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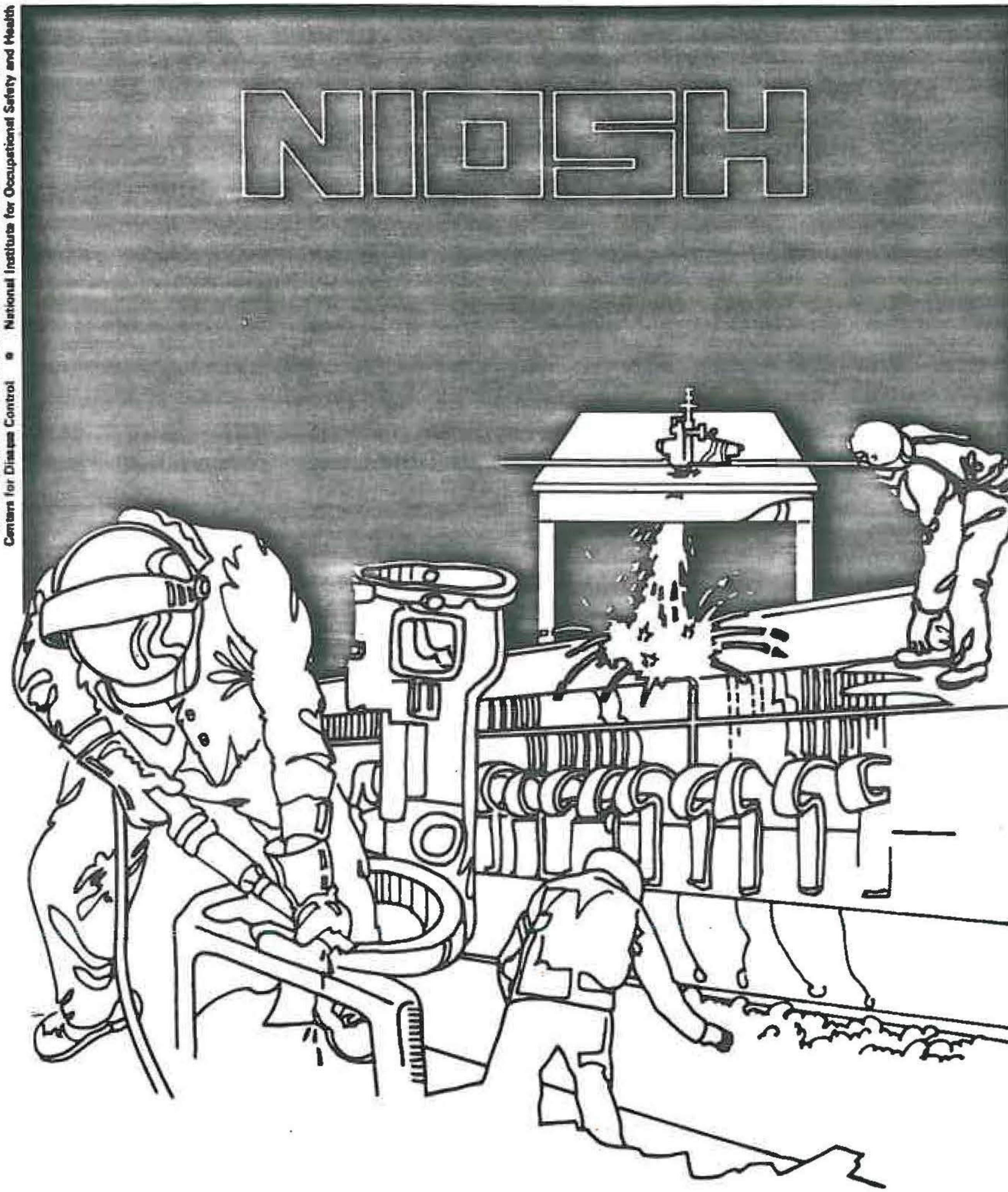

Health Hazard Evaluation Report

HETA 85-423-1904
GENERAL ELECTRIC COMPANY
EVENDALE, 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.

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GENERAL ELECTRIC COMPANY
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I. SUMMARY

The National Institute for Occupational Safety and Health (NIOSH) received a request, dated June 28, 1985, from the International Association of Machinists (IAM), Local Lodge 912, Cincinnati, Ohio, to evaluate potential carbide dust exposure from grinding and cutting operations in the cutter-grinding areas of buildings 500 and 700 at the General Electric Company (GE), Evendale, Ohio. Work in these areas involves manual and automatic grinding and sharpening of tungsten carbide tools.

NIOSH conducted a preliminary site visit to GE Evendale on September 10, 1985. A comprehensive environmental and medical follow-up survey was conducted on May 19, 21, and 23, 1986. Personal air samples for cobalt (Co), nickel (Ni), chromium (Cr), and total and respirable dust were obtained on 15 potentially exposed machinists in buildings 500 and 700. The time-weighted average (TWA) concentrations for the trace metals were calculated from both respirable and total dust fractions. Cobalt exposures from total dust samples ranged from not detectable (ND) to 97 micrograms per cubic meter (ug/m^3), TWA. Cobalt exposures from respirable dust samples ranged from ND to 4 ug/m^3, TWA. In all cases, the corresponding eight-hour TWA concentrations are nearly identical to the above values since full-shift personal sampling was performed. The American Conference of Governmental Industrial Hygienists (ACGIH) proposed Threshold Limit Value (TLV*) for Co is 50 ug/m^3. The Occupational Safety and Health Administration (OSHA) Permissible Exposure Limit (PEL) for Co is 100 ug/m^3. Both of these limits are TWAs based on eight-hour exposures. While there is no NIOSH recommended exposure limit (REL) for Co, NIOSH does recommend an action level of 50 ug/m^3 for cemented tungsten carbide dust containing more than two percent Co.

Nickel, detected in 9 personal samples, ranged in concentration from ND to 20 ug/m^3, TWA. NIOSH considers inorganic nickel to be a carcinogen and recommends personal exposures be kept below 15 ug/m^3 for a ten-hour TWA. The ACGIH TLV and OSHA PEL for nickel (metal) is 1000 ug/m^3 for an 8-hour TWA.

Total chromium (no distinction on the valence state or solubility) was measured in one personal air sample at a concentration of 5 ug/m^3. The NIOSH REL for carcinogenic hexavalent (6+) chromium compounds is 1 ug/m^3. NIOSH also recommends a level of 25 ug/m^3 for non-carcinogenic hexavalent chromium compounds, along with a 15-minute ceiling level of 50 ug/m^3. ACGIH has adopted an 8-hour TLV-TWA of 500 ug/m^3 for trivalent (3+) chromium compounds, whereas the OSHA PEL for chromium metal and insoluble salts is 1000 ug/m^3.

Respirable dust exposures ranged from ND to 1.07 mg/m^3, levels under the OSHA PEL for respirable nuisance dust of 5.0 mg/m^3. Total dust levels ranged from ND to 3.1 mg/m^3, again below the OSHA PEL for total nuisance dust of 15 mg/m^3. It should be noted, however, that nuisance dust exposure limits (whether total or respirable) are not the most appropriate criteria to use in this evaluation since other contaminants, with lower exposure limits (most notably Co), were identified in the dust samples.

Forty-one of the approximately 45 first-shift Building 700 cutter grinding area employees, and neither of the 2 grinders from Building 500, participated in the medical survey, which included a chest x-ray and determination of blood and urine Co concentrations. None of the 38 x-rays had findings suggestive of hard metal disease. Only two of 10 participants had detectable blood cobalt (limit of detection: 2.0 microgram per liter (ug/l). Nineteen (30%) of 63 urine specimens had detectable Co (limit of detection: 3.4 ug/l), but so did 3 (23%) of 13 laboratory and field blanks. The highest urine concentration for an employee was 7.6 ug/l, and only 8 (13%) exceeded 5.0 ug/l, a distribution that does not suggest appreciable occupational exposure since people without occupational exposure have urine Co levels up to 5.0 ug/l.

Based on these results, NIOSH investigators determined that a potential health hazard from airborne exposure to nickel exists among some employees in the cutter-grinding areas of Buildings 500 and 700, and a potential health hazard to cobalt exists among the employees in Building 500. Recommendations aimed at reducing exposures are included in Section VIII of this report.

Key Words: SIC 3541 (Machine Tools, Metal Cutting Types), tungsten carbide, metal dust, cobalt, nickel, chromium, respiratory protection, ventilation

II. INTRODUCTION

On June 28, 1985, the National Institute for Occupational Safety and Health received a request for a Health Hazard Evaluation from the International Association of Machinists, Local Lodge 912, Cincinnati, Ohio, to investigate potential exposure to tungsten carbide dust from a variety of grinding, sharpening, and tooling operations in cutter/grinding areas located in buildings 500 and 700 at the General Electric (GE) facility, Evendale, Ohio. NIOSH was asked to evaluate the possible health hazard of dusts generated during the grinding of tools and other components containing tungsten carbide.

NIOSH investigators conducted a comprehensive medical and environmental survey at GE on May 19, 21 and 23, 1986 to determine the levels of tungsten carbide and Co in the wet and dry grinding operations located in buildings 500 and 700. In addition to air sampling, medical monitoring was conducted to ascertain whether workers had evidence of elevated Co absorption, lung and/or other health problems related to Co exposures. Participants were notified of their blood and urine test results in June 1986, and their pulmonary function test and chest x-ray results in July 1986. An interim report describing the environmental survey findings was distributed in November 1987.

III. BACKGROUND

The GE Evendale facility is a major manufacturer of commercial and military jet engines. Two tungsten carbide cutting and grinding areas (one each in buildings 500 and 700) were evaluated to determine potential employee exposures to Co, nickel, chromium, tungsten, and total and respirable dust.

The Cutter Grind and Technical Support area, located in building 500 near column H-18, performs prototype grinding and cutting with an assortment of tungsten carbide and steel tools and components. Two grinders per shift were assigned to this department and, during the environmental and medical evaluation portion of this study, grinding was performed on first and second shifts. Since only prototype components, which require custom grinding and cutting, are handled, the overall volume of work performed by the machinists in this area is small. The employees in this department elected not to be involved in the medical portion of this evaluation.

The cutter/grinding area, located in building 700 near column G-15, services the entire plant by repairing both steel and tungsten carbide tools. This area employed 40 grinders over 2 shifts (workforce level during this evaluation), with a small staff assigned to third shift. A variety of wet and dry grinding operations are performed in this area.

Both manual and numerical (automatic) grinders are used and the machines are locally exhausted. Tool and component repairs, if necessary, are done in any of 3 ventilated brazing booths. Parts are cleaned in a ventilated shot blast cabinet located in the department.

IV. EVALUATION DESIGN

A. Environmental

The environmental assessment of employees working in the cutter-grinding areas of buildings 500 and 700 performed on May 19, 21 and 23, 1986, was designed to determine the correlation (if any) of employee pre- and post-shift urinary Co concentrations (discussed in the following section) with corresponding total and respirable cobalt air exposures measured by personal sampling during the same shift. In addition, recommendations for ventilation improvements and process modifications to reduce employee exposure to Co would be offered after examining the sample results.

Full-shift personal air samples were collected during the first shift on up to 13 potentially exposed employees. Participants were monitored for a minimum of total dust, respirable dust, Co and other trace metals on each day of the study. Two employees in the cutter-grinding shop located in building 500 were sampled for total dust, Co, and other trace metals but were not involved in the biological portion of this evaluation.

Total and respirable dust samples were collected using tared, 37 millimeter (mm), 5.0 micron pore size polyvinyl chloride (PVC) filters connected to high volume personal air sampling pumps. For determining the respirable dust fraction, NIOSH Method 600 was employed using standard 10 mm nylon cyclones with a flowrate of 1.7 liters per minute (lpm). This sampling rate provides optimum collection efficiency of dust particles smaller than 10 microns in diameter. Full-shift total dust samples, using NIOSH Method 500, were collected at a flowrate of 1.0 lpm.

A quantitative determination of trace metals, using the tared PVC filters from the respirable and total dusts samples, was made by inductively coupled plasma-atomic emission spectrometry (ICP-AES) according to NIOSH Method 7300. The PVC filters were ashed in a low temperature oxygen plasma asher (LTA) for one hour at 200 watts to remove the filter material. Five milliliters (ml) of concentrated nitric acid (HNO_3) and one-half ml of 70 percent (%) perchloric acid ($HClO_4$) were added to each sample and then taken to dryness. The residues were redissolved with 10 ml of 4% HNO_3/ 1% $HClO_4$ and then analyzed for trace metals content by ICP-AES.

Soluble and insoluble tungsten samples were collected on 37 mm, 0.8 micron pore size mixed-cellulose ester filters at flowrates ranging from 1.0 to 1.5 lpm. The samples were analyzed for soluble and insoluble tungsten and cobalt by flame atomic absorption spectroscopy according to NIOSH Method 7074.

B. Medical

All first-shift employees in the cutter/grinding areas of Buildings 500 and 700 were invited to participate in the medical survey. A self-administered questionnaire was given to each participant. The questionnaire sought basic demographic information, work history, past medical history, active medical problems, current symptoms (especially respiratory complaints), and a detailed history of occupational and non-occupational exposure to Co.

A venous blood specimen was collected and analyzed for blood cobalt, thyroid-function tests, serum creatinine, blood urea nitrogen, and a complete blood count with differential and morphology. Pre-shift and post-shift urine samples collected May 19, 21, and 23 were analyzed for Co. Urine specimens were collected after handwashing and in a manner to minimize specimen contamination. Laboratory and field blanks were collected and processed identically to the urine samples. They were analyzed at the Centers for Disease Control, Center for Environmental Health and Injury Control using a method adapted from that of Molin Christensen, et al.[1]

Pre-shift (May 19) and post-shift (May 22) pulmonary function tests (PFTs) were obtained. One-second forced expiratory volume (FEV_1) and forced vital capacity (FVC) were measured with an Ohio Medical Model 822 dry rolling seal spirometer attached to a Spirotech 200B dedicated computer. Equipment and test procedures conformed to the American Thoracic Society's then current criteria for screening spirometry.[2] Predicted values for FEV_1 and FVC were calculated using the equations of Knudson.[3] These values were multiplied by 0.85 to obtain the predicted values for Blacks.[4]

Chest x-rays were interpreted according to the ILO 1980 International Classification of Radiographs of Pneumoconioses.[5] Each x-ray was read independently by 2 radiologists certified in the use of ILO system ("B" readers). In cases of disagreement, the x-ray was read independently by a third B reader, and the majority opinion (or median value) of a disputed finding was used for analysis (and for reporting results to the participants). None of the radiologists knew the exposure status of the persons whose x-rays they were interpreting.

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 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 recommended exposure limits (REL's), (2) the ACGIH 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 REL's 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 REL's, 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 the report, it should be noted that industry is legally required to meet those levels specified by an OSHA standard.

A TWA exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Although not applicable in this evaluation, 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. Cobalt and Tungsten Carbide

The production of tungsten carbide components creates potential exposures to a number of different metal dusts including cobalt, nickel, chromium, tungsten, and titanium. Cemented tungsten carbide is a unique metal commonly used in drills, saw blades and other cutting tools because its strength, rigidity, and resistance to extreme heat. Carbide tools, for example, retain their sharpness at not only ordinary cutting temperatures (1,700 to 2,000°F) but even at temperatures approaching 3,000°F (a level existing at the interface between the carbide cutting tip and the metal being cut). Exposures to Co and other metal constituents may occur during re-sharpening and repair of tungsten carbide tools.

Cobalt is a naturally occurring element in the environment. It forms an integral part of the cyanocobalanium molecule (vitamin B_{12}). This vitamin is essential to the human diet to prevent the development of pernicious anemia (low red blood cell count).[6] The average U.S. daily Co intake from food, water and community air have been estimated to be 300 ug, 6 ug and 0.1 ug respectively.[7]

While Co is an essential element, in high concentrations it is known to have adverse effects on the lungs, heart, thyroid, skin, and blood producing system. Fibrotic lung changes have been observed in workers exposed to airborne cobalt concentration of 100 to 200 ug/m^3. A common pattern of illness is described in these reports.[8-18] The worker may first develop a cough, followed by labored breathing on exertion. This may be followed by substantial weight loss, as the individual goes on to develop a progressive interstitial pulmonary fibrosis (scar tissue in the lung). This may be accompanied by cor pulmonale (heart enlargement and failure due to the lung disease), leading ultimately to cardiorespiratory collapse and death.[6] The reported latency period from exposure to disease varies from a few years to 20 years.[6] It is unclear whether this variable latency is related to individual susceptibility or varying levels of exposure between studies.

A series of reports describe lung function test results among 155 Swedish cemented carbide workers and 74 controls matched for sex, age and smoking history.[19-21] Persons exposed to an average of 60 ug/m^3 airborne Co showed changes on pulmonary function tests, suggestive of obstructive disease, that did not regress over the weekend. Smokers were more affected than non-smokers.

Several investigators have suggested evidence of bronchitis among hard metal workers.[5-19] Asthma has been reported as early as within one month after initial exposure.[9,10,24,25] The development of asthma seems to be a true sensitization to Co. The occurrence of allergic lung sensitization has heightened plausibility in view of the occurrence of documented Co allergic dermititis that has been reported among workers using Co containing materials.[25,26] Sjogren et al has reported three, non-smoking, hard metal workers, having symptoms and signs compatible with allergic alveolitis.[27,28] The symptoms, signs and chest x-ray findings cleared following removal from the work environment, but upon re-exposure the symptoms and chest X-ray findings recurred. All three workers had eczematous skin changes and were sensitive to Co on skin patch testing.

Other physiological effects associated with Co include cardiomyopathy (disease of the heart muscle). This was first reported in the 1960's and was associated with heavy beer consumption (2 to 6 liters per day). Cobalt sulfate or Co chloride was commonly used in beer at that time as a foam stabilizer.[30-35] The signs and symptoms of affected individuals included abdominal pain, shortness of breath, lowered blood pressure, heart enlargement, pericardial effusion (fluid around the heart), tachycardia (rapid heart beat), and electrocardiographic (ECG) abnormalities. The amount of Co ingested daily by a 6 liter per day drinker was estimated to be about 5-10 mg/day (5,000 to 10,000 ug/day). Therapeutically, cobalt has been used in the treatment of anemias (low red blood cell counts). It has been shown to increase hemoglobin and hematocrit levels in humans.[36-44] Hypothyroidism and goiter have been associated with daily oral doses of 2-10 mg/kg of cobalt chloride administered over a 2-4 month period in a small percentage of people.[6] Additional effects, reported in humans but for which there is limited information available, include disturbed kidney function, hyperglycemia, mild to moderate changes in liver function tests and impaired sense of smell.[6]

The NIOSH Criteria for controlling occupational exposure to Co holds the following position concerning its possible carcinogenicity:[6]

> "Information on Co is inadequate to conclude that Co is a carcinogen. The information is also inadequate to conclude that Co is non-carcinogenic. In fact, limited data provide suggestive evidence that at least some Co containing compounds may prove carcinogenic when subjected to long-term testing by currently accepted protocols.[44,45,46] Until such testing is performed, no definitive guidelines can be given. Tumor induction at the injection site, however, would argue for the need to adequately clean any wound contaminated with Co."

The ACGIH has proposed adoption of a recommended TLV-TWA for Co of 50 ug/m^3.[47] The OSHA PEL for Co is 100 ug/m^3.[48] NIOSH recommends an action level of 50 ug/m^3 for cemented carbide dust which contains more than two percent Co.[49]

C. Nickel

Nickel can exist in both soluble and insoluble forms. Epidemiologic evidence suggests that the hazard presented by insoluble nickel compounds is not as great as that presented by soluble forms. Nickel has been reported to cause "nickel itch," an allergic dermatitis. An increase in nasal, sinus, and lung cancer has been noted in workers employed in nickel refineries, although the specific carcinogenic agent is still not defined. Metallic nickel introduced into the pleural cavity, muscle tissue, and subcutaneous tissue has been shown to be carcinogenic in test animals. NIOSH considers inorganic nickel to be a carcinogen and recommends personal exposures be kept below 15.0 ug/m^3 for a ten-hour TWA.[50] The ACGIH TLV and OSHA PEL for nickel (metal) is 1 mg/m^3 for an 8-hour TWA.[47,48]

D. Chromium

Chromium compounds can cause an allergic dermatitis in some workers. Acute exposure to chromium dust and mist may cause irritation of the eyes, nose, and throat. Chromium exists as chromates in one of three valence states: 2+, 3+, and 6+. Chromium metal and its insoluble salts, representing the divalent (2+) state, are considered to be relatively non-toxic. Chromium compounds in the trivalent (3+) state are also of a low order of toxicity. In the hexavalent (6+) state, however, chromium compounds are irritating, corrosive and are known to cause penetrating sores of the skin; ulceration and perforation of the nasal septum; inflamation of the mucous membrane; and may cause kidney or liver damage, tooth erosion and discoloration, and perforated eardrums. This hexavalent form may be carcinogenic or non-carcinoginic, depending on solubility. The less-soluble forms are considered carcinogenic. Workers in the chromate-producing industry have been reported to have an increased risk of lung cancer.

ACGIH has adopted an 8-hour TLV-TWA of 500 ug/m^3 for trivalent chromium , whereas the OSHA PEL for chromium metal and insoluble salts is 1000 ug/m^3.[47,48] The NIOSH REL for carcinogenic hexavalent chromium compounds is 1.0 ug/m^3. NIOSH also recommends a level of 25 ug/m^3 for non-carcinogenic hexavalent chromium compounds, along with a 15-minute ceiling level of 50 ug/m^3.[51]

VI. RESULTS AND DISCUSSION

A. Environmental

Full-shift personal air samples were collected on 15 employees in buildings 500 and 700 between May 19 to 23, 1986. Tables I, II, III, and IV present sample results, expressed as TWA's, for total dust, respirable dust, and Co.

Personal exposures to Co, measured from total dust samples, ranged from ND to 97 ug/m^3 while Co levels from respirable dust samples ranged from ND to 4 ug/m^3, TWA's. The limit of quantitation (LOQ) for Co and other trace metals from this sample set was 1.0 microgram per filter.

Nickel was detected in 9 personal samples, ranging from ND to 20 ug/m^3, TWA. These results are presented in Table V. Exposure to nickel dust in the cutter/grinding area of building 700 was limited to 1 employee who worked primarily with tungsten carbide parts using the following machines: Royal Oak grinders (nos. 11245, 11829, and 19684); Cincinnati Milicron Monoset grinder. The 2 grinders sampled in building 500 were both exposed to nickel dust while working with prototype tungsten carbide parts. NIOSH considers inorganic nickel to be a carcinogen and recommends exposures be kept below 15 ug/m^3 for a ten-hour TWA.

Total chromium (no distinction on the valence state or solubility) was measured in one personal air sample at a concentration of 5 ug/m^3. NIOSH recommends a standard of 25 ug/m^3 for non-carcinogenic hexavalent chromium compounds, along with a 15-minute ceiling level of 50 ug/m^3.

Respirable dust exposures ranged from ND to 1.07 mg/m^3, levels under the OSHA PEL for respirable nuisance dust of 5.0 mg/m^3. Total dust levels ranged from ND to 3.08 mg/m^3, well below the OSHA PEL for total nuisance dust of 15 mg/m^3. It should be noted, however, that nuisance dust exposure limits are not the most appropriate criteria to use in this evaluation since other contaminants, with lower exposure limits (most notable Co), were identified in these dust samples.

B. Medical

Questionnaire Data

Forty-one of the approximately 45 first-shift Building 700 cutter/grinding area employees, and neither of the 2 from Building 500, participated in the medical survey, but not all of them had all the tests. Ten persons had blood Co determinations; only 2 had levels above the laboratory's level of detection of 2.0 ug/l. Nineteen (30%) of 63 urine Co concentrations exceeded the limit of detection of 3.4 ug/l, but so did one of 6 field blanks and 2 (28%) of 7 laboratory blanks. The highest level in an employee was 7.6 ug/l, and only 8 (13%) exceeded 5.0 ug/l. These results do not suggest substantial occupational exposure, since people without occupational exposure have urine Co levels up to 5.0 ug/l.[52] None of the 38 chest x-rays had interstitial opacities, diffuse fibrosis, or pneumonitis.

Given (1) the minimal exposure to airborne Co in Building 700, (2) the low prevalences of elevated blood and urine Co levels and lack of substantially elevated urine Co levels, and (3) the absence of x-ray findings suggestive of hard metal disease, the remainder of the medical data were not analyzed. Without a reasonable distribution of exposure, there is nothing with which to associate symptoms or test results.

VII. CONCLUSIONS

Based on the results of personal air sampling for trace metals, NIOSH has determined that a potential health hazard from airborne exposure to nickel exists among some employees in the cutter-grinding areas of Buildings 500 and 700, and a potential health hazard to cobalt exists among employees in the cutter-grinding area of Building 500. None of the 38 x-rays had findings suggestive of hard metal disease, and only 2 of 10 study participants had detectable blood cobalt (limit of detection: 2.0 ug/l. Nineteen (30%) of 63 urine specimens had detectable Co (limit of detection: 3.4 ug/l), but so did 3 (23%) of 13 laboratory and field blanks. The highest urine concentration for an employee was 7.6 ug/l, and only 8 (13%) exceeded 5.0 ug/l, a distribution that does not suggest appreciable occupational exposure since people without occupational exposure have urine Co levels up to 5.0 ug/l.

VIII. RECOMMENDATIONS.

1. Single-use (disposable) respirators should not be used by employees overexposed to Co. These respirators should be replaced by half-mask or full-face respirators which offer a higher degree of protection until such time as engineering controls are implemented to reduce employee exposures below the proposed ACGIH TLV for Co of 50 ug/m^3.

2. It is recommended that, for employees exposed to inorganic nickel above 15 ug/m^3 TWA for up to a 10 hour-workshift, respiratory protection in the form of a self-contained breathing apparatus with full-facepiece, operated in pressure demand or other positive

pressure mode, be provided until such time as engineering controls are implemented to reduce employee exposures below the NIOSH REL for inorganic nickel.

3. The local exhaust ventilation system be completed in the cutter/grinding area of building 500. During this evaluation the electrical control panel controlling the ventilation system had not been completed.

4. It is recommended that the local exhaust ventilation be evaluated for effectiveness on the following machines located in the Cutter/Grinding area in building 700: Royal Oak grinders (nos. 11245, 11829, and 19684); Cincinnati Milicron Monoset grinder (no number).

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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, 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 Electric Company, Evendale, Ohio
2. International Association of Machinists, Local Lodge 912
3. NIOSH, Cincinnati, Ohio.
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

Personal and Area Air Sampling Results for Total Dust, Respirable Dust, and Cobalt

General Electric - Evendale
Cutter/Grinder Operations - Building 500
Cincinnati, Ohio
HETA 85-423

DATE	SAMPLE NO.	TIME (MIN)	FLOWRATE (LPM)[b]	SAMPLE VOL. (LITERS)	CONCENTRATION[a]	
					TOTAL DUST[c]/COBALT[d]	RESPIRABLE DUST[c]/COBALT[e]
5/19/86	F-147	445	1.0	445	0.65/ND[f]	
	F-159	444	1.0	444	1.44/60*	
	F-150	445	1.7	757		0.03/ND
	F-156	444	1.7	755		0.12/4
5/21/86	F- 1	426	1.0	426	3.08/3	
	F- 38	423	1.0	423	1.84/87*	
	F- 46[g]	422	1.7	717		0.06/ND
5/23/86	F- 75	426	1.0	426	0.99/7	
	F- 86	425	1.0	425	1.76/97*	
	F- 82[g]	403	1.7	685		0.04/ND
Evaluation Criteria:						
	ACGIH				10/50	5/
	NIOSH				None/h	None/h
	OSHA				15/100	5/100

Comments:

a All values have been field blank corrected and are expressed as the time weighted average over the period sampled. It should be noted, however, that nuisance dust exposure limits (whether total or respirable) are not the most appropriate criteria to use since other contaminants, with lower exposure limits (most notably Co), were identified in the dust samples.
b Liters per minute.
c Concentrations of total and respirable dust are expressed in milligrams per cubic meter (mg/m^3).
d Cobalt concentration from total dust samples, expressed in micrograms per cubic meter (ug/m^3).
e Cobalt concentration from respirable dust samples, expressed in micrograms per cubic meter (ug/m^3).
f Not detectable.
g Area air samples.
h The NIOSH recommended action level for cemented tungsten carbide dust, containing more than two percent cobalt, is 50 ug/m^3, ten-hour TWA.
* Indicates concentrations at or above the ACGIH TLV® for cobalt of 50 ug/m^3.

Concentrations of other trace metals:
Chromium: Chromium was not detected in any of the area samples.
Nickel: Range from ND to 20ug/m^3.

Table II

Personal Air Sampling Results for Total Dust, Respirable Dust, and Cobalt

General Electric - Evendale
Tool and Cutter Grind Operations - Building 700
Cincinnati, Ohio
HETA 85-423

DATE	SAMPLE NO.	TIME (MIN)	FLOWRATE (LPM)[b]	SAMPLE VOL. (LITERS)	CONCENTRATION[a]	
					TOTAL DUST[c]/COBALT[d]	RESPIRABLE DUST[c]/COBALT[e]
5/19/86	F-151	403	1.0	403	0.02/ND[f]	
	F-158	404	1.0	404	0.05/ND	
	F-154	406	1.0	406	0.07/ND	
	F-152	387	1.0	387	0.34/ND	
	F-160	401	1.0	401	0.05/5	
	F-146	407	1.0	407	0.29/ND	
	F- 11	372	1.0	372	0.16/ND	
	F- 13	374	1.0	374	0.11/ND	
	F- 10	162	1.0	162	0.43/ND	
	F- 24	369	1.0	369	0.16/ND	
	F-157	403	1.7	685		0.12/ND
	F- 16	404	1.7	687		0.0/ND
	F- 17	406	1.7	690		0.0/ND
	F-155	387	1.7	658		0.15/ND
	F-153	401	1.7	682		0.06/ND
	F-145	407	1.7	692		0.0/ND
	F- 9	372	1.7	632		0.0/ND
	F- 8	374	1.7	636		0.06/ND
	F- 19	380	1.7	646		0.31/ND
	F- 23	369	1.7	627		0.06/ND
Evaluation Criteria:						
	ACGIH				10/50	5/50
	NIOSH				None/g	None/g
	OSHA				15/100	5/100

Comments:

For explanation of footnotes see page 5.

Table V

Personal Air Sampling Results for Nickel

General Electric - Evendale
Tool and Cutter Grind Operations - Buildings 500 and 700
Cincinnati, Ohio
HETA 85-423

DATE	SAMPLE NO.	LOCATION	SAMPLE VOL. (LITERS)	CONCENTRATION Nickel, ug/m^3, TWA
5/19/86	FW-147	Building 500	445	13
	FW-152*	Building 700	387	3
	FW-159	Building 500	444	2
5/21/86	FW- 34*	Building 700	767	1
	FW- 37*	Building 700	451	20
	FW- 38	Building 500	423	5
5/23/86	FW- 5*	Building 700	439	8
	FW- 33*	Building 700	746	2
	FW- 75	Building 500	426	16
Evaluation Criteria:				
	ACGIH			1000
	NIOSH			15
	OSHA			1000

* Same employee in Building 700 cutter/grinding area. Employee operated Royal Oak grinders nos. 11245, 11829, and 19684 and a Cincinnati Milicron Monoset machine.

Footnotes to Tables II, III, and IV

General Electric - Evendale
Tool and Cutter Grind Operations - Building 700
Cincinnati, Ohio
HETA 85-423

a All values have been field blank corrected and are expressed as the time weighted average over the period sampled. It should be noted, however, that nuisance dust exposure limits (whether total or respirable) are not the most appropriate criteria to use since other contaminants, with lower exposure limits (most notably Co), were identified in the dust samples.

b Liters per minute.

c Concentrations of total and respirable dust are expressed in milligrams per cubic meter (mg/m^3).

d Cobalt concentration from total dust samples, expressed in micrograms per cubic meter (ug/m^3).

e Cobalt concentration from respirable dust samples, expressed in micrograms per cubic meter (ug/m^3).

f Area air samples.

g The NIOSH recommended action level for cemented tungsten carbide dust, containing more than two percent cobalt, is 50 ug/m^3, ten-hour TWA.

* Indicates concentrations at or above the ACGIH TLV® for cobalt of 50 ug/m^3.

Table IV

Personal Air Sampling Results for Total Dust, Respirable Dust, and Cobalt

General Electric - Evendale
Tool and Cutter Grind Operations - Building 700
Cincinnati, Ohio
HETA 85-423

DATE	SAMPLE NO.	TIME (MIN)	FLOWRATE (LPM)[b]	SAMPLE VOL. (LITERS)	CONCENTRATION[a]	
					TOTAL DUST[c]/COBALT[d]	RESPIRABLE DUST[c]/COBALT[e]
5/23/86	F- 26	459	1.0	459	0.15/7	
	F- 43	222	1.0	222	0.0/ND[f]	
	F- 4	453	1.0	453	0.15/2	
	F- 94	366	1.0	366	0.33/ND	
	F- 32	438	1.0	438	0.25/ND	
	F- 5	439	1.0	439	0.34/ND	
	F- 79	459	1.0	459	0.17/ND	
	F- 80	439	1.0	439	0.38/4	
	F- 74	450	1.0	450	0.33/ND	
	F- 30	459	1.7	780		0.13/ND
	F- 47	222	1.7	367		0.22/ND
	F- 36	453	1.7	770		0.06/ND
	F- 29	366	1.7	622		0.0/ND
	F- 39	438	1.7	745		0.12/ND
	F- 33	439	1.7	746		0.08/ND
	F- 83	459	1.7	780		0.15/ND
	F- 76	439	1.7	746		0.09/ND
	F- 87	450	1.7	765		0.12/ND
Evaluation Criteria:						
	ACGIH				10/50	5/50
	NIOSH				None/g	None/g
	OSHA				15/100	5/100

Comments

For explanation of footnotes see page 5.

Table III

Personal Air Sampling Results for Total Dust, Respirable Dust, and Cobalt

General Electric - Evendale
Tool and Cutter Grind Operations - Building 700
Cincinnati, Ohio
HETA 85-423

DATE	SAMPLE NO.	TIME (MIN)	FLOWRATE (LPM)[b]	SAMPLE VOL. (LITERS)	CONCENTRATION[a]	
					TOTAL DUST[c]/COBALT[d]	RESPIRABLE DUST[c]/COBALT[e]
5/21/86	F-003	411	1.0	411	0.32/ND[f]	
	F- 37	451	1.0	451	0.69/ND	
	F- 25	450	1.0	450	0.11/ND	
	F-006	449	1.0	449	0.20/ND	
	F-002	436	1.0	436	0.05/ND	
	F-007	454	1.0	454	0.18/ND	
	F- 44	455	1.0	455	0.20/ND	
	F- 31	342	1.0	342	0.0/ND	
	F- 40	411	1.7	699		0.24/ND
	F- 34	451	1.7	767		1.07/ND
	F- 35	450	1.7	765		0.04/ND
	F- 48	449	1.7	763		0.05/ND
	F- 28	436	1.7			0.07/ND
	F- 41	454	1.7	741		0.10/ND
	F- 45	455	1.7	774		0.18/ND
	F- 42	342	1.7	581		0.07/ND
Evaluation Criteria:						
	ACGIH				10/50	5/50
	NIOSH				None/g	None/g
	OSHA				15/100	5/100

Comments

For explanation of footnotes see page 5.