WALK-THROUGH SURVEY REPORT:

CONTROL OF METHYLENE CHLORIDE IN FURNITURE STRIPPING

AT

Colonial Furniture Stripping
Cincinnati, Ohio

REPORT WRITTEN BY:
Paul A. Jensen
Cheryl L. Fairfield
William F. Todd

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control
National Institute for Occupational Safety and Health
Division of Physical Sciences and Engineering
Engineering Control Technology Branch
4676 Columbia Parkway, R-5
Cincinnati, Ohio 45226

PLANT SURVEYED:	Colonial Furniture Stripping 6500 Glenway Avenue Cincinnati, Ohio 45211
SIC CODE:	7641
SURVEY DATE:	September 20, 1988
SURVEY CONDUCTED BY:	Paul A. Jensen, P.E. Cheryl L. Fairfield William F. Todd, P.E.
EMPLOYER REPRESENTATIVES:	Larry Heimbach, Owner
EMPLOYEE REPRESENTATIVES:	None (nonunion)
ANALYTICAL WORK PERFORMED BY:	DataChem, Salt Lake City, Utah

DISCLAIMER

Mention of company names or products does not constitute endorsement by the National Institute for Occupational Safety and Health.

I. INTRODUCTION

Under the authority of the Occupational Safety and Health Act of 1970 (Public Law 91-596), the National Institute for Occupational Safety and Health (NIOSH), located in the Department of Health and Human Services (formerly DHEW), conducts research to prevent occupational safety and health problems. This legislation mandated NIOSH to conduct a number of research and education programs separate from the standard setting and enforcement functions carried out by the Occupational Safety and Health Administration (OSHA) in the Department of Labor. An important area of NIOSH research deals with methods for controlling occupational exposure to potential chemical and physical hazards. The Engineering Control Technology Branch (ECTB) of the Division of Physical Sciences and Engineering has been given the lead within NIOSH to study the engineering aspects of health hazard prevention and control.

Since 1976, ECTB has conducted a number of assessments of health hazard control technology on the basis of industry, common industrial processes, or specific control techniques. Examples of these completed studies include the foundry industry, various chemical manufacturing or processing operations, spray painting, biotechnology processes, and the recirculation of exhaust air. The objective of each of these studies has been to document and evaluate effective control techniques for potential health hazards in the industry or process of interest, and to create a more general awareness of the need for or availability of an effective system of hazard control measures.

These studies involve a number of steps or phases. Initially, a series of walk-through surveys is conducted to select plants or processes with effective and potentially transferable control concepts or techniques. Next, in-depth surveys are conducted to determine both the control parameters and the effectiveness of these controls. The reports from these in-depth surveys are then used as a basis for preparing technical reports and journal articles on effective hazard control measures. Ultimately, the information from these research activities builds the data base of publicly available information on hazard control techniques for use by health professionals who are responsible for preventing occupational illness and injury.

This particular research effort (the subject of this walk-through survey) was prompted by the growing concern of the hazards of methylene chloride and the need for technical advice to furniture strippers. For years, methylene chloride and methanol have been the primary constituents in paint stripping solutions. Methylene chloride provides the furniture stripper with an effective paint remover. This project will evaluate the technology available for the control of hazardous substances in furniture stripping applications, particularly methylene chloride vapors.

Colonial Furniture Stripping was chosen as a site to conduct a walk-through survey because of the existing ventilation system on its dip tank and because Mr. Heimbach uses methylene chloride-based paint stripper. This report contains results of the walk-through survey, conclusions, and recommendations relevant to the operations at Colonial Furniture Stripping. The recommendations, if followed, will help lower the worker's exposure to methylene chloride vapors.

II. PLANT AND PROCESS DESCRIPTION

PLANT DESCRIPTION

Larry Heimbach is the owner and only worker at this furniture stripping operation. He purchased the business one year ago. Since then, he has been accepting and stripping furniture himself. The business has heavy and light workloads, depending on the time of year. Therefore, the time he spends stripping furniture varies from day to day and season to season.

The shop is a two-unit section of a single-story building which consists of approximately ten units, including office space, shops, and garage space. The entire shop consists of approximately 2,300 square feet. The actual furniture stripping area consists of approximately 580 square feet. Also in the store, there is a 180-square foot changing area adjacent to the stripping area and a 1,540-square foot garage area for office space and storage (see Figure 1).

As shown in Figure 1, very little of the total space is used for furniture stripping. Most of the space is the large office and storage area where the furniture is stored either because it has just been accepted or is waiting to be returned to the customer. This area has plenty of extra room for more furniture and for moving about comfortably. It is open to the outside by the two garage doors, which were left open the whole time we observed the furniture stripping operation. The furniture stripping area contained less free space than the storage area. The Flow-Over® tank and the adjacent dip tank were mainly used as shelf space for small items such as cans of solution. We observed the owner using the dip tank in the center of the room for his stripping. The table noted in Figure 1 was used by the owner to store his gloves when not in use.

PROCESS DESCRIPTION

Many strippers purchase preformulated solutions that are merely transferred to their process equipment by pouring or pumping. Some strippers bulk purchase the raw materials and mix stripping solutions, both for their own use and for consumer and franchise sales. Mr. Heimbach uses Paint and Varnish Remover (Stripping Products, Inc., Bethel, Connecticut) in his dip tank. Also, he uses Bix Stripper® (Bix Manufacturing Company Inc., Old Hickory, Tennessee) for any hand stripping needs. The contents of both of these solutions are shown in Figure 2. Bix Stripper® does not contain methylene chloride.

Paint may be stripped by dipping the object in an open tank containing the stripper, by spraying or brushing recycled stripper on the surface of the furniture in a large open tank (Flow-Over® system), by a combination of these two methods, or by manual application of the stripper to the furniture. There is little standardization in the industry due to the diversity in size, construction, and finish of items to be stripped, and the type of stripping solution used. This furniture stripping operation uses the dip tank and hand stripping methods. The dip tank is approximately 8 feet long by 4 feet wide and 3 feet deep. It is filled about two-thirds full with stripping solution and there are hinged doors on the top of the tank which are opened and closed when moving pieces in and out of the tank. A piece of furniture is put in the

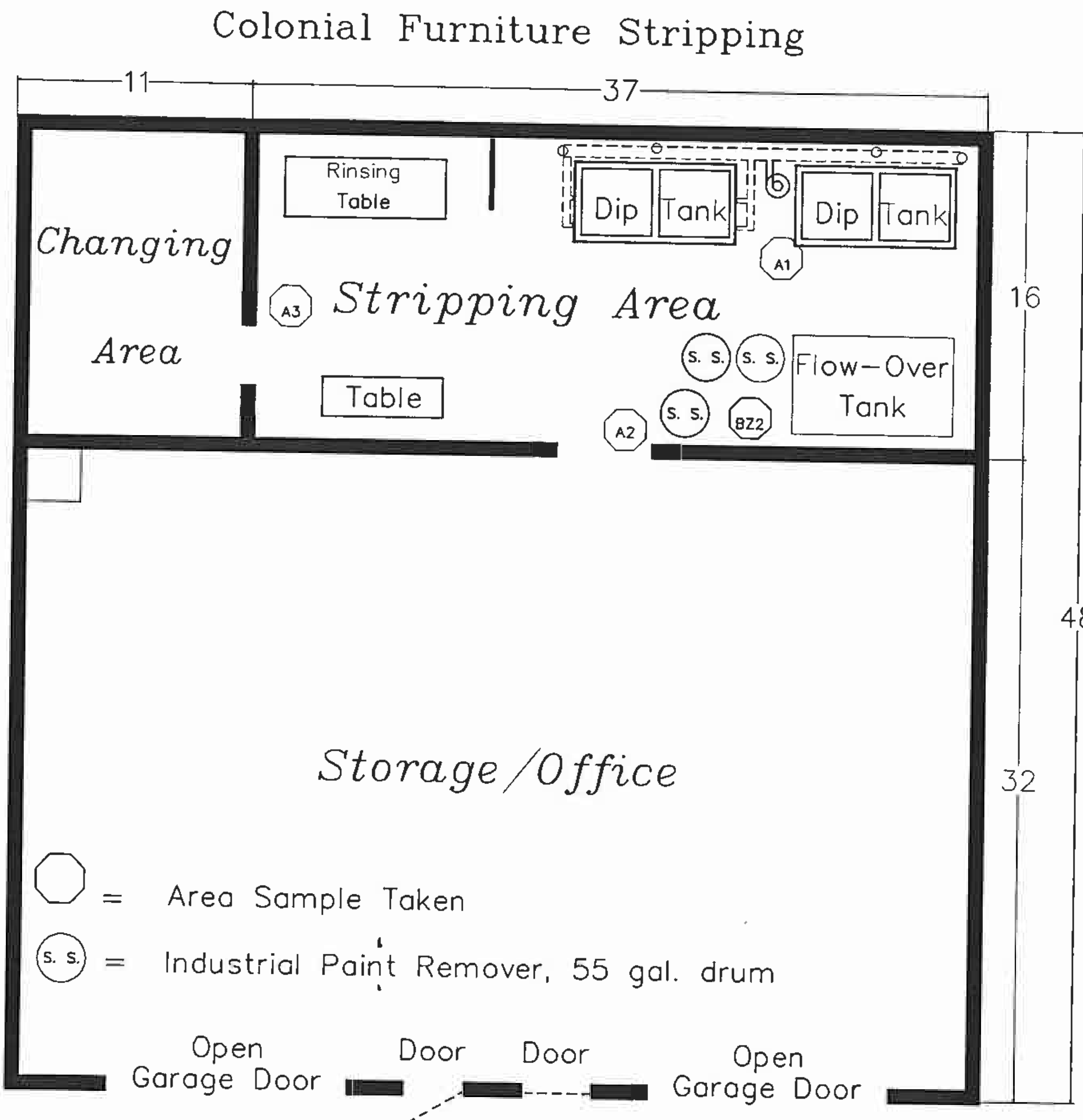

Figure 1. Shop Floor Plan

Paint & Varnish Remover
(Stripping Products, Inc., Bethel, CT)

Component	(% by wt)
Methylene Chloride	72
Methanol	20
Toluene	2
Activators, Evaporation-Retarder	4
Aqueous Solution for pH Adjustment	1
Surfactant, (Wetting Agent)	1

Bix Stripper
(Bix Manufacturing Company Inc., Old Hickory, TN)

Component	(% by wt)
Methanol	24-50
Toluene	25-30
Acetone	15-20
Sodium Methylate	< 5
Nonhazardous Components	< 5

Figure 2. Components of Stripping Solutions

tank and left for about 10 to 20 minutes, depending on the type of finish on the furniture. After removing the piece from the tank, the excess stripping solution is brushed off the piece and moved to a rinse table, where the solution and the furniture's original coating is removed using a high-pressure water nozzle and a stiff bristled brush.

Pieces are sometimes hand stripped at this operation in order to prevent damage to veneers and glued laminates. When hand stripping, the solution is brushed on the piece, which is then scraped or wiped with a rag. Often when hand stripping, it is necessary to repeat the process two or three times before the coating is completely removed from the piece. Almost all the stripping at Colonial is done using the dip tank method, because the hand stripping method requires extra time and work.

POTENTIAL HAZARDS

Potential chemical hazards in the furniture stripping industry are found primarily during the actual handling and stripping of the furniture. Other exposure sources may include the mixing or transferring of stripping solution, and vapor buildup in the room air. While performing these tasks, stripping solvents (e.g., methylene chloride, methanol, toluene, acetone, or xylene) may enter the worker's body through inhalation or absorption through the skin. The severity of the hazard depends on the formulation of the stripping solution, type of operation (i.e., dip tank, Flow-Over® system, hand stripping), work practices, duration of exposure, temperature, ventilation (i.e., type of system, location relative to worker, air patterns, and flow rates), and general workstation design.

Health effects studies of methylene chloride exposure have focused on three primary areas: effects on the central nervous system, effects on cardiovascular morbidity and mortality, and induction of cancer in exposed workers. Most recently, research has shown methylene chloride as a possible reproductive toxicant. In addition, solvents are known to affect liver function, and some studies suggest that this effect occurs secondary to methylene chloride exposure. Repeated skin contact with methylene chloride may cause dry, scaly, and cracked skin. At high airborne concentrations, vapors are irritating to the eyes and upper respiratory tract. Direct contact with the liquid can cause skin burns. Methylene chloride is a mild narcotic. Effects from intoxication include headache, giddiness, stupor, irritability, numbness, and tingling in the arms and legs. The reports of odor threshold range from 25 to 350 ppm.[1]

Methanol has very similar central nervous system effects to methylene chloride. Breathing very high concentrations may produce headache, weakness, drowsiness, light-headedness, nausea, vomiting, drunkenness, and irritation of the eyes, blurred vision, blindness, and even death. Methanol may also cause liver and kidney damage.[1]

ENVIRONMENTAL CRITERIA

As a guide to the evaluation of the hazards resulting in workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a preexisting medical condition, and/or a hypersensitivity (allergy). In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, medications, or personal habits of the worker to produce adverse health effects even if the occupational exposures are controlled at the level set by the evaluation criteria. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: (1) NIOSH recommended exposure limits (RELs), (2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLVs®), and (3) the U.S. Department of Labor (OSHA) permissible exposure limits (PELs). Often, the NIOSH RELs and ACGIH TLVs are lower than the corresponding OSHA PELs. Both NIOSH RELs and ACGIH TLVs usually are based on more recent information than are the OSHA PELs. The OSHA PELs also are required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH RELs, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet only those levels specified by the OSHA PELs.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values, which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

The current OSHA PEL for methylene chloride (29 CFR 1910.1000 Table Z-2) is an 8-hour TWA concentration of 500 parts per million (ppm), with a ceiling concentration of 1,000 ppm, and a maximum peak concentration of 2,000 ppm for no more than 5 minutes within any 2 hours. This PEL was derived from a standard recommended by the American Standards Institute (ANSI) and adopted in 1971 without rulemaking.[2] In 1986, OSHA published an Advanced Notice of Proposed Rulemaking and did not include methylene chloride in their recent PEL update. OSHA is expected to publish the Notice of Proposed Rulemaking to reduce the PEL in 1990.[3]

In 1976, the NIOSH REL for methylene chloride became 75 ppm, as a TWA for up to 10 hours per day, 40 hours per week, with a 500 ppm peak exposure as determined over any 15-minute sampling period during the workday. This REL was based on the need to prevent significant reduction in the oxygen carrying capacity of the blood which affects the central nervous system.[4] In 1986, NIOSH recommended that methylene chloride be regarded as a "potential occupational carcinogen." NIOSH further recommended that occupational exposure to methylene chloride be controlled to the lowest feasible limit. This new recommendation was based on the observation of cancers and tumors in both rats and mice exposed to methylene chloride in air.[5]

The 8-hour TWA TLV established by the ACGIH is 50 ppm with no short-term exposure limit (STEL), and is classified as a Suspected Human Carcinogen. This TLV is based on liver toxicity studies. The previous TLV of 100 ppm was based on experimental data obtained from male, nonsmoking subjects at rest. The ACGIH stated that the blood of workers who were exposed at 100 ppm of methylene chloride would have carboxyhemoglobin levels below 5% in their blood. Normal carboxyhemoglobin saturation ranges from 0.4 to 0.7% for nonsmokers and 4 to 20% for smokers. The ACGIH further cautioned that "concurrent exposures to other sources of carbon monoxide or physical activity will require assessment of the overall exposure and adjustment for the combined effect."[6]

The current OSHA PEL for methanol (29 CFR 1910.1000 Table Z-1-A) is an 8-hour TWA concentration of 200 ppm and a STEL of 250 ppm. The NIOSH REL for methanol is 200 ppm, as a TWA for up to 10 hours per day, 40 hours per week, with a ceiling of 800 ppm averaged over a 15-minute period. The 8-hour TWA TLV established by ACGIH is 200 ppm, with a 500 ppm STEL.[6]

The current OSHA PEL for acetone (29 CFR 1910.1000 Table Z-1-A) is an 8-hour TWA concentration of 750 ppm with a STEL of 1,000 ppm. The NIOSH REL for acetone is 250 ppm, as a TWA for up to 10 hours per day, 40 hours per week. The 8-hour TWA-TLV established by ACGIH is 750 ppm, with a 1,000 ppm STEL.[6]

The current OSHA PEL for toluene (29 CFR 1910.1000 Table Z-1-A) is an 8-hour TWA concentration of 100 ppm with a STEL of 150 ppm. The NIOSH REL for toluene is 100 ppm, as a TWA for up to 10 hours per day, 40 hours per week, with a ceiling of 200 ppm averaged over a 15-minute period. The 8-hour TWA-TLV established by ACGIH is 100 ppm, with a 150 ppm STEL.[6]

The current OSHA PEL for xylene (29 CFR 1910.1000 Table Z-1-A) is an 8-hour TWA concentration of 100 ppm with a STEL of 150 ppm. The NIOSH REL for xylene is 100 ppm, as a TWA for up to 10 hours per day, 40 hours per week, with a ceiling of 200 ppm averaged over a 15-minute period. The 8-hour TWA-TLV established by ACGIH is 100 ppm, with a 150 ppm STEL.[6]

III. ENVIRONMENTAL MONITORING

Sampling was conducted at the Colonial Furniture Stripping using a Photovac TIP II, and silica gel and charcoal sorbent tubes. The Photovac TIP II collected real-time samples in the worker's breathing zone. Personal air samples for methylene chloride and methanol were collected in side-by-side sorbent tubes in the breathing zone of the worker for the duration of the stripping process. Other sampling pumps were located in the stripping area, A3 near the rinse area, A2 near the doorway to the storage area, and A1 near the dip tank (see Figure 1). Breathing zone and area samples were collected using personal sampling pumps (P200A, E.I. DuPont deNemours and Co., Inc., Wilmington, Delaware). Breathing zone samples were collected for methylene chloride and methanol. Area samples were collected for methylene chloride, methanol, acetone, toluene, and xylene. Charcoal sorbent sampling tubes (SKC 226-01, SKC, Inc., Eighty Four, Pennsylvania) were used in series to collect samples for methylene chloride, acetone, toluene, styrene, and xylene. While silica gel sorbent sampling tubes (SKC 226-10, SKC, Eighty Four, Pennsylvania) were used in series to collect samples for methanol. Sampling was conducted at a nominal flow rate of 0.02 liters per minute. All sorbent tubes were sent to DataChem (Salt Lake City, Utah) for analysis using the following NIOSH methods:

Chemical Name	CHRIS Code	NIOSH Method No.
Methylene Chloride	DCM	1005
Methanol	MAL	2000
Acetone	ACT	1300
Toluene	TOL	1501
Xylenes	XYL	1501

The results of the sorbent tubes are as follows:

Chemical Sampled
(ppm 1-hour TWA)

	Methylene Chloride	Methanol	Acetone	Toluene	Xylene
BZ1	100	63	NA	NA	NA
BZ2	77	41	NA	NA	NA
A1	90	53	3	16	ND
A2	20	6	ND	ND	ND
A3	63	35	ND	10	ND

BZ1 - Breathing zone of the owner.
BZ2 - Breathing zone of NIOSH employee.
A1 - Area sample, near dip tank.
A2 - Area sample, doorway to stripping area.
A3 - Area Sample, near rinse area.
NA - Parameter not collected for analysis.
ND - Parameter not detected.

The exposure in Mr. Heimbach's breathing zone (BZ1) was 100 ppm of methylene chloride for the 1-hour sample. This exposure was less than the OSHA PEL of 500 ppm, assuming the same level of exposure for an 8-hour workday. However, NIOSH recommended that methylene chloride be controlled to the lowest feasible level based on methylene chloride's classification as a potential occupational carcinogen. Considerable improvements in the controls, with an accompanying reduction in exposure, are possible, and the lowest feasible level would therefore be considerably lower than that seen in this study. Mr. Heimbach needs to have more effective control to reduce his exposure to methylene chloride. Mr. Heimbach was also exposed to 63 ppm of methanol, which is lower than both the NIOSH REL and the OSHA PEL. The first area sample (A1) was located by the dip tank. The exposure in that area of 90 ppm shows that the amount of methylene chloride in the air near the dip tank must be controlled to the lowest feasible limit. This high concentration near the dip tank could possibly be controlled with an improved local exhaust system. The other two area samples were in the doorway to the storage area from the stripping area (A2) and near the rinse area (A3). Both of these areas had significant exposures which should also be minimized to lowest feasible limit. The second breathing zone sample (BZ2) is that of a NIOSH employee who was standing in the stripping area by the doorway to the storage area. The NIOSH employee's exposure was 77 ppm while observing the stripping operation. This significant exposure indicates that neither general nor local ventilation was adequate to reduce solvent vapors to safe levels. These data show that there may be a health risk to the Mr. Heimbach because of exposure to methylene chloride.

In addition to personal samples, real-time exposure to total solvents present in the breathing zone was measured using a Photovac TIP II (Photovac, Inc., Thornhill, Ontario, Canada) with a 10.6 eV ultraviolet lamp. The real-time verification of solvents present was synchronized with a video camera in order to detect if changes in output were correlated with certain work activities. Significant activities such as stripping, rinsing, or other movement around the room were identified and coded on a computer spreadsheet. A statistical analysis was performed to determine which activities made a significant change in concentration of methylene chloride. The TIP II can detect methanol and methylene chloride, but cannot differentiate between the two.

Statistical analyses were performed on the real-time data to see how well the data fit a material balance model and to generate hypotheses for investigation in future analyses. The statistically significant factors that affect exposure, included the following:

a. the task being performed (stripping or rinsing, other tasks in stripping area, other tasks in office area); and

b. the item being processed (chair, large/small frame).

Generally speaking, the exposure while stripping was not significantly different from the exposure while rinsing. However, other tasks in office area were lower than other tasks in the stripping area and both exposure tasks were lower than stripping and rinsing. In addition, the exposure to stripping solvents was higher while stripping a chair than while stripping small or large frames.

IV. CONTROL

PRINCIPLES OF CONTROL

Occupational exposure can be controlled by the application of a number of well-known principles, including engineering measures, work practices, personal protection, and monitoring. These principles may be applied at or near the hazard source, to the general workplace environment, or at the point of occupational exposure to individuals. Controls applied at the source of the hazard, including material substitution, process or equipment modification, isolation or automation, local ventilation, and work practices are generally preferred and most effective in terms of both occupational and environmental concerns. Controls which may be applied to hazards that have escaped into the workplace environment include dilution ventilation, dust suppression, and housekeeping. Control measures may also be applied near individual workers, including the use of ventilated control rooms, isolation booths, supplied-air cabs, work practices, and personal protective equipment.

In general, a system comprised of the above control measures is required to provide worker protection under normal operating conditions, as well as under conditions of process upset, failure, and/or maintenance. Process and workplace monitoring devices, personal exposure monitoring, and medical monitoring are important mechanisms for providing feedback concerning effectiveness of the controls in use. Ongoing monitoring and maintenance of controls to ensure proper use and operating conditions, and the education and commitment of both workers and management to occupational health are also important ingredients of a complete, effective, and durable control system.

These principles of control apply to all situations, but their optimum application varies from case to case. The application of these principles is discussed below.

ENGINEERING CONTROLS

The building used by Colonial Furniture Stripping was not designed to include a furniture stripping operation. Our assessment concludes that air movement in the stripping area is less than adequate. The stripping area has two doorways, as shown in Figure 1, one doorway to the changing room and one doorway to the storage garage. There are no other openings or vents; thus, there is no directed or uniform air movement through the room. A propeller fan was located on the floor near the doorway to the garage, but there was no apparent plan to use this fan for other than comfort. Mr. Heimbach did provide local ventilation on the dip tank to exhaust the solvent fumes. These local ventilation openings were located on the inside of both side walls and the back wall of the dip tank. The intake velocity of these ducts was not measured; however, smoke tests indicated that the velocity was very low. Some of the openings appeared to be partially plugged, resulting in flow variation at all locations. Using smoke tubes to detect the movement of air near the exhaust holes, the capture area appeared to be less than 1.5 square feet. Air from the entire surface area of the dip tank should flow toward the exhaust openings. The tank surface area that this local ventilation was able to exhaust was very small in comparison to the size of the dip tank.

Local exhaust ventilation at the source of the methylene chloride-based solution is the best primary control of vapors, short of using a nonmethylene chloride product. In light of the current local ventilation's inability to dilute the area, we suggest a local ventilation system similar to that in Figure 3 which will work than the existing system in this facility. This dip tank ventilation system is a modification of that suggested by the American Conference of Governmental Industrial Hygienists in Industrial Ventilation (VS-502).[7] This design has been modified to ventilate a dip tank area of 4 feet by 8 feet. This type of local ventilation can also be applied to the Flow-Over® system. The Industrial Commission of Ohio (791-4935) could also help in the design and evaluation of a local ventilation system. General room ventilation is a necessary secondary control method. There was no source of fresh air to the stripping area or the rest of the building, other than "natural ventilation" through the open garage doors. Vapors in the building will continue to build up if there is not sufficient air movement and exchange. Figure 4 depicts principles of dilution ventilation and shows the importance of fan location.[7]

Mr. Heimbach may wish to consider substitute products. Some research is currently being conducted to develop methylene chloride-free strippers which includes N-Methyl-2-Pyrrolidone (NMP) and DiBasic Esters (DBE) blends. The active ingredient in NMP-based paint removers is 1-methyl-2-pyrrolidinone. Research conducted by GAF industries that NMP has low potential for skin irritation, and NMP is a severe eye irritant, but permanent damage is not expected. The mutagenicity potential of NMP, as measured using the AMES test, was negative. Several other animal studies were performed, and they all showed no significant toxicological effects.[8] DiBasic esters such as dimethyl adipate, dimethyl glutarate, and dimethyl succinate are the active components of DBE based paint remover. Research conducted by DuPont and 3M indicates that DBEs caused moderate and temporary eye irritation, exhibited no reproductive or developmental toxicity, and caused no organ damage other than mild nasal effects indicative of irritation in 90-day tests. In addition, DBE was negative in several highly sensitive bacterial mutation assays, including the AMES test and in a whole animal chromosome damage study.[9,10] Thus far, data indicate that these blends require two to three times more stripping time than methylene chloride and cost approximately 50% more. Another substitute that has been on the market for many years is a blend of flammable solvents which includes acetone, methanol, toluene, and xylene (e.g., Bix Stripper®).[11] The use of this blend may be less hazardous toxicologically to the user; however, the solvents are flammable. In addition, two manufacturers of methylene chloride are developing an additive for paint stripping solutions to suppress the emissions of methylene chloride vapors.

WORK PRACTICES

Mr. Heimbach, while using the dip tank, does the stripping in three steps. First, the piece of furniture is placed in the dip tank to soak for a period of time depending on the size and finish of the piece. Mr. Heimbach must open the top hatch door of the dip tank, put the piece into the solution and close the door. Mr. Heimbach's breathing zone comes very close to the solution as he puts the piece into the tank. While the piece is in the tank, he may wait in the storage/office area, which has a negligible amount of methylene chloride

DESIGN CRITERIA

Q	-	3000	4000	5000	cfm
FSP	-	0.4	0.7	1.1	in. w.g.
U_{slot}	-	1500	2000	2500	fpm
U_{duct}	-	1000	1300	1600	fpm
$U_{tank\ edge}$	-	60	80	100	fpm

Tank dimensions: 4 ft. x 8 ft.

Slot dimensions: 8 ft. x 1 in.

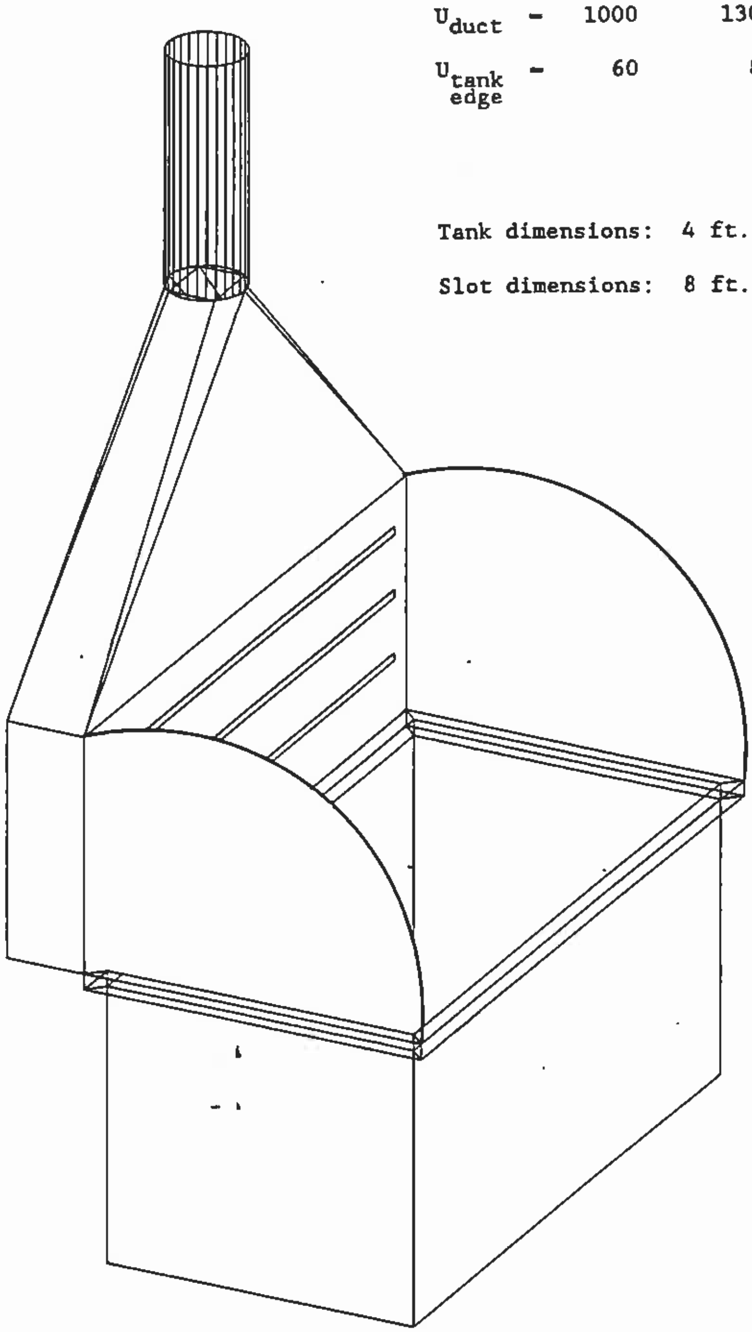

Figure 3. Recommended Ventilation System[7]

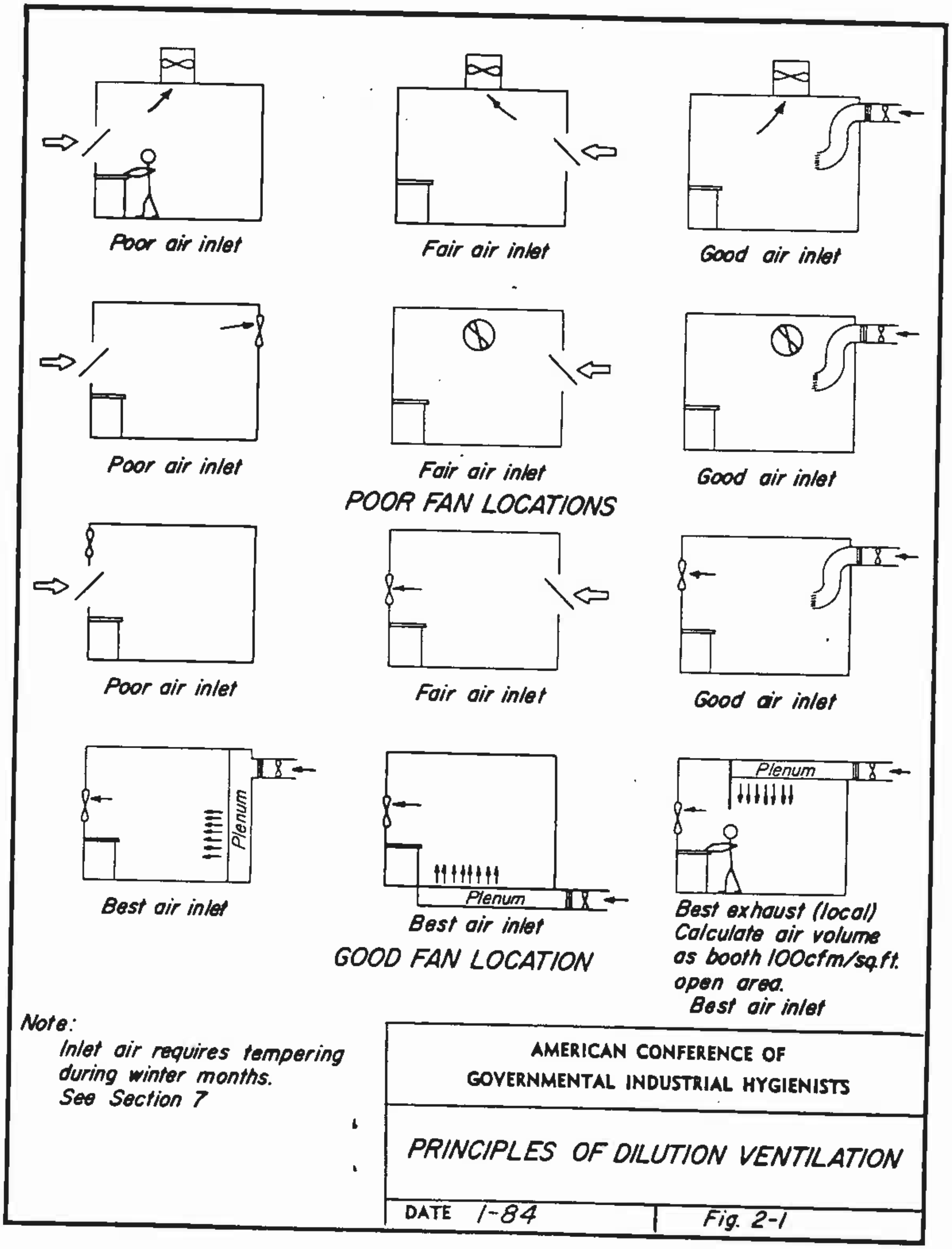

Figure 4. Dilution Ventilation[7]

From Industrial Ventilation: A Manual of Recommended Practice, 19th edition. American Conference of Governmental Industrial Hygienists - Committee on Industrial Ventilation: Edwards Brothers, Inc., Ann Arbor, Michigan, 1986. Adapted with permission of ACGIH.

vapor buildup. When he returns, he opens the tank door, removes the piece, and shuts the door. The second step is to wipe and brush the extra solution off the piece of furniture. The piece is placed on the rinse table, and a high-pressure water nozzle is used to rinse the piece with water for the third step of the operation. Once the piece is rinsed, it is set aside to dry. Mr. Heimbach wears neoprene gloves and boots while stripping, rinsing, and all other handling of the solution-soaked furniture. However, no other personal protective equipment is worn.

Mr. Heimbach also strips pieces by hand, because the solution in the dip tank may deteriorate the glue. Hand stripping requires the solution to be brushed onto the piece, scraped off, and finally rinsed. The process is a bit slower and often requires repetitions to remove the finish from all cracks and crevices.

Good work practices can significantly reduce worker exposure. Keeping the worker's head or more specifically his breathing zone as far as possible from the stripping solution and the furniture will lower the exposure. Keeping all wet cloths, brushes, or tools in a ventilated area or in an airtight container will also help lower exposure. Paint scrapings contain substantial amounts of methylene chloride and should be stored in airtight containers until properly disposed. Any clothing that becomes soaked with stripping solution should be immediately removed and the exposure area thoroughly washed. Soiled clothing should not be taken home and washed with other clothes.

An effective employee education and training program can also reduce potential for exposure to methylene chloride and is required under OSHA's hazard communication standard (29 CFR 1910.1200). If anyone is employed to assist the owner, the program should contain the following elements:

The hazards of methylene chloride exposure;

Safe handling of methylene chloride and other relevant work practices and methods which can be used to prevent respiratory, skin, or eye contact;

Use, care, and limitations of respirators and other personal protective equipment;

Effective housekeeping procedures;

First aid and emergency procedures; and

Relevant personal hygiene aspects for controlling methylene chloride exposure.[12]

PERSONAL PROTECTIVE EQUIPMENT

The owner, Mr. Heimbach, wore boots and neoprene gloves while doing all his stripping work. In operations where splashing, spilling, spraying, or skin and eye contact with methylene chloride may occur, employees should wear protective solvent-impermeable gloves (long enough to cover the forearms), aprons, shoe coverings, and chemical splash goggles. Neoprene (currently used), butyl rubber, nitrile rubber, or polyvinyl chloride (PVC) provide limited protection against methylene chloride and should be used with caution and only for short-term contact with this solvent. Whenever swelling or softening of the gloves or seepage of methylene chloride into the glove is observed, the gloves should be disposed of immediately and replaced.[12]

A study conducted by NIOSH researchers demonstrated that full shift use of chemical cartridges are not adequate for removing methylene chloride, since cartridge breakthrough time is approximately 40 minutes for a methylene chloride challenge of 15 parts per million.[13] Because the odor threshold of methylene chloride is near the PEL, methylene chloride will not be detected until significant breakthrough has occurred. Though not generally recommended, respirators with organic vapor cartridges may be used for short-term exposure to low levels of methylene chloride, provided the cartridges are changed prior to breakthrough (every 15 to 30 minutes, depending on room concentrations). Because NIOSH has identified methylene chloride as a potential human carcinogen in the workplace, two types of respirators are recommended: a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure demand or other positive pressure mode, or a supplied-air respirator (SAR) with a full facepiece operated in pressure demand or other positive pressure mode in combination with an auxiliary SCBA operated in pressure demand or other positive pressure mode. The auxiliary SCBA must be of sufficient duration to permit escape to safety if the air supply is interrupted. Where employees must wear respirators, an appropriate respiratory protection program in accordance with 29 CFR 1910.134 must be instituted.[14]

V. CONCLUSION AND RECOMMENDATIONS

In view of the results from the environmental monitoring conducted at Colonial Furniture Stripping, it is believed that there is a significant exposure to methylene chloride. Since the exposure to Mr. Heimbach and the general area around the dip tank is above the ACGIH TLV and the NIOSH REL, Mr. Heimbach should lower his overall exposure. We suggest that Mr. Heimbach look into a better general room ventilation system and more importantly look into a better local exhaust system at the dip tank. A local exhaust system could remove a large amount of the methylene chloride vapors before they reach the user's breathing zone. As previously suggested, the Industrial Commission of Ohio could help in the design or improvement of the existing local ventilation at the dip tank. In addition to improvements in the ventilation, Mr. Heimbach may be able to further reduce his exposure to methylene chloride by using more personal protective equipment. Mr. Heimbach already wears rubber gloves while handling anything which may be contaminated with methylene chloride. In addition to gloves, eye protection is suggested in the event that methylene chloride is accidently splashed in the eye. Because methylene chloride can be absorbed through the skin, it is important to use a new pair of gloves when deterioration or seepage through the gloves is detected. Workers should wear an apron and change articles of clothing when they become soiled. An employee education program, including good work practices to limit the inhalation of methylene chloride, will also reduce the worker's exposure, should the owner hire full- or part-time help.

An in-depth survey at Colonial Furniture Stripping would be not be beneficial to the overall project because of the inadequacy of the existing ventilation system and the low volume of furniture stripped at this facility.

V. REFERENCES

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VI. APPENDICES

A. MSDS: Bix Stripper® (Bix Manufacturing Company, Inc., Old Hickory, Tennessee).

B. MSDS: Paint and Varnish Remover (Stripping Products, Inc., Bethel, Connecticut).

C. Estimation of Real-Time Worker Exposure.

BIX

DATE: 10/87

Emergency Phone No.
1-800-251-1098
615-847-3421
Weekends & Nights
800-447-0070
or
615-847-4867

MATERIAL SAFETY DATA FOR Bix Stripper

Section I — PRODUCT INFORMATION

GENERAL OR GENERIC ID.	Paint Remover
TRADE NAME AND SYNONYMS	Bix Stripper Series 01000
DOT HAZARD CLASSIFICATION	Flammable Liquid
DOT SHIPPING NAME	Paint Related Material NA 1263

Section II — HAZARDOUS COMPONENTS

COMPONENT	% (BY WT.)	TLV (ppm)	VAPOR PRESSURE (mm Hg at 25° C)
Methanol	24-50	200	98
Toluene	25-30	100	22
Acetone	15-20	750	186
[redacted] Sodium Methylate	Less than 5	2	N/A
Non-hazardous Components	Less than 5	N/A	N/A

Section III — PHYSICAL DATA

pH	9.8 (10% suspension)
Specific Gravity (20° C/20° C)	0.851
Freezing Point (ASTM)	N/A
Boiling Range	100-122° F
Freeze/Thaw Stability	N/A
Cooling/Warming Stability	Stable (4 cycles @ -20° C to 30° C)
Flash Point (Open Cup, ASTM)	16° C
Evaporation Rate (Ether = 1)	Greater than 1
Vapor Density (Air = 1)	1.6
% Volatiles (Oven, 100° C)	92.5% (w/w)
Cloud Point (ASTM)	N/A
Appearance	Semi-paste
Color	Amber
Odor	Toluene/Methanol
Relative Viscosity	High

Section IV — FIRE AND EXPLOSION DATA

FLAMMABILITY CLASSIFICATION (OSHA): Flammable Liquid—Class I-B
FLASH POINT: 16° C
EXTINGUISHING MEDIA: Alcohol foam or carbon dioxide or dry chemical.
SPECIAL FIRE FIGHTING PROCEDURES: Wear self-contained breathing apparatus with a full face piece operated in pressure-demand or other positive pressure mode when fighting fires.
UNUSUAL FIRE AND EXPLOSION HAZARDS: Vapors are heavier than air, and may travel along the ground or may be moved by ventilation and ignited by pilot lights, other flames, sparks, heaters, smoking, electric motors, static discharge, or other ignition sources at locations distant from material handling point. Never use welding or cutting torch on or near containers (even empty) because product (even just residue) can ignite explosively.

BIX MANUFACTURING COMPANY INC.
P.O. Box 391 • 1116 FOWLER STREET • OLD HICKORY, TN. 37138-0391 • 615/847-3421 • (OUTSIDE TN) 1-800-251-1098

Section V HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE (TLV) OF MIXTURE: 100 ppm
(By calculation, App C, ACGIH Handbook)
EFFECTS OF OVEREXPOSURE
EYE CONTACT: Severe irritation, redness, tearing, blurred vision
SKIN CONTACT: Prolonged or repeated contact can cause moderate irritation, defatting, dermatitis. Skin absorption may potentially contribute to the overall exposure to this material. Appropriate measures should be taken to prevent absorption so that the TLV is not invalidated.
INGESTION: Can cause gastro-intestinal irritation, nausea, vomiting, diarrhea, blindness and death. Aspiration of material into the lungs can cause chemical pneumonitis which can be fatal.
INHALATION: Excessive inhalation of vapors can cause nasal and respiratory irritation, dizziness, weakness, fatigue, nausea, headache, possible unconsciousness and even asphyxiation
EMERGENCY AND FIRST AID PROCEDURES
EYE CONTACT: Immediately flush with water for 15 minutes. Seek medical attention if pain or redness persist
SKIN CONTACT: Flush with water. Remove contaminated clothing. Wash skin three times with soap and water. Launder contaminated clothing before re-use
INGESTION: If swallowed, do not induce vomiting. Drink one glassful of water. Contact physician or poison control center immediately
INHALATION: Move to fresh air and avoid breathing fumes. If breathing is difficult, administer oxygen. If breathing has stopped, give artificial respiration. Keep person warm, quiet, and get medical attention
CHRONIC OR LONG-TERM EFFECTS: Overexposure to the components of this material has apparently been found to cause the following effects in laboratory animals: Liver abnormalities, kidney damage, eye damage, lung damage, spleen damage, brain damage, nervous system damage. Overexposure to the components of this material has been suggested as a cause of the following effects in humans: Eye damage, liver abnormalities. Reports have associated repeated and prolonged occupational overexposure to solvents with permanent brain and nervous system damage

Section VI REACTIVITY DATA

HAZARDOUS POLYMERIZATION: Cannot occur.
STABILITY: Stable
HAZARDOUS DECOMPOSITION PRODUCTS: Carbon dioxide, carbon monoxide, various hydrocarbons.
INCOMPATIBILITY (MATERIALS TO AVOID): Strong oxidizing agents, strong alkalies, strong mineral acids

Section VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED: Eliminate all sources of ignition such as flares, flames (including pilot lights), and electrical sparks. Absorb liquid on paper, vermiculite, floor absorbent or other absorbent material and transfer to hood or outdoors.
WASTE DISPOSAL METHODS: Allow volatile portion to evaporate. Dispose of remaining material in accordance with applicable regulations. Contaminated absorbent may be deposited in a landfill in accordance with local, state and federal regulations

Section VIII PROTECTIVE EQUIPMENT TO BE USED

RESPIRATORY PROTECTION: If TLV of the product or any component is exceeded, a NIOSH/MSHA jointly approved air supplied respirator is advised in absence of proper environmental control. OSHA regulations also permit other NIOSH/MSHA respirators under specified conditions (see your safety equipment supplier). Engineering or administrative controls should be implemented to reduce exposure.
VENTILATION: Provide sufficient mechanical (general and/or local exhaust) ventilation to maintain exposure below TLV s
PROTECTIVE GLOVES: Wear resistant gloves such as neoprene, nitrile rubber, natural rubber
EYE PROTECTION: Chemical splash goggles in compliance with OSHA regulations are advised. However, OSHA regulations also permit other type safety glasses (consult your safety equipment supplier)
OTHER PROTECTIVE EQUIPMENT: To prevent repeated or prolonged skin contact, wear impervious clothing and boots
HYGIENIC PRACTICES: Avoid skin or eye contact. Avoid breathing fumes. Do not swallow.

Section IX SPECIAL PRECAUTIONS OR OTHER COMMENTS

SPECIAL PRECAUTIONS IN HANDLING AND STORAGE: Containers of this material may be hazardous when emptied, since emptied containers retain product residues. All hazard precautions given in the data sheet should be observed. Temperatures in storage should not exceed 100° F. Open containers carefully if at elevated temperatures. Close covers tightly after each use. Keep away from heat, sparks, flames, or other sources of ignition.
OTHER SPECIAL PRECAUTIONS: This material is moderately corrosive to aluminum and tin-plated steel, with low corrosivity toward galvanized steel. The material attacks gel coatings and fiberglass board. Intentional misuse by deliberately concentrating and inhaling the contents of this material may be harmful or fatal.

MATERIAL SAFETY DATA SHEET

MANUFACTURER'S NAME
Stripping Products, Inc.
P.O. Box 309
Bethel, CT 06801
DATE OF PREPARATION
11/85

EMERGENCY TELEPHONE NO.
1-800-243-6670
INFORMATION TELEPHONE NO.
203-743-3294

SECTION I — PRODUCT IDENTIFICATION

PRODUCT NUMBER: S.P.I. #1, #2SA, #3, Safety Strip, Power Off, #1P, Metal Strip
PRODUCT NAME: Paint & Varnish Remover, (Furniture Stripper)
PRODUCT CLASS: Mixture.

SECTION II — HAZARDOUS INGREDIENTS

INGREDIENT	PERCENT WT.	OCCUPATIONAL EXPOSURE LIMITS OSHA PEL	VAPOR PRESSURE
Methylene Chloride	72.00	500 P.P.M.	420 mm/Hg @ 25°C
Methanol	20.00	200 P.P.M.	97 mm/Hg @ 20°C
Toluene	2.00	200 P.P.M.	22 mm/Hg @ 20°C
Activators, Evaporation—Retarder	4.00	N/A	N/A
Aqueous Solution for PH adjustment	1.00	N/A	N/A
Surfactant, (Wetting Agent)	1.00	N/A	N/A

* A.C.G.I.H. has recommended a T.L.V. of 100 P.P.M. State regulations may vary from Federal regulations. Consult before using product.

SECTION III — PHYSICAL DATA

BOILING RANGE: 104°F — 232°F VAPOR DENSITY: HEAVIER THAN AIR

EVAPORATION RATE: SLOWER THAN ETHER 93% VOLATILE VOLUME WT/GAL.: 9.91#

SECTION IV — FIRE AND EXPLOSION HAZARD DATA

FLASH POINT none to Boiling Point " T C C " LEL 1 2
EXTINGUISHING MEDIA
[X] FOAM [X] "ALCOHOL" FOAM [X CO2 [X] DRY CHEMICAL [X] WATER FOG [ ] OTHER

UNUSUAL FIRE AND EXPLOSION HAZARDS remover contains chlorinated solvents which can form flammable vapor/air mixtures at high concentrations at elevated temperatures (above ambient) At high temperatures (during fire) the remover decomposes and irritating vapors are formed -hydrochloric acid as gas and others (Carbon monoxide)

SPECIAL FIREFIGHTING PROCEDURES Self-contained breathing apparatus with a full facepiece operated in pressure-demand or positive pressure mode

SECTION V — HEALTH HAZARD DATA

EFFECTS OF OVEREXPOSURE Excessive inhalation of vapors can cause nasal and respiratory irritation, dizziness weakness fatigue nausea, headache possible unconsciousness and even asphyxiation/death
Carboxhemoglobin levels can be elevated in persons exposed to methylene chloride and can cause a substantial stress on the cardiovascular system This elevation can be additive to the increase caused by smoking and other carbon monoxide sources

SWALLOWING May cause gastrointestinal irritation, nausea headache, possible blindness and death

MEDICAL CONDITIONS PRONE TO AGGRAVATION BY EXPOSURE Acute and chronic liver and kidney disease, chronic lung disease anemia, coronary disease or rhythm disorders of the heart

PRIMARY ROUTE(S) OF ENTRY [X] DERMAL [X] INHALATION [ ] INGESTION

EMERGENCY AND FIRST AID PROCEDURES

IF ON SKIN Thoroughly wash exposed area with soap and water Remove contaminated clothing Launder contaminated clothing before reuse

IF IN EYES Flush with large amounts of water for at least 15 minutes, lifting upper and lower lids occasionally Get medical attention

IF SWALLOWED Call physician, poison control center or hospital emergency room IMMEDIATELY for instructions to induce vomiting NEVER GIVE ANYTHING TO AN UNCONSCIOUS PERSON

IF BREATHED If affected remove individual to fresh air If breathing is difficult administer oxygen If breathing has stopped give artificial respiration Keep person warm quiet and get medical attention Do not give stimulants Epinephrine or Ephedrine may adversely affect the heart with fatal results

SECTION VI — REACTIVITY DATA

STABILITY [X] STABLE under normal conditions
HAZARDOUS POLYMERIZATION [ ] MAY OCCUR [X] WILL NOT OCCUR
HAZARDOUS DECOMPOSITION PRODUCTS
CONDITIONS TO AVOID contact with pure oxygen alkali metals open flames, electrical sparks welding torches Storage in aluminum containers is not recommended
INCOMPATIBILITY (MATERIALS TO AVOID) same as above also avoid contact with strong alkalies, strong oxidizing agents

SECTION VII — SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED ventilate area of spill before attempting cleanup Cover spilled remover with absorbent material VERMICULITE or similar Do not use Sawdust. Place wet absorbent into metal containers (covered) and place outdoors Spark proof tools (shovels/scoops) should be used

WASTE DISPOSAL METHOD dispose of remover waste in accordance with all local state and federal regulations

SECTION VIII — SAFE HANDLING AND USE INFORMATION

RESPIRATORY PROTECTION recommended for emergency escape purposes only
VENTILATION mechanical ventilation sufficient to keep exposure below federal state and local regulations
PROTECTIVE GLOVES solvent resistant type (Neoprene or similar)
EYE PROTECTION splash-proof goggles (Eye wash facility)
OTHER PROTECTIVE EQUIPMENT solvent resistant aprons and armguards to avoid soaking of work clothes
HYGIENIC PRACTICES Wash hands after handling remover Remove contaminated clothing immediately

SECTION IX — SPECIAL PRECAUTIONS

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING Store drums in cool well ventilated place If stored outdoors DO NOT STORE IN DIRECT SUNLIGHT Keep containers (drums) tightly closed and store bung up Aluminum metal containers are not recommended for storage Before opening drums partially loosen bung in order to release pressure Never exceed storage temperature of 90°F

OTHER PRECAUTIONS The remover being of the volatile solvent type requires certain precautions in the use and handling Eye bath and safety shower should be provided The vapors cause irritation of the eyes redness of the skin and irritation of the respiratory tract Prolonged breathing of vapors can cause loss of consciousness and may be fatal Do not get into eyes, on skin or clothing. Do not take internally. Avoid breathing of vapors Wash-up thoroughly with soap and warm water after handling

NOTICE: DATA AND RECOMMENDATIONS PRESENTED HEREIN ARE BASED ON OUR RESEARCH AND THAT OF OUR SUPPLIERS AND ARE BELIEVED TO BE ACCURATE NO GUARANTEE OF THEIR ACCURACY IS MADE HOWEVER AND THE PRODUCT DESCRIBED IS DISTRIBUTED WITHOUT WARRANTY EXPRESSED OR IMPLIED AND THE PERSON RECEIVING IT SHALL MAKE HIS OWN DETERMINATION OF THE SUITABILITY THEREOF FOR HIS PARTICULAR PURPOSE
AS USE CONDITIONS ARE NOT WITHIN ITS CONTROL SELLER ASSUMES NO OBLIGATION OR LIABILITY FOR ASSISTANCE FURNISHED WITH REFERENCE TO THE PROPER USE AND DISPOSAL OF ITS PRODUCTS

APPENDIX C

ESTIMATION OF REAL-TIME WORKER EXPOSURE

The following formula was used to convert the output of the TIP II® (volts) to concentration of contaminant (ppm):

$$C(t) = IR(t) * ST * (\sum t / \sum IR(t))$$

where:

- $C(t)$ = concentration of vapor at time t (ppm);
- $IR(t)$ = instrument response at time t (volts);
- ST = TWA concentration of contaminant as collected on sorbent tubes for the time period $\sum t$ (ppm);
- $\sum t$ = total elapsed time of sampling (seconds); and
- $\sum IR(t)$ = sum of the instrument response at every time interval (volts).

The major assumption in this estimation method is that dilution is instantaneous and occurs with no change in the relative vapor ratios. In addition, it is assumed that there is linear variation in instrument response with respect to changes in concentration of all contaminants in the air.