Sheet Metal and Air Conditioning Contractors' National Association

Safe Handling of Fiberglass Reinforced Plastic (FRP)

SMACNA
Safety and Health Department
In cooperation with The Composites Fabricators Association
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1.0 General

1.1 OSHA Regulations and Hazard Communication

The United States Department of Labor, Occupational Safety and Health Administration (OSHA), regulates safety and health in the workplace. OSHA has several regulations which apply to manufacturing and joining fiberglass reinforced plastic (FRP) duct. The regulations applicable to this type of work may be found both in the General Industry Regulations and in the Construction Regulations.

The Hazard Communication Standard requires employers to maintain Materials Safety Data Sheets (MSDS's) on all chemicals in use in the workplace. MSDS's should contain all important product information relating to safety and health, including carcinogenicity, short and long term effects, engineering controls, work practice controls, personal protective equipment, reactivity information, storage requirements, routes of entry into the body, spill containment information, and disposal requirements.

It is necessary to review and understand the MSDS's of all products before beginning work. Manufacturers of thermoset resins and ductwork produce MSDS's with extensive information contained in them. Another reason why these sheets should be reviewed before each job is that the products change periodically, and the manufacturers will update the sheets with any new hazards present (or hazards eliminated). All of the health and safety information presented in this paper is designed to complement the information provided on MSDS's, not replace it.

OSHA's standards on airborne contaminants set limits on airborne levels of dusts and vapors that workers may be exposed to. The limits are called OSHA permissible exposure limits (PEL's). The National Institute for Occupational Safety and Health (NIOSH) and the American Conference of Governmental Industrial Hygienists (ACGIH) also have airborne limits for worker exposure. NIOSH and ACGIH limits are recommendations, and employers are usually not cited if workers are exposed in excess of these recommendations if there is an OSHA PEL for the chemical that is not exceeded. However, the NIOSH and ACGIH limits are often based on recent scientific data, and therefore more protective for workers. Best practice dictates trying to keep worker exposure less than the lowest of either the OSHA PEL or the NIOSH or ACGIH recommended levels.

The OSHA standard for air contaminants requires that the employer reduce exposure through the use of engineering controls and work practices, but allows the use of respirators where these controls are either not feasible or do not reduce employee exposure below the PEL. Engineering controls and work practice controls will be more thoroughly discussed in the section entitled "Control Methods".

The OSHA standard on respirators applies to both general industry and construction workplaces. Respiratory protection, when required, must be accompanied by a comprehensive program. Where respirators are not required, but used for "comfort"

reasons, parts of a program still need to be in place. Requirements of respirator programs will be discussed in the "Control Methods" section.

The OSHA standards for personal protective equipment (PPE) require that appropriate PPE be selected. Appropriate PPE for common chemicals used in the joining of FRP duct will be discussed in the section titled "Control Methods".

1.2 Styrene

Thermoset resins contain styrene monomer. Styrene is a hazardous chemical that has been classified as a possible carcinogen to humans by the International Agency for Research on Cancer (IARC). This is partially based on recent mouse studies and it is not known how or if the results are applicable to humans. For this reason, it is important to keep workers' exposure to styrene under the established safe exposure levels.

Styrene can be absorbed into the body by inhalation and through the skin and eyes. Both airborne and skin over exposure to styrene should be avoided. The health effects of styrene include irritation of the eyes, nose, and respiratory system. Additionally, headache, fatigue, dizziness, confusion, malaise, drowsiness, weakness, and unsteady gait may result from over exposure to styrene. Skin exposure can lead to the defatting of the skin. Long-term effects of over exposure to this chemical include central nervous system disorders and liver injury. Comprehensive reviews of the developmental and reproductive data indicate that styrene is likely not teratogenic (i.e. causing birth defects), and provides little indication that styrene exposure could lead to any developmental or reproductive toxicity. The data for mutagenicity is mixed and the data are inadequate to classify it as a mutagen.

Styrene has a sweet floral odor, and most individuals can smell styrene at levels below 1 part styrene per million parts air (ppm). The OSHA PEL for styrene is 100 ppm as an eight-hour time-weighted average, with higher allowable limits for shorter durations (200 ppm 15-minute average and 600 ppm 5 minute average). NIOSH has identified lower recommended limits of 50 ppm as an eight-hour time-weighted average and 100 ppm as a fifteen-minute average. [Note: the OSHA limits are based on technology from 1968, as OSHA has not been able to successfully update many of their PELs since then.]

However, OSHA has entered into a voluntary agreement with the composites industry to control exposure to styrene. OSHA has formally endorsed a styrene industry proposal for a voluntary 50 ppm workplace limit on styrene. Members of the Styrene Information and Research Council (SIRC), Composites Institute (CI), Composite Fabricators Association (CFA), International Cast Polymers Association (ICPA) and National Marine Manufacturers Association (NMMA) have agreed to promote the use of engineering controls, work practices, and respiratory protection to achieve this voluntary limit for styrene. These organizations are good sources for additional information on styrene

Because most people can smell styrene at levels lower than the OSHA PEL and NIOSH Recommended Exposure Limit, the odor serves as a warning of exposure and can help workers recognize if the respirator being used is functioning properly [Note: OSHA does not allow the employer to use the presence of odor to be the indicator that respirator cartridges need to be changed. The employer must develop a change schedule based on the concentration of contaminant present and other factors in the workplace.]

1.3 Fiberglass

In field installation of FRP duct, there are several activities that could result in exposure to nuisance dust including dust from fiberglass and resin. During the preparation for joining the duct, the installer must handle, cut, and sand the duct material including fiberglass strapping. These activities could lead to the generation of airborne particles. The worker can generally not see the presence of airborne particles. Table Z-3 of the OSHA regulations (Subpart Z - 1910 1000) establishes allowable limits on the exposure to inert or nuisance dust at 15mg/m3 and if the dust is respirable, the limit is 5mg/m3

There has been considerable research concerning glass wool fibers and glass fibers. The IARC has recently concluded its re-evaluation of the carcinogenic risk of airborne man-made vitreous fibers including glass wool and glass filaments. The committee evaluated data concerning the more commonly used vitreous fiber wools including insulation glass wool, rock (stone) wool and slag wool, and now considers them not classifiable as to carcinogenicity to humans (Group 3). Continuous glass filaments, which are used principally to reinforce plastics, are also considered not classifiable as to carcinogenicity to humans. Epidemiological studies published during the 15 years since the previous IARC Monographs review of these fibers in 1988 provide no evidence of increased risks of lung cancer or of mesothelioma (cancer of the lining of the body cavities) from occupational exposures during manufacture of these materials, and inadequate evidence overall of any cancer risk.

2.0 Safety

2.1 Reactivity

Mixing of resins with catalysts, promoters, and inhibitors during field installation of FRP ductwork requires special attention. The use of promoters or accelerators may be called for if the working time of the room temperature cured system needs to be shortened due to cool temperatures or other reasons. Methyl ethyl ketone peroxide (MEKP) is the most widely used room temperature cure catalyst, and it always requires the use of a promoter to polymerize. Whenever a promoter is used, it should always be mixed thoroughly with the resin before adding the catalyst. Mixing a catalyst with a promoter is extremely hazardous and may result in an explosive reaction. CAUTION: MEKP AND OTHER CATALYSTS MUST NEVER BE ADDED DIRECTLY TO PROMOTERS – THE MIXTURE COULD BE EXPLOSIVE!

2.2 Flammability

Thermoset polyester and vinyl ester liquid resins are flammable due to the presence of styrene monomer. These resins should be stored away from heat sources such as: space heaters, open flames, and spark producing equipment. *SMOKING IS STRICTLY PROHIBITED*

In the event of a fire involving styrenated resins, it is recommended that the flames be extinguished by using a foam, dry powder, or carbon dioxide fire extinguisher. The use of high pressure water is not recommended to extinguish fires involving resins and it may actually spread the fire. However, water fog, mist, and water from sprinkler systems has been shown to be effective in controlling resin fires.

When these resins burn, toxic gases such as carbon monoxide and halogenated products of combustion may be produced. A self-contained breathing apparatus should be worn when extinguishing resin fires.

2.3 Storage

Resins received in drums should be stored below 80 F (27 C) in a covered storage area outside of the main workplace. The resin drums should be kept away from direct sunlight or other heat sources.

Styrenated resins have a limited storage life, which is determined by the resin manufacturer. Elevated temperatures decrease the storage life. Styrenated resins should not be stored with oxidizing agents, catalysts (such as peroxides), strong acids, and aluminum chlorides. Violent reactions can occur if these chemicals come in contact with styrene monomer. Storage areas should be well ventilated to avoid buildup of toxic or flammable atmospheres. OSHA may require the use of a flammable storage cabinet or flammable storage room, depending upon the quantity of material stored.

Containers should be tightly sealed to prevent water absorption by the resin and styrene monomer evaporation.

3.0 Health

3.1 Skin Contact

Prolonged or repeated resin skin contact may cause contact dermatitis. Contact dermatitis can develop due to the material being irritating to the skin. It also can be caused by an allergic reaction to something in products used, and many workers develop allergenic contact dermatitis due to exposure to epoxies. If skin problems persist, employees should seek the attention of a dermatologist and inform them of the products used at work.

Proper glove use is needed, because in addition to chemicals harming skin, some components of the resins may be absorbed through the skin, into the bloodstream Once in the body, damage can occur to target organs such as the liver, reproductive system, and central nervous system.

Fiberglass is also irritating to the skin and exposed skin can develop a rash. Skin should be washed before eating and smoking after work is completed.

Protective gloves and clothing should be worn to avoid skin contact while handling styrenated resins and fiberglass, and recommendations for types of personal protective equipment are included in the section entitled "Control Methods."

3.2 Inhalation

Styrene has been classified as a possible human carcinogen by IARC and the hazards of over exposure were discussed previously.

3.3 Eye Contact

Over-exposure to these chemicals used in FRP duct installation cause eye irritation, stinging, redness, or swelling Some chemicals, including styrene not only cause irritation, but can be absorbed into the bloodstream through the eyes. Information on protective measures is included in the section called Control Methods.

3.4 Ingestion

The ingestion of any chemical can cause the uptake of the chemicals into the blood, or could cause other adverse effects If liquid resin is accidentally swallowed, do not induce vomiting as the resin material is an aspiration hazard (seek medical attention immediately)

The hazard of ingestion exists for liquids and solids. Therefore it is important to make sure that workers wash hands thoroughly whenever they are soiled and before eating or smoking to remove contaminates

3.5 Chronic Health Effects

The known chronic health effects of materials used in the field installation of FRP duct work were addressed previously in this chapter, under styrene and fiberglass. Additional chronic health effects are unknown, but the material safety data sheet should be consulted to determine if additional information is discovered in the future.

4.0 Control Methods

4.1 Engineering Controls

Engineering controls should be implemented before personal protective equipment, whenever possible, to control health and safety hazards associated with joining FRP ductwork. For airborne contaminants, where exposure may be above OSHA PEL's or recommended limits, local exhaust ventilation should be used whenever possible to capture contaminates at the point of generation. During cutting and grinding operations involving materials containing fiberglass, local exhaust ventilation should be used to reduce worker exposure to styrene and other components of resins, promoters, catalysts and inhibitors.

4.2 Personal Protective Equipment

Where the use of engineering controls is not possible, the use of personal protective equipment may be needed to reduce worker exposure to material used in field installation of FRP ductwork.

To protect the skin, workers should wear gloves and other protective clothing where there is a potential for contact. Butyl or neoprene gloves are recommended when contact is anticipated. Gloves contaminated on the inside should be replaced, and clothing contaminated with resin should be removed. Any skin that comes in contact with liquid resins should be washed thoroughly with soap and water as soon as possible, and prior to eating, smoking, and leaving the worksite location.

To protect the respiratory system when over exposure is possible, appropriate respirators should be worn. Where there is potential for over exposure to nuisance dust, respirators equipped with NIOSH approved HEPA N-100, P-100 or R-100 filters should be used. Where there is a potential for over exposure to styrene monomer, respirators should be equipped with an organic vapor cartridge. Respirators should be used in conformance with the OSHA Respirator Standard and with a proper respiratory protection program.

According to OSHA, components of a minimally acceptable respiratory protection program include: a written program; the designation of a program administrator; procedures for selecting respirators; medical evaluations of employees required to wear respirators; fit testing procedures; routine and emergency use procedures; cleaning, disinfecting, storing, inspecting, repairing, discarding, and maintaining respirators; procedures for ensuring air quality for supplied air respirators; training in respiratory hazards and proper use and maintenance, and a program to evaluate procedures.

Chemical goggles should be worn at all times when working with liquid resin if there is a potential for splashing. While grinding, cutting, and sanding cured laminates, protective goggles should be worn to protect against flying particles and dusts. If exposure to chemicals used in joining FRP ductwork cause eye irritation, stinging, redness, or

swelling, flush the eyes with plenty of water. DO NOT RUB DRY. If symptoms persist, seek medical attention.

5.0 Environment

5.1 Spills and Cleanup

Small resin spills of less than 3.5 oz (100 grams) can be wiped up with paper towels and safety solvent. Spills greater than 3 5 oz (100 grams) and less than 10 gallons (38 liters) should be cleaned up with sand or other absorbent material, then shoveled into a container for proper disposal. The sticky residue should be removed with rags, then washed with safe solvent and hot soapy water. The area shall be continuously ventilated in order to maintain airborne concentrations below the OSHA PEL's or NIOSH or ACGIH recommended exposure limits.

Larger resin spills should be contained promptly with a periphery of sand dike. The liquid resin should be scooped up, if possible, and placed in drums. Residue should be absorbed with sand and then shoveled into containers for proper disposal. Final cleanup of the spilled area should follow the same procedures as described above for small spills (including adequate ventilation)

In the event airborne contaminant levels are not known, the employer should assume that airborne concentrations are Immediately Dangerous to Life and Health (IDLH) [Note: This is required under OSHA's respirator standard.] A self-contained breathing apparatus should be used in conformance to the requirements of the OSHA Respirator Standard

5.1 Disposal

Local and state guidelines should be carefully followed when disposing of liquid resins Generally, liquid resins are not acceptable in landfills. Such liquid waste may be sent to an approved incinerator for disposal. Small quantities can be converted to a solid by means of polymerization (POLYM Standard).

Some states allow the disposal of solid resin or cured laminates in landfill areas. Prior to disposing waste materials, it is recommended that the proper state or local agency be contacted to confirm the approved method of disposal for cured resin parts and residue.

6.0 Summary

Since the data on health effects, use, and application of FRP varies, applicable engineering and administrative controls to protect workers should be evaluated against current and reliable information such as MSDS' to ensure that safety and health concerns are adequately addressed