A Commercial Cleaning Company Worker Dies of Carbon Monoxide (CO) Poisoning at a Warehouse in Washington State

FACE/WA
Fatality Assessment and Control Evaluation

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Washington State Department of Labor & Industries

SHARP
Safety & Health Assessment & Research for Prevention

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DEFINITIONS

ACGIH	American Conference of Government Industrial Hygienists
CFK	Coburn-Forster-Kane
CO	Carbon monoxide
CO_2	Carbon dioxide
COHb	Carboxyhemoglobin
DOSH	Division of Occupational Safety & Health
FACE	Fatality Assessment and Control Evaluation
HR	Human resources
HVAC	Heating ventilation and air conditioning
L&I	Labor & Industries
NIOSH	National Institute for Occupational Safety and Health
O_2	Oxygen
OSHA	Occupational Safety and Health Administration
PEL	Personal exposure limit
PPE	Personal protective equipment
ppm	Parts per million
REL	Recommended exposure limit
SAE	Standard analytic error
SCBA	Self-contained breathing apparatus
SEIU	Service Employees International Union
SHARP	Safety & Health & Research for Prevention
TLV	Threshold limit value
TWA	Time-weighted average
WA	Washington State
WISHA	Washington Industrial Safety and Health Act

SUMMARY

In April of 2006, a 35-year-old Hispanic male, foreign-born commercial cleaning worker died from carbon monoxide (CO) poisoning in an empty warehouse in Washington State. The victim was assigned to clean the warehouse's office area carpets. The victim was working alone on a Sunday evening and he last spoke with his supervisor by two-way radio at approximately 7:00 pm.

The victim drove the van inside the empty warehouse and parked near offices that he was assigned to clean. He ran his truck-mounted gasoline powered carpet cleaner for several hours until he succumbed to the CO generated by the carpet cleaner. The victim was found the following day at 1:45 pm by the property management company's building engineer lying across the passenger seat of the company van that he had driven to the site. All the doors to the warehouse were closed and there was no mechanical or natural ventilation.

The building engineer called 911 and the local fire and rescue team arrived at the scene. Upon arrival, they measured high CO concentration with direct reading instruments. Because of this, the rescue team used self-contained breathing apparatus (SCBA) to enter the warehouse and confirmed that the victim was deceased. They then ventilated the warehouse for 90 minutes so others could enter the area to investigate the incident scene.

RECOMMENDATIONS

To prevent similar occurrences in the future, the Washington State Fatality Assessment and Control Evaluation (FACE) investigation team recommends that commercial cleaners, facility maintenance employers, and other operations that use combustion engine equipment to follow these guidelines:

- **Do not use gasoline or other fuel-powered engines, equipment, or tools inside buildings or areas where carbon monoxide can build up.**

- **Work with manufacturers to re-design the truck-mounted carpet cleaner so that the unit more effectively reduces or eliminates carbon monoxide in the exhaust gases or prohibits exhausting into the van and work area.**

- **Ensure carbon monoxide detectors with alarms are used when employees work with fuel-powered engines in environments where CO is likely to build up.**

- **Use a "Risk Assessment" or "Job Hazard Analysis" tool to identify potential carbon monoxide sources and exposures and how to avoid them.**

- **Educate workers regarding hazards, sources, symptoms, and control of CO exposure.**

- **Ensure that employees work in pairs on new or unfamiliar jobs and that a continuous communication plan is in effect.**

INTRODUCTION

Carbon monoxide, or CO, is the most common type of fatal air poisoning. It is an odorless, colorless and poisonous gas that can cause sudden illness and death. CO is found in combustion fumes, such as those produced, for example, by trucks and cars, small gasoline engines, portable gasoline-powered generators, power washers, forklifts, and propane-powered heaters. [(1)]

In April of 2006, the Washington State FACE Program (WA FACE) was notified by the Washington State Division of Occupational Safety & Health (DOSH), of the death of a 38-year-old commercial cleaning service worker. The victim died after lethal exposure to CO while working on a carpet cleaning job for his company at an empty warehouse / office location.

The Washington FACE Field Investigator spoke with the regional DOSH representatives involved in investigating the case, including the industrial hygiene supervisor and the compliance safety and health officer.

The DOSH representatives reviewed details of the work site, which included job assignments and the work being done at the time of the incident. They also discussed input related to all personnel involved and equipment usage, and they helped define the incident site location.

In December 2009, the FACE Field Investigator and FACE Research Analyst traveled to the cleaning services representative's office and met with the Regional Director of Human Services who also serves as the Regional Director of Risk Management to review the case.

During the site visit, the janitorial services representative provided information regarding the history of the company and many of their health and safety processes that were in place both at the time and after the incident. He also provided insight into the details surrounding the incident event and reviewed changes that have been made by their company and corporate safety staff since the incident.

Employer

The employer is a janitorial services operation which is a sub-unit of a larger corporation consisting of several types of businesses. The company has multiple operations across the country including facilities located in the Northwest. Each business is a separate operation that reports to the national corporate office.

The company started in the early 1900's washing windows and then transitioned into a full-service janitorial company. They now include a multitude of facility services such as elevator, engineering, lighting, mechanical, and parking as well as comprehensive commercial janitorial services.

The parent company was headquartered out of state and at the time of the incident employed about 70,000 people.

The branch location where the victim was employed was opened in the mid-1950s and employed approximately 375 people at the time of the incident.

According to the branch human resources director, English is a second language for the majority of the company's employees. Fifteen languages are spoken by their employees. Many of these employees are foreign-born and come from Mexico, Central America, Eastern Europe, former republics of the Soviet Union, Africa, Pacific Islands, and Asia. Approximately ten percent of their employees are Hispanic. To facilitate communication, the company uses supervisors who are fluent in the same languages to communicate with employees who have English as their second language. Many of their supervisors speak several languages.

Victim

The victim was employed as a carpet cleaning technician and had worked for this employer for approximately 1 year prior to the fatal incident. His normal shift was from 4:30 pm until 1:30 am Sunday through Thursday. He worked in the janitorial services business sector for an unknown number of years prior to his employment with the current company. The victim had many general janitorial skills, and the employer indicated that they thought he was very proficient and comfortable with most if not all cleaning assignments that he was given. Considering the victim's level of experience, the employer was considering promoting him to a supervisor position at the branch office.

The victim was of Hispanic descent and was foreign-born, but the employer was not aware of any language or communication barriers related to the employee's ability to read or comprehend any of the warning labels on the cleaning equipment being used (see Photo 6). There was also no apparent language barrier during safety meetings or other written or verbal instructions for the job from the victim's supervisor.

The employer indicated that the victim had performed this type of cleaning job many times, both as part of their cleaning team and also working alone for various customers and at a variety of customer sites. The victim's supervisor determined that the job the victim was working on the night of the incident only required one person to complete this carpet cleaning assignment.

The victim's job title was "Floorperson" and the employer indicated that the victim was an experienced employee who knew how to perform all of the jobs and use all of the equipment described in the job responsibilities. These included the operation of the truck-mounted carpet cleaner involved in this incident.

The specific tasks associated with this incident as provided by the employer included:

- Strip and wax floors
- High speed buff floors
- Spin bonnet and steam extract carpets
- Spot carpets
- Sweep and mop floors

Equipment the victim was expected to operate included:

- High speed buffer
- Low speed buffer
- Carpet extractor (which included the use of the truck-mounted carpet cleaner)
- Wet-dry vacuum

Equipment

The carpet cleaning equipment used by the victim was a truck-mounted, slide in, gasoline-powered unit (see Photo 5). The employer purchased the carpet cleaner from a supply company which installed it. This equipment is powered by a small, spark ignition 21 horsepower Briggs and Stratton engine that is fueled by gasoline pumped directly from the van's gas tank. This engine is not equipped with an emission control device. The engine throttle for the carpet cleaning unit was found pulled out to "high"

when the first responders arrived at the incident scene. The work van's battery was dead. After the van's battery was recharged, its gas gauge was checked and found to be on empty. The carpet cleaner has its own 12-volt battery; therefore, the van does not need to be running to operate the cleaner.

Exhaust from the Briggs and Stratton engine is partially diverted into the water tank's heat exchanger. During divert mode, cooler exhaust is emitted through the larger pipe and hot exhaust is emitted through the smaller pipe at the front of the cleaner. Once water in the tank reaches the set temperature, the unit switches to muffler mode and all engine exhaust is emitted via the smaller exhaust pipe at the front of the cleaner. To the left of the exhaust pipe on the front of the cleaner, there is a caution label (see Photo 6) stating "engine produces toxic exhaust gas."

Exposure

Initial screening by DOSH personnel for CO from the exhaust pipes indicated levels above 1000 ppm. A further test by DOSH used a Blanke CO Series 2500 exhaust gas analyzer (Blanke Industries Inc., Wauconda, IL) to measure CO in the engine exhaust after 10-minutes of operation. The divert mode was disengaged so that all exhaust was emitted through the smaller exhaust pipe. The Blanke CO analyzer measured 3.75% or 37,500 ppm CO in the exhaust stream.

The victim ran the truck-mounted gasoline-powered carpet cleaner inside a warehouse with the building's doors closed, no open windows, and the HVAC system turned off (see Photo 1 and Photo 2). These conditions contributed to a decreasing level of oxygen as it was consumed in the combustion process and a resulting change in the exhaust gas composition from carbon dioxide to carbon monoxide.

It was estimated that the victim spent 2.75 hours cleaning the carpets inside the office space and 1.75 hours at a resting state in the van's passenger seat with the gasoline-powered engine running before he asphyxiated at 11:00 pm. The victim was exposed to exhaust fumes containing high levels of CO gas for approximately 270 minutes before he asphyxiated from exposure to CO gas.

Using their modified Coburn-Forster-Kane (CFK) model from the NIOSH Criteria Document (NIOSH 1972)[(2)], the OSHA Salt Lake Technical Center calculated the victim's 8-hour time-weighted average exposure to CO and the mean concentration of CO for the 270-minute period. The CFK computer model used %COHb in blood and other sampling variables to calculate the CO exposure levels of the victim. Based on the laboratory's calculations, the victim's 8-hour time-weighted average (TWA) exposure

was 706 ppm CO (SAE = 0.130). The mean calculated CO ppm for his 27-minute exposure was 1255 (SAE = 0.130). The victim's TWA exposure to CO was 20.2 times the permissible exposure limit (PEL) of 35.0 ppm. [3,4] The medical examiner reported the result of the toxicological analysis of the victim's blood to be a blood-carboxyhemoglobin level of 66% at the time of death. See APPENDIX B, Tables 1 and 2 for health effects and regulatory exposure limits for CO.

Employer Safety Program and Training

At the time of the incident the organization had a written safety plan in place, but it did not have written safety polices specifically covering the carpet cleaning process using the truck-mounted carpet cleaner or details related to the hazards of CO exposure. New employees were given a copy of the company's employee handbook, which did not address the safety and health hazards that cleaning technicians might encounter as part of their job duties. The company did provide informal task and operation specific training for their workers prior to the incident on an "as needed" basis to review and talk about new cleaning products or new equipment. Training did not deal with hazards related to the cleaning agents or the new equipment being introduced to their work processes.

Each department manger was responsible for providing task and equipment specific training to their employees after an initial Human Resources (HR) Department training. Neither the HR department nor the Cleaning Department manager provided their carpet cleaning technicians or other employees with training on the hazards of gas-powered equipment. The employer was not able to provide training records for any of the equipment that the victim was supposed to operate.

Prior to the incident, there was a company-wide expectation that their employees would "just know" the hazards that were related to the job, such as CO exposure and other associated risks of the job. The carpet cleaning job was expected to have been an easy janitorial task, especially for someone as experienced as the victim. He apparently did not understand or recognize the hazards related to CO which is generated from gasoline powered equipment

Based on the FACE team's discussion with the regional HR/risk management director, it is not clear how well the company's existing safety guidelines were understood by the area management team, their employees, or the victim at the time of the incident. Other company carpet cleaner technicians stated in interviews with DOSH inspectors that they had parked inside building areas such as parking garages in the past to conduct their cleaning operations.

Since the fatal event, the company identified deficiencies in their safety training program. Safety training has become more formalized and more frequent for all their employees within the organization. Customized training is also provided by manufacturers and consultants for their janitorial services employees, and not just the supervisors. The company created a CO hazard communication document for its janitorial workers which they have translated into fifteen languages. They now have mandatory carbon monoxide hazard awareness training for employees who work with fuel powered internal combustion equipment. The new training is conducted on a regular basis and covers requirements prescribed by the Washington State Hazard Communication rule.

Organized Labor Safety Program and Training

The janitorial services company local branch where the victim worked was a unionized facility. The victim belonged to the Services Employees International Union (SEIU). The SEIU local based in Washington, represents and organizes janitors, security officers, and other property services workers throughout the state. The SEIU represents over 2 million service workers in North America and has a diverse membership with about 40% of their members being foreign-born or first generation immigrant population.

The janitorial services company has joint labor / management safety committees which meet monthly at each of their branch offices. In these meetings, the employer provided informal training on various aspects of the cleaning business activities including specialized cleaning applications and equipment. The employer also brought in distributor representatives who provided information about the primary use and handling of cleaning products to the janitorial services supervisors who in turn presented the information to their employees. None of the supervisors or members of the cleaning staff had any specific training regarding the truck-mounted carpet cleaner.

DOSH follow up with the vendor who had supplied and installed the truck-mounted carpet cleaner indicated that the vendor had not been contracted by the janitorial services company to provide training regarding the carpet cleaning unit.

The SEIU documented that the victim attended safety meetings but there was no documentation related to training using the truck-mounted carpet cleaner or hazards related to CO exposures.

INVESTIGATION

The incident being reviewed by WA FACE took place at a warehouse facility located in western Washington State. The commercial realty company for the warehouse contacted the janitorial service branch, the victim's employer, to clean carpets in the empty office spaces. They wanted to show the warehouse to potential customers on the following day.

On a Sunday evening in April 2006, at about 4:30 PM the victim arrived at the janitorial services company branch shop where he worked. The normal working hours for the company's commercial cleaners, including the victim, were from 4:30 PM to 1:30 AM Sunday through Thursday.

The victim reported to his supervisor that evening, as he routinely did, and got his job assignment for the night. The janitorial service branch office had a work order set up for a carpet cleaning job for that evening.

After getting his work assignment for the evening, the victim and his supervisor went over the equipment and materials needed for the job. The same supervisor had previously conducted a site visit and determined the number of workers and how long the job would take.

The victim was assigned two carpet cleaning jobs. The first job, a "TAG" assignment was expected to take no longer than 3 hours, not counting travel time from the branch office. The company calls it a "TAG" job when it is not a regular customer account. It is often a one-time request. The second job would have concluded his shift with a return back to the branch office somewhere around 2:00 am Monday morning. He was to perform both jobs working alone.

It was normal for the victim to be assigned work when he arrived at the branch area location. It was also common company practice for the victim and other janitorial service employees to be assigned to work at a location alone. This was dependent on the nature and extent of the cleaning job.

At about 5:30 the victim left the branch office location driving one of the company vans equipped with a truck-mounted carpet cleaner and the tools and chemicals needed for the job (see Photo 3). The specific equipment involved in this incident was a truck-mounted carpet cleaner (see Photo 4 and Photo 5) that had been purchased from and installed into a Chevrolet Astro Van by a local equipment dealer in 2004.

It is estimated that the victim arrived at the carpet cleaning job site at approximately 6:00 pm. The cleaning site was in an industrial complex that had multiple combination office and warehouse spaces for small businesses to lease by a property management company (see Photo 7). The job site itself was currently an unoccupied facility. He was to clean 2,000 square feet of carpet in the office area.

The victim unlocked one of the warehouse bay doors and drove the van into the 4,000 square foot warehouse (see Photo 8) and parked it close to the office spaces where the carpets were to be cleaned (see Photo 1). Most nearby businesses were closed. It is possible that the victim closed the doors because he was concerned about working alone on a Sunday night in an isolated area. The company and its employees had experienced work place violence incidents and equipment theft in the past, so it was an issue for workers in the field.

Interviews with other employees indicated that it was not unusual nor against company policy to park a vehicle in a warehouse space that would accommodate a vehicle and provide security both for the equipment and the people working on the job.

The victim next connected water hoses for the truck-mounted carpet cleaner to an inside water source near the office area of the job site location. His decision to use the inside source of water might have been based on security reasons, according to the janitorial services Director of Human Services / Regional Director of Risk Management.

The victim briefly spoke with his supervisor by radio sometime between 7:00 pm and 7:30 pm. According to his supervisor, the victim reported that it was a routine job and there were no problems reported.

The victim took a break during the cleaning cycle and sat in the passenger seat of the work van, apparently drinking a beverage. The carpet cleaner was still running. He may have been feeling ill from the unrecognized effects of the CO exposure he was experiencing and needed to sit. He had cleaned all but 100 square feet of carpet.

The victim's supervisor tried to contact the victim several times after the initial communication earlier that evening, and also tried again the following morning using the company walkie-talkie phone system to see how the victim was doing and find out the progress of the evening jobs. This included follow up with the victim regarding the second job that the victim was scheduled to complete that shift.

Previously, the victim always responded quickly when contacted by radio. But the employer representative indicated that at the time of the incident they were having

problems with their phone service and were having difficulty in communicating with their workers at job sites. The janitorial services company has since changed to a more reliable phone service.

Per the janitorial services company policy, employees are supposed to check back with their supervisor to report the status of their evening's work before heading home after the end of their shift.

The janitorial services manager contacted the victim's supervisor at 5:30 am to report that the van assigned to the victim had not been returned to the company shop. The manager thought the victim might have taken the van home that evening, especially if the cleaning jobs had taken longer than expected. This previously happened with other employees. Phone calls were made to his home. He had not returned home according to his wife.

After unsuccessfully trying to contact the victim, the manager contacted the property management company's building engineer and asked him to check if the carpet cleaning job had been completed and if the van was still at the job location. The building engineer went to the warehouse where he found the victim unresponsive in the van's passenger seat.

The building engineer contacted the local fire department and emergency responders soon arrived at the office warehouse incident site. They noted a strong smell of vehicle exhaust in the air and took a reading of the warehouse atmosphere from the door and found that the air concentration was 500 ppm of CO. Emergency personnel used supplied air to enter the warehouse. They found the victim slumped in the seat of the van and unresponsive. They were not able to resuscitate him; he appeared to have been dead for some time. The fire department called the police and the medical examiner's office to investigate the incident.

Incident Timeline

Sunday

4:30 pm-The victim began his shift.

6:00 pm-The victim arrived at the incident job site.

7:00 pm-The janitorial service branch supervisor was in contact with the victim via radio.

8:00 pm-The victim was expected to complete the first job.

Monday

1:30 am-The victim was expected to finish the second job and clock-out.

5:30 am-The janitorial department manager observed the company cleaning equipment van had not been returned.

1:45 pm-The building engineer arrived at the warehouse location, unlocked and opened the building, found the unresponsive victim, and called 911 shortly after.

2:00 pm- The local Fire and Rescue team responded to the warehouse location and found high levels of CO and ventilated the building.

CAUSE OF DEATH

The medical examiner listed the cause of death as toxic asphyxia due to inhalation of CO (engine exhaust).

RECOMMENDATIONS AND DISCUSSION

Recommendation #1: Do not use gasoline or other fuel-powered engines, equipment, or tools inside buildings or areas where carbon monoxide can build up.

Discussion:

Vehicles with truck-mounted carpet cleaning units should be parked outdoors with no exceptions. Opening windows and doors may not provide adequate ventilation to make a work safe indoor environment.

Workers should also strategically park their vehicles outside, so that they place the fuel-powered equipment away from doors, windows, or air intake vents that can allow CO to infiltrate and build up inside.

When work must be done using internal combustion engines inside buildings, warehouse locations, parking garages, or other semi-enclosed areas, it is recommended that one use equipment with engines powered by electricity or compressed air.

Workers should never be in the van when the truck-mounted carpet cleaning unit is operating and exhausting into the immediate environment. Even when operating at optimal conditions, internal combustion engines generate particulate matter, hydrocarbons, oxides of nitrogen, and other exhaust gases with damaging health effects.

Recommendation #2: Work with manufacturers to re-design the truck-mounted carpet cleaner so that the unit more effectively reduces or eliminates carbon monoxide in the exhaust gases or prohibits exhausting into the van and work area.

Discussion:

Employers should work with manufacturers to design and engineer carpet cleaning and other internal combustion engine equipment with safer emissions controls. The most effective control device would be a real-time exhaust gas CO sensor. Exhaust gas monitoring may also be achieved using an oxygen (O_2) sensor, common on gas and diesel engines, which monitors the level of O_2 available to convert CO into the less toxic carbon dioxide (CO_2). The sensors provide feedback to a simple control unit programmed to shut off the engine if CO or O_2 levels vary from optimal engine operating or potentially hazardous conditions.

Catalytic convertors are also effective emissions control devices and are common on automobile and diesel truck engines. Catalytic convertors change CO into the less toxic carbon dioxide (CO_2). However, convertor efficiency decreases as engine efficiency decreases as in anoxic environments and should be used in conjunction with engine sensors to balance and control engine operating conditions. [5]

Truck-mounted cleaning systems should also be designed and maintained to prevent exhaust gases from entering the vehicle and the work environment by diverting exhaust gases. This can be achieved using a leak proof exhaust hose that will screw or clamp-on to the engine or existing exhaust and be long and flexible enough to route exhaust gases away from the van and work space. Similar hoses are used in auto repair facilities to route exhaust gases outdoors.

Recommendation #3: Ensure CO detectors with alarms are used when employees work with fuel-powered engines in environments where CO is likely to build up.

Discussion:

Personal CO monitors should be used whenever a fuel-burning generator is used as an energy source and there is potential for CO to accumulate. Personal CO monitors should provide a means of direct reading of CO exposure concentrations with preset alarm warnings for hazardous concentrations (see Photo 9) and should have both visual and audible alarm and warning functions. Fixed site ambient CO monitors should also be used near the CO source. [6] CO monitors should be capable of recording and responding to peak CO concentrations and average CO exposures over time.

According to OSHA, The carbon monoxide content of the atmosphere in a room, building, vehicle, railcar or any enclosed space shall be maintained at not more than 50 parts per million (ppm) (0.005%) as an eight hour average area level and employees shall be removed from the enclosed space if the carbon monoxide concentration exceeds a ceiling of 100 ppm (0.01%).

WA FACE recommends that CO monitors be set to activate the alarm or warning at an exposure concentration of 35 ppm (0.0035%) which is the level generally accepted to have no adverse health effects in healthy humans. Any CO alarm or warning should initiate evacuation of the workplace, shutting down the generator and immediate contact with a supervisor. The employer should then work with the employee to establish procedures to diminish and prevent further exposure before resuming work.

Make sure that all employees are properly trained on the functions and capabilities of the monitoring system. Make sure the training is in a language that they clearly understand. Make sure that the monitoring equipment is properly maintained and calibrated on a regular basis as recommended by the manufacturer.

Recommendation #4: Use a "Risk Assessment" or "Job Hazard Analysis" tool to identify potential CO sources and exposures and how to avoid them.

Discussion:

CO gas is a colorless, odorless, chemical asphyxiant. Therefore, it is crucial that a thorough risk assessment or job hazard analysis be carried out by an employer to identify possible sources of CO which can be hazardous to exposed workers.

A risk assessment or job hazard analysis for CO exposure should include these steps:

1. Identify all potentially exposed individuals and groups.
2. Identify the processes, tasks, and areas where hazardous exposures could occur.
3. Analyze the potential health risks of the hazardous exposures (e.g., compare against occupational exposure limits).
4. Estimate probability and severity of potential exposure.
5. Assess, measure, and verify the exposures if prompted by #4.
6. Identify hierarchy of control measures from engineering to PPE.
7. Analyze the effectiveness of existing control measures.
8. Determine if new or additional control measures are needed.
9. Set priorities for action.
10. Develop, implement, and monitor a risk control action plan or review existing risk control action plan.
11. Maintain accurate and systematic records or amend existing risk control action plan and use alternative and/or additional control measures.
12. Review and amend at regular intervals or earlier if changes to processes or new developments are proposed.

Employers should conduct follow up assessments in the field to ensure workers both understand and know how to apply the training and instruction at the work site.

Recommendation #5: Educate workers regarding hazards, sources, symptoms, and control of CO exposure.

Discussion:

Employers should use the results of the risk and job hazard assessment to educate their employees regarding CO and how to prevent exposures while doing their job. Employers should contact the equipment manufacturer for safety guidelines and operating procedures. This information should be used to provide employees with equipment specific applicable safety instruction. The manufacturer's operating manual for this equipment contains a section of precautions with warnings for CO, toxic fumes, and engine exhaust, among others. In the manual, warnings are defined as conditions that can cause possible injury or death. The CO warning explicitly instructs users to "Position vehicle so that fumes will be directed away from the job site. Do not Park where exhaust fumes can enter a building through open doors, windows, air conditioning units, or kitchen fans". These warnings should also instruct users how to recognize the symptoms of CO poisoning. Employers should also advocate that the manufacturer emphasize the warnings in the operating manual by changing the section

title from ‘precaution’ to ‘danger: read before operating’ and moving this section toward the beginning of the operating manual. The front panel of the equipment reads ‘DO NOT operate in a confined area’ and more instruction on keeping exhaust gas from entering buildings (see Photo 6). This warning should be expanded to be more explicit and read ‘DO NOT operate in a confined area or indoors’. Educational and training materials, warning signs, and safety training should be available in languages appropriate for employees.

Recommendation #6: Ensure that employees work in pairs on new or unfamiliar jobs and that a continuous communication plan is in effect.

Discussion:

Employers should evaluate the potential hazards faced by solitary workers and assess the risks to them and should ensure that measures are in place to control or avoid such risks. These measures should include employees working in pairs, especially when dispatched to new or unfamiliar jobs or remote locations where safety may be a concern. Employees should be trained to continuously monitor the status of their co-workers and how to respond in an emergency. In addition to working in pairs, employers should develop plans for maintaining continuous communication between employees and with their supervisors or dispatchers. The communication plan should have redundancies where possible to deal with equipment issues and guidelines that are strictly followed when there are breaks in communication. In this incident, there was a disruption in communication between the manager and employee which may have been caused by faulty communication equipment or the status of the employee. The break in communication should have prompted the employer to respond or send emergency response to the scene. Situations where an employee is unresponsive and may have been incapacitated by a toxic exposure should be approached with extreme caution. Numerous multiple fatality incidents have resulted from responders or rescuers attempting to aid another employee in a toxic environment without first monitoring and remediating the environment to ensure safe entry.

RESOURCES

Consultation and information is available to provide recommendations for an effective safety and training program for your company.

Washington State Department of Labor & Industries
www.lni.wa.gov/
Washington State Department of Labor & Industries carbon monoxide web page
Division of Occupation Safety and Health (DOSH)
1-800-423-7233

Safety & Health Assessment & Research for Prevention (SHARP)
www.lni.wa.gov/Safety/Research/
1-888-667-4277

The National Institute for Occupational Safety and Health (NIOSH)
www.cdc.gov/niosh/
NIOSH Carbon Monoxide web page
Carbon Monoxide Hazards from Small Gasoline Powered Engines

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- The Employer's representative involved in the incident
- Division of Occupation Safety and Health (DOSH) Compliance Operations
- Division of Occupation Safety and Health (DOSH) Enforcement
- Federal FACE Program Management (NIOSH)
- Safety & Health Assessment & Research for Prevention (SHARP)
- Washington State Attorney General's Office

APPPENDIX A. Photos

Photo 1. Carpet cleaning van parked in warehouse at incident scene. The open door to the rear of the van was where the victim accessed the office space in order to clean its carpets.

Photo 2. Carpet cleaning van (vehicle on the right) in warehouse at incident scene. The overhead sliding door was closed when the victim was found in the van.

Photo 3. Van equipped with carpet cleaning equipment that was used by the victim.

Photo 4. Incident van showing the truck-mounted gasoline powered carpet cleaner.

Photo5. Truck-mounted carpet cleaner in incident van.

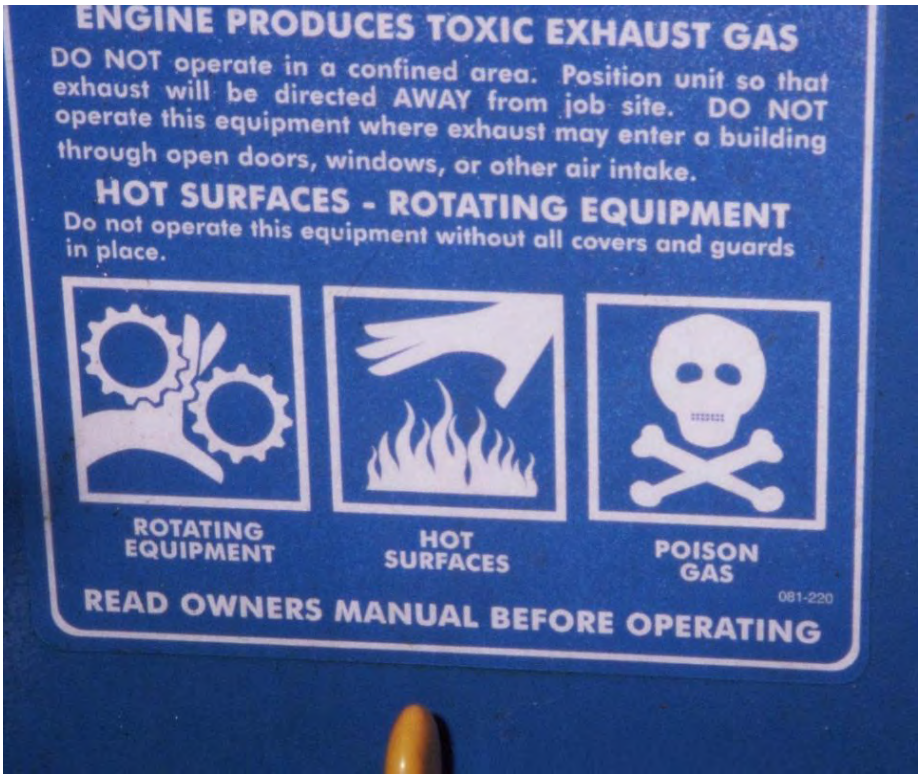

Photo 6. Warning on carpet cleaning machine.

Photo 7. Incident location exterior of office and warehouse where the victim cleaned carpets. This is a view of the office area; the warehouse is located in the rear.

Photo 8. Incident location warehouse (victim accessed the warehouse and its office space through this door).

Photo 9. Example of personal portable carbon monoxide monitor.

APPENDIX B. Tables

TABLE 1. Health effects of carbon monoxide[A]

CO in air, ppm[B]	Percent CO in air	Symptoms experienced by healthy adults
Less than 35 ppm	0.0035%	No effect in healthy adults
100 ppm	0.01 %	Slight headache, fatigue, shortness of breath, errors in judgment
200 ppm	0.02%	Headache, fatigue, nausea, dizziness
400 ppm	0.04%	Severe headache, fatigue, nausea, dizziness, confusion, can be life-threatening after 3 hours of exposure
800 ppm	0.08%	Headache, confusion, collapse, death if exposure is prolonged
1500 ppm	0.15%	Headache, dizziness, nausea, convulsions, collapse, death within 1 hour
3000 ppm	0.3%	Death within 30 minutes
6000 ppm	0.6%	Death within 10-15 minutes
12,000 ppm	1.2%	Nearly instant death

[A]Adapted from Washington State Department of Labor and Industries
[B]parts per million

TABLE 2. Carbon monoxide exposure limits

Organization	8-hour TWA[A], ppm[B]	Ceiling, ppm	IDLH[C], ppm
OSHA PEL[D]	50	-	-
NIOSH REL[E]	35	200	1200
WISHA PEL[F]	35	200	1500
ACGIH TLV[G]	25	-	-

[A] Time-weighted average
[B] parts per million
[C] Immediately dangerous to life and health
[D] Occupational Safety and Health Administration personal exposure limit
[E] National Institute for Occupational Safety and Health recommended exposure limit
[F] Washington Industrial Safety and Health Act personal exposure limit
[G] American Conference of Government Industrial Hygienists threshold limit value

APPENDIX C. Risk Assessment Template

Risk Assessment

Company Name:

_____

Prepared by:

_____

This is a sample entry for a common hazard to illustrate how the template can be used. Consider how this applies to your business and continue to identify hazards and fill-in the table.

What are the hazards?	Who might be harmed and how?	What are you already doing?	What further action is necessary?	Action by whom?	Action by when?	Done
Slips and trips	Staff and others may be injured if they trip over objects or slip on spills.	General good housekeeping. Areas well lit. No hoses or cables without warnings. Staff keeps locations clean and clear of debris.	Better, more timely housekeeping on spills.	All staff, supervisors to monitor.	Starting now, review in 1 month.	

- Employers with five or more employees should have a written health and safety policy and risk assessment.
- Adapted from Health and Safety Executive www.hse.gov.uk/risk/guidance.htm

APPENDIX D. Job Hazard Analysis Template

Job Hazard Analysis

Date of analysis: _____

_____

People who participated:

_____

_____

_____

_____

Tasks/jobs where injuries occur, or can occur	
How people get hurt	**What causes them to get hurt?**

- The above form is made from a "table" in Microsoft Word. You can type as much as you want in any one of the boxes, and it will continue to expand as much as you need.
- If you want to add more rows, just click on "Table" on the top row of your screen. From the menu that drops down, click on "Insert." That will let you add rows – either above or below the one you're on.
- Adapted from WA L&I Small Business Basics www.lni.wa.gov/Safety/Basics/SmallBusiness/General/JobHazardAnalysis.asp

References

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Washington State FACE Program Information

The Washington State Fatality Assessment and Control (WA FACE) program is one of many workplace health and safety programs administered by the Washington State Department of Labor & Industries' Safety & Health & Research for Prevention (SHARP) program. It is a research program designed to identify and study fatal occupational injuries. Under a cooperative agreement with the National Institute for Occupational Safety and Health (NIOSH), WA FACE collects information on occupational fatalities in WA State and targets specific types of fatalities for evaluation. WA FACE investigators evaluate information from multiple sources. Findings are summarized in narrative reports that include recommendations for preventing similar events in the future. These recommendations are distributed to employers, workers, and other organizations interested in promoting workplace safety. NIOSH-funded, state-based FACE programs include: California, Iowa, Kentucky, Massachusetts, Michigan, New Jersey, New York, Oregon, and Washington. WA FACE does not determine fault or legal liability associated with a fatal incident. Names of employers, victims and/or witnesses are not included in written investigative reports or other databases to protect the confidentiality of those who voluntarily participate in the program.

Additional information regarding the WA FACE program can be obtained from:

Washington State FACE Program
www.lni.wa.gov/Safety/Research/FACE/default.asp
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