U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 76-102-374

DOMORE OFFICE FURNITURE, INC.
ELKHART, INDIANA

MARCH 1977

## I. TOXICITY DETERMINATION

The following determinations have been made based upon environmental air samples collected on September 22, and December 14, 1976, confidential employee interviews, evaluation of ventilation systems, evaluation of work procedures and available toxicity information:

1. Employees exposures to welding fumes, Rust-Lick, a proprietary acid, a proprietary base, nuisance dust and organic vapors did not pose a health hazard at the concentrations measured at the time of this evaluation.

2. Measurements revealed an inadequate ventilation system.

3. There is a general lack of knowledge by the employer and employees of the types of materials being used, the toxicological properties of these materials and safe handling procedures.

4. All employees interviewed reported one or more symptoms which they felt were work related. It was reported that during episodes of high symptom occurrence multiple workers were usually involved and a number were fearful about their health. Simple removal of the affected employee from the plant (outside) or sitting down or someone "talking the worker down" resulted in complete resolution of a majority of the symptoms. No biomedical test abnormalities were discovered on any of the employees and symptoms usually cleared rapidly.

It is felt that the cause of the problems at Domore is a multifactorial one. There is presently an inefficient, inadequate ventilation system which may lead to unnecessary exposure of employees to Rust-Lick, acid and base cleaning operations, welding fumes and organic vapors. This in combination with employee lack of knowledge of the materials with which they work and fear or anxiety can cause the types of problems reported.

## II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Service, Information and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability, through NTIS can be obtained from NIOSH, Publications Office, at the Cincinnati address. Copies of this report have been sent to:

a) Domore Office Furniture, Elkhart, Indiana
b) Authorized representatives of employees - Local 15206, USW
c) U.S. Department of Labor - Region V
d) NIOSH - Region V

For the purpose of informing the approximately 12 "affected employees", the employer shall promptly "post", for a period of 30 calendar days, the Determination Report in a prominent place(s) near where exposed employees work.

## III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by an employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health (NIOSH), received such a request from an authorized representative of Local 15206 of the United Steelworkers of America regarding employees exposure to Rust-Lick, a water soluble chemical coolant and rust inhibitor. Reported symptoms included headache, dizziness, loss of coordination and nausea.

## IV. HEALTH HAZARD EVALUATION

### A. Conditions of Use

Domore Office Furniture is engaged in manufacturing various types of office furniture. Operations in the areas of concern include cleaning metal parts, sanding and polishing, cutting, drilling, punch press operations, welding and spray painting. Approximately 12 employees work in these areas.

Employees expressed a great deal of concern over the flat-finishing process. Steel and sometimes aluminum parts are processed through the flat finisher which cleans and polishes the metal pieces. The flat-finisher uses Rust-Lick which is a water soluble chemical coolant and rust inhibitor. The Rust-Lick is supplied to the flat-finisher from a 1200 gallon tank located underneath the floor in an adjoining room. This tank acts as a settling tank for the fine metal particles suspended in the coolant from the flat-finishing operation before it is recirculated through the system. The tank is enclosed, aerated and cleaned periodically. The mixture in the tank is 7 gallons of Rust-Lick to 1100 gallons of water.

The Rust-Lick tank is located in the cleaning room. The room contains four cleaning tanks, one acidic, one basic and two water rinse tanks. The tanks are heated and have no local ventilation. The room contains one wall exhaust fan. One employee works in the area.

The flat-finisher is located in the metal working department. Several punch presses and drills are located in the immediate area. Adjacent to these is a welding station and three double belt sanders. The belt sanders are equipped with local ventilation (Roto-Clone system) which was recently vented out the roof. The measured ventilation at the belt sanders was 50-75 fpm. Six to eight employees work in the area on steel and aluminum parts.

Two rooms adjacent to this area, all of which are connected, contain welding and brazing operations. The brazing operations have local ventilation. (The ducts, however, were not properly positioned for effective use at the time of this survey.) Three welding stations are located in the other room. No local exhaust system is provided. A fan was installed in a housing above the roof. This system, however, provides no real air circulation in the room. There are three welders and two brazers that work mainly on steel parts. The welders use a carbon-steel welding wire. Therefore, no other fume more toxic than iron oxide should be produced during the welding and brazing operations.

A small room connected to the cleaning room and welding area contains an abrasive cut-off saw. One employee operates the abrasive cut-off saw. A local ventilation system was present but measurements revealed the air movement at the cutting site was only 25-50 fpm.

A paint booth is located in the same area but some distance from the flat-finisher. Spray painting was being done on hooks outside the paint booth. Ventilation measurements showed the face velocity at this point to be 50 fpm. Measurements revealed air movement was 100 fpm at the location of the conveyor system inside the paint booth. The painting, however, was not being conducted at this site.

During the time period between the initial and follow-up surveys, a make-up air unit was installed in the area of the flat-finisher. The specifications of the unit were unknown and no attempt was made to ensure that a balanced system was established.

B. Evaluation Methods

1. Environmental

An initial survey was conducted on September 22-23, 1976. Environmental samples were collected for the components of Rust-Lick. A liquid bulk sample of Rust-Lick was taken from the tank for chemical and biological analyses. Several charcoal tube samples were collected. The samples were analyzed by gas chromatography to identify and quantitate the organic substances which were present. Area air samples were also collected for the base used in the cleaning operation.

On the follow-up survey conducted on December 14, 1976, personal breathing zone samples for total particulate were collected on the polishers, brazers and abrasive cut-off saw operator. Welders exposure to welding fumes were monitored by collecting samples inside the welding helmets. This was accomplished by utilizing modified welding helmets. The parts cleaning operation was evaluated by collecting area impinger samples adjacent to the tanks. Samples were obtained for both the acid and base. A charcoal tube sample was taken on the painter to determine exposure to organic vapors. Another bulk sample also was collected from the Rust-Lick tank for chemical and biological analyses.

2. Medical

On the initial survey, non-directed medical questionnaires were conducted with employees in the area of concern. The symptomatology elicited on the initial visit proved to be unusual and was difficult to explain considering the materials and processes used at the plant. A medical evaluation by a NIOSH physician was conducted on December 14, 1976. The medical histories of 11 workers who had been affected in the past were evaluated. Previous lab data collected by Mansfield Laboratories, a local laboratory hired by the company, was reviewed. A conversation with the physician at the Simpson Medical Center who had evaluated a number of workers since the onset of the problem took place.

C. Evaluation Criteria

1. Physiological Effects

Welding Fumes

Inhalation of iron oxide fume or dust causes an apparently benign pneumoconiosis termed siderosis. Iron oxide fume alone does not cause fibrosis in animals lungs and the same probably applies to humans. Six to ten years

of exposure are usually required before x-ray changes occur. The x-ray changes are indistinguishable from other pneumoconiosis. Numerous studies of those exposed to welding fumes who had x-ray changes had normal spirograms but lung compliance was reduced and those with the most severe reduction complained of dyspnea.

Toluene

The primary effect of toluene is narcosis. It may produce fatigue, weakness, confusion, lacrimation and paresthesia at lower doses. At higher concentrations euphoria, headache, dizziness, dilated pupils and nausea may occur.

Xylene

Xylene is a primary irritant affecting eyes, mucous membranes and skin. High levels affects hematopoietic system in animals. Excessive exposure to high levels can cause pulmonary edema and severe liver dysfunction. Xylene may also cause dizziness, drowsiness, incoordination at high levels.

Rust-Lick

This proprietary compound is a water additive that cleans and prevents rust formation on metal. The only potentially hazardous chemicals present are nitrosamines which are currently suspect carcinogens[1].

Nuisance Dusts

Nuisance dusts have little adverse effects on the lungs and do not produce significant disease or toxicity when exposures are kept under reasonable control. These dusts are biologically inert that when inhaled the architecture of the alveoli remains intact; little or no scar tissue is formed; and any reaction provoked is potentially reversible. Excessive concentrations in workroom air may reduce visibility, cause unpleasant accumulations in the eyes, ears, nose, and secondarily cause injury to the skin due to vigorous cleansing procedures necessary for their removal.

2. Environmental Criteria

To assess the potential toxicity for the concentrations of air contaminants found in the place of employement, three primary sources of criteria were used: (1) NIOSH criteria for recommended Standards for occupational exposures to substances (Criteria Documents); (2) recommended and proposed threshold limit values (TLV's) and their supporting documentation as set forth by the American conference of Governmental Industrial Hygienists (ACGIH) (1975); and (3) occupational health standards as promulgated by the U.S. Department of Labor (29 CFR Part 1910.1000).

In the following tabulation, criteria selected for this evaluation by the author are presented with references.

| Substances | Permissible Exposures (8-hour Time Weighted Average) |
|---|---|
| [1]Welding Fume | 5 mg/M$^3$* |
| [2]Total Nuisance Dust | 10 mg/M$^3$ |
| [3]Toluene | 100 ppm** |
| [4]Xylene | 100 ppm |

[1]Reference: The 1976 ACGIH TLV.

[2]Reference: The 1976 ACGIH TLV. The current Occupational Safety and Health Administration (OSHA) standard is 15 mg/M$^3$.

[3]Reference: The NIOSH 1973 criteria document and the 1976 ACGIH TLV. The current OSHA standard is 200 ppm.

[4]Reference: The NIOSH 1975 criteria document, the 1976 ACGIH TLV and the current OSHA standard.

*Units of measured concentrations are:
a) mg/M$^3$ - milligrams of substance per cubic meter of air
**b) ppm - parts of gas or vapor per million parts of air

TLV's or standards for substances are established at levels designated to protect workers occupationally exposed on an 8-hour per day, 40-hour per week basis over a working lifetime. Because of wide variation in individual susceptibility, some workers may experience discomfort at or below the designated levels. Thus, an evaluation of the work place cannot be based entirely upon comparisons made against TLV's or standards as various TLV's and standards do not represent absolute protection of all workers. The ventilation criteria used in this report follow the guidelines outlined in the NIOSH technical information publication "Recommended Industrial Ventilation Guidelines", January 1976.

E. Evaluation Results and Discussion

Eleven employees were interviewed during the medical evaluation on December 14, 1976, 10 males and one female. The mean age was 45 with a range of 26 to 62. The symptoms elicited during the evaluation are seen in Table I. Every worker thought he or she had problems related to work and all workers reported more than one symptom. The symptoms were not present during this evaluation and were said to occur sporadically over the last 1-2 years. It was reported that during episodes of high symptom occurrence multiple workers were usually involved and a number were fearful about their health. It was apparent that simple removal of the affected employee from the plant (outside) or sitting down and someone "talking the worker down" resulted in complete resolution of a majority of the symptoms.

Of these 11 workers, four had been seen by their private physicians and others had been evaluated at the Simpson Medical Center. All of the studies (which included extensive blood examinations, x-rays, EKG's, etc.) done on the workers involved showed no significant abnormalities in any of the evaluations done.

The tank in which a water-Rust-Lick mixture is circulated and stored was sampled at various times for bacterial, fungal and acid fast growth. This tank was the alleged cause of the symptomatology reported. As is seen in Table II bacterial counts were consistant from laboratory to laboratory and colony count was dependent on time intervals elapsed between changes of tank fluid (i.e., the longer the time interval, the higher the bacterial count). No significant pathogenic bacterial contaminants were present and laboratory analysis showed no other additives present besides the Rust-Lick components.

Analysis of the liquid bulk sample did reveal the presence of a trace of nitrosamines, approximately 6 ppm. Nitrosamines have been regarded as one of the most potent families of animal carcinogens[1]. Although nitrosamines are suspected to be human carcinogens, their carcinogenic potential in man has not been proven. Until more information on the potential hazards due to exposure to nitrosamines is available, it is recommended that proper work procedures be followed which can help minimize dermal and respiratory exposures to substances containing these chemicals. Such work practices are listed in the recommendations at the end of this report.

In addition to the chemical and bacterial analyses, environmental air samples for the various components of Rust-Lick were collected. No detectable levels of any of the components were found. Air samples also were collected for the acid and base (proprietary compounds) used to clean parts. The concentrations measured were below levels believed to cause adverse health effects.

The results of the samples collected for welding fumes are given in Table III. The levels are all below the recommended criteria of 5 mg/M$^3$. Although the measured concentrations are below the criteria, it is recommended that some type of local ventilation system be installed due to the lack of general ventilation.

The total particulate concentrations measured on the polishers, brazers and abrasive cut off saw are given in Table IV. All levels are below the recommended standard of 10 mg/M$^3$ for nuisance dust. Ventilation measurements, however, revealed that the local ventilation at the belt sanders was 50-75 fpm. Minimum values should be 100 fpm. Measured local ventilation at the abrasive cut-off saw was 25-50 fpm. Minimum value should be 250 fpm.

Sampling at various sites with charcoal tubes for organic vapors showed only low levels of organics which included xylene and toluene. All concentrations were well below levels believed to cause adverse health effects.

The unusual variety of symptoms, the lack of high levels of any offending agents and the rapidity with which most symptoms cleared after worker removal or "talking down" indicate a combination of factors causing the problems at Domore. The absence of positive biomedical findings in the past year as well as the fear that was elicited from several of the workers brought about by these episodes seem to suggest a fear-anxiety state, implicating hyperventilation (respiratory alkalosis) as a contributing cause of these problems. Increased breathing rates brought on by fear (or anxiety) can result in lower blood carbon dioxide levels. This causes an increase in blood pH which in turn may lead to a variety of symptoms including headache, blurred vision, nausea, numbness or tingling of the upper and lower extremities, tightness in the chest and others. Removal from the conditions causing the fear or "talking down" may lead to reversal of symptoms in a short period of time with no residual effects. This is a physiologic phenomena usually caused by fear or anxiety.

It is believed that the cause of the problems at Domore is a multifactorial one. There are presently inefficient, inadequate, general and local ventilation systems which may lead to inappropriate worker exposure to welding and brazing fumes, Rust-Lick-water vapor mixture and a small amount of organic solvents. This in combination with employee lack of knowledge of the materials with which they work and fear or anxiety can cause this type of symptom complex. In the opinion of the authors, the fact that no biomedical test abnormalities were discovered and the rapidity with which symptoms clear substantiates this.

It is felt that if the following recommendations are followed, the problems at Domore will be greatly reduced or eliminated.

F. Recommendations

1. A complete evaluation of the general ventilation needs of the plant should be conducted by a qualified consultant. Local ventilation systems should be improved to meet minimal standards[2].

a. Measured local ventilation at the abrasive cut-off saw was 25-50 fpm. (Minimum values should be 250 fpm)

b. Measured local ventilation at the belt sanders was 50-75 fpm. (Minimum values should be 100 fpm)

c. Local ventilation in the welding area should be installed.

2. A system should be developed to identify chemicals and materials being used in the plant and appropriate handling and disposal procedures outlined.

a. There is a general lack of knowledge by the company and employees of chemical or substances which are being used. A tank was located in the cleaning area which contained an acid, was heated and had no ventilation. The acid being used and its concentrations were unknown. The solvent base of the paints or lacquer thinners were unknown. The composition of the welding rods and fluxes being used were also unknown.

3. Educate employer and employees in regard to kinds of substances worked with and good work practices to use when working with these compounds. Also educate employees in regard to the use of protective equipment or local ventilation systems which are available.

a. Employees should be instructed on the proper positioning of local ventilation at the brazing stations.

b. Spray painting was being performed on hooks outside the paint booth. Ventilation measurements showed the face velocity at this point to be 50 fpm. (Minimum value should be 100 fpm.) Measurements revealed the air movement was 100 fpm at the location of the conveyor system that was located inside the paint booth. The spray painting, however, was not being conducted at that site.

c. Employees working as polishers were not provided with or using adequate eye protection.

4. Better housekeeping practices should be followed.

a. Open, partially filled cans of old paint or used solvent were observed around the paint booth. Such practices should be eliminated.

b. Employees in the belt sanding area were observed cleaning their work sites using air hoses. This procedure should be replaced with a vacuum system which confines rather than disperses the dust.

5. Institute a medical surveillance program in which a physical examination, chest x-ray and basic blood tests (CBC and SMA-12) be performed on a regular basis.

6. Change fluid in Rust-Lick tanks every 7-10 days to prevent bacterial over-colonization.

7. Industrial hygiene practices to minimize dermal and respiratory exposure to cutting fluids should be instituted.

The following are suggested good industrial hygiene practices that can help in minimizing exposure to cutting fluids. The recent detection of nitrosamines in certain cutting fluids has compounded the recognized problem of cutting oil control.

a. Engineering Control. The most effective control of any contaminant is control at the source of generation. Effective engineering measures include the use of local exhaust ventilation, with a suitable collector, or the use of electrostatic precipitator.

b. Substitution. The substitution of a cutting fluid that does not contain either nitrosamine contaminated amines, or the necessary ingredients (amines and nitrites) for nitrosamine formation, is another possible control measure. Since many of the proprietary ingredients of cutting fluids have not undergone complete toxicological evaluation, caution should be used when contemplating any change from one cutting fluid formulation to another, giving full consideration to the potential hazards of the substitute.

c. Respirators. Personal respiratory protective devices should only be used as an interim measure while engineering controls are being installed, or non-routine use and during emergencies. Considering the carcinogenic potential and the lack of a standard for nitrosamines as a group, the only available personal respiratory protective measure recommended is the use of a positive pressure supplied air respirator or a positive pressure self-contained breathing apparatus.

d. Protective clothing. Impervious clothing should be provided and should be replaced or repaired as necessary. Non-impervious clothing is not suggested, but if used, it should be removed and laundered frequently to remove all traces of cutting fluids before being reworn. (Laundry personnel should be made aware of the potential hazard from handling contaminated clothing.)

e. Personal cleanliness. All exposed areas of the body and any area that becomes wet with cutting fluids should be washed with soap or mild detergent. Frequent showering is recommended.

f. Isolation. Where possible, any operations involved with cutting fluids should be placed in an isolated area to reduce exposure to employees not directly concerned with the operations.

g. Barrier creams. Barrier creams may provide protection against dermal irritation and skin absorption, however, the barrier cream should not contain secondary or tertiary amines (which may react to form nitrosamines in the presence of nitrites).

## V. REFERENCES

1. NIOSH Current Intelligence Bulletin: Nitrosamines in Cutting Fluids, October 6, 1976.

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TABLE I

Domore Office Furniture
Elkhart, Indiana

SYMPTOMS BY HISTORY

| | YES | NO | PERCENT |
|---|---|---|---|
| Symptoms Related to Work | 11 | 0 | 100% |
| Dizziness | 7 | 4 | 64% |
| Weakness of Extremities | 7 | 4 | 64% |
| Headache | 5 | 6 | 45% |
| Fear of Work Environment | 4 | 7 | 36% |
| Tightness in Chest or Thorat | 4 | 7 | 36% |
| Burning Eyes, Nose or Throat | 4 | 7 | 36% |
| Loss of Consciousness or Feeling of Impending Loss of Consciousness | 3 | 8 | 27% |
| Visual Disturbances (Blurred Vision) | 8 | 8 | 27% |
| Tingling Sensations in Hands & Feet | 3 | 8 | 27% |
| Loss of Coordination | 2 | 9 | 18% |
| Nervousness | 2 | 9 | 18% |
| Nausea | 1 | 10 | 9% |
| Dry Mouth | 1 | 10 | 9% |

TABLE II

Domore Office Furniture
Elkhart, Indiana
MICROBIOLOGY EVALUATION OF TANK FLUID

| LABORATORY | DATES | TEST | BACTERIA ISOLATED | COLONY COUNT |
|---|---|---|---|---|
| Mansfield Lab | 3/19/76 (Tank changed) 3/17/76 | Bacterial Count | (1) Pseudomonas SP<br>(@) Moraxella SP | 43,000 per cc |
| Mansfield Lab | 3/31/76 | Bacterial Count | (1) Pseudomonas SP<br>(2) Moraxella SP | 394,000 per cc |
| Medical Diagnostic Services (MDS) | 9/30/76 | Fungal Culture | Negative | -- |
| | | Acid Fast Culture | Negative | -- |
| MDS | 12/6/76 | Bacterial Culture | Moraxella SP | 200,000 per cc |
| MDS | 12/24/76 (Tank changed) 6 days before | Bacterial Culture | Moraxella SP<br>Pseudomonas SP<br>Alcaligenes SP | 90,000 per cc |

TABLE III

Domore Office Furniture
Elkhart, Indiana

Total Welding Fumes
December 14, 1976

| Sample Location | Sample Number | Sampling Period | Sample Volume (liters) | Welding Fume $mg/M^3$ |
|---|---|---|---|---|
| Welder A | V2361 | 9:40-12:00<br>12:30-14:45 | 412 | 2.6 |
| Welder B | V2386 | 10:00-11:20<br>1:15-14:45 | 255 | 4.0 |
| Welder C | V2397 | 10:05-12:00<br>12:30-14:45 | 375 | 1.4 |

TABLE IV

Total Particulate
December 14, 1976

| Sample Location | Sample Number | Sampling Period | Sample Volume (liters) | Total Particulate $(mg/M^3)$ |
|---|---|---|---|---|
| Polisher A | V3184 | 9:05-11:55<br>12:30-14:50 | 382 | 2.7 |
| Polisher B | V3197 | 9:10-12:00<br>12:30-14:52 | 465 | 2.9 |
| Polisher C | V3191 | 12:00-14:50 | 165 | 6.0 |
| Abrasive Cut-Off Saw | V3190 | 10:03-12:00<br>12:32-14:55 | 392 | 1.6 |
| Brazer A | V1179 | 10:15-12:00<br>12:35-15:00 | 375 | 1.2 |
| Brazer B | V1171 | 10:20-12:02<br>12:31-14:56 | 370 | 2.2 |