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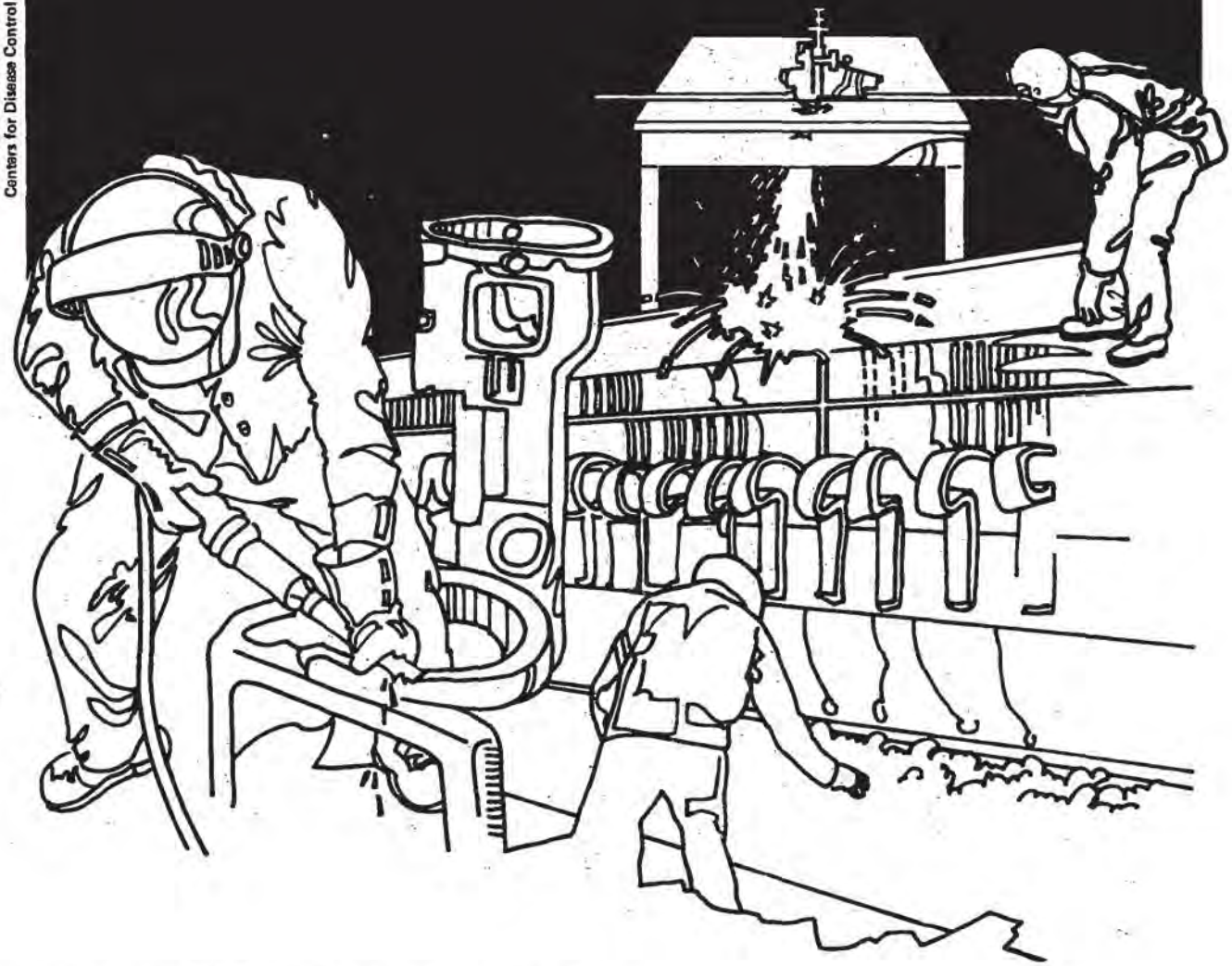

Health Hazard Evaluation Report

HETA 82-328-1360
GENERAL MAGNETICS, INC.
BLOOMFIELD, NEW JERSEY

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.

HETA 82-328-1360
SEPTEMBER 1983
GENERAL MAGNETICS, INC.
BLOOMFIELD, NEW JERSEY

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I. SUMMARY

In July, 1982 the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate lead exposure at General Magnetics, Inc, Bloomfield, New Jersey. General Magnetics produces custom electronic modulators. There are roughly ten employees potentially exposed to lead during soldering and plating operations.

Visits to perform medical and environmental testing took place from September 1982 to January 1983. Medical testing consisted of performing interviews and collecting blood samples for lead erythroprotoporphyrin, and hematocrit.

Personal air samples for lead were collected while employees were engaged in electronic soldering, gas torch soldering and a plating operation called "tinning". The local exhaust ventilation systems at the soldering work bench and in the tinning booth were evaluated.

Analysis of both medical and environmental data indicated no lead overexposure for these workers. Blood lead levels ranged from 4-14 micrograms per milliters (ug/100ml). These levels are comparable to values seen for people without any occupational lead exposure (less than 20 ug/100 ml). The measured air lead levels were between one and two micrograms per meter cubed (ug/m^3) except during tinning operations, when a slightly higher concentration of 3.5 ug/m^3 was measured. These measurements are well below the OSHA action level of 30 ug/m^3 for an eight hour day.

On the basis of the data obtained in this investigation, NIOSH determined that a hazard from overexposure to lead does not exist at this work place under the current conditions of use. Recommendations are included in the report for a modification in the ventilation system and changes in work practices which would further control possible hazardous exposures. An educational program for all employees on the health effects of lead exposure is also recommended.

KEYWORDS: SIC 3662 (Radio and Television Transmitting, Signaling, and Detection Equipment and Apparatus) soldering, electronic assembly, lead.

II. INTRODUCTION

In July 1982, the National Institute for Occupational Safety Health (NIOSH) received a request for a Health Hazard Evaluation from the management of General Magnetics Inc. Bloomfield, New Jersey. The company had received a citation from OSHA on June 10, 1982 for not meeting the requirements of the OSHA lead standard (29CFR1910.1025). In response to this citation and in order to determine if employees are exposed to hazardous levels of lead, General Magnetics Inc. requested that NIOSH conduct a Health Hazard Evaluation.

III. BACKGROUND

General Magnetics is a company of approximately 15 employees which manufactures small electronic modulators. Its products are used as components in weapons guidance systems, aircraft and space exploration devices. Each production item is especially designed for a particular customer. There is potential exposure to lead during three distinct operations: electronic soldering, gas-torch soldering and "tinning".

Electronic soldering is used by the eight employees in the main production area, and by the three employees who work in the machine shop. Although the temperatures used in electronic soldering have been considered to be too low to generate high concentrations of lead fume, (1,2) a recent publication suggests that this assumption should be re-evaluated in the light of the new OSHA standard.(2) The duration of potential lead exposures to employees in the main production area is between 10 minutes and 2 hours per day, according to a task analysis done by management.

There is a potential lead exposure to workers in the machine shop during "final assembly" operations which require the use of solders containing lead. During final assembly boxes are constructed of a nickel steel alloy. These boxes will contain the electrical components made in the main production area. The sides of the boxes are fastened by gas torch soldering which generates higher temperatures than does electronic soldering. Most of this soldering work is done with 40% lead solder. According to the company task analysis, final assembly workers spend between two and two and a half hours a day soldering.

Another potential exposure to lead occurs during tinning operations when the boxes which house the electrical components are coated with a molten lead-tin alloy. The same workers who do the final assembly also do the tinning. Metal parts are manually dipped in a molten lead-tin alloy (containing 60% lead and 40% tin) and spun in the air to promote drying. The tinning is done in a small, closed room which is under negative pressure with respect to the rest of the work areas. There is a canopy hood type local exhaust system which is meant to exhaust fumes rising from the molten lead-tin alloy.

Supply air comes through a series of parallel slots in the door to the room. Before each part is dipped into the molten metal bath, the lead oxide film on the surface of the bath is skimmed off and discarded. The potential for exposure to lead is known to increase when molten lead comes into contact with air currents through pouring, stirring or other agitation.(3,4)

Local exhaust ventilation systems have been installed to control the potential exposures during tinning and final assembly soldering, but no local exhaust is available for the workers in the main production area engaged in electronic soldering.

IV. METHODS

Between September 1982 and January 1983, an occupational physician and industrial hygienist made several visits to evaluate conditions at General Magnetics. During the initial visit a plant walkthrough inspection was conducted and employees were interviewed. During subsequent visits, blood samples were drawn, air monitoring was conducted and the existing ventilation systems were evaluated.

Blood samples were taken from eight employees who were potentially exposed to lead in the soldering and tinning operations. Analyses were done for lead, erythroprotoporphyrin (EP) and hematocrit. The EP is a sensitive indicator of lead exposure. The hematocrit test detects possible anemia which can be caused by lead poisoning. The hematocrit can also be useful to interpret the EP test, since anemia can result in an elevated EP level.

(Samples were taken on December 7, 1982 of employees engaged in electronic soldering in the front room. On January 28, 1983 air monitoring was conducted to evaluate the other two operations which could generate lead fume: gas torch soldering and tinning operations.) These samples for lead were collected and analyzed by NIOSH method S341.(5). Lead samples were taken using Dupont Model p-2599 pumps operating at 1.5 liters per minute. The collection medium was a 37 millimeter diameter, 0.8 micrometer pore size mixed cellulose ester membrane filter holder. The analysis was performed by digesting the filter with nitric acid and aspirating the sample into an atomic absorption spectrophotometer to determine the concentration.

Face velocities for the local ventilation system were measured with an Alnor Velometer. The system over the soldering bench in the back room was evaluated. The ventilation system in the tinning room was also evaluated.

V. EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by 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 pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. 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 Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based solely 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 an OSHA standard.

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.

B. Toxic Effects of Lead

Exposure to lead may disrupt the formation of red blood cells and cause damage to the nervous, reproductive and urinary systems. The early effects of lead poisoning commonly cause symptoms such as fatigue, loss of appetite, aching bones and muscles, constipation and irritability. In cases of extreme overexposure, seizures, coma and death may develop.(6)

Lead poisoning is insidious in that damage may occur before symptoms appear. For example, the disruption of red blood cell formation begins when the lead absorbed by the body causes concentrations of lead in blood to reach levels between 20 and 40 micrograms of lead per 100 grams of blood. (40 ug/100g) Effects on the nervous system in terms of behavior and nerve conductivity can be seen at levels between 40 and 60 ug/100g.

Chronic overexposure to lead may be associated with kidney disease and or high blood pressure. Exposure to lead has also been found to impair the reproductive functioning of both men and women. For example decreases in sperm counts have been described at 30-40 ug/100g.(7)

The current OSHA standard sets a maximum permissable exposure limit of fifty micrograms of lead per cubic meter of air.(50 ug/m^3) In addition, an action level is set at 30 ug/m^3, at which certain protective measures such as regular air monitoring must begin. The OSHA stantard also requires that workers whose blood lead exceeds 50ug/100g be removed from lead exposure.

VI. RESULTS AND DISCUSSION

The results of the blood testing are shown in Table I along with the range of values normally found in the general population. The interpretation of lead screening values to determine occupational exposures must recognize that low levels of lead are found in the general population as a result of environmental exposures. The results of all blood tests shown in Table I were within the range of values expected in the general population.

The results of the air monitoring for lead are shown in Table II. The production operations conducted during air monitoring were representative of typical working conditions. Therefore, the air monitoring indicates that employees are exposed to lead levels below the maximum permissable exposure level of 50 micrograms per cubic meter for an 8 hour work day established by the U.S. Department of Labor OSHA Lead Standard (CFR 1910.1025). The measured exposures are also well below the action level set by the OSHA standard of 30 micrograms per cubic meter for an 8 hour day.

The flow rates in the duct openings above the soldering work bench in the back room were measured using an Alnor Velometer. The configuration of this system allows it to be used with one or two fans. When one fan was operating, the average flow rate at the face of the three ducts was 520 feet per minute (fpm). When both fans were operating the average flow rate in the three ducts increased to 650 fpm. Both fans are normally used. Because of the distance between the duct openings and the work bench and because of distance between the duct openings and the work bench and because of air turbulence created by the shape of the duct openings, the flow rate where the soldering is actually performed on the work bench is calculated to be approximately 50 fpm. This is below the velocity recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) for silver soldering operations, i.e., an air velocity of 100 fpm at the point of operation.(8)

The local exhaust ventilation system in the tinning booth was evaluated using an Alnor Velometer. This system encloses the melting pot leaving one open side. It has an average face velocity of 160 feet per minute and a surface area of 15 square feet. Although no ventilation standards have been published for these operation,(2) the air monitoring results indicate that lead levels in this area are far below the OSHA standard. Therefore this ventilation system should be considered acceptable for its present purpose.

VII. CONCLUSION AND RECOMMENDATIONS

Based on the results of the environmental and medical tests, employees at General Magnetics are not at risk of overexposure to lead. The current operation at General Magnetics do not generate concentrations of Lead in air which would present a health hazard to employees. The present ventilation system is adequate to control potential lead exposures. If the processes are changed, then the ventilation system and potential exposures should be reevaluated.

Nevertheless additional control measures are recommended in several areas to ensure that the employees° health is fully protected.

1. The capture velocity at the work bench in the machine shop should be increased from 50 fpm to 100 fpm, in order to meet the recommendations set by the ACGIH for lead-based silver soldering operations. This can be accomplished by extending the existing duct six inches closer to the workbench or by installing a flange or bell mouth at the hood opening of the exhaust system. This would also protect these employees more fully from exposure to the fumes which may be generated by the fluoride fluxes used in this area.

2. The melting pot which contains the lead-tin alloy used for tinning should be covered with a fire resistant material when not in use. This would reduce the formation of waste metal and reduce the potential for lead exposure for longer periods of time or, if new processes are introduced, then air monitoring should be repeated.

3. An employee education program should be implemented to ensure that all employees understand the potential health effects of lead exposure and the provisions of the lead standard issued by the U.S. Department of Labor, Occupational Safety and Health Administration. Copies of Appendices A and B of the OSHA Lead Standard are enclosed. These should be distributed to all employees.

VIII. REFERENCES

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X. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. 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:

1. General Magnetics, Inc.
2. United Steelworkers of America.
3. NIOSH, Region II
4. OSHA, Region II

For the purpose of informing affected employees, copies of this report shall be posted by the employer in a prominent place accessible to the employees for a period of 30 calendar days.

TABLE I

Summary of Lead Screening Tests
General Magnetics, Inc. - Eight Employees
Bloomfield, New Jersey
November 1982

TEST	MEDIAN VALUE	RANGE OF VALUES	VALUES FOUND IN GENERAL POPULATION
Blood Lead(ug/100ml)	10	4-14	0-20
EP(ug/100ml)	20	15-35	less than 50
Hematocrit (%)	44 (female) 47 (male)	40-46 (female) 43-47 (male)	37-47 (females) 42-52 (males)

EP=Erythroprotoporphyrin

TABLE II

Lead Concentrations in Air Samples

General Magnetics Inc.
Bloomfield, N.J.

Operation	Work Area	Date of Monitoring	Time of Sampling (Hours)	Lead Concentrations micrograms of lead per cubic meter of air (ug/m^3)	Local Ventilation Present
Electronic Soldering	Main Production Area	12-7-82	5	1	No
	Front Room	12-7-82	2.5	2	No
		12-7-82	5.5	less than 1	No
		12-7-82	6.3	1	No
Gas Soldering	Machine Shop Back Room	1-28-83	6.5	1	Yes
Electronic Soldering		1-28-83	2.5	1.4	Yes
Tinning	Tinning Booth	1-28-83	2.7	3.5	Yes

Note: All air samples represent personal exposures to workers in these areas. Samples were collected in the breathing zones of employees working with lead.