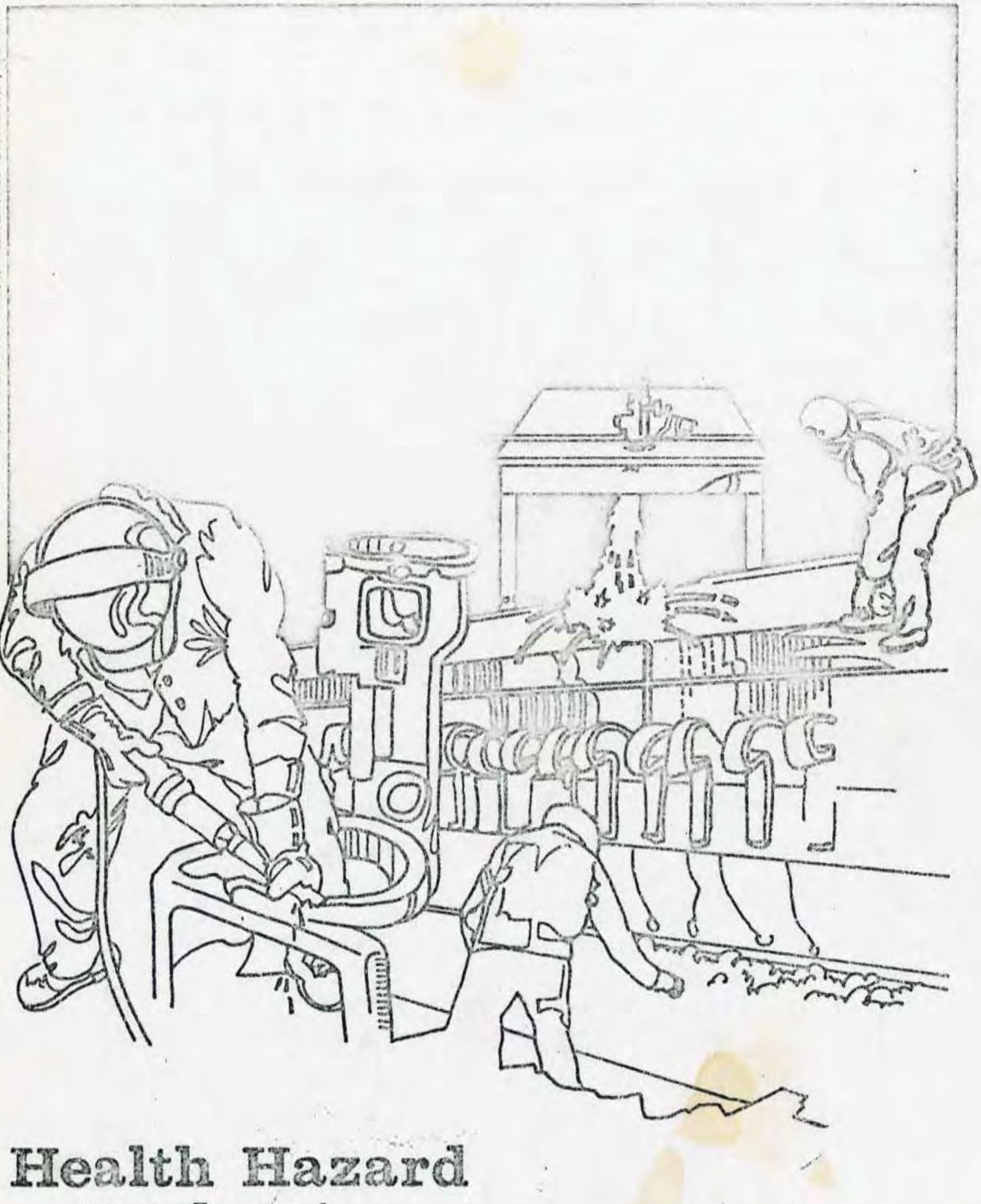
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES ■ Public Health Service
Centers for Disease Control ■ National Institute for Occupational Safety and Health



Health Hazard Evaluation Report

HETA 82-011-1143
GOODYEAR AEROSPACE CORPORATION
AKRON, 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 82-011-1143
JULY 1982
GOODYEAR AEROSPACE CORP.
AKRON, OHIO

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I. SUMMARY

On October 12th, 1981, the National Institute for Occupational Safety and Health (NIOSH) received a request for a health hazard evaluation from the local union at Goodyear Aerospace Corporation, Akron, Ohio. The request identified activities in the welding shops of 543D and in the maintenance shops as sources of possible health hazards resulting from exposures to ozone and welding fumes.

On November 23-24, 1981, NIOSH conducted a medical and environmental survey. Personal samples for welding fumes were taken on five workers in 543D and on two maintenance welders. Ten welders, five in plant D and five in maintenance, and 10 non-welders serving as a non-exposed comparison group filled out a medical questionnaire and gave a spot urine specimen for analysis of fluoride, cadmium and β_2 -microglobulins.

In the welding area of 543D, the exposures were: aluminum, range 13 to 115 ug/M^3 (mean 21 ug/M^3); cadmium, range 1 to 739 ug/M^3 (mean 181 ug/M^3); iron, range 1 to 38 ug/M^3 (mean 14 ug/M^3); and nickel, none-detected. In the maintenance welding department, two welders were sampled, and had exposures to the four metal fumes of: aluminum, range 19 to 115 ug/M^3 (mean 67 ug/M^3); cadmium, range 2 to 6 ug/M^3 (mean 4 ug/M^3); iron, range 328 to 740 ug/M^3 (mean 534 ug/M^3); and nickel, range 4 to 54 ug/M^3, (mean 29 ug/M^3). The American Conference of Governmental Industrial Hygienists (ACGIH) recommends an 8 hour time-weighted-average (TWA) of 10,000 ug/M^3 for aluminum. NIOSH recommends 40 ug/M^3 as a 10 hour TWA for cadmium; the Occupational Safety and Health Administration (OSHA) standard for cadmium is 100 ug/M^3. OSHA has set a standard of 10,000 ug/M^3 for iron and its oxide. NIOSH recommends a TWA of 15 ug/M^3 for nickel, while the OSHA standard is 1000 ug/M^3.

Ozone exposures were measured in 543D because of the extensive use of gas-shielded welding techniques. The range of exposures was from 0.024 to 0.157 ppm (mean 0.054 ppm). The highest exposure was measured during the use of a portable MIG welder called the 'squirt gun'. Most TIG and MIG welding generated exposures between 25 and 33% of that produced by the 'squirt gun'. The OSHA standard for ozone exposure is 0.1 ppm for an 8 hour TWA. ACGIH recommends that ozone exposure for a 15 minute short-term exposure level (STEL) be limited to 0.1 ppm.

A statistically significant higher proportion of welders than non-welders reported eye irritation (60% welders vs. 10% non-welders) and headache (60% welders vs. 0% non-welders). It was not possible to associate these symptoms with any particular welding operation. Results of spot urine analyses for fluoride and cadmium were well within generally accepted normal ranges. Excretion of β_2 -microglobulin and β_2 -microglobulin corrected for urinary creatinine indicators of renal tubular damage, were within normal limits.

On the basis of the study conducted November 24, 1981, at Goodyear Aerospace Corporation, NIOSH concludes that periodic occasional overexposures to cadmium, nickel, and ozone do occur among welders. Environmental monitoring of worker exposures should be conducted on a periodic basis for all operations. Recommendations for improvement of ventilation are included in the report.

KEYWORDS: SIC 1990 (Ordinance and Accessories), welding, ozone, cadmium, nickel, iron, aluminum

II. INTRODUCTION

On October 2, 1981, Local 856 of the United Auto Workers (UAW), Akron, Ohio, requested the National Institute for Occupational Safety and Health (NIOSH) to conduct a Health Hazard Evaluation of the welding shops in Plant D and of the Maintenance Departments at Goodyear Aerospace Corporation (GAC), Akron, Ohio. Of particular concern were exposures to ozone and metal fumes from welding.

An opening conference and walk-through survey were conducted November 23, 1981. Present at the meeting were representatives of Local 856 UAW, GAC, and NIOSH. On November 24, environmental sampling was performed for ozone, metal fumes, and secondary solvent exposures in Plant D, and for metal fumes in the Maintenance Shop. Results of the sampling for ozone were sent to both union and management representatives on December 15, 1981.

III. BACKGROUND

Goodyear Aerospace Corporation at Akron, Ohio, produces defense systems hardware, gas centrifuges for uranium enrichment, aircraft wheels, tire products, and brakes, as well as other materials used by the aerospace industry.

The plant D welding shop is currently engaged in welding together aluminum alloy housings for underwater mines. The primary welding techniques in use are tungsten inert gas (TIG) and mixed inert gas (MIG). These techniques use high voltage arc to fuse the metal pieces, while shielding the weld areas with inert gases to prevent impurities from forming on the welds. On occasion, electric AC arc-consumable electrode welding is done, as is silver soldering and brazing.

Maintenance welders carry out repair welding throughout the facility. On the day of the NIOSH survey, electric arc-consumable electrode welding was being done on ferrous metal.

IV. EVALUATION DESIGN AND METHODS

Environmental

Seven personal breathing zone samples were taken for metal fumes using Dupont P-2500 pumps at a sampling rate of 1.7 liters per minute (lpm) over the duration of the workshift (7-8 hours). They were collected outside of the welding helmet on 0.8u mixed cellulose ester (MCE) filters.

Because the metal being welded consisted of a special aluminum alloy, the analysis for fumes was conducted by inductively coupled plasma atomic emission spectroscopy (ICPAES). Filters were ashed with concentrated nitric acid and the residues then dissolved in dilute acid. Using this technique, the lower limit of detection for the sample set was 1.0 micrograms (ug) per filter.

Eight ozone samples were taken using NIOSH method S8. Since the workers were often required to weld on the inside of the aluminum tubes, personal samples were collected by the hygienists holding the impingers near the welders face shields. NIOSH method P&CAM 154 was used to analyze the KI solution by colorimetric means. Problems with solution instability were circumvented courtesy of GAC which donated laboratory facilities and personnel to have the samples analyzed within 30 minutes of the end of the sampling period.

Fluorides and hexavalent chromium were not sampled for because fluxed welding was done for only a short period and no stainless steel was welded that day.

Medical

A questionnaire was administered to ten welders, five in plant D and five in maintenance. Ten non-welders, primarily machinists, five from plant D and five from maintenance, served as a non-exposed comparison group. The questionnaire sought information about smoking history, occupational history, job activities, and adverse health effects which have been reported to result from excesssive exposure to ozone, cadmium, or fluoride, i.e., eye, nose, and throat irritation; nosebleeds; shortness of breath; pain or tightness in the chest; coughing; wheezing; headache; gastrointestinal disturbances; skin irritation or rash; chills; sweating; decreased sense of smell; drowsiness; and reduced ability to concentrate.

A spot urine specimen was obtained from each participant, and analyzed for levels of fluoride, cadmium, and β_2 - microglobulin. Fluoride was analyzed by the NIOSH fluoride in urine method (1). Cadmium was analyzed using a graphite furnace atomic absorption method. β_2 -microglobulin was analyzed using a radioimmunoassay.

V. EVALUATION CRITERIA

The environmental evaluation criteria used in this report as related to airborne exposures to toxic substances are (1) NIOSH recommended levels (2) Federal Occupational Safety and Health Standards (as promulgated and enforced by the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor (29 CFR 1910.1000) and (3) Threshold Limit Values (TLVs) and their supporting documentation as set forth by the American Conference of Governmental Industrial Hygienists (ACGIH).

Following in a brief discussion pertaining to the primary health effects associated with exposure to the various substances evaluated and the associated evaluation criteria.

Aluminum

Exposures to aluminum fume may cause weakness, fatigue, and respiratory distress. The American Conference of Governmental Industrial Hygienists (ACGIH) has recommended that exposures for 8 hours not exceed 10,000 micrograms per cubic meter (ug/M^3) on the basis of a time-weighted-average (TWA).

Cadmium

Cadmium is a toxic heavy metal which may enter the body either by ingestion (swallowing) or by inhalation (breathing) of cadmium metal or oxide. Once absorbed into the body, cadmium accumulates in organs throughout the body, but major depositions occur in the liver and kidneys. Acute inhalation exposure to high levels of cadmium can cause pneumonia or pulmonary edema, as well as liver and kidney damage (2). Chronic exposure may lead to emphysema of the lungs and kidney disease, or cancer of the prostate (3). There is also limited evidence that occupational cadmium exposure may be associated with lung cancer.

Cadmium deposited in the kidneys may lead to renal tubular damage resulting in excessive urinary loss of low molecular weight proteins, such as β_2 -microglobulins, and ultimately kidney failure. Urinary cadmium and β_2 -microglobulin levels serve as indicators of cadmium exposure. Cadmium levels in urine are not consistently related to severity or duration of exposure, and are useful only as confirmation of cadmium absorption. Wide variation exists in reported acceptable ranges of urinary cadmium. Utah Biomedical Test Laboratories, the laboratory which performed the urine cadmium analyses in this investigation, does not report normal values for urinary cadmium. Environmental Science Associates reports a normal range of 0.64-8.90 ug/l. A British occupational health publication reports that levels of 10 ug/l are found in non-exposed populations, and levels higher than 25 ug/l are evidence of excessive exposure (4).

The normal range for urinary β_2 -microglobulin reported by Metpath Laboratories is 4-370 ng/ml. Previous experience has shown that results are more closely grouped when raw spot urine results are corrected for urinary creatinine. When results are thus presented as β_2 -microglobulin (corrected), values up to 150 ug β_2 -microglobulin/g creatinine are within normal limits.

NIOSH recommends that worker exposures to cadmium dust or fume be limited to not more than 200 ug/M^3 during a 15-minute ceiling period or not more than 40 ug/M^3, as a time-weighted average (TWA) over a 10-hour shift. The Occupational Safety and Health Administration (OSHA) standard for cadmium dust exposure is 200 ug/M^3, and for cadmium fume exposure 100 ug/M^3, using an 8-hour TWA for each.

Iron

Long-term inhalation exposure to iron, particularly iron oxide, gives a mottled appearance to the lungs on X-ray, a condition referred to as siderosis. This is considered a benign pneumoconiosis with no significant physiological impairment. OSHA has set 10 mg/M^3 as its standard. ACGIH recommends 5 mg/M^3.

Nickel

Nickel fume exposures result from welding on nickel-plated parts or nickel-containing alloys such as stainless steel. Inhalation exposures to nickel and nickel oxide dusts have produced malignant pulmonary neoplasms in guinea pigs and rats. The systemic toxicity of nickel fumes has not been thoroughly researched, although nasal cancers have been shown to occur with greater frequency among furnace workers in nickel refineries. On the basis of the aforementioned animal studies, NIOSH recommends that exposures to nickel should not exceed 15 ug/M^3. OSHA has set a 8 hour TWA standard of 1000 ug/M^3 (5).

Fluoride

Short-term exposure to fluoride-containing dust can cause irritation of the eyes and respiratory tract. Swallowing fluoride can cause numerous symptoms, including a salty or soapy taste, vomiting, abdominal pain, diarrhea, shortnesss of breath, muscular weakness, and convulsions. Repeated exposure to excessive concentrations of fluoride-containing dust can cause skin rash and excessive calcification of bone and ligaments (3).

Absorbed fluoride is partially stored in bone and partly excreted in the urine. With continued exposure, and deposition of fluoride in bone, the fraction appearing in the urine increases. The exact relationship between urine fluoride level and deposition of fluoride in bone is not completely understood. Consequently some variation exists in recommended limits of urine fluoride levels. According to Heyrath (6), an average daily urine output of 4 mg. of fluoride reflects maximum permissible fluoride exposure. Largent states that there is "little need for concern" if urinary fluoride levels are below 4 mg/l; further monitoring or controls should be considered only if levels exceed 6 mg/l (7). NIOSH guidelines indicate that detectable osteosclerosis does not occur with urine levels below 5 mg/l in preshift samples taken after two days off work, and is unlikely with levels of 5-8 mg/l (8).

The current OSHA standard for fluoride is 2.5 milligrams of fluoride per cubic meter of air (mg/M^3) averaged over an eight-hour work shift. NIOSH has recommended that the permissible exposure limit be changed to 2.5 mg/M^3 averaged over a work shift of upto 10 hours per day, 40 hour per week.

Ozone

Occupational exposure to ozone occurs during welding shielded by inert gases. Exposure to excessive levels of ozone produces acute symptoms, including irritation of eyes, nose and throat, and cough. Higher ozone concentrations can lead to headache, upset stomach, vomiting, chest tightness or pain, and shortness of breath (8,9). Daily intermittent exposure to ozone concentrations over 5 ppm may result in incapacitating pulmonary congestion (10). While chronic pulmonary changes after long-term exposure to ozone have been reported in animal experiments, these effects have not been demonstrated in humans. No method is available for biologic monitoring of ozone exposure.

Several standards are applied to ozone exposures. ACGIH has recommended a short-term exposure limit (STEL) for a fifteen minute exposure not to exceed 0.3 ppm, with an eight-hour TWA of 0.1 ppm. The OSHA standard currently is 0.1 ppm for an 8 hour TWA.

VI. RESULTS AND DISCUSSION

A. ENVIRONMENTAL

Metals

Results of personal breathing zone samples for metal fumes are presented in Table 1. Seven welders were sampled for most of their eight hour shift. In the welding area of 543D, exposures were: aluminum, range 13 to 115 ug/M^3 with an average exposure of 21 ug/M^3; cadmium, range 1 to 739 ug/M^3 with an average exposure of 181 ug/M^3; iron, range 1 to 38 ug/M^3 with an average exposure of 14 ug/M^3; and nickel, all none-detected.

In the Maintenance welding department, two welders were sampled, and had exposures to the four metal fumes of: aluminum, range 19 to 115 ug/M^3 with an average exposure of 67 ug/M^3; cadmium, range 2 to 6 ug/M^3, with an average exposure of 4 ug/M^3; iron, range 328 to 740 ug/M^3, with an avergage exposure of 534 ug/M^3; and nickel, range 4 to 54 ug/M^3, with an average exposure of 29 ug/M^3.

For all welders, exposures to aluminum and iron fume were inconsequential. Significant exposures to cadmium were measured for two welding operations in 543D.

A welder in 543D who was performing the 'boss insert' weld inside of a Captor housing had a time weighted average exposure to cadmium of 163 ug/M^3. During the day, at least eight such inside welds were made. Because the welder had to lean inside the cylinder to affect the welds, dilution ventilation was unable to carry away the contaminant. This sample demonstrates excessive airborne concentrations near the breathing zone and the need for local exhaust when such inside welds are made. Another welder in 543D welding on cadmium coated parts was exposed to a concentration of 739 ug/M^3 of cadmium fume. The general dilution ventilation in the department was not satisfactory to control the exposure.

One of the two welders sampled in the Maintenance Department was exposed to 54 ug/M^3 of nickel fume. The nickel exposures in this department will depend upon the type of metal or alloy that is being welded, and the levels measured reflect the potential for intermittent overexposure. In the interest of continuing worker safety and health considerations, additional sampling should be performed based on the evidence for carcinogenicity of nickel.

Ozone

Personal sampling results from ozone exposures are summarized in Table 2. Ozone exposures were measured in 543D because of the extensive use of gas-shielded welding techniques. For all operations, the range of exposures was from 0.024 to 0.157 ppm, with an average exposure of 0.054 ppm. The highest exposure was measured during the use of a portable MIG welder called the 'squirt gun'. Most TIG and MIG welding generated exposures between 25 and 33% of the 'squirt gun' (0.024-0.056 ppm).

Ozone exposures were below the current OSHA standards. Again, exposures could be higher or lower based on the positioning of the sampling impinger inside of the welding helmet. Practically, this type of sampling could not be done. It is the opinion of the NIOSH hygienist that ozone concentrations encountered during the daily welding could be reduced. Ozone is an irritant and has a pungent odor. The ozone concentrations encountered while the hygienists were holding the sampling train to approximate a breathing zone sample were sufficient to cause somewhat labored breathing and a tightness in the chest.

B. MEDICAL

Demographic data

The mean age of the ten welders was 34 years (range 21-54), compared to a mean age of 36 years for the non-welders (range 24-48). The mean number of years on the job at Goodyear for the welders was 5.2 (Range 2 months-31 years). A number of welders had been employed as welders in other firms prior to employment at Goodyear. Thus the mean number of years welding, regardless of place of employment, was 9.4 (Range 3-33 years).

Symptomatology

The following symptoms were reported on the questionnaire:

SYMPTOM	WELDERS (10)	NON-WELDERS (10)
Eye irritation	6	1
Nose/throat irritation	5	1
Headache	6	0
Sweats	1	0
Upset stomach	1	0
Skin rash	1	0
Reduced ability to concentrate	1	0
Bad taste in mouth	3	0
Chest pain	1	0

The difference between the proportion of welders and non-welders reporting eye irritation and headache was statistically significant at the 5% level (Fisher's exact test, one-tailed). For eye irritation, $P=0.028$; for headache, $P=0.005$. For nose/throat irritation, $P=0.07$, indicating 'borderline' statistical significance. All five welders in plant D complained of eye irritation, but this could not be associated with a particular welding process.

Four welders reported exposure to cadmium, one reported no exposure, and five were uncertain. Of those reporting exposure, maximum exposure reported was one hour per week on the average, but this was variable. Seven welders reported exposure to fluoride-containing fluxes, one reported no exposure, and two were uncertain. Of those reporting use of flux, reported exposure ranged from one to forty hours per week.

A statistically significant higher proportion of welders than non-welders reported eye irritation and headache. It was not possible to associate these symptoms with any particular welding operation. No attempt was made to correlate symptoms with reported exposure to fluoride and cadmium, since most welders were unsure of their exposure, and reported length of exposure was probably not a reliable index of exposure.

Eye irritation in welders is commonly caused by exposure to ultraviolet radiation, and intense flashes of light could conceivably lead to headaches. This possibility was not evaluated in this investigation.

Urinalysis

Results of urine fluoride, cadmium, and β_2-microglobulin are presented in Table 3.

Results of urine analyses for fluoride do not indicate excessive fluoride excretion. All values of urinary fluoride are well below the upper limit of accepted normal ranges.

None of the values of urinary cadmium exceed 3ug/l. While accepted normal values of urinary cadmium vary from laboratory to laboratory, all urine cadmium values obtained on the day of this study are well within generally accepted normal ranges. The NIOSH criteria document on cadmium suggests that further medical investigation be conducted if urinary cadmium levels exceed 10 ug/l (11).

All of the values of β_2 -microglobulin and β_2 -microglobulin corrected for urinary creatinine are within normal limits. The results show no evidence of renal tubular damage from cadmium exposure.

Headache and eye irritation have been reported as acute effects of excessive fluoride, cadmium and ozone exposure. The normal urine fluoride results and limited use of fluxes argue against excessive fluoride exposure as the etiology of the symptoms. Normal urine β_2 -microglobulin and cadmium results do not rule out acute excessive cadmium exposure as the cause of the symptoms, since both of these laboratory determinations better reflect chronic, rather than acute symptomatology. Ozone exposure as the source of the symptoms cannot be excluded.

VII. RECOMMENDATIONS

1. No eating, drinking, smoking, or application of cosmetics is to be permitted in any area where welding is being performed.

2. Cadmium-coated parts are to be welded under conditions of local exhaust ventilation.

3. Welds made inside the Captor tubes should be performed using exhaust ventilation or at a minimum increased air-flow through the tube. It is understood that gas-shielded welding does readily adapt to local exhaust. An increase in general dilution ventilation would be acceptable as long as periodic remonitoring of worker expsoures demonstrated the effectiveness of that technique.

4. Ozone levels, while in accordance with the extant standards, should be decreased to provide workers with more tolerable welding conditions. If an increase in general dilution ventilation was found to be ineffective in reducing exposures, personal protective equipment (NIOSH approved chemical cartridge respirators of the proper type and fit) should be provided for those workers experiencing discomfort or irritation from ozone exposures. Because many of the welding operations require the welder to wear protective face shielding, it is hoped that steps toward improvements in ventilation capacity will be undertaken by GAC.

5. All operations should be periodically and systematically monitored to insure a safe welding environment.

6. All welding operations should comply with the regulations set forth in General Industry Occupational Safety and Health Standards (29 CFR 1910.252).

VIII. REFERENCES

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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), 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. Authorized Representative, Local 856, United Auto Workers, Akron, Ohio
2. Goodyear Aerospace Corporation, Akron, Ohio
3. NIOSH, Region 5
4. OSHA, Region 5

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 1

Results of Personal Samples for
Aluminum, Cadmium, Iron and Nickel Fumes

Goodyear Aerospace Corporation
Akron, Ohio
HETA 82-011

November 23-24, 1981

Job Classification	Sampling Period (minutes)	ALUMINUM as oxide (ug/M^3)	CADMIUM as oxide (ug/M^3)	IRON as oxide (ug/M^3)	NICKEL as oxide (ug/M^3)
Welder-543D TIG[1] on Al alloy	430	32	163	37.5	ND[3]
Welder-543D TIG on Al alloy	451	12	1.0	1.0	ND
Welder-543D Auto MIG[2] on Al	431	20	2.6	5.3	ND
Welder-543D TIG and Ag-solder	414	14	1.0	7.9	ND
Welder-543D Cd-coated parts	387	25	739	16.5	ND
Maintenance welder A+B (Cast iron and steel welding)	419	19	1.7	740.0	4.3
Maintenance welder A+B	413	114	5.5	328.0	53.9
Evaluation Criteria:					
NIOSH (8-hour TWA)			40		15
OSHA (8-hour TWA)			100	10,000	1000
ACGIH (8-hour TWA)		10,000		5,000	

1- Tungsten Inert Gas - Ar shield
2- Mixed Inert Gas - Ar shield
3- ND - not detected

Limit of Detection is 1.0 ug/filter for all four substances.

Table 2

Results of Personal Samples for Ozone

Goodyear Aerospace Corporation
Akron, Ohio
HETA 81-011

November 24, 1981

Job Description	Sampling Period	OZONE (ppm)
MIG welding, outside bead, Captor mine housing	48 min	0.024
Same as above -GAC sample	48 min	0.037
TIG welding, boss insert, inside housing	44 min	0.026
TIG welding, boss insert, outside housing	44 min	0.038
MIG welding, outside bead, Captor mine	53 min	0.035
TIG welding, inside housing	53 min	0.056
AC welding, 4043 rod, 6061 aluminum	51 min	0.057
MIG welding, 'squirt gun'	13 min	0.157
Evaluation criteria:		
OSHA (8-hour TWA)		0.1
ACGIH 15 minute STEL		0.3

TABLE 3

Urine: Fluoride, Cadmium, and β_2 -microglobulin Concentrations

Goodyear Aerospace Corporation
Akron, Ohio
HETA 82-011

	Fluoride (mg/l)	Cadmium (ug/l)	β_2 -microglobulin (ng/ml)	β_2 -microglobulin (corrected) (ug/g creatinine)
			DEPT. D WELDERS	
1.	1.13	1	11.1	2.94
2.	1.22	1	17.4	5.28
3.	1.75	1	4.6	1.16
4.	0.79	1	28.5	23.9
5.	1.14	1	14.5	4.33
			DEPT. D NON-WELDERS	
1.	0.83	1	59.6	14.9
2.	0.94	1	60.3	73.5
3.	2.25	1	53.5	15.1
4.	0.48	1	29.1	39.3
5.	0.79	1	20.2	18.7
			MAINTENANCE WELDERS	
1.	0.97	1	52.9	30.8
2.	QNS*	QNS*	20.4	4.82
3.	1.95	1	156	45.8
4.	1.08	1	149	86.6
5.	0.68	1	144	29.4
			MAINTENANCE NON-WELDERS	
1.	1.18	3	75.4	33.8
2.	1.33	1	35.1	10.0
3.	1.06	1	104	36.2
4.	1.33	2	115	47.3
5.	1.29	1	155	121

* Quantity not sufficient

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