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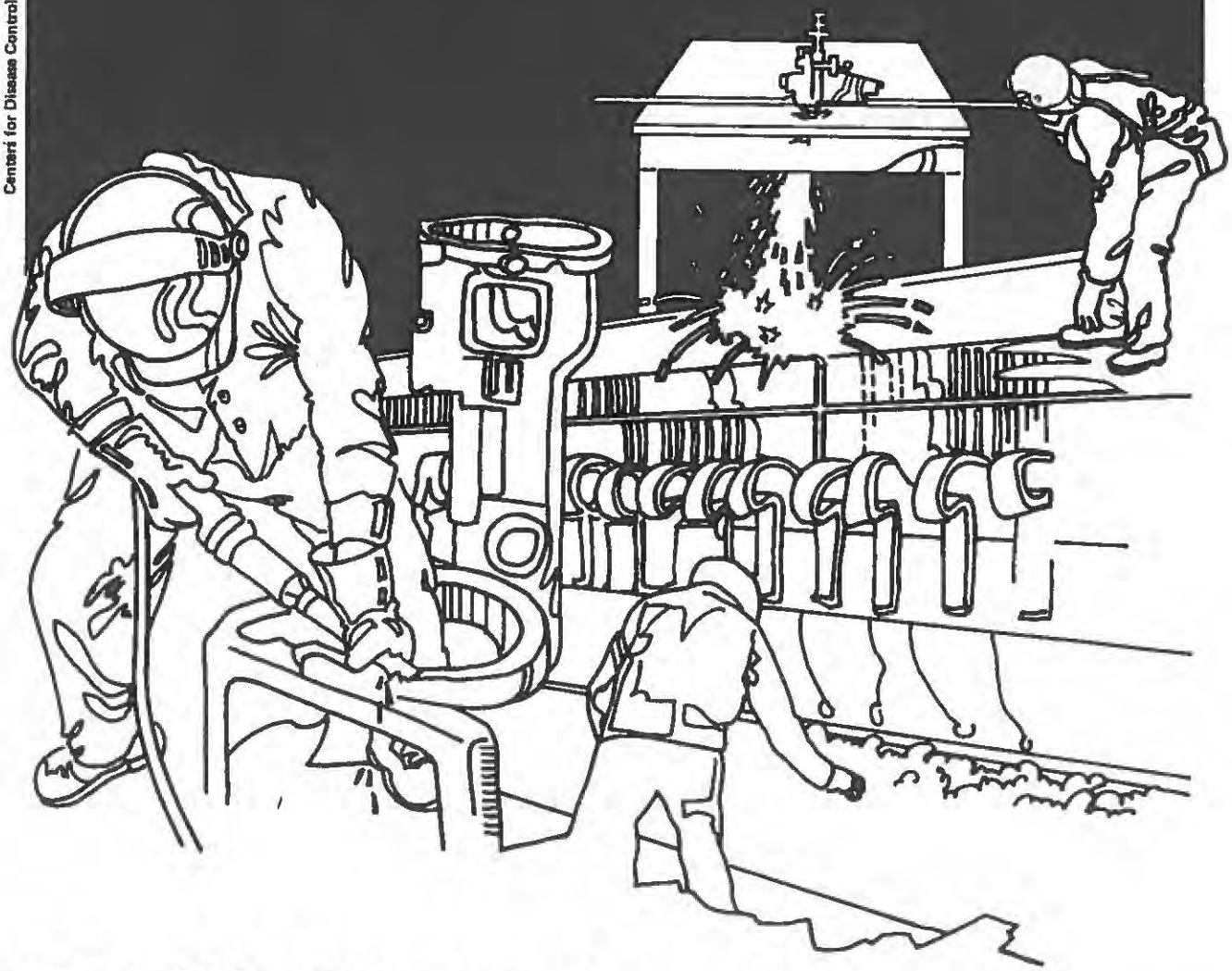

Health Hazard Evaluation Report

HETA 81-048-969
GYRO-TECH INCORPORATED
GREENDALE, WISCONSIN

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from 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 Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

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

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Gyro-Tech Incorporated
Greendale, Wisconsin

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I. SUMMARY

On November 6, 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request from an authorized representative of employees at Gyro-Tech, Incorporated, Greendale, Wisconsin, for a health hazard evaluation. The request was prompted by employee concern that the recent health problems of two employees might be related to the use of the substance "Primer T" in assembly operations.

On January 21, 1981, NIOSH investigators conducted a walk-through inspection of the assembly area, employee interviews and the collection of materials used in the process. The medical records of two employees and records of previous Occupational Safety and Health Administration (OSHA) inspections were also obtained. Since the company had discontinued the use of Primer T prior to the investigation, the original process conditions were later duplicated under a laboratory hood to enable NIOSH investigators to collect environmental samples for qualitative identification of emissions.

Analysis of the NIOSH environmental samples collected during the duplicated process conditions revealed the composition of the emissions to be primarily methyl chloroform (1,1,1-trichloroethane) and n,n-methyl-p-toluidine, with a lesser amount of benzyl alcohol. OSHA environmental data collected during the use of Primer T at the plant on August 21, 1980, indicated that short term time weighted average (TWA) values for methyl chloroform had ranged from 17.5 to 181 parts of contaminant per million parts of air (ppm). These concentrations were below the NIOSH recommended standard of 350 ppm on a 15 minute ceiling basis. In addition, N,N-dimethyl-p-toluidine had been detected at levels of 0.13 and 0.21 mg/M^3, although no environmental limit or information on the possible systemic health effects of this substance was noted in the literature.

Three current employees reported mucous membrane and upper airway irritation; in addition the medical records of one of these workers indicated several episodes of edema of the upper airway. A former employee who had worked at the operation for approximately one and a half years, was diagnosed as having a carcinoma of the vocal cords.

Based on available toxicological information and data collected during the survey, NIOSH has determined that there is no existing evidence to connect the development of cancer in a worker at Gyro-Tech Inc., with exposure to Primer T. However, reported episodes of mucous membrane and upper airway irritation could have resulted from exposures to this substance or to the methyl chloroform used in the process. Recommendations on proper use of organic solvents, designed to alleviate potential health hazards, are contained in Section VIII of this report.

KEY WORDS: Primer T, Methyl Chloroform, N,N-dimethyl-p-toluidine, SIC 3231

II. INTRODUCTION

On November 6, 1980, an authorized representative of the employees at Gyro-Tech, Inc., Greendale, Wisconsin, requested a NIOSH health hazard evaluation to determine if a hazard existed from the use of Primer T in assembly operations at the plant. The request was prompted by employee concern that the recent health problems of two workers might be related to the use of this substance.

On January 21, 1981, NIOSH investigators conducted an initial survey at the facility. This consisted of an opening conference with management and union representatives, a walk-through inspection of the assembly area, employee interviews and the collection of materials used in the process. In addition, medical records were obtained from the personal physicians of two employees, and records of previous inspections were obtained from OSHA. Since the process had been discontinued prior to the NIOSH survey, the process conditions were later duplicated under a laboratory hood to enable collection of environmental samples for qualitative identification of emissions.

III. BACKGROUND

The plant is engaged in the manufacture of automated entrance systems, primarily sliding and swinging glass doors. The plant has been at its present location for 8 years and employs 75 production workers. Approximately 3.5 gallons of Primer T, applied in 6 ounce aerosol cans, was used in plant operations between November 1977 and June 1980. During this period a total of five employees were directly involved in its use.

Primer T, manufactured by the Loctite Corporation, is a curing agent for use with Loctite Anaerobic Adhesives. Its composition is primarily organic solvents (approximately 90% methyl chloroform and 7% isopropanol) with a small percentage of catalytic agent (2% n,n-dimethyl p-toluidine). Upon application the solvent evaporates leaving a thin film of curing agent. An adhesive is then applied over the surface and cures when the parts are joined.

The process at Gyro-Tech would begin with an employee hand wiping approximately twenty-five aluminum housings using rags soaked with methyl chloroform, then allowing them to dry. Next, the cylindrical portion of the housing was sprayed with Primer T for 2 to 3 seconds, then heated with a heat gun (maximum rated temperature - 1000°F) for 2 to 10 minutes. A bearing set coated with adhesive/sealant was then placed in the housing and allowed to cure. The process was then repeated with the remaining units. Total time spent on this operation was estimated at one and one-half hours, every two days.

Local exhaust ventilation was not present at this operation, however portable fans were utilized in the area for general air movement. With the exception of gloves used for heat protection, personal protective equipment was not used by the employees. Cigarette smoking was also reported in the area during the use of these substances.

IV. METHODS AND MATERIALS

A. Environmental

Environmental data collected by OSHA on August 21, 1980, was evaluated. This included short term samples which had been collected at the breathing zone of two employees during the process of concern. Samples analyis had been conducted for methyl chloroform, n,n-dimethyl p-toluidine, and 2-mercaptobenzothiazole.

Since the process was discontinued prior to the NIOSH evaluation, it was not possible to collect samples to quantitate employee exposures. Therefore, using materials collected during the initial survey, a series of tests were designed to enable the collection of environmental samples for qualitative characterization of emissions. Tests were conducted under a laboratory hood and samples were collected using battery powered pumps operating at 1.0 liters per minute (lpm), attached via tygon tubing to the collecting media. For each test, side by side samples were collected using charcoal and porous polymer tubes. The samples were qualitatively analyzed by gas chromatography - mass spectrometry. The following briefly describes the tests conducted.

Trial 1 - The cylindrical surface of the aluminum housing was sprayed with Primer T for 3 seconds. A portable heat gun was aligned with the cylindrical end of the housing, and operated for 5 minutes. Samples were collected 6 inches behind the cylinder. The tip of a thermometer was placed in an indentation in the metal cylinder to reflect the temperature of the aluminum surface. The maximum recorded temperature was 392^{o}F.

Trial 2 - This test was conducted in the same manner as Trial 1, except that the thermometer tip was placed in the middle of the cylinder to reflect the air stream temperature from the heat gun. The maximum recorded temperature was 795^{o}F.

Trial 3 - Immediately following Trial 2, a bearing set was placed in the cylinder. Samples were collected for 6 minutes at a distance of 1 inch from the bearing set.

Trial 4 - Ten milliters (ml) of Primer T was placed in a 50 ml Erlenmeyer flask and heated to evaporation (4 minutes). Samples were collected at the mouth of the flask during this period.

B. Medical

Confidential interviews were conducted with four employees working in the sub-assembly area of the plant. Medical records were obtained for 2 employees who had previously worked with Primer T.

V. EVALUATION CRITERIA

A number of sources recommend airborne levels of substances under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect. Due to variations in individual susceptability, a small percentage of workers may experience effects at levels at or below the recommended criteria; a smaller percentage may be more seriously affected by aggravation of a pre-existing condition or by a hypersensitivity reaction[1]. Following is a listing of the environmental limits and primary health effects for the major substances identified.

A. Methyl Chloroform

The NIOSH recommended level for occupational exposure to methyl chloroform is not to exceed a ceiling concentration of 350 ppm as determined by a 15 minute sampling period.[2] The current federal standard (OSHA) for exposure to methyl chloroform is not to exceed 350 ppm on an eight hour TWA basis.[3] The primary health effects from exposure to methyl chloroform include central nervous system depression, headache, dizziness, incoordination, lightheadedness, drowsiness, generalized weakness, toxic hepatitis, nausea, vomiting, diarrhea, hypotension, bradycardia, cardia arrhythmias, skin dryness and irritation, and mucous membrane irritation. Due to the similarity between this chemical and a group of known animal carcinogens, NIOSH recommends care in the industrial use of this agent, though no evidence exists at the current time either in animals or humans to implicate it as a carcinogen[4].

B. Benzyl Alcohol

Benzyl alcohol is a compound of relatively low toxicity which in the industrial setting rarely causes acute or chronic effects through inhalation. At high doses, attained most commonly by oral injestion, it can cause central nervous system depression, nausea, vomiting, incoordination of gait or movement, and euphoria. Chronic high dose exposure can cause liver, peripheral nervous system, cardiac, and hematologic toxicity. These chronic effects have not been reported in the industrial setting.[5]

Alcohols, administered orally at low doses, have recently been associated with congenital defects in the offspring of pregnant woman. Because of its widespread use relative to other members of this family, benzyl alcohol is currently being tested for carcinogenicity.[6]

C. N,N-dimethyl-p-toluidine

No information is currently available concerning possible systemic health effects of N,N-dimethyl-p-toluidine in the toxicological literature. Ortho-toluidine, a related compound, at high doses is noted to cause anemia, hematuria, anuria, jaundice, and central nervous system dysfunction.[7] Also, a recent study has suggested that p-toluidine may be associated with contact skin reactions in sensitive individuals.[8]

VI. RESULTS

A. Environmental

Gas chromatographic analysis of the simulated process samples revealed that all samples had similar chromatograms which differed only in the relative amounts of the compounds present. The sample containing the largest amounts of the compounds was analyzed by mass spectrometry for identification of individual peaks. The primary substances found were methyl chloroform and n,n-methyl-p-toluidine, with a lesser amount of benzyl alcohol. In addition, trace quantities of trichloroethylene, alpha-pinene, beta-pinene, limonene, an isomer of methyl toluidine, an aromatic compound - possibly tetramethylbenzene, and two isomers with the molecular formula $C_{10}H_{18}O$ - possibly alpha-terpineol and beta-terpineol were detected, possibly present as thermal decomposition products or impurities of the Primer T.

The OSHA data indicated that personal exposures were within the environmental criteria. Short term samples for 1,1,1-trichloroethane ranged from 17.5 to 181 ppm. Eight-hour time weighted average exposures for two employees were 21.8 ppm and 15.1 ppm. N,N-dimethyl-p-toluidine was detected at levels of 0.13 and 0.21 mg/M^3, and 2-mercaptobenzothiazole was not detected in the samples. A complete listing of the OSHA environmetal results is given in Tables 1 and 2.

B. Medical

Three of four current employees reported mucous membrane and upper airway irritation associated with their activities in the area of concern. The medical records of one of these employees noted edema of the upper airway on several occasions which improved with removal from the job. The other two employees did not seek medical attention for their occasional mucous membrane and upper airway irritation, but reported improvement of their symptoms during periods away from the work site.

A former employee was diagnosed in April, 1980 as having a carcinoma of the vocal cords. Symptoms of hoarseness and upper airway irritation were reported to have begun three to four months prior to the diagnosis, without previous episodes. This employee was involved in the use of Primer T for approximately one and a half years immediately prior to the development of the carcinoma.

VII. DISCUSSION AND CONCLUSIONS

The toxicological literature reports no known association between the major chemicals detected in the air in this area and the development of cancer. The episodic nature of the low level exposure, along with the short latent period of one and a half years, makes an association between the observed case of carcinoma and the workplace exposure highly unlikely. Furthermore, the former employees history of cigarette smoking provides a likely causative source for this problem.

The prevalence of upper airway irritation in the current employees in the area is consistent with the known effects of the chemical exposures. All of these agents may be irritating to mucous membranes in sufficient dosages and could certainly cause the symptoms described. Further, the suggestion in the literature that p-toluidine is an allergenic or sensitizing agent may account for the variability in symptoms. While some of the employees may have been reacting only to the irritating effects of these agents, the one employee may have been sensitive or allergic to p-toluidine, thereby increasing upper airway reaction. Long term exposures causing upper airway irritation should be avoided, as chronic changes may occur in the respiratory tract in such individuals.

VIII. RECOMMENDATIONS

The discontinued use of Primer T alleviates the need for recommendations regarding that particular substance. However, the following recommendations relating to the use of organic solvents (e.g., methyl chloroform) are made to alleviate the possibility of potential health problems when working with these substances.

1. Work with solvents should be conducted in a well-ventilated area. Local exhaust ventilation would provide an effective way of removing solvent vapors from the workers breathing zone.

2. Since solvents can remove the skins natural barrier of protective lubricants which could possibly lead to dermatitis, and also some solvents can be absorbed into the body through the skin, protective gloves should be worn to minimize skin contact.

3. Where the possibility exists that solvents could be splashed into the eyes, safety goggles or other eye protection should be worn.

4. Smoking should not be permitted in areas where solvents are in use. Solvents should not be used around hot metal surfaces or flames as most solvents are flammable and many solvents (especially chlorinated solvents) may break down to form other more toxic gasses when heated.

5. Solvent soaked rags should be placed in a covered metal container and removed from the area daily.

6. Employees should be educated in the safe use of the solvents which they are working with.

IX. REFERENCES

1. American Conference of Governmental Industrial Hygienists, "Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Enviromnent with Intended Changes for 1980".

2. "Criteria for a Recommended Standard ... Occupational Exposure to 1,1,1-trichloroethane (Methyl Chloroform)", National Institute for Occupational Safety and Health, D.H.E.W. Publication No. 76-184.

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XI. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

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

1. Requestor
2. Gyro-Tech Incorporated, Greendale, Wisconsin
3. U.S. Department of Labor, OSHA - Region V
4. NIOSH Regional Offices/Divisions

For the purposes of informing the affected employees, copies of the report should be posted in a prominent place accessible to the employees, for a period of 30 calendar days.

TABLE 1
RESULTS OF OSHA ENVIRONMETAL SAMPLES COLLECTED FOR METHYL CHLOROFORM
AT GYRO-TECH, INC.
(8/21/80)

Employee Number	Time of Sample (am)	Pump Flow Rate (lpm)	Sample Volume (liters)	Short Term TWA* Concentration Methyl chloroform (ppm)	Eight Hour TWA** Concentration Methyl chloroform (ppm)
1	7:24 - 8:14	0.1	5.0	176	
1	8:15 - 8:59	0.1	4.4	17.5	
1	8:59 - 9:11	0.1	1.2	139	
1	----------				21.8
2	7:31 - 8:11	0.1	4.0	181	
2	8:12 - 9:25	0.1	7.3	ND	
2	----------				15.1

* - Short term TWA's were calculated based on the sample duration.
** - Eight hour TWA's were calculated based on the cumulative exposure of each employee, averaged for an eight hour work day.
ND = None detected.

TABLE 2
RESULTS OF OSHA ENVIRONMETAL SAMPLES COLLECTED FOR
N,N-DIMETHYL P-TOLUIDINE AND 2-MERCAPTOBENZOTHIAZOLE
AT GYRO-TECH, INC.
(8/21/80)

Employee Number	Time of Sample (am)	Pump Flow Rate (lpm)	Sample Volume (liters)	N,N-dimethyl p-toluidine (mg/M3)	2-Mercapto-benzothiazole (mg/M3)
1	7:31 - 8:13	1.0	42	0.13	ND
2	7:31 - 8:10	1.0	39	0.21	ND

Note: Concentrations given are TWA's for the sample duration.

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