>1. Enforcement of workplace regulations</li> <li>1. Medical surveillance</li> <li>1. Personal Protective Equipment</li> </ol>



**Table 10. Survey Responses for Asphalt (including fumes)**

Respondent Occupation	Hazard Rank	Physical Form of Hazard	Industry/Business where Exposure Occurs (Comments)	Job Title of Exposed Workers	Tasks Performed by Exposed Workers	Top Reasons for Concern (Ranked)	Top Actions Necessary (Ranked)
Labor representative	2	Vapor Fume	Construction, road/highway work (Asphalt fumes)	Asphalt raker	<ul style="list-style-type: none"> <li>• Raking fresh asphalt</li> <li>• Shoveling</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>2. Large number of exposed workers</li> <li>3. Illness/symptoms observed in workers</li> </ol>	<ol style="list-style-type: none"> <li>1. Engineering controls</li> <li>2. Personal Protective Equipment</li> <li>3. Enforcement of workplace regulations</li> </ol>
				Laborer	<ul style="list-style-type: none"> <li>• Shoveling</li> <li>• Plant laborer working at asphalt plant</li> </ul>		
IH Consultant (private company)	2	Vapor Fume Mist Gas	Hot tar roofing	Rofer	<ul style="list-style-type: none"> <li>• Exposure to asphalt, vapor, mist, fume (PAHs) while roofing</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>1. Lack of available exposure or health information</li> <li>1. Large number of exposed workers</li> </ol>	<ol style="list-style-type: none"> <li>1. Education and training of employers</li> <li>1. Education and training of workers</li> <li>1. Enforcement of workplace regulations</li> <li>1. Personal Protective Equipment</li> </ol>
Corporate health & safety professional	2	Vapor	Road construction	Road paver operator	<ul style="list-style-type: none"> <li>• Driving paving machine</li> </ul>	<ol style="list-style-type: none"> <li>1. Health effects described in the literature</li> <li>2. Large number of exposed workers</li> <li>3. Lack of available exposure or health information</li> </ol>	<ol style="list-style-type: none"> <li>1. Education and training of workers</li> <li>2. Education and training of employers</li> <li>3. Administrative controls</li> </ol>
				Asphalt spreader	<ul style="list-style-type: none"> <li>• Shoveling asphalt gravel</li> <li>• Spreading gravel</li> </ul>		
				Dump truck driver	<ul style="list-style-type: none"> <li>• Dumping out asphalt gravel</li> <li>• Driving dump truck</li> </ul>		

### **Bodily Fluids**

Bodily fluids were mentioned five times, and was the highest ranked hazard for four respondents (see Table 11). Workers engaged in health care-related occupations (Paramedics/Emergency Medical Technicians, nurses, and instructors) in addition to laboratory technicians and corrections officers were identified as being at risk from exposure to bodily fluids. Note that other respondents mentioned several biological exposures and pathogens associated with bodily fluids, although they are not included in Table 11 (see the entries in Table B-1 under OIICS Source Code 53 - Infectious and parasitic agents). These hazards included “bloodborne pathogens” (mentioned by three respondents), “AIDS”, “Hepatitis B”, “airborne pathogens” and “blood products” (each mentioned by one respondent; exposure in the health care industry was the primary concern).

There was no agreement on either the top concerns associated with exposure to bodily fluids or the actions required to reduce or eliminate exposures.

### **Solvents**

Solvents were mentioned four times, and was the highest ranked hazard for three respondents (see Table 12). A variety of workers in several industries were identified as being at risk from solvent exposure. Note that other respondents mentioned solvents when describing exposures to Paints (see Table 5) and Isocyanates (see Table 6.). In addition, other respondents mentioned individual solvents (see Table B-1), although they are not included in Table 12: methylene chloride (mentioned by two respondents), methyl ethyl ketone, and turpentine (each mentioned by one respondent).

The top concern associated with solvents was “illness/symptoms observed in workers”, including skin irritation (the highest-ranked concern for three respondents). The top action suggested to reduce or eliminate exposure was “education and training of workers” (the highest-ranked action for three respondents).

### **Asbestos**

Asbestos was mentioned four times, and was the highest ranked hazard for three respondents (see Table 13). A variety of workers in several industries were identified as being at risk from asbestos exposure.

There was no agreement on the top concerns associated with exposure to asbestos. The top action suggested to reduce or eliminate exposure was “personal protective equipment” (the highest-ranked action for three respondents).

**Table 11. Survey Responses for Bodily Fluids**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Worker	1	Solid Liquid Mist	Firefighting, Emergency medical service (EMS)	Firefighter/ paramedic	<ul style="list-style-type: none"> <li>• Venipuncture</li> <li>• Intubation</li> <li>• Wound treatment</li> </ul>	<ol style="list-style-type: none"> <li>1. Illness/symptoms observed in workers</li> <li>2. Large number of exposed workers</li> <li>3. Lack of available exposure or health information</li> </ol>	<ol style="list-style-type: none"> <li>1. Medical surveillance</li> <li>2. Personal Protective Equipment</li> <li>3. Education and training of workers</li> </ol>
				Firefighter EMT	<ul style="list-style-type: none"> <li>• Wound treatment</li> <li>• Application of oxygen</li> <li>• CPR</li> </ul>		
				Fire captain EMT	<ul style="list-style-type: none"> <li>• Wound treatment</li> <li>• CPR</li> </ul>		
Corporate health & safety professional	1	Liquid	Cancer research clinic	Nurses	<ul style="list-style-type: none"> <li>• Collecting fluids samples</li> <li>• Cleaning hickman lines</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for developing life threatening illness (HIV, HBV, HCV)</li> </ol>	<ol style="list-style-type: none"> <li>1. Education and training of workers</li> <li>2. Education and training of employers</li> <li>3. Personal Protective Equipment</li> </ol>
				Phleboto-mists	<ul style="list-style-type: none"> <li>• Drawing and handling blood</li> </ul>		
				Lab technicians	<ul style="list-style-type: none"> <li>• Processing body fluids samples</li> </ul>		

**Table 11. Survey Responses for Bodily Fluids**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Labor representative	1	Solid Liquid Vapor Mist	Emergency medical services (Sleep deprivation increases the likelihood of exposure to blood- and bodily fluid-borne pathogens)	Paramedic	<ul style="list-style-type: none"> <li>Emergency medical response and transportation</li> </ul>	<ol style="list-style-type: none"> <li>Shifts are 24+ hours long without adequate rest</li> <li>Health effects described in the literature</li> <li>Potential for exceeding workplace exposure limit</li> </ol>	<ol style="list-style-type: none"> <li>Administrative controls (work shift modification to ensure rest periods of adequate length)</li> <li>Enforcement of workplace regulations</li> </ol>
				Emergency medical technician	<ul style="list-style-type: none"> <li>Emergency medical response and transportation</li> </ul>		
Corrections Officer – County Jail	1	Solid Liquid Vapor Mist	County Jail	Corrections officer	<ul style="list-style-type: none"> <li>Supervising inmates</li> <li>Stopping fights/assaults</li> <li>Stopping suicide attempts</li> </ul>	<ol style="list-style-type: none"> <li>Large number of exposed workers</li> <li>Overall number of injuries to officers and Sergeants</li> <li>Illness/symptoms observed in workers</li> </ol>	<ol style="list-style-type: none"> <li>Administrative controls</li> <li>Personal Protective Equipment</li> <li>Engineering controls</li> </ol>
				Corrections Sgt.	<ul style="list-style-type: none"> <li>Supervising corrections officers</li> <li>Stopping fights/assaults</li> <li>Stopping suicide attempts</li> </ul>		

**Table 11. Survey Responses for Bodily Fluids**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Government agency health & safety professional	2	Liquid Mist	Health care settings, including phlebotomy, nursing courses.  (The number one action most effective in reducing needle stick or exposures bloodborne pathogens is eliminating procedure that puts employee or student at a hazard. If not feasible, using sharps with engineering sharps injury protections whenever using sharps on live humans and practicing phlebotomy on manikins. Education is a necessary second step.)	Instructors	<ul style="list-style-type: none"> <li>Practicing procedures on students or other humans</li> </ul>	<ol style="list-style-type: none"> <li>Potential for exceeding workplace exposure limit</li> <li>Health effects described in the literature</li> <li>Large number of exposed workers</li> </ol>	<ol style="list-style-type: none"> <li>Engineering controls</li> <li>Education and training of employers</li> <li>Education and training of workers</li> </ol>
				Students	<ul style="list-style-type: none"> <li>Practicing procedures on students or other living humans</li> </ul>		

**Table 12. Survey Responses for Solvents**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Labor representative	1	Liquid Fume? Mist	Sawmill Maintenance (Parts cleaning solvents)	Mechanic, rolling stock	<ul style="list-style-type: none"> <li>• Cleaning of parts</li> <li>• Assembling parts</li> <li>• Quality control</li> </ul>	<ol style="list-style-type: none"> <li>1. Large number of exposed workers</li> <li>2. Potential for exceeding workplace exposure limit</li> <li>3. Health effects described in the literature</li> </ol>	<ol style="list-style-type: none"> <li>1. Engineering controls</li> <li>2. Education and training of workers</li> <li>3. Personal Protective Equipment</li> </ol>
				Millwright	<ul style="list-style-type: none"> <li>• Cleaning of parts</li> <li>• Assembling parts</li> <li>• Quality control</li> </ul>		
				Machinist	<ul style="list-style-type: none"> <li>• Cleaning of parts</li> <li>• Handling of parts for remanufacture</li> <li>• Assembly of parts</li> </ul>		
EH&S Technologist (Hazardous materials & waste)	1	Liquid Vapor Mist	Research facilities (Simultaneous exposures from a xylene still and bulking operation located in the same room. No ventilation in hold of trucks represents a confined space that exceeds TLVs. This was brought to the attention of management, but no actions were taken to date. No exposure monitoring has been taken. There are ineffective risk communication and management policies.)	EH&S Technologists	<ul style="list-style-type: none"> <li>• Waste collection and transportation</li> <li>• Waste processing</li> <li>• Waste bulking and recycling and lab packing</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>1. Illness/symptoms observed in workers</li> <li>1. Health effects described in the literature</li> <li>1. Lack of available exposure or health information</li> <li>1. Large number of exposed workers</li> </ol>	<ol style="list-style-type: none"> <li>1. Poorly maintained policies, poor preventative maintenance of engineering controls</li> <li>1. Education and training of employers</li> <li>1. Education and training of workers</li> <li>1. Enforcement of workplace regulations</li> <li>1. Medical surveillance</li> <li>1. Personal Protective Equipment</li> <li>1. Engineering Controls</li> </ol>
				Waste handlers (contractors)	<ul style="list-style-type: none"> <li>• Waste lab packing</li> <li>• Waste bulking and processing</li> <li>• Loading and transporting</li> </ul>		
				Industrial hygienist	<ul style="list-style-type: none"> <li>• Recycling</li> <li>• Waste neutralization and remediation</li> <li>• Waste treatment</li> </ul>		

**Table 12. Survey Responses for Solvents**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Academic IH or researcher	1	Liquid	Laboratories (Acetone/MEI)	Research Scientist	<ul style="list-style-type: none"> <li>• Making standards/test atmospheres.</li> <li>• Cleaning parts</li> </ul>	1. Potential for exceeding workplace exposure limit	<ol style="list-style-type: none"> <li>1. Education and training of workers</li> <li>2. Personal Protective Equipment</li> </ol>
				Student Res. Asst.	<ul style="list-style-type: none"> <li>• Collecting bench test data</li> <li>• Preparing gas/vapor standards</li> </ul>	1. Skin irritation	
Government agency health & safety professional	3	Vapor	Not specified	Painters	<ul style="list-style-type: none"> <li>• Painting</li> <li>• Prepping surfaces</li> </ul>	1. Illness/symptoms observed in workers	<ol style="list-style-type: none"> <li>1. Education and training of workers</li> <li>2. Education and training of employers</li> <li>3. Engineering controls</li> </ol>
				Printers	<ul style="list-style-type: none"> <li>• Cleaning rollers</li> </ul>	<ol style="list-style-type: none"> <li>2. Health effects described in the literature</li> <li>2. Large number of exposed workers</li> </ol>	

**Table 13. Survey Responses for Asbestos**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Labor representative	1	Dust	Potrooms, courtyards	Carbon Setter	<ul style="list-style-type: none"> <li>• Sweeping</li> <li>• Cleaning courtyards</li> </ul>	<ol style="list-style-type: none"> <li>1. Large number of exposed workers</li> <li>2. Potential for exceeding workplace exposure limit</li> <li>3. Illness/symptoms observed in workers</li> </ol>	<ol style="list-style-type: none"> <li>1. Personal Protective Equipment</li> <li>2. Administrative controls</li> <li>3. Engineering controls</li> </ol>
				Pot Tender	<ul style="list-style-type: none"> <li>• Sweeping</li> <li>• Cleaning courtyards</li> </ul>		
IH Consultant (private company)	1	Dust	Asbestos abatement	Air monitoring technician	<ul style="list-style-type: none"> <li>• Perform air monitoring and inspections</li> </ul>	<ol style="list-style-type: none"> <li>1. Health effects described in the literature</li> <li>2. Lack of available exposure or health information</li> <li>3. Large number of exposed workers</li> </ol>	<ol style="list-style-type: none"> <li>1. Personal Protective Equipment</li> <li>2. Education and training of employers</li> <li>3. Education and training of workers</li> </ol>
Airport Manager	1	Dust	Airport industrial park	Maintenance worker	<ul style="list-style-type: none"> <li>• Removal or installation of asbestos shingles</li> <li>• Removal of asbestos hard board</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>1. Illness/symptoms observed in workers</li> <li>1. Health effects described in the literature</li> <li>1. Lack of available exposure or health information</li> <li>1. Large number of exposed workers</li> </ol>	<ol style="list-style-type: none"> <li>1. Education and training of employers</li> <li>1. Education and training of workers</li> <li>1. Enforcement of workplace regulations</li> <li>1. Personal Protective Equipment</li> </ol>



**Table 13. Survey Responses for Asbestos**

<b>Respondent Occupation</b>	<b>Hazard Rank</b>	<b>Physical Form of Hazard</b>	<b>Industry/Business where Exposure Occurs (Comments)</b>	<b>Job Title of Exposed Workers</b>	<b>Tasks Performed by Exposed Workers</b>	<b>Top Reasons for Concern (Ranked)</b>	<b>Top Actions Necessary (Ranked)</b>
Not specified	2	Solid? Dust	Boiler Repair	Boilermaker	<ul style="list-style-type: none"> <li>• Removing insulation on steam pipes</li> <li>• Removing gasket material</li> <li>• Removing insulation coating on steel</li> </ul>	<ol style="list-style-type: none"> <li>1. Potential for exceeding workplace exposure limit</li> <li>2. Illness/symptoms observed in workers</li> <li>3. Large number of exposed workers</li> </ol>	<ol style="list-style-type: none"> <li>1. Education and training of employers</li> <li>2. Education and training of workers</li> <li>3. Enforcement of workplace regulations</li> </ol>

## **Industries Associated with the Principal Hazards**

Many respondents provided insufficient information to assign four-digit SIC codes to their specified industry of concern. Consequently, businesses were coded at the Industry Division level. (Each Division is comprised of several Major Industry Groups, which are denoted by two-digit SIC codes.)

The Industry Divisions associated with the ten most frequently mentioned hazards are summarized in Table 14. The following Industry Divisions were not associated with these hazards and were excluded from the table: Agriculture, Forestry, and Fishing (Division A); Retail Trade (Division G); and Finance, Insurance, and Real Estate (Division H).

The most frequently mentioned Industry Division was Construction (22 hazard mentions), in which silica and asphalt were the primary hazards of concern. Seven of the ten most frequently mentioned hazards were associated with the construction industry.

The next most frequently mentioned industry (Services) was mentioned 11 times; eight of the ten most frequently mentioned hazards were associated with this Industry Division.

**Table 14. Industries Associated with the Principal Hazards**

Hazard	Number of Hazard Mentions by Industry Division:								
	Division B: Mining	Division C: Construction	Division D: Manufacturing	Division E: Transportation, Communications, Electric, Gas, and Sanitary Services	Division F: Wholesale Trade	Division I: Services	Division J: Public Administration	Not Classifiable	TOTAL
Silica (including abrasive blasting, silica dusts, and fibrous siliceous dusts)	1	10				1			12
Paints (including "fumes" and coatings)		3	2			2			7
Isocyanates (including TDI, MDI, polyisocyanate liquid, and urethanes)		1	2			2		2	7
Welding fumes		1	1	1		2		1	6
Carbon monoxide (including vehicle exhaust and exhaust gases)			1	1	2			1	5
Molds		1						4	5
Asphalt (including fumes)		5							5
Bodily fluids				1		1	2	1	5
Solvents			1			2		1	4
Asbestos		1	1	1		1			4
<b>TOTAL</b>	<b>1</b>	<b>22</b>	<b>8</b>	<b>4</b>	<b>2</b>	<b>11</b>	<b>2</b>	<b>10</b>	<b>60</b>



## Discussion

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The survey of occupational chemical and biological hazards was the first such study conducted in Washington State. By soliciting the opinions of a broad spectrum of stakeholders, we anticipated gathering data that would help prioritize workplace hazards for public health intervention. However, the poor response to the survey did not allow us to draw conclusions about the relative importance of the hazards identified. Further, additional hazards that may be of great importance may have not have been mentioned by the relatively few respondents. Nonetheless, the survey data may be used as a starting point for working with stakeholders to further evaluate the specified hazards and identify appropriate education and outreach activities. A more effective use of this survey instrument may be to target stakeholders associated with specific industry sectors.

A striking feature of the principal hazards identified (especially silica, paints, welding fumes, carbon monoxide, asphalt, bodily fluids, solvents, and asbestos) is that they have been recognized as causes of illness in the working population for decades, if not centuries. Clearly, there continues to be a need to develop and implement effective prevention and outreach activities aimed at reducing or eliminating exposures to these well-documented hazards. The construction industry was mentioned most frequently; the principal hazards associated with this industry were silica and asphalt.

Other hazards identified in this study may be considered as “emerging”. For example, although isocyanates have been recognized as a hazard for decades in the automotive painting industry (NIOSH 1996b), the relatively recent use of these substances as coatings for truck bed liners and other surfaces deserves attention (Lofgren et al. 2003). Similarly, it has been suggested that mold exposures in office environments have become more problematic since the relatively recent advent of “tight buildings” and the reliance on complex ventilation and air conditioning units to supply fresh air to building occupants. Again, there is a vital need for health & safety professionals to characterize these exposures and effectively communicate the concomitant risks to concerned workers and employers.

The concern mentioned most frequently in association with the principal hazards was the potential for exceeding the workplace exposure limit; this was the top concern associated with exposure to silica, paints, welding fumes, carbon monoxide, and asphalt. Clearly, there is a need for health & safety professionals to evaluate exposures relative to Permissible Exposure Limits and to mitigate exposures that exceed workplace standards.

According to the “hierarchy of industrial hygiene controls”, personal protective equipment (PPE) should be viewed as the last line of defense against exposure to hazardous materials. Engineering- and administrative- controls should always be considered before relying on PPE to protect workers. However, survey respondents ranked PPE as the most effective means to reduce or eliminate exposures to silica, paints, welding fumes, molds, asphalt, and asbestos. While PPE may be the only practicable solution in certain circumstances, there is a critical need for health & safety professionals to evaluate these exposures, so that workers are not dependent on PPE.

Readers interested in discussing the hazards identified in this study are encouraged to contact the SHARP Program at 1-888-66-SHARP.

## References

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- Baggs J et al. 2000. Workers' Compensation Based Surveillance of Asthma, Hospitalized Burns, and Adult Blood Lead Levels in Washington State, 1994-1998. Technical report 64-1-2000. Safety & Health Assessment & Research for Prevention, Washington State Department of Labor and Industries, Olympia, Washington.
- Baggs J, Curwick C, Silverstein B. 2002. Work-Related Burns in Washington State, 1994 to 1998. *Journal of Occupational and Environmental Medicine*, 44(7), 692-699.
- Cohen M, Kalat J, Silverstein S. 1999. Work-Related Traumatic Head and Brain Injuries in Washington State, 1990-1997. Technical report 57-1-1999. Safety & Health Assessment & Research for Prevention, Washington State Department of Labor and Industries, Olympia, Washington.
- Department of Health. 2002a. Work-related Asthma. In: *The Health of Washington State*, July 2002. Available from: <http://www.doh.wa.gov/HWS>.
- Department of Health. 2002b. Fatal Occupational Injuries. In: *The Health of Washington State*, July 2002. Available from: <http://www.doh.wa.gov/HWS>.
- Drozdowsky SL. 2000. Development of a workplace chemical ranking system to identify the chemicals most hazardous to workers in Washington. Thesis (M.E.S.). The Evergreen State College.
- Foley M. 2002. Violence in Washington Workplaces, 1995-2000. Technical report 39-4-2002. Safety & Health Assessment & Research for Prevention, Washington State Department of Labor and Industries, Olympia, Washington.
- Greife A, Young R, Carroll M, Sieber WK, Pedersen D, Sundin D, Seta J. 1995. National Institute for Occupational Safety and Health general industry occupational exposure databases: Their structure, capabilities, and limitations. *Applied Occupational and Environmental Hygiene*, 10(4), 264-269.
- Lofgren DJ et al. 2003. MDI exposure for spray-on truck bed lining. Submitted to *Applied Occupational and Environmental Hygiene Journal*.

- National Institute for Occupational Safety and Health. 1988. National occupational exposure survey field guidelines. Vol. I. Seta JA, Sundin DS, Pedersen DH, eds. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 88-106.
- National Institute for Occupational Safety and Health. 1989a. National occupational exposure survey sampling methodology. Vol. II. Sieber WK, ed. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 89-102.
- National Institute for Occupational Safety and Health. 1989b. National occupational exposure survey analysis of management interview responses. Vol. III. Pedersen DH, Sieber WK, eds. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 89-103.
- National Institute for Occupational Safety and Health. 1996a. National Occupational Research Agenda, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, April 1996. Available from: <http://www.cdc.gov/niosh/tools.html#surveys>
- National Institute for Occupational Safety and Health. 1996b. NIOSH Alert: Preventing asthma and death from diisocyanate exposure. U.S. Department of Health and Human Services, Centers for Disease Control, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication No. 96-111. Available from: <http://www.cdc.gov/niosh/asthma.html>.
- Sama S et al. 1998. Work-Related Skin Disorders in Washington State, 1993-1997. Technical report 36-4-1998. Safety & Health Assessment & Research for Prevention, Washington State Department of Labor and Industries, Olympia, Washington.
- Silverstein B, Kalat J. 2002. Work-related Musculoskeletal Disorders of the Neck, Back and Upper Extremity in Washington State, 1992-2000. Technical report 40-6-2002. Safety & Health Assessment & Research for Prevention, Washington State Department of Labor and Industries, Olympia, Washington.
- Whittaker SG, Curwick CC. 2001. Surveillance for Occupational Lead Poisoning, State of Washington, 1993-2001: Incorporating data from May 15, 1993 through June 30, 2001. Technical report 44-3-2001. Safety & Health Assessment & Research for Prevention, Washington State Department of Labor and Industries, Olympia, Washington.



## **Appendix A:**

### **Chemical and Biological Hazards Survey**





STATE OF WASHINGTON  
DEPARTMENT OF LABOR AND INDUSTRIES  
**Safety & Health Assessment & Research for Prevention (SHARP)**  
PO Box 44330, Olympia, WA 98504-4330 (360) 902-5669

October 22, 2001

Dear Safety & Health Professional:

The SHARP Program is asking for the safety & health community's help in setting our research, education, and outreach priorities. Washington workplaces contain numerous chemical and biological hazards that have the potential to cause adverse health effects, like cancer, asthma, and skin problems. While Workers' Compensation data can be used to identify work-related injuries, these data are less useful for tracking chemical and biological exposures that cause adverse health problems. SHARP has therefore developed a *Survey of Chemical and Biological Hazards* to help identify the most serious chemical and biological hazards in Washington workplaces and the workers who are exposed to them. The survey is being distributed to labor organizations, businesses, and health & safety professionals across Washington State.

Your input is critically important in this effort. We are asking you to describe up to three chemical or biological hazards that you think are the biggest problems in Washington workplaces. "Chemical hazards" are any form (solid, liquid, or gas) of a hazardous chemical substance (including dusts, vapors, mists, fumes, etc.). "Biological hazards" include animal tissues (e.g., meats), bodily fluids (like blood, urine, or feces), bacteria, viruses, molds, or fungi.

Please return the completed **survey and cover sheet** to the SHARP Program **no later than November 16, 2001** - in the enclosed postage-paid return envelope or fax it to 360-902-5672. SHARP's mission is to conduct research, monitoring, and demonstration projects that promote healthy work environments and the prevention of workplace injuries and illnesses. **SHARP does not enforce regulations, compliance, or penalties.** All information you provide will be treated in the strictest confidence. We will not share any information that would identify a survey participant with anyone. We will only publish data that summarizes information for all respondents combined (with no identifying information).

Although you may complete this survey anonymously, please provide your contact information if you would like to discuss your selection with SHARP researchers or receive a copy of the survey results. Your name and affiliation will not be shared with anyone outside of the SHARP Program.

Please call SHARP toll-free at 1-888-66-SHARP (1-888-667-4277) or e-mail me at [whiw235@LNI.wa.gov](mailto:whiw235@LNI.wa.gov) if you have any questions about this survey. For more information about SHARP, please visit our web site at [www.LNI.wa.gov/sharp](http://www.LNI.wa.gov/sharp).

**Thank you for helping SHARP protect Washington's workers from hazardous exposures!**

Sincerely,

Steve Whittaker, Ph.D.  
SHARP Toxicologist

Enclosures





STATE OF WASHINGTON  
DEPARTMENT OF LABOR AND INDUSTRIES  
**Safety & Health Assessment & Research for Prevention (SHARP)**  
PO Box 44330, Olympia, WA 98504-4330 (360) 902-5669

October 22, 2001

Dear Labor Representative:

The SHARP Program is asking for organized labor's help in setting our research, education, and outreach priorities. Washington workplaces contain numerous chemical and biological hazards that have the potential to cause adverse health effects, like cancer, asthma, and skin problems. While Workers' Compensation data can be used to identify work-related injuries, these data are less useful for tracking chemical and biological exposures that cause adverse health problems. SHARP has therefore developed a *Survey of Chemical and Biological Hazards* to help identify the most serious chemical and biological hazards in Washington workplaces and the workers who are exposed to them. The survey is being distributed to labor organizations, businesses, and health & safety professionals across Washington State.

The input of Washington's working men and women is critically important in this effort. We are asking that you identify a suitably qualified individual within your labor organization to complete this survey. We would like your representative to describe up to three chemical or biological hazards that he or she thinks are the biggest problems in Washington workplaces. "Chemical hazards" are any form (solid, liquid, or gas) of a hazardous chemical substance (including dusts, vapors, mists, fumes, etc.). "Biological hazards" include animal tissues (e.g., meats), bodily fluids (like blood, urine, or feces), bacteria, viruses, molds, or fungi.

Please have your representative return the completed **survey and cover sheet** to the SHARP Program **no later than November 16, 2001** - in the enclosed postage-paid return envelope or fax it to 360-902-5672. SHARP's mission is to conduct research, monitoring, and demonstration projects that promote healthy work environments and the prevention of workplace injuries and illnesses. **SHARP does not enforce regulations, compliance, or penalties.** All information provided will be treated in the strictest confidence. We will not share any information that would identify a survey participant with anyone. We will only publish data that summarizes information for all respondents combined (with no identifying information).

Although this survey may be completed anonymously, the survey respondent may provide contact information if he or she would like to discuss the selection with SHARP researchers or receive a copy of the survey results. Participants' names and affiliations will not be shared with anyone outside of the SHARP Program.

Please call SHARP toll-free at 1-888-66-SHARP (1-888-667-4277) or e-mail me at [whiw235@LNI.wa.gov](mailto:whiw235@LNI.wa.gov) if you have any questions about this survey. For more information about SHARP, please visit our web site at [www.LNI.wa.gov/sharp](http://www.LNI.wa.gov/sharp).

**Thank you for helping SHARP protect Washington's workers from hazardous exposures!**

Sincerely,

Steve Whittaker, Ph.D.  
SHARP Toxicologist

Enclosures





STATE OF WASHINGTON  
DEPARTMENT OF LABOR AND INDUSTRIES  
**Safety & Health Assessment & Research for Prevention (SHARP)**  
PO Box 44330, Olympia, WA 98504-4330 (360) 902-5669

January 3, 2002

Dear Business Association Member:

The SHARP Program is asking for the business community's help in setting our research, education, and outreach priorities. Washington workplaces contain numerous chemical and biological hazards that have the potential to cause adverse health effects, like cancer, asthma, and skin problems. While Workers' Compensation data can be used to identify work-related injuries, these data are less useful for tracking chemical and biological exposures that cause adverse health problems. SHARP has therefore developed a *Survey of Chemical and Biological Hazards* to help identify the most serious chemical and biological hazards in Washington workplaces and the workers who are exposed to them. The survey is being distributed to labor organizations, businesses, and health & safety professionals across Washington State.

The input of Washington's business community is critically important in this effort. We are asking that you identify a suitably qualified individual within your association to complete this survey. We would like your representative to describe up to three chemical or biological hazards that he or she thinks are the biggest problems in Washington workplaces. "Chemical hazards" are any form (solid, liquid, or gas) of a hazardous chemical substance (including dusts, vapors, mists, fumes, etc.). "Biological hazards" include animal tissues (e.g., meats), bodily fluids (like blood, urine, or feces), bacteria, viruses, molds, or fungi.

Please have your representative return the completed **survey and cover sheet** to the SHARP Program **no later than February 15, 2002** - in the enclosed postage-paid return envelope or fax it to 360-902-5672. SHARP's mission is to conduct research, monitoring, and demonstration projects that promote healthy work environments and the prevention of workplace injuries and illnesses. **SHARP does not enforce regulations, compliance, or penalties.** All information provided will be treated in the strictest confidence. We will not share any information that would identify a survey participant with anyone. We will only publish data that summarizes information for all respondents combined (with no identifying information).

Although this survey may be completed anonymously, the survey respondent may provide contact information if he or she would like to discuss the selection with SHARP researchers or receive a copy of the survey results. Participants' names and affiliations will not be shared with anyone outside of the SHARP Program.

Please call SHARP toll-free at 1-888-66-SHARP (1-888-667-4277) or e-mail me at [whiw235@LNI.wa.gov](mailto:whiw235@LNI.wa.gov) if you have any questions about this survey. For more information about SHARP, please visit our web site at [www.LNI.wa.gov/sharp](http://www.LNI.wa.gov/sharp).

**Thank you for helping SHARP protect Washington's workers from hazardous exposures!**

Sincerely,

Steve Whittaker, Ph.D.  
SHARP Toxicologist

Enclosures





# SHARP's Survey of Chemical and Biological Hazards in Washington State Workplaces

## SURVEY INSTRUCTIONS

In order to help us correctly record your concern, please provide the precise name of the hazard, rather than using general terms like "metal", "solvent", or "pesticide". For a specific product, please provide the manufacturer's and the product's name as they appear on the MSDS. You may include a copy of the MSDS in the return envelope. If you cannot identify the chemical or locate the MSDS, you may provide a detailed description on the reverse side of the survey sheet. **Please use a black or dark blue pen to complete the survey. Please print any handwritten comments.**

Please rank your hazards in order of importance. For example, the sheet entitled "Hazard #1" should be the hazard that you think is most important and "Hazard #3" the least important. You may submit only one or two hazards for consideration. An example of a completed survey is attached for your information.

**Please return the completed survey and this cover sheet to the SHARP Program in the enclosed postage-paid return envelope no later than November 16, 2001. You may also fax them to 360-902-5672 (please be sure to fax both sides if you have made notes on the reverse of the survey). If you would like additional copies, please contact SHARP at 1-888-66-SHARP or download a copy from our web site at [www.LNI.wa.gov/sharp/HazChem](http://www.LNI.wa.gov/sharp/HazChem).**

## WHAT IS YOUR OCCUPATION?

Which job title **best** describes your position (please check **only** one):

- Labor representative
- Employer
- Worker
- Government agency health & safety professional
- Corporate health & safety professional
- IH Consultant (private company)
- Academic IH or researcher
- Plant or facility health & safety professional
- Other (specify) \_\_\_\_\_

## CONTACT INFORMATION (OPTIONAL)

Although you may complete this survey anonymously, please provide contact information if you would like to discuss your selection with SHARP researchers or receive a copy of the results. Your name and affiliation will not be shared with anyone outside of the SHARP Program:

Name (Last, First): \_\_\_\_\_

Affiliation: \_\_\_\_\_

Phone: (\_\_\_\_\_) \_\_\_\_\_

Fax: (\_\_\_\_\_) \_\_\_\_\_

E-mail: \_\_\_\_\_



- EXAMPLE -

**HAZARD #1**

1. Name of hazard: SOLUBLE METALWORKING FLUID

2. Physical form of hazard (check all that apply):

- Solid       Liquid       Fume       Gas  
 Dust       Vapor       Mist       Other (specify) DROPLETS

3. Industry/business where exposure occurs: AEROSPACE / MACHINE SHOP

4. What are the job titles of the exposed workers and what tasks do they perform? (List in rank order of exposure):

Job Title 1. <u>MACHINIST</u>	Job Task 1. <u>MACHINING PARTS</u> Job Task 2. <u>MACHINE MAINTENANCE</u> Job Task 3. <u>PART CLEAN-UP</u>
Job Title 2. <u>ASSEMBLER</u>	Job Task 1. <u>CLEANING OFF PARTS</u> Job Task 2. <u>ASSEMBLING PARTS</u> Job Task 3. _____
Job Title 3. <u>SUPERVISOR</u>	Job Task 1. <u>INSPECTING PARTS</u> Job Task 2. <u>MACHINE MAINTENANCE</u> Job Task 3. _____

5. Why is this hazard a concern? (Rank in order of concern, where "1" is the primary reason for concern and "6" is the lowest concern):

- 1 Potential for exceeding workplace exposure limit      2 Lack of available exposure or health information  
3 Illness/symptoms observed in workers      5 Large number of exposed workers  
4 Health effects described in the literature      \_\_\_\_\_ Other (specify) \_\_\_\_\_

6. What actions do you think would be the most effective in reducing or eliminating exposures to this hazard? (Rank in order of effectiveness, where "1" is the most effective action and "8" is the least effective):

- 6 Education and training of employers      5 Workplace controls - personal protective equipment<sup>a</sup>  
3 Education and training of workers      2 Workplace controls - administrative controls<sup>b</sup>  
4 Enforcement of workplace regulations      1 Workplace controls - engineering controls<sup>c</sup>  
7 Medical surveillance (physical exams, blood or urine tests, etc.)      \_\_\_\_\_ Other (specify) \_\_\_\_\_

<sup>a</sup>Personal protective equipment includes gloves, gauntlets, coveralls, aprons, respirators, boots, shoes, and face or eye protection.

<sup>b</sup>Administrative controls include job rotation or other work shift modifications, prohibition of eating and tobacco use, housekeeping (e.g., surface cleaning), hygiene facilities (e.g., wash stations, showers), laundry facilities, and maintenance programs.

<sup>c</sup>Engineering controls include enclosure of the process (e.g., glove box), wetting the process, enclosure of the employee (e.g., control room), remote/robotic control, local exhaust ventilation (e.g., hood at source), and dilution ventilation (e.g., fans, general ventilation).

Comments

SEE ATTACHED MSDS

Please use the reverse side of this sheet to provide additional information.



# HAZARD #1

1. Name of hazard: \_\_\_\_\_

2. Physical form of hazard (check all that apply):

- Solid       Liquid       Fume       Gas  
 Dust       Vapor       Mist       Other (specify) \_\_\_\_\_

3. Industry/business where exposure occurs: \_\_\_\_\_

4. What are the job titles of the exposed workers and what tasks do they perform? (List in rank order of exposure):

Job Title 1. _____	Job Task 1. _____ Job Task 2. _____ Job Task 3. _____
Job Title 2. _____	Job Task 1. _____ Job Task 2. _____ Job Task 3. _____
Job Title 3. _____	Job Task 1. _____ Job Task 2. _____ Job Task 3. _____

5. Why is this hazard a concern? (Rank in order of concern, where "1" is the primary reason for concern and "6" is the lowest concern):

- Potential for exceeding workplace exposure limit       Lack of available exposure or health information  
 Illness/symptoms observed in workers       Large number of exposed workers  
 Health effects described in the literature       Other (specify) \_\_\_\_\_

6. What actions do you think would be the most effective in reducing or eliminating exposures to this hazard? (Rank in order of effectiveness, where "1" is the most effective action and "8" is the least effective):

- Education and training of employers       Workplace controls – personal protective equipment<sup>a</sup>  
 Education and training of workers       Workplace controls – administrative controls<sup>b</sup>  
 Enforcement of workplace regulations       Workplace controls – engineering controls<sup>c</sup>  
 Medical surveillance (physical exams, blood or urine tests, etc.)       Other (specify) \_\_\_\_\_

<sup>a</sup>Personal protective equipment includes gloves, gauntlets, coveralls, aprons, respirators, boots, shoes, and face or eye protection.

<sup>b</sup>Administrative controls include job rotation or other work shift modifications, prohibition of eating and tobacco use, housekeeping (e.g., surface cleaning), hygiene facilities (e.g., wash stations, showers), laundry facilities, and maintenance programs.

<sup>c</sup>Engineering controls include enclosure of the process (e.g., glove box), wetting the process, enclosure of the employee (e.g., control room), remote/robotic control, local exhaust ventilation (e.g., hood at source), and dilution ventilation (e.g., fans, general ventilation).

## Comments

Please use the reverse side of this sheet to provide additional information.



## HAZARD #2

1. Name of hazard: \_\_\_\_\_

2. Physical form of hazard (check all that apply):

- Solid       Liquid       Fume       Gas  
 Dust       Vapor       Mist       Other (specify) \_\_\_\_\_

3. Industry/business where exposure occurs: \_\_\_\_\_

4. What are the job titles of the exposed workers and what tasks do they perform? (List in rank order of exposure):

Job Title 1. _____	Job Task 1. _____ Job Task 2. _____ Job Task 3. _____
Job Title 2. _____	Job Task 1. _____ Job Task 2. _____ Job Task 3. _____
Job Title 3. _____	Job Task 1. _____ Job Task 2. _____ Job Task 3. _____

5. Why is this hazard a concern? (Rank in order of concern, where "1" is the primary reason for concern and "6" is the lowest concern):

- Potential for exceeding workplace exposure limit       Lack of available exposure or health information  
 Illness/symptoms observed in workers       Large number of exposed workers  
 Health effects described in the literature       Other (specify) \_\_\_\_\_

6. What actions do you think would be the most effective in reducing or eliminating exposures to this hazard? (Rank in order of effectiveness, where "1" is the most effective action and "8" is the least effective):

- Education and training of employers       Workplace controls – personal protective equipment<sup>a</sup>  
 Education and training of workers       Workplace controls – administrative controls<sup>b</sup>  
 Enforcement of workplace regulations       Workplace controls – engineering controls<sup>c</sup>  
 Medical surveillance (physical exams, blood or urine tests, etc.)       Other (specify) \_\_\_\_\_

<sup>a</sup>Personal protective equipment includes gloves, gauntlets, coveralls, aprons, respirators, boots, shoes, and face or eye protection.

<sup>b</sup>Administrative controls include job rotation or other work shift modifications, prohibition of eating and tobacco use, housekeeping (e.g., surface cleaning), hygiene facilities (e.g., wash stations, showers), laundry facilities, and maintenance programs.

<sup>c</sup>Engineering controls include enclosure of the process (e.g., glove box), wetting the process, enclosure of the employee (e.g., control room), remote/robotic control, local exhaust ventilation (e.g., hood at source), and dilution ventilation (e.g., fans, general ventilation).

### Comments

Please use the reverse side of this sheet to provide additional information.





## HAZARD #3

1. Name of hazard: \_\_\_\_\_

2. Physical form of hazard (check all that apply):

- Solid       Liquid       Fume       Gas  
 Dust       Vapor       Mist       Other (specify) \_\_\_\_\_

3. Industry/business where exposure occurs: \_\_\_\_\_

4. What are the job titles of the exposed workers and what tasks do they perform? (List in rank order of exposure):

Job Title 1. _____	Job Task 1. _____ Job Task 2. _____ Job Task 3. _____
Job Title 2. _____	Job Task 1. _____ Job Task 2. _____ Job Task 3. _____
Job Title 3. _____	Job Task 1. _____ Job Task 2. _____ Job Task 3. _____

5. Why is this hazard a concern? (Rank in order of concern, where "1" is the primary reason for concern and "6" is the lowest concern):

- Potential for exceeding workplace exposure limit       Lack of available exposure or health information  
 Illness/symptoms observed in workers       Large number of exposed workers  
 Health effects described in the literature       Other (specify) \_\_\_\_\_

6. What actions do you think would be the most effective in reducing or eliminating exposures to this hazard? (Rank in order of effectiveness, where "1" is the most effective action and "8" is the least effective):

- Education and training of employers       Workplace controls – personal protective equipment<sup>a</sup>  
 Education and training of workers       Workplace controls – administrative controls<sup>b</sup>  
 Enforcement of workplace regulations       Workplace controls – engineering controls<sup>c</sup>  
 Medical surveillance (physical exams, blood or urine tests, etc.)       Other (specify) \_\_\_\_\_

<sup>a</sup>Personal protective equipment includes gloves, gauntlets, coveralls, aprons, respirators, boots, shoes, and face or eye protection.

<sup>b</sup>Administrative controls include job rotation or other work shift modifications, prohibition of eating and tobacco use, housekeeping (e.g., surface cleaning), hygiene facilities (e.g., wash stations, showers), laundry facilities, and maintenance programs.

<sup>c</sup>Engineering controls include enclosure of the process (e.g., glove box), wetting the process, enclosure of the employee (e.g., control room), remote/robotic control, local exhaust ventilation (e.g., hood at source), and dilution ventilation (e.g., fans, general ventilation).

### Comments

Please use the reverse side of this sheet to provide additional information



**Appendix B:**  
**Hazards Identified**



<b>Table B-1. Hazards Identified by Survey Respondents</b>				
<b>OIICS Source/Hazard</b>	<b>Number of Mentions as:</b>			<b>Total</b>
	<b>Hazard Rank #1</b>	<b>Hazard Rank #2</b>	<b>Hazard Rank #3</b>	
<b>Chemicals and chemical products, unspecified (00)</b>				<b>10</b>
Analytical reagents		1		1
Biological and chemical agents	1			1
Chemical and biological hazards		1		1
Chemical carcinogens		1		1
Chemicals	1			1
Confined spaces			1	1
Hazardous materials	1			1
Reproductive toxins			1	1
Test gases		1		1
VOCs			1	1
<b>Acids (01)</b>				<b>1</b>
Acids			1	1
<b>Alkalis (02)</b>				<b>2</b>
Cement mix-C34	1			1
Dust (Concrete/sheetrock)		1		1
<b>Aromatics and hydrocarbon derivatives, except halogenated (03)</b>				<b>3</b>
Formaldehyde	1			1
Gluteraldehyde	1			1
Methyl ethyl ketone	1			1
<b>Halogens and halogen compounds (04)</b>				<b>6</b>
Chlorine	1			1
Chlorine dioxide		1		1
Fluoride		1		1
Isoflurane	1			1
Methylene chloride	2			2

<b>Table B-1. Hazards Identified by Survey Respondents</b>				
<b>OIICS Source/Hazard</b>	<b>Number of Mentions as:</b>			<b>Total</b>
	<b>Hazard Rank #1</b>	<b>Hazard Rank #2</b>	<b>Hazard Rank #3</b>	
<b>Metallic particulates, trace elements, dusts, powders, fumes (05)</b>				<b>12</b>
Aluminum		1		1
Beryllium	1			1
Hard metals		1		1
Lead		1		1
Metals	1			1
Veral dust (silver dust)	1			1
Welding fumes	4	2		6
<b>Agricultural chemicals and other pesticides (06)</b>				<b>2</b>
Pesticides	1	1		2
<b>Chemical products – general (07)</b>				<b>27</b>
Buried drop wire splices (Splicing chemicals)		1		1
Chemical for copier (including toner)	1	1		2
Cleaning materials			1	1
Hair chemicals			1	1
Lacquer thinner		1		1
Metalworking fluids		1	2	3
Organic vapors (Glues/mastics)		1		1
Paint (including fumes and coatings)	4	2	1	7
Photographic chemicals		1		1
PVC glue		1		1
Research pharmaceuticals		1		1
Silicon lubricant	1			1
Solvents	3		1	4
Tear gas	1			1
Turpentine			1	1

<b>Table B-1. Hazards Identified by Survey Respondents</b>				
<b>OIICS Source/Hazard</b>	<b>Number of Mentions as:</b>			<b>Total</b>
	<b>Hazard Rank #1</b>	<b>Hazard Rank #2</b>	<b>Hazard Rank #3</b>	
<b>Coal, natural gas, petroleum fuels and products, nec (08)</b>				<b>5</b>
Coal tar pitch (including volatiles)			2	2
Gasoline			1	1
Oil smoke		1		1
Petroleum coke	1			1
<b>Other chemicals (09)</b>				<b>28</b>
Ammonia	2			2
Carbon monoxide (including vehicle exhaust and exhaust gases)	4		1	5
Chemical fire		1		1
Epichlorondydrin/resin formulations with bisphenol A		1		1
Epoxy resin		1		1
Hazardous waste	2		1	3
Hazardous waste samples	1			1
Isocyanates (including TDI, MDI, polyisocyanate liquid, and urethanes)		2	5	7
Mixed chemicals		1		1
Mixed waste	3			3
Multiple			1	1
Radiation	1			1
Radioactive waste	1			1
<b>Tars, sealants, caulking, insulation materials (46)</b>				<b>6</b>
Asphalt (including fumes)	2	3		5
Cable encapsulant	1			1
<b>Animals and animal products (51)</b>				<b>2</b>
Bird droppings/bird bodies		1		1
Head lice	1			1

<b>Table B-1. Hazards Identified by Survey Respondents</b>				
<b>OIICS Source/Hazard</b>	<b>Number of Mentions as:</b>			<b>Total</b>
	<b>Hazard Rank #1</b>	<b>Hazard Rank #2</b>	<b>Hazard Rank #3</b>	
<b>Infectious and parasitic agents (53)</b>				<b>14</b>
AIDS		1		1
Airborne pathogens	1	1		2
Bacteria	1			1
Blood products		1		1
Bloodborne pathogens	2	1		3
Hepatitis B		1		1
Molds	2	3		5
<b>Nonmetallic minerals, except fuel (55)</b>				<b>18</b>
Asbestos	3	1		4
Refractory ceramic fibers	1			1
Silica (including abrasive blasting, silica dusts, and fibrous siliceous dusts)	8	3	1	12
Vermiculite		1		1
<b>Person - other than injured or ill worker (57)</b>				<b>5</b>
Bodily fluids	4	1		5
<b>Apparel and textiles (92)</b>				<b>1</b>
Latex			1	1
<b>Atmospheric and environmental conditions (93)</b>				<b>1</b>
Smoke	1			1
<b>Scrap, waste, debris (95)</b>				<b>4</b>
Dust	1			1
Roofing dust			1	1
Sewage	1			1
Wood dust		1		1