U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45202

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 74-2&8-164

THE VENDO COMPANY
KANSAS CITY, MISSOURI
DECEMBER 1974

I. TOXICITY DETERMINATION

It has been determined, by NIOSH investigators during evaluations conducted in February and March 1974, that employees in Department 24 are exposed to toxic concentrations of fumes, particulates, and/or gases from welding and metal-finishing operations. This is based upon: (1) employees exhibiting medical symptomatology to one or more agents in Department 24; (2) environmental dust and fume sampling results exceeding, in some instances, federal health standards for total inert dust, Fe_2O_3 (iron oxide), ZnO (zinc oxide), and Cu (copper); and (3) other sampling results for gases suggesting elevated concentrations of ozone, carbon monoxide, and carbon dioxide.

It has been determined that employees in Department 15 may occasionally be exposed to toxic concentrations of trichloroethylene during degreasing operations. This is based upon reported medical symptomatology which workers experience on particular occasions when the degreaser is in frequent use. Environmental air samples for trichloroethylene were all less than, but approached during continuous operation, the federal health standard of 535 mg/M^3 for trichloroethylene at the time of the NIOSH environmental survey.

It has also been determined, in Departments 12 and 15, that paint-stripping solvents (methyl cellosolve and methylene chloride) were not at concentrations hazardous to employees at the time of the survey. This is based upon the lack of medical symptomatology and environmental sample results which are well below the federal standards for these compounds.

Detailed information concerning the medical and environmental results of this determination are contained in the body of the report. Recommendations are included in this determination which are designed to keep employee exposure to these agents to a minimum.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report of the evaluation are available upon request from the Hazard Evaluation Services Branch, NIOSH, U. S. Post Office Building, Room 508, Fifth & Walnut Streets, Cincinnati, Ohio 45202. Copies have been sent to:

a. The Vendo Co., Kansas City, Missouri
b. Authorized Representative of Employees
c. U. S. Department of Labor - Region VII
d. NIOSH - Region VII

For the purpose of informing the approximately "47" affected employees" the employer will promptly "post" the Determination Report in a prominent place(s) near where affected employees work for a period of 30 calendar days.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 699(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by any 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 the employer and an authorized representative of employees of the Vendo Company to evaluate the potential hazards associated with operations in Departments 24, 12, and 15. The requests and subsequent discussions with management and union representatives during the initial evaluation on February 6-7, 1974, showed the areas of concern to involve: (1) welding fumes and dusts arising from welding and metal-finishing operations in Department 24 and (2) organic vapors and fumes from degreasing and paint-stripping operations in Departments 12 and 15. The requests were prompted by management and union to determine the environmental levels of the contaminants involved and any necessary corrective actions to improve the employees' environment.

IV. HEALTH HAZARD EVALUATION

A. Plant Process - Conditions of Use

The Vendo Company is one of the larger vending machine manufacturers in the world. The corporate offices and largest production facility are centered in Kansas City, Missouri, with approximately 350 administrative and 750 production personnel located there. Production begins with steel stripping and sheeting

and ends with the final vending machine, of which there are many models and types. On February 6-7, 1974, NIOSH investigators visited the Vendo Company with regard to the specific areas of concern. During this visit detailed discussions with management and union representatives and a walk-through evaluation of the areas covered by the request were conducted. A description of each of these areas follows:

Department 24: This department conducts cutting, welding, grinding, and buffing steel parts in construction of the vending cabinet shell. In this area there are 38 men employed, 32 on day shift and 6 on evening shift. The job titles of the employees in this area include: gas and arc welders, metal finishers and mold material handlers, helium-shielded arc welders, and spot welders. The welding, cutting, grinding, and buffing operations are done on cold rolled steel, paint lock steel, and occasionally galvanized steel; the latter types of steel have a zinc outer coating. The helium-shielded arc welders often weld on stainless steel.

Departments 12 (Paint) and 15 (Electroplating): In Department 15 various vending machine parts are cleaned, plated, and occasionally polished. The cleaning process in the electroplating area employs the intermittent use of a trichloroethylene vapor degreasing tank located in one corner of the department. Zinc electroplating, acid and wash, and similar operations are also carried out in this area. However these operations were not included in the request because there were no employee complaints. There are a total of 7-8 men employed in this area, 5 or 6 of whom work on the day shift with most jobs being rotated on a weekly basis. The only activity of concern in the paint area is the stripping of paint from parts which takes place in 2 large stripping tanks, employing both hot and cold stripper solutions. This operation involves 1-2 employees. The chief complaints from the employess were reactions to the odors and fumes from the solutions used in degreasing and stripping operations primarily involving exposure to trichloroethylene, methylene chloride, and methyl cellosolve. However, the current paint-stripping operation will not be in operation after July 1974 as it is being replaced with a separate, new facility which will burn the paint off in a furnace.

B. Evaluation Design

A summary of the procedures used to evaluate the areas of concern included: on-site interviews with representatives of union and management, a walk-through inspection of the workplace, contacting manufacturers of products used to identify toxic substances, administration of medical questionnaires to most workers potentially exposed to plant contaminants, and extensive air sampling to detect and measure exposures to airborne contaminants.

Following the initial medical and environmental survey on February 6-7, 1974, it was necessary to return to the facility on March 20-21, 1974, to conduct further indepth environmental evaluation of airborne contaminants.

C. Evaluation Methods

1. Environmental

Personal air samples collected a representative sample of air in the breathing zone of the workers and were primarily used to evaluate the employees' exposure. General area samples were also collected in specific locations in the working environment.

Charcoal tubes were used for collecting organic vapors and were analyzed by NIOSH Laboratories in Cincinnati, Ohio by the gas chromatographic method reported by W.D. White, et al.[1] Vinyl-metracel filters were used for obtaining respirable dust particulate (10 mm MSA cyclone and filter cassette) and total dust particulate (Millipore Field Monitor) and analyzed for Fe_2O_3, ZnO, Mn, Cu, Ni, Cr, and Mg by NIOSH Laboratories in Cincinnati, Ohio using standard atomic absorption methods for these agents.

Ozone, carbon monoxide, carbon dioxide, nitrogen dioxide, and oxides of nitrogen were measured using direct reading detector tubes in the breathing zone of employees. This was done in accordance with routine instructions for use of the MSA Universal Test Kit and/or Draeger Kit.

2. Medical

Medical Evaluation consisted of the following: (a) review of OSHA 100 and 102 Forms and conversation with plant nurse; (b) questionnaire-interview of a sample of workers from Department 24, 15, and 12; and (c) collection of pre- and post-shift urine samples for trichloroacetic acid (TCA) and trichloroethanol (TCE) from employees in Department 15 as well as from non-exposed individuals outside of Department 15.

D. Evaluation Criteria

1. Environmental Standards

The Occupational Health Standards promulgated by the U.S. Department of Labor (Federal Register, October 18, 1972, Title 29, Chapter XVII, Subpart G, Tables G-1, G-2) applicable to the primary individual substances considered in this evaluation are as follow:

Substance	Standard - mg/M^3
Magnesium Oxide Fume (MgO)	15
"C"-Manganese	5
Chromium as Cr-Chromic, Chromous Salts/ Metal and Insoluble Salts	0.5/1
Iron Oxide Fume	10
Nickel as Ni	1
Zinc Oxide Fume (ZnO)	5
Molybdenum as Mo-Soluble/Insoluble	1/15
Copper as Cu-Fume/Dusts and Mists	0.1/1.0
Total Inert Dusts (Particulate)	15
Respirable Inert Dusts (Particulate)	5
Fluoride	2.5
Nitrogen Dioxide	9
Carbon Monoxide	55
Carbon Dioxide	9000
Ozone	0.2
Methylene Chloride	1750
Methyl Cellosolve	80
Trichloroethylene	535

"C" - Ceiling Value - employees' exposure shall not, at any time, exceed ceiling value above for Manganese.

mg/M^3 - milligrams of contaminant per cubic meter of air

Occupational Health Standards are established at levels designed to protect individuals occupationally-exposed to individual substances on an 8-hour per day, 40-hour per week basis over a normal working lifetime.

It should be noted that the above limits are regulatory and as such, may not represent more current recommendations based on more recent technical information. For instance, NIOSH has recommended a standard for carbon monoxide of 38.5 mg/M^3. Additionally, the American Conference of Governmental Industrial Hygienists (ACGIH) has also established similar environmental health standards (Threshold Limit Values - TLV) based upon current research findings. In some instances these may be more conservative than those in the Federal Register and may include substances not currently recorded in the Federal Register. For instance, the ACGIH has recently established a TLV for arc-welding fume (total particulate) of 5 mg/M^3 which is considerably below the present federal standard of 15 mg/M^3. Consideration is also made for those substances which cause similar adverse effects and may thus be additive in eliciting toxic effects.

2. Biological Standards/Criteria

The biologic criteria used to determine a toxic response to the substances under investigation consist of symptoms and signs associated with each substance when toxic exposure occurs. A brief review of the substances of primary concern in each department follows.

DEPARTMENT 24:

(1) Metal Fumes

Of particular interest are the fumes of zinc and manganese. Breathing excessive amounts of fumes from these metals (as well as other metals) can bring about "metal fume fever." The symptoms of metal fume fever include chills and fever, which rarely exceeds 102°F, upset stomach and vomiting, dryness of the throat, cough, weakness, and aching of the head and body. They often occur some hours after exposure to welding fumes and usually last only a day.[2,3]

(2) Iron Oxide (Fe_2O_3)

Prolonged, excessive exposure to this agent gives rise to "iron pigmentation" of the lungs, known as siderosis, which is generally considered a benign pneumoconiosis. This type of dust or fume is found in a number of jobs (welding, iron ore mining, foundry and fettling operations, and others). Regarding the systemic absorption of iron from iron oxide inhalation, no evidence of impairment has been noted. With regard to local effects, upper respiratory and sinus irritation and congestion have been known to occur with excessive exposure to the dust or fume.[4,5]

(3) Ozone (O_3)

When exposed to very low concentrations of ozone for even brief periods of time, an individual may notice a pungent, sharp odor. As the concentration of ozone increases, the odor often seems to lessen. One then may experience irritation to the eyes, dryness of the nose and throat, and cough. If the ozone concentration continues to rise more severe symptoms may develop. These may include headache, upset stomach or vomiting, pain or tightness in the chest, shortness of breath, or tiredness, or weight loss which may last for several days to weeks. Finally, with higher levels of exposure lung edema and hemorrhage, and ultimately death, may take place if the individual continues his exposure.[6]

(4) Carbon Monoxide (CO)

The acute effects resulting from exposure to increasing concentrations of CO are well defined. Because CO is an odorless gas, the sense of smell does not help in detecting its presence. Early symptoms include tightness across the forehead and slight headache. As the concentration increases, throbbing bitemporal headache ensues followed by weakness, dizziness, dimness of vision, nausea and vomiting. Finally, collapse, coma and death may occur if high levels of exposure continue. Also, the effect of chronic low level exposure has been associated with deleterious effects on the heart circulation and mild adverse behavioral effects as noted by psychological testing.[2]

(5) Oxides of Nitrogen (NOx)

The pungent odor of NO is detected at very low levels. As concentrations increase, the gas becomes mildly irritant to the eyes, nose, and upper respiratory mucosa. Very high concentrations of the gas appear to have a red-brown tint and exposure to them can lead to serious pulmonary effects.[2]

DEPARTMENTS 15 AND 12

(1) Trichloroethylene (TRI)

TRI which has a sweet odor has been noted to cause a wide variety of effects in persons exposed to its vapors. Such exposures are at levels considerably above the present federal standard of 100 ppm for an 8-hour time-weighted average concentration. Toxic effects include symptoms and signs of headache, dizziness, vertigo, tremors, nausea and vomiting, sleepiness, fatigue, light headedness, and unconsciousness. Paralysis of the fifth cranial nerve has been reported in association with TRI exposure. Cardiovascular effects include cardiac arrhythmias at very high exposures. Liver and kidney function appears to be little affected in inhalation exposure, even in high concentrations of TRI. Upper respiratory irritation, eye watering, and sleep intolerance have also been reported.[7]

(2) Methylene Chloride

This agent is first detected by a sweetish odor at concentrations above 300 parts per million (ppm). As the concentration becomes considerably higher, symptoms of excessive exposure may be evident - dizziness, nausea, tingling or numbness of the extremities, sense of fullness in the head, tiredness, and drunkenness. Very high concentrations may lead to rapid unconsciousness.

One other recently-noted effect has been the production of carboxyhemoglobin (COHb) in individuals exposed to methylene chloride. Even low levels of COHb in the blood have been associated with detrimental effects on heart circulation and physicological function.[8]

(3) Methy Cellosolve (Ethylene Glycol Monoethyl Ether)

This compound, which has a mild ethereal odor and a bitter taste, may give rise to acute irritation effects on the skin, eyes, and mucous membranes if concentrations are sufficiently high. Prolonged exposure to lower concentrations which may be systemically toxic have negligible warning properties. Symptoms and signs which have been associated with long-term exposure to excessive concentrations of methyl cellosolve include weakness, headache, sleepiness, gastrointestinal upset, weight loss, neurologic abnormalities, and anemia.[8]

E. Evaluation Results and Discussion

1. Environmental Results and Discussion

a. Department 24 - A total of 19 air samples were obtained for analysis. The results are listed in Table I. All samples were obtained over periods from 3 to 7.7 hours and are considered to be representative of an 8-hour time-weighted average (TWA) for the operations evaluated.

Seven air samples were obtained for evaluation of the general area with results varying from 0.87 to 5.05 mg/M^3. When compared to the ACGIH's TLV of 5 mg/M^3 for arc-welding fumes (total particulate), the results indicate a need for better local control of welding fumes in these areas. Sampling for carbon monoxide was also carried out in the general area, and all results were well below (i.e. less than 50% of) the federal health standards for carbon monoxide.

There were 12 personal air samples obtained from representative arc-welding fume (total particulate) and grinding dust operations. These samples were analyzed for total particulate or dust, Fe_2O_3, ZnO, Mn, and Cu. Of these samples, one sample exceeded (maximum of .15 mg/M^3) the federal standard of .1 mg/M^3 for Cu; two samples exceeded (maximum of 6.6 mg/M^3) the federal standard of 5 mg/M^3 for ZnO; two samples exceeded (maximum 15.23 mg/M^3) the federal standard of 10 mg/M^3 for Fe_2O_3; and two samples (maximum 21.19 mg/M^3) exceeded the federal standard for total nuisance dust of 15 mg/M^3.

It should be noted that 5 of the 7 samples obtained from the door and cabinet welders exceeded (maximum of 18.6 mg/M^3) the TLV of 5 mg/M^3 for arc welding fume (particulate) and the other two samples were considered quite high. All sample results (general area and personal) in the Heliarc area were less than the TLV and federal health standards for these agents.

The following summarizes the sample results for CO, CO_2, ozone, nitrogen dioxide, and nitrous fumes using MSA and/or Draeger sample tubes in the breathing zone of the door and cabinet welders. Although the results are not considered as an 8-hour, time-weighted average (TWA), they indicate the order of magnitude of exposure of welders during actual welding operations.

Carbon Monoxide (CO) - Results varied from approximately 55 mg/M^3 to slightly more than 110 mg/M^3 with an average of 66 mg/M^3 for the door welder and 82 mg/M^3 for the cabinet welders. These results were also confirmed with an MSA Direct Reading Meter for CO which showed CO levels in these areas to be much higher than the other results. One result showed a level approaching 300 mg/M^3 which occurred during a particularly long weld where one might anticipate a build-up of CO. Most welding is accomplished with short welds.

Carbon Dioxide (CO_2) - Sample results varied from around 9,000 mg/M^3 to 35,000 mg/M^3 with an average of 14,000 mg/M^3 for the door and cabinet welders. Results were essentially the same for door and cabinet welders.

Ozone (O_3) - Sample results varied from .2 mg/M^3 to .5 mg/M^3 with the higher results occurring during the longer welds in the cabinet area.

Nitrogen Dioxide (NO_2) and Nitrous Fumes (NO_x) - Sample results did not show any significant concentrations (i.e., all values less than 2 mg/M^3) for nitrogen.

The results in the breathing zone of the Heliarc welder showed concentrations for CO varying from about 10 mg/M^3 to less than 28 mg/M^3 and for ozone from .4 mg/M^3 to 1.0 mg/M^3 with an average of about .6 mg/M^3.

The above sample results indicate toxic exposure of the MIG welders to various contaminants (e.g. total particulate from welding fumes, etc.) in the door and cabinet areas and are indicative of potentially toxic conditions to the Heliarc welders as well. Results for the grinding operations particularly the door grinders, also show conditions to be toxic. All

results of the personal, general area, and breathing zone samples show a need to provide considerably better control at the point of operation of the MIG-CO_2 welding, Heliarc welding, and grinding operations. Furthermore, the results show that exposures are primarily confined to those employees directly involved in these operations. Other operations (e.g. spot-welding, material handling, etc.) in this department were not evaluated as it was the NIOSH investigators' judgment that employees in these operations were not significantly exposed.

b. Departments 12 & 15 - There were 24 charcoal tube personal air samples obtained and analyzed for trichloroethylene, methylene chloride, and methyl cellosolve. The only significant results were for trichloroethylene and methylene chloride sampled from the degreaser operator and the paint-stripper operator respectively. All results for the plater operators were less than 15% of the appropriate health standards for all contaminants evaluated. The following is a summary of the significant results from Table II:

(1) Personal samples from the degreaser operator indicated a time-weighted average of 253 mg/M^3 for trichloroethylene which is slightly less than 50% of the federal health standard of 535 mg/M^3. The maximum sample result for one hour was 508 mg/M^3 which represented the normal operation when the degreaser was in continuous use for about one hour during this period. Results for methylene chloride were less than 1% of the health standard.

(2) Personal samples for the stripper operator resulted in a time-weighted average of 108 mg/M^3 for methylene chloride which is 6% of the health standard of 1750 mg/M^3. The maximum result for one hour was 403 mg/M^3 which is slightly less than 25% of the health standard. Results for trichloroethylene were less than 3% of the health standard.

With the exception of the degreaser and stripper operators, there were no significant exposures to other personnel. At the time of the environmental survey, the stripping and degreasing operations were less than usual. However, it should be noted that the levels of contaminants approached the health standard for trichloroethylene when degreasing operations were being carried out. Furthermore, during the environmental evaluation the operator appeared well versed in the operation of the degreaser. In contrast, when the degreaser was operated by another employee, the odor of trichloroethylene vapor was quite noticeable by the employees and the NIOSH investigators at the time of the initial plant visit. These facts suggest that toxic concentrations of trichloroethylene may develop when careful operation of the degreaser does not take place.

2. Medical Results

Review of the OSHA 100 and 102 Forms for 1973 indicated no reported cases of occupational illness; no excessive number of injuries was noted. Conversation with the plant nurse substantiated these findings.

a. Department 24 - Questionnaire interview of a sample of employees within Department 24 was carried out. The following groups of men were interviewed:

TOTAL: 18 out of 33 workers interviewed (18/33)
Gas and arc welders (8/9)
Metal finishers and mold material handlers (6/10)
Helium-shielded arc welders (2/2)
Spot welders (2/12)

A wide variety of symptoms was noted in the employees with the most prevalant symptoms being: cough with sputum production, dark nasal discharge, bad taste in the mouth, nausea or upset stomach, and chest pain or shortness of breath. Symptoms generally occurred only occasionally and in a few instances were associated with particular work practices. For example, several men reported nausea, sinus problems and chest pains when welding on metals which have a heavy oily film on them. Others had similar complaints when welding on paint-lock (zinc-coated) steel. There were other symptoms of lesser frequency reported which included eye irritation, headaches, loss of appetite, sneezing, and fatigue.

The results of the questionnaire interview indicate not only irritative effects taking place in some of the welders, metal finishers, and mold material handlers, but also symptoms suggestive of a more toxic exposure (i.e., nausea, chest pain, shortness of breath). Such symptomatology could follow from exposure to carbon monoxide, ozone, oxides of nitrogen, and/or metal fumes; environmental measurements indicate exposure to excessive concentrations of such substances.

Because environmental sampling and medical interviews did not take place simultaneously, specific correlation of worker complaints with particular concentrations is not possible. However, the environmental and medical findings indicate that under certain conditions: (1) MIG-CO_2 welding operations generate toxic concentrations of total particulate, iron oxide, zinc oxide, copper, and possibly carbon monoxide, carbon dioxide, and ozone; (2) grinding operations (i.e., door grinding) generates toxic concentrations of total dust, iron oxide, and zinc oxide. Furthermore, Heliarc welding and cabinet grinding operations are implicated as potentially toxic because of environmental and medical findings.

b. Departments 15 & 12 - At the time of the medical interviews in the plating department (i.e. Department 15) there were only three individuals who had worked for four months or longer; each of these men was interviewed. All of them noted occasional lightheadedness when they were exposed to the trichloroethylene vapors for extended periods of time. Another symptom associated with the trichloroethylene vapors was headache. Symptoms of chest tightness and nausea were also mentioned when vapors from the strip tank in Department 12 occasionally drifted into the plating area. Of interest was the fact that the only individual working in the strip tank area at the time of the NIOSH investigation denied having experienced any symptoms in the past. Urine samples were analyzed for trichloroacetic acid (TCA) and trichloroethanol (TCE) by the Tanaka and Ideka method[10] by the NIOSH Laboratory and the results are presented in Table II attached.

The symptoms of occasional lightheadedness and headache which were associated with trichloroethylene vapors imply that the men in the plating department may on occasion by exposed to toxic concentrations of trichloroethylene. Urine results indicate (as one would expect) that the employees in the plating department have a definite exposure to trichloroethylene. The values on the day of collection of the urine samples showed rather low levels of TCA and TCE. Although no values have been established for normal and abnormal levels of excretion for TCA and TCE, these levels when compared to controls indicate exposure to trichloroethylene.

It is difficult to draw any conclusions regarding the exposure of employees in Department 15 to vapors from the hot and cold stripping tanks in the adjacent Department 12. The symptoms of chest tightness and nausea which were sometimes associated with these vapors are not the characteristic symptoms noted with exposure to excessive concentrations of methylene chloride or methylene cellosolve.

F. Recommendations

In view of the above medical and environmental evaluation determination, the following recommendations are made to ameliorate the existing hazard(s) and to provide a better environment for the employees covered by this determination.

Department 24

1. Improvement of the general make-up (supply) and exhaust systems with local exhaust systems located as close to the work as is feasible at the CO_2-MIG welding operations in the door and cabinet areas, as well as Heliarc welding operations, is recommended. Similar considerations should be given for grinding operations, particularly those in the door area. Emphasis should be made for providing local exhaust ventilation for these operations.

2. The use of approved respirators should be continued and enforced until adequate engineering controls (ie.e, ventilation) are provided. The respiratory protection program should be conducted in accordance with Part 1910.132 - Subpart I - Personal Protective Equipment of Title 29 of the Code of Federal Regulations - Chapter XVII.

3. Because of exposure to a number of respiratory contaminants, employees should have pre-employment and periodic evaluation of respiratory function. Such a program might include pre-employment history and physical examination, chest x-ray and pulmonary function testing. Appropriate periodic evaluation of respiratory function should subsequently take place.

4. Aisle curtains should be provided for grinders, particularly in the door area to prevent sparks from burning persons passing through the area.

Departments 15 & 12

1. Evaluation of the degreasing operation as well as preparation of standard operating procedures should take place to assure that operations are in accordance with the parameters recommended by the manufacturer and good industrial hygiene practices. Slot ventilation should be considered as a further method of controlling degreasing vapors.

2. Housekeeping (particularly on walking surfaces) should be improved to provide a better working environment.

3. The use of protective equipment (e.g. shoes, gloves, etc.) should be enforced and employees should have their arms covered to avoid caustic or acid drips or splashes.

V. REFERENCES

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VI. AUTHORSHIP AND ACKNOWLEDGEMENTS

Report Prepared By:

Raymond L. Hervin
Regional Industrial Hygienist
Region VII
Kansas City, Missouri

John W. Cromer, Jr., M.D.
Medical Officer
Medical Services Branch
Cincinnati, Ohio 45202

George J. Butler
Coordinator
Division of Technical Services
Salt Lake City, Utah 84108

Originating Office:

Jerome P. Flesch, Chief
Hazard Evaluation Services Branch
Division of Technical Services
Cincinnati, Ohio 45202

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TABLE I

ENVIRONMENTAL RESULTS FOR ARC-WELDING FUME (TOTAL PARTICULATE) OR GRINDING DUST IN DEPARTMENT 24

(mg/M^3 - milligrams of contaminant per cubic meter of air)

Sample No. & Type	Operation	mg/M^3 Fumes (Total Particulate)	mg/M^3 Fe_2O_3	mg/M^3 ZnO	mg/M^3 Mn	mg/M^3 Cu
		General Area Sample Results				
19	Door Welding Area	2.53	1.87	0.535	0.091	0.031
PVC-129	Door Welding Area	3.38	-	-	-	-
PVC-126	Door Welding Area	5.05	-	-	-	-
18	Cabinet Welding Area	1.69	1.10	0.530	0.045	0.016
PVC-123	Cabinet Welding Area	3.93	-	-	-	-
PVC-125	Cabinet Welding Area	3.71	-	-	-	-
PVC-120	Heliarc Welding Area	0.87	-	-	-	-
		Personal Sample Results				
PVC-122	Door Welder	1.45	-	-	-	-
12	Door Welder	6.55	5.18	1.092	0.222	0.059
2	Door Welder	4.76	4.07	0.405	0.228	0.060
8	Door Welder	3.81	3.34	0.264	0.145	0.055
PVC-124	Cabinet Welder	8.50	-	-	-	-
17	Cabinet Welder	18.59	11.29	6.623	0.532	0.145
9	Cabinet Welder	9.89	6.69	2.753	0.366	0.079
PVC-128	Heliarc Welder	3.89	-	-	-	-
44	Heliarc Welder	1.66	1.31	0.322	0.023	0.007
10	Door Grinder	11.31*	7.72*	3.486*	0.063*	0.045*
20	Door Grinder	21.19*	15.23*	5.789*	0.101*	0.073*
16	Cabinet Grinder	6.44*	4.02*	2.341*	0.057*	0.025*
	Federal Standards or ACGIH TLV'S	5.00** 15.00*	10.00** -	5.000** -	5.000** -	0.100** 1.00*

*Dust
**Fume
- No analysis performed

Analysis of the PVC filters was done by the gravimetric method for fume (total particulate) Regarding all other sample results, these analyses were done by the atomic absorption metho for Fe_2O_3, ZnO, Mn, and Cu and these results added to obtain the figure reported for fume (total particulate). The millipore filters were also analyzed for Cr, Ni, Mg, and fluoride with all results less than 15% of the respective standards for these agents.

TABLE II

ENVIRONMENTAL SAMPLING RESULTS FOR CHARCOAL TUBE SAMPLES - DEPARTMENTS 12 & 15

(mg/M^3 - milligrams of contaminant per cubic meter of air)

Personal Sample No.	Operation	mg/M^3 Methylene Chloride	mg/M^3 Trichloroethylene
4	Degreaser	4	508
19	"	<3.5	265
13	"	10	58
25	"	<3.5	180
26	Plater No. 1	<3.5	43
6	"	<3.5	28
10	"	20	18
25	"	5	74
1	Plater No. 2	7	20
18	"	<3.5	<5
21	"	9	7
15	"	6	9
5	Plater No. 3	<3.5	15
9	"	<3.5	10
11	"	7	5
14	"	6	13
2	Plater No. 4	6	
17	"	4	
20	"	25	
7	"	4	
3	Stripper	6	10
16	"	11	8
22	"	403	7
12	"	10	8
Federal Standard		1750	535

Note: Methyl Cellosolve not detected in above samples.

TABLE III

TRICHLOROETHYLENE (TRI) URINE METABOLITES

	TCA (mgm/gm. creatinine)		TCE (mgm/gm. creatinine)	
	AM	PM	AM	PM
Non-exposed (outside Dept. 15)				
DH	0	0	0	0.7
BG	0	0	0.98	0
GB	0	0	0.8	0.5
EC	2.4	0	11.9	0.7
*IB	0.5	9.6	6.3	12.7
Exposed (inside Dept. 15)				
KI	4.3	2.6	13.0	5.1
RS	5.8	1.7	10.3	14.2
TT	10.0	1.2	25.0	54.9
CS	5.6	24.7	60.0	131.0
JF	15.4	5.7	36.1	18.7
HW	2.9	2.6	28.3	60.8

*Although this individual did not work in the plating area, he worked adjacent to the plating area and could be considered to have some exposure to TRI vapors.