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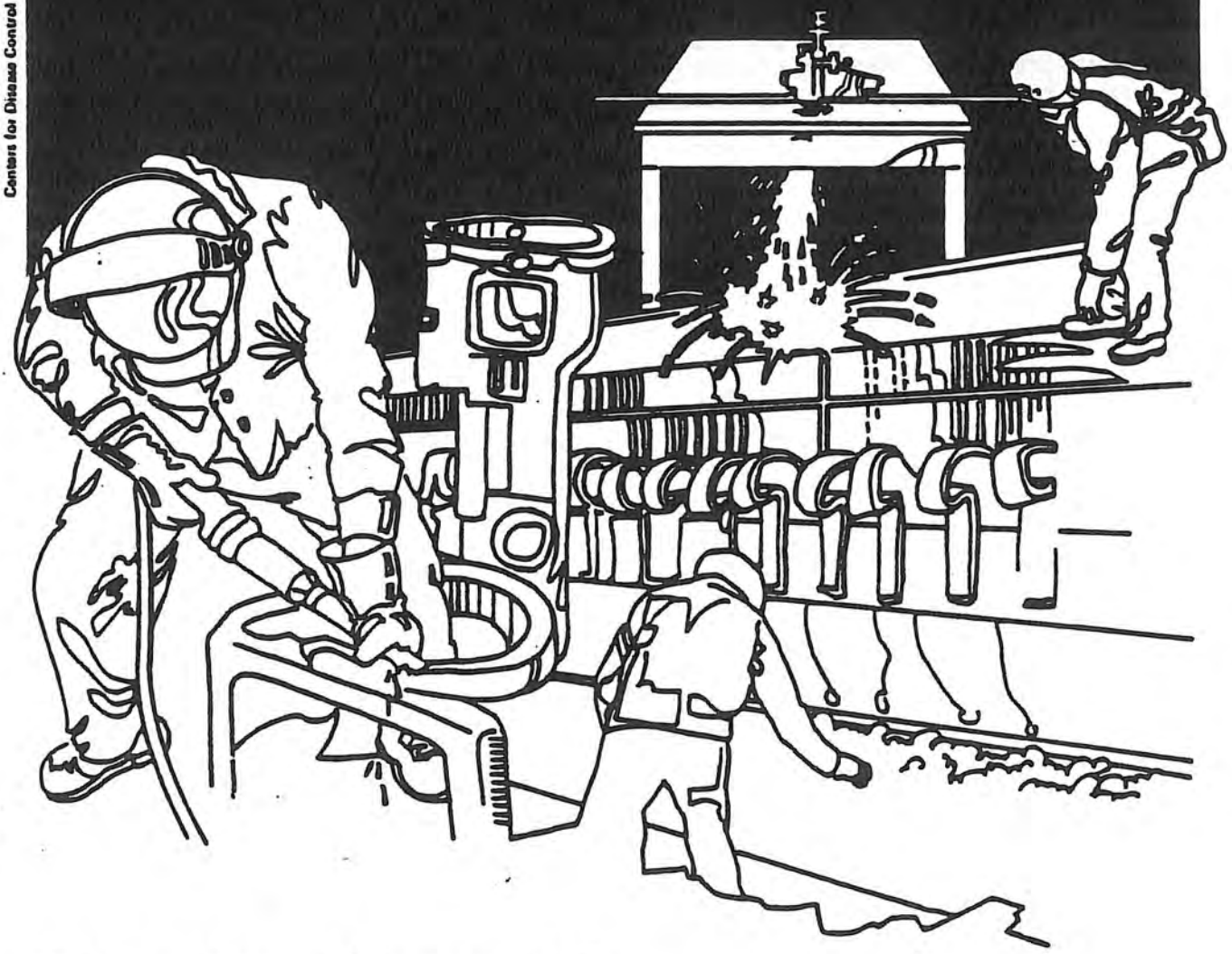

Health Hazard Evaluation Report

HETA 85-252-1625
E-Z GO DIVISION OF TEXTRON, INC.
AUGUSTA, GEORGIA

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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 85-252-1625
September 1985
E-Z GO DIVISION OF TEXTRON, INCORPORATED
AUGUSTA, GEORGIA

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I. SUMMARY

In March 1985, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation at E-Z Go Division of Textron, Incorporated in Augusta, Georgia. NIOSH was requested to evaluate workers exposures to welding fumes in the small parts welding shop. On April 23-24, 1985, NIOSH investigators conducted environmental and medical evaluations.

Personal exposure to copper fumes (10 samples) during the survey had a maximum of 0.01 milligrams per cubic meter (mg/m^3); the Occupational Safety and Health Administration's (OSHA) 8-hour time-weighted average (TWA) permissible exposure limit (PEL) is 0.1 mg/m^3. Personal exposure to iron oxide fumes (Fe_2O_3) ranged from 0.57 to 2.91 mg/m^3; the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV®) is 5 mg/m^3. Personal exposure to manganese ranged from 0.06 to 0.27 mg/m^3; the ACGIH TLV® is 1.0 mg/m^3. Personal exposure to zinc oxide ranged from 0.03 to 0.10 mg/m^3; the OSHA 8-hour TWA PEL is 5 mg/m^3. The three personal exposures to total particulate ranged from 2.17 to 8.45 mg/m^3; the ACGIH TLV® is 10 mg/m^3. The face velocity for each of the 13 welding booths was measured using a thermal anemometer and smoke tubes. The average face velocity for each of the 13 welding booths where the welding was being performed was less than 50 linear feet per minute (LFPM), which is not adequate to capture the fumes generated from the welding operations.

Twenty-four of the 25 workers on the day and evening shifts in the welding shop were interviewed privately. On direct questioning, five reported experiencing headache at work, nine reported nausea at work, eight reported smoke related eye irritation, three reported welding flash burns to the eye, five reported throat irritation at work, four reported smoke related nasal irritation, and five reported smoke related breathing difficulties. One welder reported experiencing a probable episode of metal fume fever and four reported having experienced symptoms possibly due to metal fume fever.

Based on the air sampling results, it is concluded overexposure to welding fumes did not occur in the small parts welding operations at the time of this survey on April 23-24, 1985. However, the ventilation survey showed that existing ventilation was not adequate to capture the smoke generated during welding. In addition, employee interviews indicated that many workers experienced discomfort secondary to airborne contamination in the weld shop. Because of these findings we encourage the company to continue the efforts already in progress to improve the ventilation in the weld shop. Recommendations to aid in providing a safe and healthful working environment are presented in Section VIII of this report.

KEYWORDS: SIC 3711 (Motor vehicles and passenger car bodies) welding, copper fumes, iron oxide fumes, manganese fumes, zinc oxide fumes and total particulate.

II. INTRODUCTION

In March 1985, NIOSH received a request for a health hazard evaluation at E-Z Go Division of Textron Inc., in Augusta, Georgia. NIOSH was requested to evaluate employees' exposure to welding fumes in the small parts welding shop. On April 23-24, 1985, a NIOSH team conducted an environmental/medical evaluation. Personal airborne samples were collected for copper, iron oxide, manganese, zinc oxide and total particulate. The medical evaluation consisted of 24 private interviews with workers on the day and evening shifts in the small parts welding shop, to elicit symptomatology possibly related to exposures in the work environment.

III. BACKGROUND

E-Z Go, Inc., Augusta, Georgia manufacture golf cars and utility vehicles. The request for a health hazard evaluation was for the small parts welding shop where employees were exposed to welding fumes. The welding shop building is approximately 60' x 80' and houses 14 welding booths. The welding booths are enclosed on all sides except the front with a tapered exhaust duct on top of the booth leading to a larger duct. The type of welding is metal inert gas (MIG) on carbon steel and some galvanized steel. The welding shop is provided with local ventilation and electrostatic precipitators. Respiratory protection is not required.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

Ten personal air samples for copper, iron oxide, manganese, and zinc oxide were collected in the welding shop on mixed cellulose ester filters using a battery-powered vacuum pump operated at a flow rate of 1.5 liters per minute (LPM). The metal samples were analyzed by atomic absorption spectroscopy using NIOSH Method 173.[1]

Personal air samples for total particulate were collected on preweighed FWSB filters using a battery-powered vacuum pump at a flow rate of 1.5 LPM. The total weight of each sample was determined by weighing the sample plus the filter on an electrobalance and subtracting the previously determined tare weight of the filter. The tare and gross weighings were done in duplicate.

Indicator tube sampling was done for carbon monoxide, ozone and phosgene.

Local exhaust ventilation on the welding booths were evaluated using smoke tubes and a thermal anemometer.

B. Medical

Private medical interviews were conducted with 24 of 25 workers on the day and evening shifts in the small parts welding shop to elicit symptomatology possibly related to exposure to welding fumes in the work environment.

V. EVALUATION 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 primarily on

concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet 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.

1. Copper - Copper exposures may occur by ingestion and inhalation. Copper is an irritant to the eyes, nose and respiratory tract. It causes perforation of nasal spectum, metal fume fever, and dermatitis. Ingestion may produce nausea, vomiting, and diarrhea. Chronic exposures may produce pigment cirrhosis of the liver. Maintaining a worker's exposure below 0.1 mg/m^3 for an 8-hour TWA should protect the worker from any of these effects.[2]

2. Iron Oxide - Arc welders, especially those who work in welding shops with poor ventilation, may develop a condition called siderosis after 5 to 15 years as a welder. A worker with siderosis presents an abnormal chest X-ray that shows fine modular stipling in both lung fields. Animal experiments suggest that the X-ray pattern is due to groups of lung macrophage cells that are filled with iron oxide. It is not clear if the iron oxide causes adverse health effects but epidemiological studies suggest that arc welders (perhaps becuase of exposures to many noxious gases and fumes present in a welding shop) may be at increased risk for development of chronic pulmonary impairment especially if they smoke.[3]

3. Manganese - Manganese metal alloys and compounds are mild irritants to the eyes. Mucous membranes and skin, chronic respiratory exposure to manganese compounds can produce adverse neurological symptoms that include lack of energy, decreased appetite, headache, and lack of coordination. In severe cases parkinson like signs (lack of facial expression, rigidity, tremor) may be present. Some researchers feel that manganese dioxide dust may irritate the lungs and possibly increased suseptibility to pulmonary infections by impairing the lungs ability to remove foreign material (dust, bacteria, etc.).[3]

4. Zinc Oxide - Overexposures to zinc oxide may produce metal fume fever, also known as brass chills, welders' ague, copper fever, zinc fever, and Monday morning fever, is a syndrome that arises after respiratory exposure to the fume of any of several metals. Fume is generated when a metal is heated to above its melting point, typically in such settings as brass foundry work, welding,

galvanized steel, and acetylene or plasma arc cutting. Exposure to fumes of zinc, copper, and magnesium are the most common causes. Symptoms, such as thirst, metallic taste, dry mouth, and headache, occur about four to eight hours after fume exposure. Cough, chills with irregular fever, dyspnea, muscle pain, and a sense of weakness and fatigue may develop over the subsequent few hours. The illness is self-limited and usually resolves within 24-48 hours. Illness can occur after an individual's first exposure to fume. Exposure to fume within a day or so of initial exposure tends to elicit less severe symptoms, but repeat exposure after having avoided metal fume for a longer period makes the individual susceptible again to the initial symptoms. The name "Monday morning fever" is used among workers with Monday through Friday fume exposure who become ill after a Monday exposure, feel well for the rest of the work week, and become ill again the next Monday.[4,5,6]

5. Total Particulate

In contrast to fibrogenic dust which, when inhaled in excessive amounts, cause scar tissue to be formed in the lungs, so called "nuisance" dusts are stated to have little adverse effects on lungs and do not produce significant organic disease or toxic effects when exposures are kept under reasonable control. The "nuisance" dusts have also been called (biologically) "inert" dusts, but the latter term is inappropriate to the extent that there is no dust which does not evoke some cellular response in the lungs when inhaled in sufficient amount. However, the lung tissue reaction caused by inhalation of "nuisance dusts" has the following characteristics: 1) the architecture of the air sources remains intact; 2) collagen (scar tissue) is not formed to a significant extent; and 3) the tissue reaction is potentially reversible.

Excessive concentrations of dusts in the work room air may seriously reduce visibility; may cause irritaiton of the eyes, ears, and nasal passages; or cause injury to the skin or mucous membranes by chemical or mechanical action per se, or by the rigorous skin cleansing procedures necessary for their removal.[7]

VI. RESULTS AND DISCUSSION

A. Environmental

Results of the personal air samples collected on April 24, 1985 in the small parts welding shop for copper, iron, manganese, zinc oxide, and total particulate are presented in Table I.

Personal exposure to copper fumes (10 samples) during the survey had a maximum of 0.01 mg/m^3. The OSHA 8-hour TWA PEL is 0.1 mg/m^3.

Ten personal air samples indicated exposures to iron oxide fumes (Fe_2O_3) ranged from 0.57 to 2.91 mg/m^3. The ACGIH TLV® is 5 mg/m^3.

Ten personal air samples indicated exposures to manganese ranged from 0.06 to 0.27 mg/m^3. The ACGIH TLV® is 1.0 mg/m^3.

Ten personal air samples indicated exposures to zinc oxide ranged from 0.03 to 0.10 mg/m^3. The OSHA 8-hour TWA PEL is 5 mg/m^3.

Three personal air samples indicated exposures to total particulate ranged from 2.17 to 8.45 mg/m^3. The ACGIH TLV® is 10 mg/m^3. The high result (8.45 mg/m^3) at welding booth C-108 can be attributed to large pieces being welded outside the ventilated hood thus releasing welding fumes to the general area.

Results of the indicator tube samples for carbon monoxide ranged from 5 to 10 parts per million (ppm) with a mean of 8 ppm. (NIOSH recommendation is 35 ppm 8-hour TWA.) Ozone and phosgene results were all nondetectable.

The face velocity of the 13 welding booths were measured using a thermal anemometer and smoke tubes. The average face velocity of each of the 13 welding booths where the welding was being performed was less than 50 LFPM which is not adequate to capture the fumes generated from the welding operations. (The American Conference of Governmental Industrial Hygienists Industrial Ventilation Manual Recommends 125 LFPM face velocity.) It was also observed that large amounts of noxious smoke were emitted in the room when parts covered with cutting fluid or oil were welded.

B. Medical

Twenty-four of the 25 workers on the day and evening shifts in the welding shop were interviewed privately. Their ages ranged from 21 to 62 (Median 30 years old) and they had worked in the weld shop for periods ranging from 2 months to 24 years (median 30 months). On non-directed questioning 19 mentioned that frequently there was excessive welding smoke in the shop. Thirteen reported that some of the parts to be welded were coverd with oil and that much noxious smoke was generated when these oil covered parts were welded. In many instances the ventilation was not adequate to capture this smoke. Five workers reported that occasionally the

ventilation for the welding booths would be shut off for maintenance and the shop would soon become very smoky. On most such occasions they would be required to continue work despite the presence of unusually severe atmospheric contamination. Several employees reported that occasionally they would be required to weld "black pipe" which was coated with a substance that, when welded, gave off copious quantities of a noxious smoke which produced nausea in the welder and in nearby workers.

On direct questioning, five reported experiencing headache at work, nine reported nausea at work, eight reported smoke related eye irritation, three reported welding flash burns to the eye, five reported throat irritation at work, four reported smoke related nasal irritation, and five reported smoke related breathing difficulties. One welder reported experiencing a probable episode of metal fume fever and four reported having experienced symptoms possibly due to metal fume fever. Discomfort was especially intense when exposed to smoke generated when welding oily parts or a pipe coated with a black substance.

VII. CONCLUSIONS

Based on the air sampling results, it is concluded overexposure to welding fumes did not occur in the small parts welding operations at the time of this survey on April 23-24, 1985. However, the ventilation survey showed that existing ventilation was not adequate to capture the smoke generated during welding. In addition, employee interviews indicated that many workers reported frequently experiencing irritating symptoms due to exposure to welding smoke and several had experienced work related symptoms compatable with metal fume fever. Because of these findings we encourage the company to continue the efforts already in progress to improve the ventilation in the weld shop. Implementation of the following recommendations should help to lower the welding shop employees' exposure to airborne contaminants.

VIII. RECOMMENDATIONS

1. The welding shop ventilation and the welding booths ventilation should be operating whenever employees are welding.

2. Several welding booths of sufficient size to accommodate the largest parts should be installed so that large pieces no longer must be welded outside the ventilated welding booths thus releasing welding fumes to the general area.

3. Oil and cutting fluid should be removed from parts to be welded prior to their arrival in the welding shop so that the parts will not generate excessive smoke when they are welded.

4. Workers should be advised to avoid exposure to welding fumes and cautioned about the hazard of developing metal fume fever secondary to exposure to zinc oxide fume that can be generated when welding galvanized metal.

IX. REFERENCES

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 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. Requester, Augusta, Georgia
2. E-Z Go Division of Textron Incorporated, Augusta, Georgia
3. NIOSH, Region IV
4. OSHA, Region IV

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

Personal Airborne Concentration for Copper, Iron, Manganese, Zinc and Total Particulate

E-Z Go Division of Textron, Incorporated
HETA 85-252

April 24, 1985

Job and/or Location	Sampling Period	Volume (liters)	Copper mg/m^3*	Iron mg/m^3	Manganese mg/m^3	Zinc mg/m^3	Total Particulate mg/m^3
Welder - Booth C-128	0702-1509	730	0.01	0.58	0.06	0.03	-
Welder - Booth C-103	0705-1507	773	0.01	0.57	0.06	0.03	-
Welder - Booth C-111	0708-1510	676	0.01	1.63	0.13	0.04	-
Welder - Booth C-127	0718-1508	655	0.01	1.25	0.11	0.05	-
Welder - Booth C-104	0722-1507	697	0.01	0.67	0.08	0.10	-
Welder - Booth C-109	0725-1507	693	0.01	2.60	0.27	0.08	-
Welder - Booth C-102	0729-1443	651	0.01	1.69	0.18	0.05	-
Welder - Booth C-115	0733-1448	652	0.01	2.91	0.26	0.07	-
Welder - Booth C-129	0740-1505	618	0.01	0.86	0.10	0.06	-
Welder - Booth C-131	0742-1505	664	0.01	0.57	0.08	0.04	-
Welder - Booth C-120	0710-1450	690	-	-	-	-	3.20
Welder - Booth C-122	0712-1508	714	-	-	-	-	2.17
Welder - Booth C-108	0737-1447	645	-	-	-	-	8.45
Environmental Criteria (mg/m^3)			0.1	5.0	1.0	5.0	10.0
Limit of Detection (mg/m^3)			0.0002	0.001	0.0002	0.0002	0.01

* mg/m^3 - Milligrams of substance per cubic meter of air sampled.

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