U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
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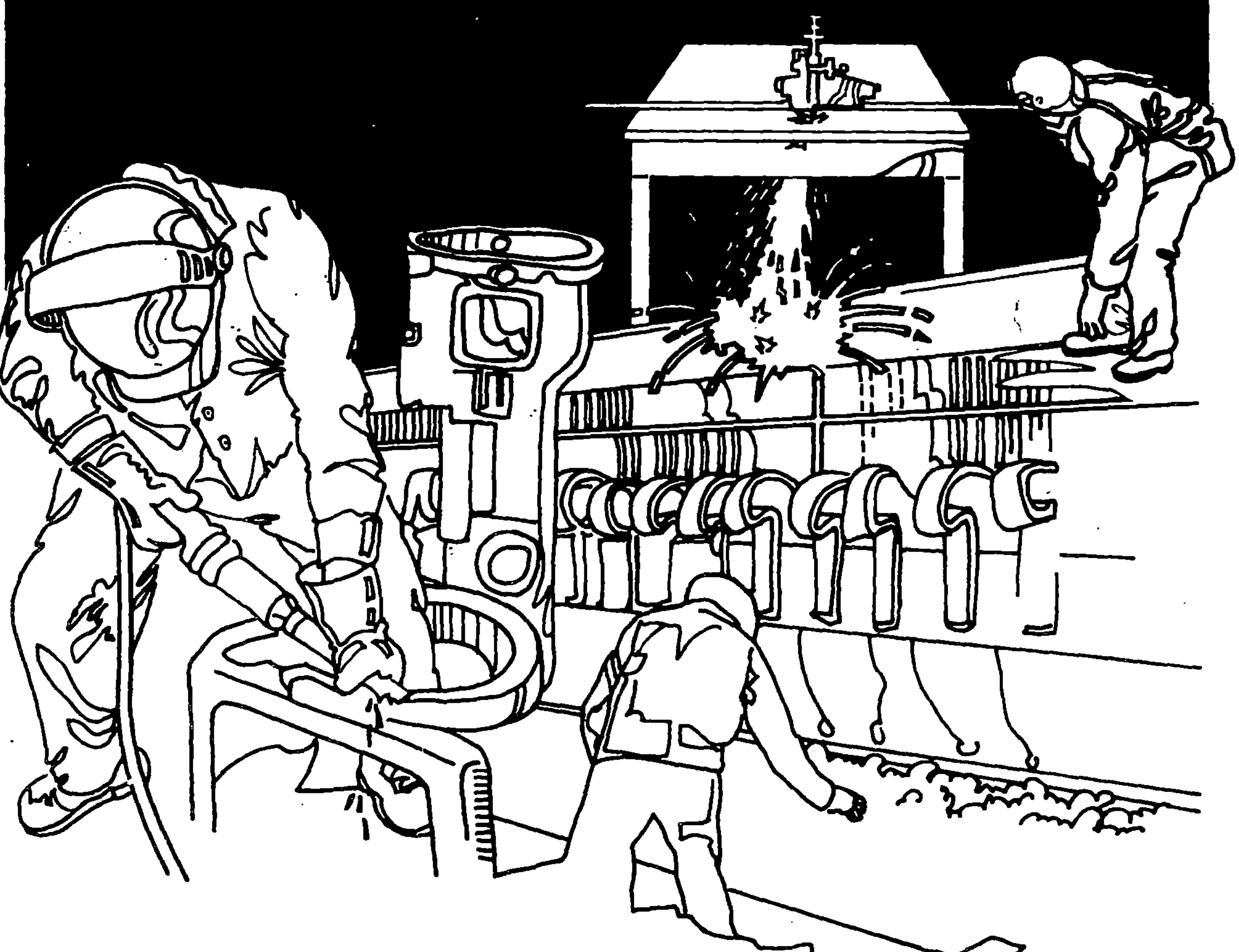

Health Hazard Evaluation Report

HETA 80-172-1032
GENERAL ELECTRIC
CINCINNATI, OHIO

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 80-172-1032
JANUARY 1982
GENERAL ELECTRIC
CINCINNATI, OHIO

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I. SUMMARY

In May, 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request from the International Association of Machinists and Aerospace Workers (IAMAW) to determine if the approximately seventy workers employed as instrumentation mechanics at the General Electric aircraft engine plant in Cincinnati, Ohio, were experiencing adverse health effects due to their work environment. These employees are potentially exposed to metal fumes, fluxes, solvents, blasting grit and carbon monoxide in the construction and application of monitoring devices designed to test jet engines. Due to the nature of the job, there is also a significant stress factor, and the union was concerned with what they felt might be a higher than normal rate of heart disease among employees of this job classification.

On July 23, and October 16, 1980, visits were made to the work site to collect information on work processes and employee exposures. Environmental measurements were made for nickel, total particulate and carbon monoxide. Subsequently an epidemiologic investigation was conducted using employee questionnaires and a review of medical and personnel records.

Seven of nine environmental measurements for airborne nickel were at or below the limit of detection of 3 micrograms of nickel per cubic meter of air (ug/m^3). The other two samples, one personal and one area, were approximately three times the NIOSH recommended maximum time-weighted average concentration of 15 ug/m^3. Concentrations of airborne particulate ranged from 0.1 to 0.4 milligrams per cubic meter of air (mg/m^3), all samples being below the evaluation criteria of 10 mg/m^3. All carbon monoxide measurements were below both the limit of detection of 5 parts of carbon monoxide per million parts of air (ppm), and the evaluation criteria of 35 ppm. The rate of heart disease was greater in the instrumentation mechanics than in a comparison group chosen from maintenance mechanics (14% compared with 5%). This increase was not statistically significant, but warrants monitoring.

One personal exposure for nickel was measured above the NIOSH recommended criteria of 15 ug/m^3 and represents a potential health hazard to this instrumentation mechanic. No other environmental contaminants were measured at levels which would be expected to cause heart or other health problems. The apparent, though not statistically significant, excess of heart disease in instrumentation mechanics is suggestive that the group may have an elevated risk of heart disease. Efforts should be made to evaluate job stress and personal risk factors pertaining to these workers.

KEYWORDS: SIC 3724, Nickel, Carbon Monoxide, Heart disease.

II. INTRODUCTION

Under the Occupational Safety and Health Act of 1970, NIOSH investigates the toxic effects of substances found in the workplace. In May, 1980, NIOSH received a request from the International Association of Machinists and Aerospace Workers (IAMAW) to determine if there was an increased rate of heart attacks among workers employed as instrumentation mechanics in the General Electric plant in Cincinnati, Ohio. A visit was made to the plant on July 23, 1980, to conduct a walk-through survey and collect information on operations and exposures. An investigation of employee's environmental exposures was made on October 16, 1980. Following this, an epidemiologic evaluation was conducted using questionnaires and medical records. The company and the union were informed of the results of the environmental investigation on December 18, 1980, and of the epidemiologic study on February 24, 1981.

III. BACKGROUND

This General Electric plant is engaged in the manufacture of jet aircraft engines. It is the responsibility of the approximately seventy instrumentation mechanics at this facility to fabricate and install devices on engine assemblies to measure temperature, pressure, and other physical parameters. The job requires a high degree of experience and expertise in the shaping and forming of a large number of metal alloys and related materials. Various processes and materials are frequently employed by workers in this department. In the machine shop several metal alloys are cut, polished, welded, drilled or machined. These processes could create dusts and vapors of the various metals in the alloys. A "flame spray" operation, used to coat metal parts with an additional layer of alloy, also creates the possibility of metal exposure by vaporizing the material and discharging it onto the workpiece in a manner similar to spray painting. Installation of the devices is by welding, soldering, or cementing. These are sources of metal fumes and solvent vapors. Surface blasting of workpieces using an aluminum oxide grit is a source of airborne dust.

IV. EVALUATION METHODS

Personal breathing zone and general area air samples were collected using battery powered sampling pumps to determine atmospheric concentrations of nickel and particulate. Analysis was by atomic absorption spectrometry for nickel and reweighing of tared filters for particulate. A separate analysis to determine exposure to aluminum oxide was not done since the criteria for this compound and for total particulate are the same and separate analyses would have been redundant. Length-of-stain detector tube measurements were made to determine carbon monoxide concentration. Work practices were observed and control measures such as exhaust ventilation were measured using a thermal anemometer. Materials and processes in the evaluated area were reviewed for potential hazards. Measurements were not made for other metals, blast grit, or solvents due to the relative toxicity of these materials, the small quantities used, and the short duration of use.

In order to determine the prevalence of heart disease among instrument mechanics, a medical history questionnaire was sent to the home address of 101 current and former instrumentation mechanics. Fifty maintenance mechanics were randomly selected to serve as a comparison population and also sent the same questionnaire. The questionnaire was primarily designed to elicit information on the history and prevalence of heart disease, including heart attack, murmur, angina, and high blood pressure. Demographic data such as age and employment duration was also collected. Also enclosed was a letter from the chairman of Lodge 912 of the IAMAW encouraging members to complete and return the questionnaires. The objective of the study was to compare the prevalence of heart disease in the instrumentation mechanics with that in a similar group that perform different work.

Since only 37% (56 of 151) of the questionnaires were returned, the medical and personnel records of 169 current and former instrumentation mechanics and 42 maintenance mechanics were reviewed. Information was collected on cardiovascular problems, absenteeism, disability, physical examinations, and related material. All analyses were based on this review.

V. EVALUATION CRITERIA

In a criteria document on inorganic nickel,[1] NIOSH recommends an exposure limit of 15 micrograms of nickel per cubic meter of air (ug/m^3) as a time weighted average concentration for up to a 10 hour work day, a 40 hour work week. The permissible exposure level established by the Occupational Safety and Health Administration (OSHA) is 1 mg/m^3 or 1,000 ug/m^3.[5] Inhalation of nickel can result in an increased incidence of lung and nasal cancer, and appreciable skin contact can cause dermatitis.

The evaluation criteria for airborne particulate or "nuisance dust" is based on its ability to reduce workshop visibility, create unpleasant deposits in the ears, eyes, and nasal passages, or cause injury to the skin or mucous membranes by chemical or mechanical action per se or by rigorous cleansing procedures necessary for its removal. The American Conference of Governmental Industrial Hygienists (ACGIH) has recommended a concentration of 10 milligrams of dust per cubic meter of air (mg/m^3) as a maximum acceptable level in air.[2] The OSHA permissible exposure level is 15 mg/m^3.[5]

NIOSH[3] recommends limiting exposure to carbon monoxide to 35 parts per million (ppm) as a time weighted average. This concentration is designed to protect the safety and health of workers who are performing a normal 8 hour per day, 40 hour per week work assignment. The OSHA permissible exposure level for carbon monoxide is 50 ppm.[5] Overexposure to carbon monoxide can result in headaches, nausea, dizziness, weakness, and heart effects.

VI. RESULTS AND DISCUSSION

The results of environmental measurements of nickel and total dust are presented in Table I. Most of these measurements were personal breathing zone samples worn by instrumentation application shop (IAS) employees. One personal sample and one area sample for nickel were above the NIOSH recommended concentration of 15 ug/m^3. The dust samples were all below the most stringent standard of 10 mg/m^3.

Three measurements were made for carbon monoxide between 10:00 and 11:00 a.m.; one in the front area of the instrumentation shop, one in the grit blast room, and one in the machine shop. All showed no detectable concentration (less than 5 ppm) of carbon monoxide.

Measurements of air flow at the spray booths indicated average face velocities of 340 feet per minute (fpm) for the west room flame spray booth, and 230 fpm for the east room alumina spray booth. Both of these spray booths provided protection greater than the minimum recommendation of 200 fpm.[4]

The results of questionnaires and record reviews are presented in Table II. This table gives both demographic and heart disease data for the instrumentation mechanics and the maintanance mechanics. Instrumentation mechanics were generally older with a mean age of 50.3 years compared with 42.6 years for maintenance mechanics. The rate of heart disease, i.e. all those that had a history of myocardial infarction (heart attack), angina, or coronary by-pass operation, was 2.8 times greater in the instrumentation than in the maintenance mechanics (13.6% compared with 4.7%). This was not statistically significant at p less than 0.10. None of the indicators of heart disease, for the instrumentation mechanics, either alone or in combination, were statistically significant using Chi-square tests. Statistical significance, however, is a function of sample size. In this study, the number of instrumentation mechanics studied was 169, and the number of maintenance mechanics was 42. If larger samples were used, with the rates of disease increased proportionally, the probablilty of a significant result would have been increased.

Moreover, the lack of statistical significance does not preclude the presence of underlying biological significance. The instrumentation mechanics could be at increased risk of heart disease due to job factors or personal risk factors, including age, smoking history, exercise, weight, etc. Little data is available on the stress due to the type or quantity of work performed by instrumentation mechanics. It is likely that this type of work could be a source of stress that affects the cardiovascular system. Additionally, no useful data has been gathered on their personal risk factors such as smoking or exercise patterns.

While one personal exposure to nickel was measured above the recommended criteria of 15 ug/m^3, no other environmental contaminants were measured at harmful levels. With the exception of that one measurement, no toxic materials were found in the workplace in concentrations which would cause heart disease or other health problems. The epidemiologic investigation indicated that the rate of heart disease is not significantly greater among instrumentation mechanics than maintenance mechanics.

VII. RECOMMENDATIONS

Workers should be counseled about the need for exercise and the role of cigarette smoking in heart disease.

Management should consider evaluating the activities and schedules of instrumentation mechanics for stress loads and efforts should be considered for stress reduction. The following publications may be useful in these regards: 1) Machine Pacing and Occupational Stress, G. Salvendy and M.J. Smith (eds), Taylor and Francis Ltd., London, 1981; and 2) Job Demands and Worker Health, National Institute for Occupational Safety and Health, 1975, Washington, Publication 75-160 (available through the National Technical Information Service, PB 276809, Springfield, Virginia 22161).

The west metal spray room should be resampled for nickel. If the concentration is again on the order of 50 ug/m^3, the area should be cleaned to reduce this level.

Flame spraying, grit blasting and most other operations have established procedures and protective devices to be used by employees. Adherence to these principles, including use of respirators, face shields and hearing protection when appropriate, is encouraged.

VIII. REFERENCES

1. Criteria for a Recommended Standard ... Occupational Exposure to Inorganic Nickel, U.S. Department of Health Education and Welfare, Public Health Service, National Institute for Occupational Safety and Health, Publication Number 77-164, May 1977.

2. Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1981, Published by the American Conference of Governmental Industrial Hygienists, P.O. Box 1937, Cincinnati, Ohio 45201.

3. Criteria for a Recommended Standard ... Occupational Exposure to Carbon Monoxide, U.S. Department of Health Education and Welfare,

Public Health Service, National Institute for Occupational Safety and Health, Publication Number HSM 73-11000, 1972.

4. Industrial Ventilation - A Manual of Recommended Practice, American Conference of Governmental Industrial Hygienist, 16th Edition, Lansing, Michigan, 1980.

5. U.S. Department of Labor, Occupational Safety and Health Administration, OSHA Safety and Health Standards (20 CFR 1910) (Revised Nov. 7, 1978).

IX. AUTHORSHIP AND ACKNOWLEDGEMENTS

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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), 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. International Association of Machinists and Aerospace Workers
2. General Electric Company
3. NIOSH, Region V
4. OSHA, Region V

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
NICKEL AND DUST CONCENTRATIONS

GENERAL ELECTRIC
CINCINNATI, OHIO
HETA 80-172

October 15, 1980

Description	Duration	Concentration Nickel	Dust
Employee spent 4-5 hours stripping wire; also spent time in grit blast and metal spray rooms, but was not blasting or spraying	7:05am-2:45pm	46 ug/m^3	0.4 mg/m^3
Employee worked most of day in machine shop, approx. 1/2 hour grit blasting and 1/2 hour on cut-off wheel	7:25am-2:55pm	3	0.1
Employee worked most of day in machine shop, approx. 20 minutes grit blasting, 30 minutes silver soldering, 10 minutes grinding	7:20am-2:50pm	3	0.1
Employee spent full shift stripping wire in Bldg. 500	7:35am-2:55pm	3	0.3
Employee spent full shift stripping wire in Bldg. 500	7:45am-3:05pm	3	0.4
Area sample in grit blast room, at breathing zone height behind pencil blaster	8:10am-2:04pm	3	None Detected
Area sample in west metal spray room, at breathing zone height near face of spray booth	8:05am-2:35pm	51	---
Employee spent most of day in machine shop, approx. 1 hour grit blasting, 1/2 hour silver soldering	8:20am-2:55pm	3	---
Employee spent most of day in machine shop, approx. 10 minutes grit blasting, 5 minutes grinding, 5 minutes nichrome welding, 5 minutes metal spraying	7:10am-2:40pm	3	---
Recommended Maximum Time-Weighted Average Concentration		15	10

TABLE II

DEMOGRAPHIC AND HEART DISEASE DATA FOR
INSTRUMENTATION AND MAINTENANCE MECHANICS

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CINCINNATI, OHIO

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	Instrumentation	Maintenance
Number evaluated	169	42
Mean Age (yrs.)	50.2 (SD 7.8)	42.6 (SD 11.6)
History of:		
a) Myocardial Infarction	9.5%	4.8%
b) Coronary By-pass	3.0%	0%
c) Angina	1.2%	0%
d) Elevated blood pressure*	14.8%	16.7%
e) Other Cardiovascular conditions	8.9%	4.8%

*Excluding anyone with a history of myocardial infarction or coronary by-pass.

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