Two Vietnamese Floor Sanders Die When Wood Floor Finish Product Ignites - Massachusetts

Investigation: # 04-MA-032
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SUMMARY

On September 2, 2004, two 35-year-old floor sanders (victims) were fatally injured and two other floor sanders were burned, one seriously, when the three-family house they were working in caught fire. The victims were refinishing the wood floors in the third floor unit and the stairs leading up to the third floor unit of the multifamily house. The incident occurred when the flammable lacquer floor sealer that they were applying ignited, causing the house to catch fire. Calls were placed to emergency medical services (EMS) and the fire department. Within minutes, EMS and fire department personnel arrived at the site to attend to the victims and control the fire. One of the victims was pronounced dead at the scene. The other three workers were transported to a local hospital where a second worker died of his burns the following day.
The Massachusetts FACE Program concluded that to prevent similar occurrences in the future, employers should:

- **Use wood floor finishing products that are less flammable (products with flash points greater than 100°F) for indoor applications**
- **Ensure that ignition sources including gas pilot lights are extinguished prior to beginning work**
- **Ensure that work areas are adequately ventilated during indoor application of wood floor finishing products**
- **Conduct job hazard analyses and implement and enforce a safety checklist to be completed prior to beginning work**
- **Develop, implement, and enforce a written hazard communication program that includes training employees about the chemicals they work with and the associated hazards and controls of these chemicals.**

The wood floor finishing industry and other stakeholders, such as contractors, insurance companies, and government agencies should**:**

- **Educate consumers about the hazards associated with finishing wood floors and actions that can be taken to minimize these hazards, such as the use of less flammable floor finishing products.**

Homeowners finishing wood floors themselves or through a hired contractor should:

- **Ensure that only less flammable floor finishing products (products with flash points greater than 100°F) are used inside their homes.**

In addition, policymakers should:

- **Consider developing regulatory approaches to minimize the risk of fires and explosions during wood floor finishing.**

BACKGROUND

Wood floor sanding and finishing can expose workers, building occupants, and homeowners to a variety of health and safety hazards. In Massachusetts, three workers have died within a ten month period (September 2004 – July 2005) in fires resulting from wood floor finishing when the flammable lacquer floor sealer they were applying ignited. All three of these fatally injured workers were Vietnamese immigrants. According to a Safety Bulletin released by the Boston Fire Department, between 1995 and September 2004, Boston, Massachusetts has experienced more than 25 fires directly attributed to hardwood floor installation and refinishing, resulting in a property loss value of over 1.5 million dollars. This Safety Bulletin has been included at the end of this Massachusetts FACE report.

Nationally from 1992-2002, 52 fatal injuries were sustained by workers in the floor laying/other floor work business (Bureau of Labor Statistic, Census of Fatal Occupational Injuries data, using Standard Industrial Code 1752, not necessarily wood floors). Of these injuries, 21% (11/52) resulted from fires and explosions. Five of the workers who died due to fire or explosion were employed specifically in wood floor sanding.

In 2004, the Massachusetts Floor Finishing Safety Task Force was formed with members from community, health, safety, academic, and economic development organizations. A report has been released by this task force and is referenced at the end of this Massachusetts FACE report.

INTRODUCTION

On September 3, 2004, the Massachusetts FACE Program was alerted by local media that on September 2, 2004, one floor sander was fatally injured and three others were seriously burned when the house they were working in caught fire. An investigation was initiated. On September 6, 2004, the Massachusetts FACE Program was again alerted by local media that a second worker had died of the injuries he sustained during the September 2, 2004 incident. On October 10, 2004 the Massachusetts FACE Director interviewed a representative of the victims' company. The fire report, death certificates, corporate information, and Occupational Safety and Health Administration (OSHA) information were reviewed during the course of the investigation.

The employer, a wood floor company, had been in business for 21 years at the time of the incident. The company employed approximately eight workers that were split into two work crews comprised of two to four workers per crew, depending on the job size. The victims each had between two and five years of experience.

The company did not have a written comprehensive hazard communication program. Although the victims did receive on-the-job training, the training did not address the hazards associated with this incident. The company provided workers with respirators, but did not have safety procedures for respirator use. The employees did not have union representation. Both of the fatally injured workers were Vietnamese immigrants. The company owner is also Vietnamese.

INVESTIGATION

The company was hired to refinish the wood floor in a third floor unit and two sets of wood stairs leading up to the third floor in a multifamily house (Figure 1). One stairway connected the first floor to the second floor and the other stairway connected the second floor to the third floor. At the time of the incident, the third floor unit was vacant and the bottom two units were occupied. The owners of the multifamily house lived in the first unit, which comprised the entire first floor and a section of the second floor. The remaining area on the second floor comprised the second unit and the entire third floor was one unit. The owners of the house were home at the time of the incident and the second unit occupants were not home.

During the interview, the company representative described their usual floor finishing procedure, which included but was not limited to the following:

- Opening windows and extinguishing pilot lights and other possible ignition sources, prior to beginning the sanding task.
- Sanding wood areas to be refinished using electric sanding equipment, such as drum sanders and edge sanders. The company representative stated that the majority of their sanding equipment has dust collecting systems, but that these systems do not collect 100% of the dust. Manual hand sanding is often performed as well.
- Vacuuming the sanded area to remove the remaining wood dust.
- Applying floor primer to the sanded area. The company representative reported that the floor primer typically used was a lacquer sealer, which takes approximately 30 - 45 minutes to dry.
- Applying two coats of polyurethane once the lacquer sealer is dry. Typically an hour is allowed between applications of the first and second coats. The second coat of polyurethane takes approximately one day to completely dry.

The day of the incident was the company's first day on site. Four floor sanders were assigned to the job, with one of the floor sanders also acting as a field supervisor. Two of the workers arrived at the house at 8:45 a.m. and started sanding the stairway that led from the first floor to the second floor. These workers then moved to sanding the stairway that led from the second floor to the third floor and the wood floors in the third floor unit. Once finished with the sanding task, the two workers vacuumed the remaining wood dust within the third floor unit and the stairs that connected the second floor to the third floor. At approximately 11:00 a.m. the workers stopped vacuuming and started to apply the lacquer sealer to the wood floors in the third floor unit.

According to the manufacturer’s material safety data sheet (MSDS), the lacquer sealer being used contained, but was not limited to, acetone, toluene, xylene, and keytones and had the following physical characteristics:

- Hazardous Material Identification System (HMIS) ratings of: health (2), flammability (3), and instability (0). HMIS is a numerical rating system ranging from zero to four: minimal

hazard (0), slight hazard (1), moderate hazard (2), serious hazard (3), and severe hazard (4) (Figure 2).

- Vapor density rating greater than one (this lacquer sealer is heavier than air).
- Percent volatile (the percentage of a liquid or solid that will evaporate at an ambient temperature of 70° Fahrenheit (F)) rating of 72% - 84%.
- Flash point (lowest temperature at which a chemical's vapors are concentrated enough to ignite) rating of 9° F.
- Flammability classification rating of 1B (flash point below 73° F and boiling point at or above 100° F).

At approximately 11:30 a.m., two more workers arrived at the house to help apply the wood floor finishing products. Immediately prior to the incident, at approximately 12:45 p.m., one of the two surviving workers was vacuuming the second floor stairway landing and the other surviving worker was in the second floor bathroom. At this same time, the two victims were up on the third floor of the house applying the lacquer sealer. One was inside the third floor unit (victim #1) and the other victim (victim #2) was located in the upper section of the stairway that led up to the third floor from the second floor.

When the vapors from the lacquer sealer ignited it caused an explosion and created a fireball that traveled through the two stairways down to the first floor. The explosion also resulted in a fire that engulfed the entire third floor of the multifamily house. The two surviving floor sanders had been the furthest from the explosion and were the first two workers to exit the burning house. The floor sander who was located in the stairway that led to the third floor unit (victim #2) exited the house with his clothes on fire shortly after the two surviving workers exited the house. The fourth floor sander (victim #1), who was working inside the third floor unit, did not exit the burning house.

There were multiple ignition sources within the third floor unit, such as gas appliances and electrical sources. Gas appliances within the third floor unit included, but were not limited to the gas heating unit located above the ceiling, and the gas stove located in the kitchen. Electrical ignition sources included, but were not limited to, the refrigerator located in the kitchen, and electrical switches located throughout the unit.

The two owners of the house and a friend of theirs were home at the time of the incident. After hearing the explosion and realizing that the house was on fire, they called 911 and exited the house. A nearby off-duty firefighter, who had heard the smoke alarms and noticed the smoke, arrived at the incident site and attended to the three floor sanders who had exited the house. Personnel from the local fire department and emergency medical services (EMS) arrived within minutes of notification. Due to a language barrier between the floor sanders, who spoke Vietnamese and the fire fighter and EMS personnel who spoke English, the information that a fourth floor sander (victim #1) was still inside the burning house was not able to be communicated.

Victim #1 was found by fire fighters inside the first floor stairway and was pronounced dead at the scene. The three floor sanders who exited the house were all taken to a local hospital. At the hospital, a second floor sander (victim #2) died of his severe burns the following day. One of the two surviving floor sanders was released from the hospital a few days later, and the other remained in critical condition in the hospital for an extended period of time with severe burns. A short time after the incident, the house was torn down due to extensive fire damage.

Investigations conducted by OSHA, the Massachusetts State Fire Marshal, and the local fire department determined that the ignition source was most likely the gas stove pilot located in the kitchen of the third floor unit. In addition, it was concluded that the windows in the third floor unit were most likely closed at the time of the incident.

CAUSE OF DEATH

The medical examiner listed the cause of death for victim #1 as severe charring thermal burns and for victim #2 as complications of severe thermal burns.

RECOMMENDATIONS/DISCUSSION

Recommendation #1: Employers should use wood floor finishing products that are less flammable (products with flash points greater than 100° F) for indoor applications.

Discussion: The flash point of a liquid is the lowest temperature at which it gives off enough vapors to ignite when a source of ignition (see recommendation #2) is present. The lower the flash point of a liquid, the higher the risk of fire or explosion. Many floor finishing products with flash points greater than 100° F, which are less flammable, are available. The flash point of a product can be found on the product label or the manufacturer's material safety data sheet (MSDS) or by calling the manufacturer.

In this incident, a highly flammable lacquer sealer (flash point of 9° F) was being used indoors. When finishing wood floors indoors, less flammable floor finishing products (products with flash points greater than 100° F) should always be used. Less flammable products will greatly reduce the risk of product ignition, explosions, and fires.

Recommendation #2: Employers should ensure that open flames and other ignition sources including gas pilot lights are extinguished prior to beginning work.

Discussion: In this case, the third floor unit had a number of potential ignition sources within 50 feet of where the lacquer floor sealer was being applied. Investigating agencies concluded that at least one of these ignition sources, the gas stove pilot, was not extinguished prior to the beginning of work and was most likely the ignition source.

Open flames and other ignition sources within 50 feet of floor finishing product application should to be extinguished. Sources of ignition include, but are not limited to, cigarettes and lighters, pilot lights for gas appliances (gas stoves, gas hot water heaters, gas heating units, gas clothes dryers), cycling electrical appliances (refrigerators, air conditioners, electric heating units, electric hot water heaters), and electrical devices that could be inadvertently switched on (lights, radios, electrical switches). Cigarettes should not be smoked or light within the work area, gas pilots should be extinguished and cycling electrical appliances and other electrical devices should be turned off and unplugged prior to using flammable products. It should be ensured that electrical switches, such as light switches, are not turned on or off during the entire floor finishing process, from sanding to when the applied floor finishing product is dried. In addition, when possible the power to the work area should be turned off during floor finishing.

Recommendation #3: Employers should ensure that work areas are adequately ventilated during indoor application of wood floor finishing products.

Discussion: In this case, it was concluded that the third floor unit's windows were most likely closed at the time of the incident and that no other means of ventilation was being used in the work area where the lacquer sealer was being applied. Inadequate ventilation during indoor application of flammable floor finishing products, such as lacquer sealers, can lead to a buildup of the product vapors to a concentration that could easily ignite.

It is recommended that employers ensure work areas are adequately ventilated for the products being used. Ventilation should draw the air out of the work area during indoor floor finishing and could include opening windows and using fans classified as explosion proof that are plugged in outside of the work area. Work area ventilation should continue until the applied floor finishing product is dry.

Providing adequate ventilation during indoor use of flammable wood floor finishing products, including lacquer sealers, can be problematic because too much air flow can interfere with the quality of the wood floor finish. The complexity of ensuring indoor work areas are adequately ventilated while applying flammable floor finishing products without jeopardizing the quality of the wood floor finish underscores the importance of using products with flash points above 100°F for indoor use.

Recommendation #4: Employers should conduct job hazard analyses and implement and enforce safety checklists to be completed prior to beginning work.

Discussion: The surviving employees reported that they were not the individuals responsible for extinguishing pilot lights and opening windows, but they thought the windows in the third floor unit could have been open and that the pilots and other ignition sources were extinguished prior to the beginning of work.

Before the start of a floor finishing job, a competent person* should work with the homeowner to gather as much information as possible on ignition sources within the work area and ventilation

options. This information and the product manufacturer's safety precautions should be incorporated into a wood floor finishing safety checklist that is given to the work crew before going to the work site for the first time. The employer should ensure that employees perform the tasks on the safety checklist prior to starting work. This could be accomplished by the employer routinely performing unscheduled site visits. It should be made clear by the employer that if employees are not following the checklist prior to beginning work, they will be reprimanded. In addition, it should also be made clear to employees that if they feel uncomfortable about a current work situation because of safety and/or health reasons, work should be stopped immediately or not begun and the employer should be notified.

**Competent person:* a person through training or knowledge who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

Recommendation #5: Employers should develop, implement, and enforce a written hazard communication program that includes training employees about the chemicals they work with and the associated hazards and controls of these chemicals.

Discussion: Employers are required by the Occupational Safety and Health Administration (OSHA) to instruct employees in the recognition and avoidance of unsafe conditions, in the regulations applicable to their work, in this case floor finishing, and to control or eliminate any hazards or other exposures that could result in serious illness or injury.

Floor finishing companies should develop and implement a hazard communication program that includes identifying and developing a list of all hazardous chemicals used and generated in floor finishing, obtaining material safety data sheets (MSDSs) and labels for each hazardous chemical and informing employees about these chemicals and the associated hazards through employer provided training. Hazard communication training should include, but not be limited to:

- an explanation of material safety data sheets and the labeling system
- where and how employees can obtain and use the appropriate hazard information
- safety and health hazards of the chemicals used and generated in floor finishing
- methods and observations that may be used to detect a presence (or an elevated level) of hazardous chemicals at the jobsite
- measures for employees to protect themselves from hazards, such as appropriate work practices, emergency procedures, and personal protective equipment.

It is required that all trainings be documented. Documentation should include: who provided the training and their qualifications, the content of the training, workers who were trained, and any assessments of workers' comprehension of the training.

Companies that employ workers who do not understand English should identify the languages spoken by their employees and design, implement, and enforce a multi-lingual hazard communication program. To the extent feasible, the hazard communication program should be developed at a literacy level that corresponds with the literacy level of the company's workforce. Companies may need to consider providing special safety training for workers with low literacy to meet their safety responsibilities.

Help for companies is available through the Massachusetts Division of Occupational Safety (DOS) which offers free consultation services designed to help small employers recognize and control potential safety and health hazards at their worksites, improve their safety and health programs, and assist in training employees (http://www.mass.gov/dos/consult/index.htm).

In addition, the Massachusetts Department of Industrial Accidents (DIA) has Occupational Safety and Health Training Grants available for companies and organizations that are covered by the Massachusetts Workers' Compensation Law. The grant money must be used to provide and improve prevention education and training in occupational safety and health to employers/employees within the Commonwealth (http://www.mass.gov/dia/Safety/index.htm).

The Office of the State Fire Marshal works to preserve life and property from fire and explosion by prevention, engineering, education, and enforcement (www.mass.gov/dfs/osfm/exec/index.htm).

Recommendation #6: The wood floor finishing industry and other stakeholders, such as contractors, insurance companies, and government agencies should educate consumers about the hazards associated with finishing wood floors and actions that can be taken to minimize these hazards, such as the use of less flammable floor finishing products.

Discussion: An educated consumer will be able to make the best decisions about which floor finishing process to choose and which contractor to hire based on their knowledge of associated hazards and available product choices. Consumer education should be a joint effort involving floor finishing contractors, insurance companies and government agencies.

Floor finishing contractors and insurance companies should provide information to consumers about floor finishing options and the impact of all available products. Government agencies should consider the implementation of an outreach program to inform the public about associated hazards and the availability of less flammable products for floor finishing.

Recommendation #7: Homeowners finishing wood floors themselves or through a hired contractor should ensure that only less flammable floor finishing products (products with flash points greater than 100° F) are used inside their home.

Discussion: Homeowners who ensure that only less flammable products, products with flash points greater than 100° F, are allowed to be used inside their home will minimize the risk of fires and/or explosions that could endanger themselves, their families, and workers (when using contractors).

Recommendation #8: Policymakers should consider developing regulatory approaches to minimize the risk of fires and explosions during wood floor finishing.

Discussion: There are a number of regulatory approaches that may reduce the risk of fires and explosions associated with wood floor finishing and thereby protect workers and the general public. The effectiveness and the feasibility of the following approaches should be explored:

- State licensing requirements for wood floor finishers that would require training, designation of competent persons, and oversight of business practices.
- Permitting rules that would require contractors or homeowners to notify local fire departments or other appropriate local agencies of plans for wood floor finishing jobs involving the use of flammable products. Information about product selection and safe work practices would be handed to the person obtaining the permit.
- Disclosure requirements that direct wood floor refinishers and manufacturers to provide information to consumers about the flash point and toxicity of the products to be used in their homes.
- Requiring the use of less flammable products (products with flash points greater than 100° F) when finishing wood floors indoors.

The wood floor finishing industry in Massachusetts consists mainly of small businesses, many of whom are Vietnamese owned and staffed (particularly in the Boston area). Representatives from the wood floor finishing industry and the Vietnamese community should play an integral part in exploring licensing, permitting or disclosure requirements, to ensure that the procedures are feasible, economical and linguistically appropriate.

REFERENCES

Code of Federal Regulations, 29 CFR 1910.1200 Hazard Communication. Government Printing Office

Code of Federal Regulations, 29 CFR 1926.21 Safety training and education. Government Printing Office

Code of Federal Regulations, 29 CFR 1926.20 General safety and health provisions. Government Printing Office

Code of Federal Regulations, 29 CFR 1926.57 Ventilation. Government Printing Office

Boston Fire Department, Press Release, Safety Bulletin Hazards Associated With Hardwood Floor Refinishing. Accessed October 18, 2004 at http://www.cityofboston.gov/bfd/download/Hardwood%20Floor%20Refinishing%20PR.pdf

National Fire Protection Association, Frequently asked questions. Accessed September 23, 2005 at http://www.nfpa.org/faq.asp?categoryID=920#22899

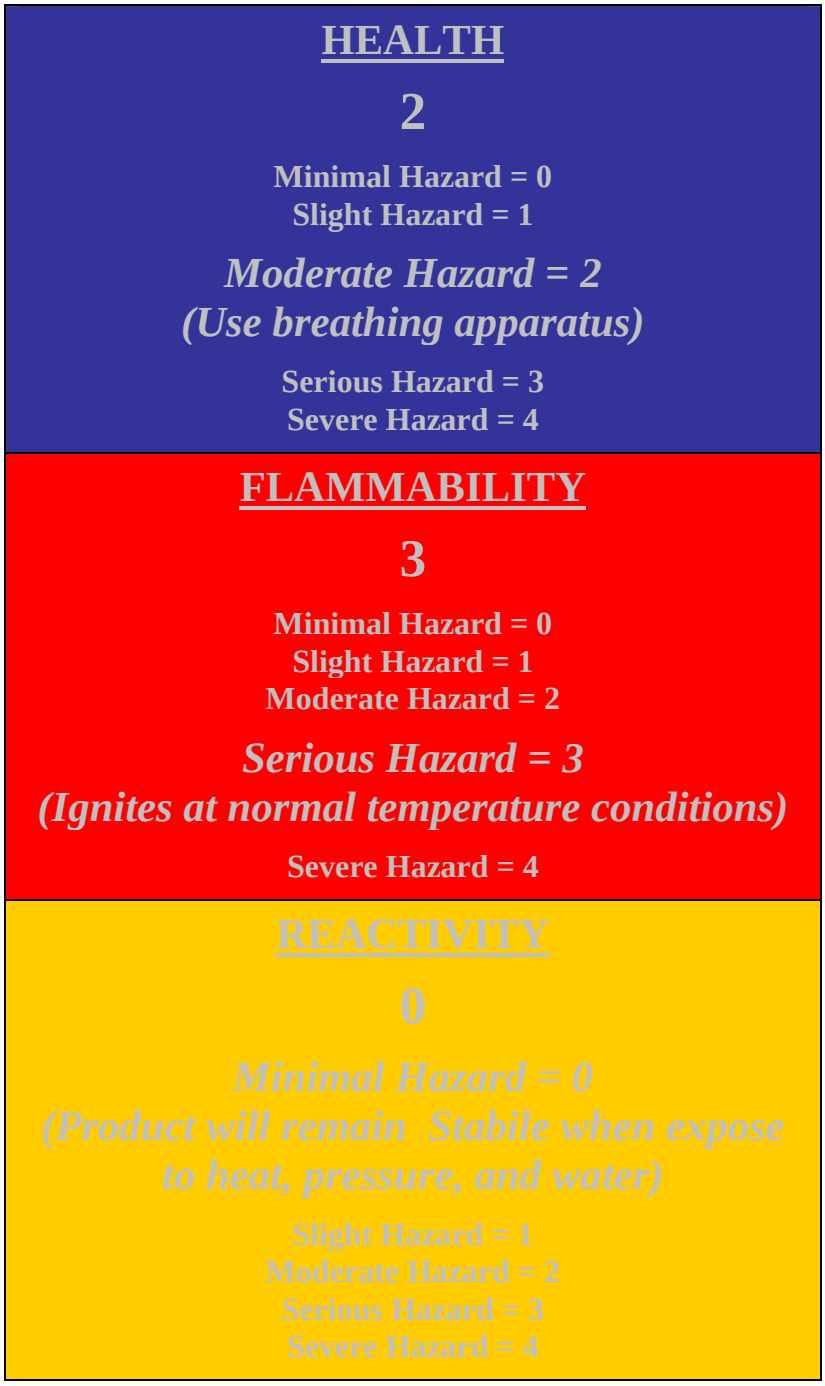
Massachusetts Floor Finishing Safety Task Force, Protecting Workers and Homeowners from Wood Floor-Finishing Hazards in Massachusetts, September 29, 2005. Accessed September 29, 2005 at www.masscosh.org/Floor%20Finsihing%20White%20Paper%20Sep%2027%2005-Final.doc

Green Seal, Choose Green Report, February 2005. Accessed March 2005 at http://www.greenseal.org/recommendations/CGR_wood_finish.pdf

Figure 1 – Two photos of the house involved in the incident

Photographs from the Somerville News accessed on 5/26/2005 at:
Somervillenews.typepad.com/the_somerville_news/news/index.html

Figure 2 – Example of a Hazardous Material Identification System (HMIS) label with the HMIS ratings for the lacquer sealer used in this incident.



September 15, 2004

PRESS RELEASE

SAFETY BULLETIN

HAZARDS ASSOCIATED WITH HARDWOOD FLOOR REFINISHING

In light of the recent tragic event in Somerville regarding the death of two construction workers, the Boston Fire Department is issuing the following safety bulletin. This safety bulletin is designed to inform contractors, managers and homeowners to the potential hazards and dangers associated with hardwood floor installation and finishing/refinishing.

Since 1995 the City of Boston has experienced more than 25 fires directly attributed to hardwood floor installation and refinishing. This resulted in a property loss value of over 1.5 million dollars. In the majority of cases the cause of the fire resulted from failure to follow the manufacturer's safety precautions in the handling, use and storage of the floor finishing chemicals.

The process of hardwood floor installation and finishing or refinishing involves the use of any number of the following kinds of products:

- **Adhesives** - For gluing wood flooring to concrete or other surfaces
- **Sealers** - Chemicals used to seal the wood surface after sanding
- **Surface Finishes** - These finishes remain on the surface of the floor and form a protective coating

Contractors must be thoroughly familiar with the manufacturer's instructions and safety precautions associated with the products in use. Building managers and property owners should question their contractor as to the type of finishing chemicals the contractor is planning on using. In particular they should request from the contractor a copy of the manufacturer's safety precautions and review those sections pertaining to flammability and health hazards.

Improper handling of these products may present the following hazards:
Fire or Explosion

The use of these chemicals in poorly ventilated or enclosed areas may cause a significant build-up of flammable vapors. A spark or open flame could ignite the vapors causing a fire or explosion.

September 15, 2004

Health and Environment

Refinishing can create a large amount of dust from sanding. There is also the potential for chemical emissions from the sealer or surface finish. These products contain organic solvents and other substances: polyurethane, ureaformaldehyde and various resins. Workers who improperly handle the products can be exposed to high levels of vapors. Prolonged and repeated exposure may produce adverse health effects.

Safety Recommendations

- Always follow all of the manufacturer's safety precautions.
- All open flames and sources of ignition that may be present or within the heating or ventilation systems must be eliminated (example: pilot lights, electrical motors, open flame or smoking).
- Adequate ventilation must be provided per the manufacturer's recommendation.
- Adequate respiratory protection shall be provided and used.
- Less flammable or non-flammable products should be used when available.
- Less toxic products should be used when available to prevent adverse health effects in workers.

The Law

Commonwealth of Massachusetts regulations to date:

Flammable Liquids used for Floor Refinishing

527 CMR 14.03 (6) allows recognized tradesmen or artisans to have and use 5 gallons of flammable liquids without obtaining a permit, provided it is removed from the building or structure upon completion of each working day.

They must have a suitable fire extinguisher of a least 1A-10BC rating available at all times.

527 CMR 14.04 (8) in locations where flammable vapors may be present, precautions shall be taken to prevent ignition by eliminating or controlling sources of ignition. Sources of ignition shall include open flames, lightening, smoking, cutting, and welding, hot surfaces, frictional heat, sparks, static (electrical and mechanical), spontaneous ignition, physical chemical reactions and radiant heat. The Head of the Fire Department shall prohibit the use of devices or order the suspension of an operation when proper precautionary measures are not taken.

Other sources of ignition: stoves, refrigerators, electric lights and switches, heating equipment, fans used for ventilation if not of the proper type.

BFPC 17.02 Permit Required

A permit shall be obtained for application of finishing materials by spraying, dipping or other means of which use of more than one gallon of flammable or combustible liquids or fluidized powders in any working day. No permit will be required for small, intermittent spraying operations for domestic or other incidental use unless required by the Head of the Fire Department when such operations are a major process of a business.

In closing this information is provided on the Boston Fire Department website at www.cityofboston.gov/bfd. Additional questions can be directed to the Fire Marshal at:

Boston Fire Department
Fire Marshal
1010 Massachusetts Avenue
Boston, MA 02118

Phone: 617-343-3402