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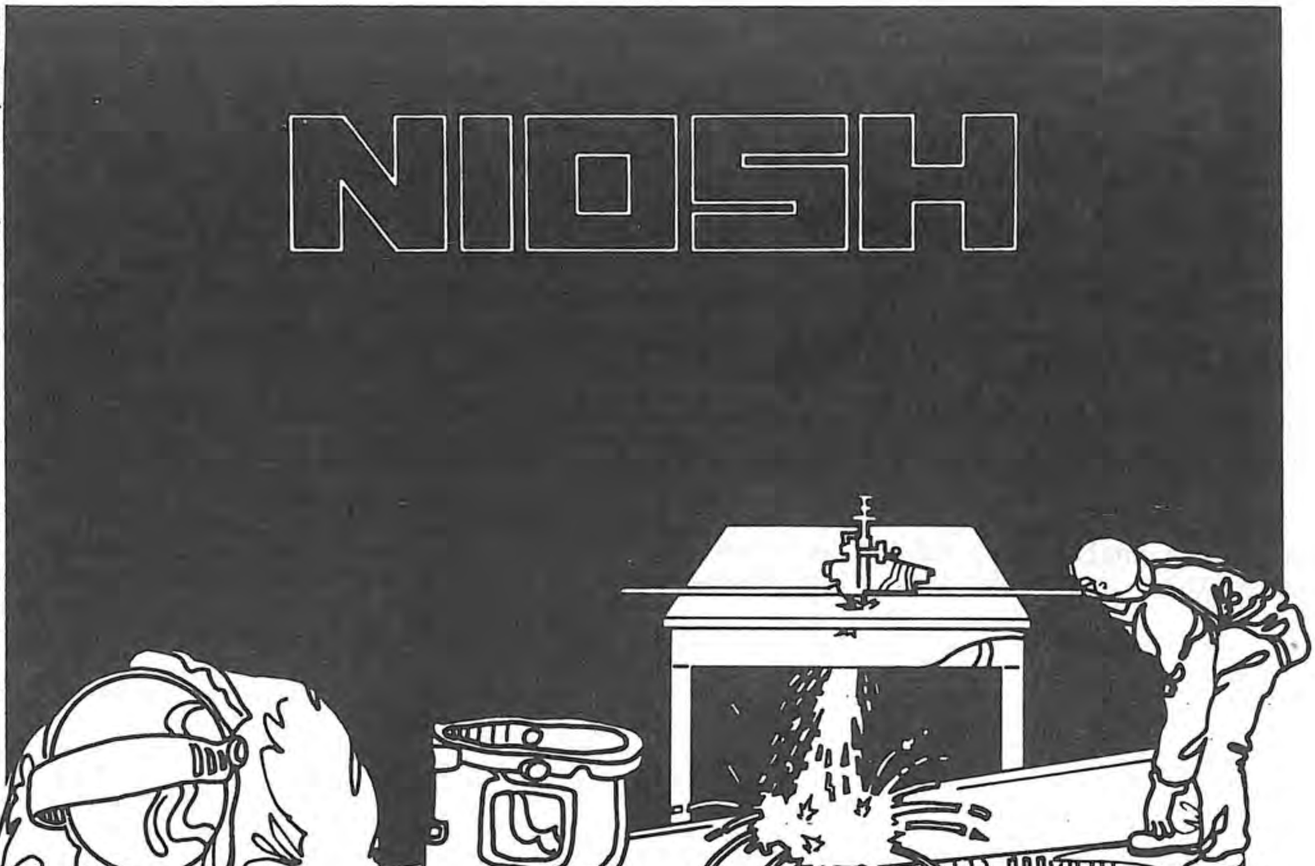

Health Hazard Evaluation Report

HHE 80-129-812
FORD MOTOR COMPANY-
OHIO TRUCK PLANT
AVON LAKE, 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. 699(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.

HE 80-129-812
February 1981
Ford Motor Company-
Ohio Truck Plant
Avon Lake, Ohio

NIOSH INVESTIGATORS:
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I. SUMMARY

On May 5, 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request from Local 2000, United Auto Workers (U.A.W.) to conduct a health hazard evaluation at Ford Motor Company's Ohio Truck Plant. The request reported that nail disorders had occurred among clean up and maintenance workers having contact with hydraulic fluid. A subsequent request was also made to evaluate production worker exposures to zinc oxide and welding fumes during the assembly of galvanized van body parts.

The Ford Motor Company Ohio Truck Plant assembles van bodies from pre-stamped components, including some already galvanized. Bodies are assembled by induction welding performed at manually operated hand gun stations and at programmed automated units. Finish welding is done with semi-automatic wire welders. The number of workers varies, with 365 workers holding welding classification and 40-80 engaged in maintenance.

Air sampling, both personal breathing-zone and area, was conducted during the first shifts on August 19 and 20, 1980. A medical evaluation was conducted concurrently. Dermatologic and general work histories were obtained, workers' skin was examined, and selected skin and nail scrapings were cultured and examined microscopically.

Environmental data indicated no overexposure to oil mist, copper fume, iron oxide fume, manganese fume, zinc oxide or fume, or total welding fumes. Values were all less than one half the applicable evaluation criteria. Bulk samples of hydraulic fluid, an oil emulsion, had a pH of about 7.5. Cultures of the emulsion, both fresh and used, did not reveal the presence of fungal species which have been associated with nail disorders. The medical data obtained was insufficient to determine whether, in general, hydraulic fluid contributed to the occurrence, exacerbation, or persistence of the identified dermatologic problems.

Based on the data obtained from this investigation, NIOSH determined that a hazard from overexposure to metals in welding fumes does not exist. Pathogenic fungi associated with skin and nail disorders were not present in the cultures of hydraulic fluid obtained during the survey. A recommendation is made for reducing worker contact to spilled hydraulic fluid during equipment repairs.

KEYWORDS: SIC 3713 (Truck and Bus Bodies), hydraulic fluid, induction welding, fungus, welding fumes, galvanized steel, zinc.

II. INTRODUCTION

On May 5, 1980, the National Institute for Occupational Safety and Health (NIOSH) received a request from the Health and Safety Representative of Local 2000, United Automobile, Aerospace and Agricultural Implement Workers of America, U.A.W., to conduct a health hazard evaluation at Ford Motor Company's Ohio Truck Plant, Avon Lake, Ohio. The request concerned nail disorders among clean up and maintenance workers having direct contact with hydraulic fluid. Subsequently, a request was made to also evaluate production worker exposures to zinc oxide and welding fumes during the assembly of galvanized van body parts. The health hazard evaluation was conducted August 18-20, 1980. Delay of the survey was due to the slumping automobile market which resulted in extended plant closings and made scheduling of the survey difficult. The survey took place during the second week of the 1981 model year production.

III. BACKGROUND

A. Facility Description

The Ford Motor Company's Ohio Truck Plant occupies a one million-square-foot single story building built in 1946. It was acquired by Ford in 1973 and converted from its previous use as a Fruehauf truck trailer plant. General ventilation is present with roof fans located in elevated portions of the ceiling. Ceiling height averages between 29 and 35 feet. Large man coolers are scattered around the various assembly areas to provide some local air movement. Production areas are made up of 50- by 50-foot bays.

B. Workforce

The plant currently employs 1405 hourly workers, with 1223 male employees averaging 37 years of age and 11 years of service. 365 people hold welding classifications, including the production lines, maintenance, and the body shop. The plant operates two 8-hour production shifts per day, five days per week, and three maintenance shifts.

C. Process Description

Sub-assembly area: Parts are brought into the plant pre-stamped, some galvanized, and covered with an oil film. Component body parts are prefabricated at off-line weld gun stations (or sub-assembly stations) with the use of hand-operated induction welding units (also called pinch welding). Assembled parts from these build-up operations are fed into automation units which assemble the complete body sides, floor pan, and front body. The mobility of induction welding units, in the handgun and automation units, is due to hydraulic and compressed air systems, and all induction welding tips are water cooled. The assembled van body parts meet at the body framing fixture where the two sides, floor pan, and front body are automatically welded together. Induction welding requires no fluxes and no consumable welding stock. No solvents are used to remove the oil film prior to welding.

The base metal, flat rolled steel, is fused in the weld by passage of an electric current through the welding tips. A strip or bead of weld sealer, similar to caulking compound, may be used between the two pieces of metal being fused.

Final Assembly Area: In this area the roof is attached to the body and the van is then transferred to the final assembly area where oxyacetylene and arc welding is used to touch-up any missed welds and to finish body welds. Fine wire welding is done using metal inert gas welding machines, an automatic welding wire, and carbon dioxide (CO_2) as a blanket gas. Doors are fitted and metal repair is also done at this stage. The van body is transported to the painting department and then by truck to another plant for final assembly.

The plant operates at a production rate of 40 van bodies per hour, although this rate fluctuates due to equipment down time and off-line sub-assembly production. Fine wire and underbody touch-up welders appear to be the only workers welding throughout the entire shift.

D. Environmental Control of Hydraulic Fluid

The hydraulic fluid skin exposures are reported to occur when maintenance workers repair the automated units. NIOSH investigators observed hydraulic fluid accumulations in the base of the underbody (floor pan) sub-assembly automation unit and in the left-hand body side sub-assembly unit. In some areas cardboard had been put down, but it too was saturated with the hydraulic fluid. The space in areas where repairs would be made is very limited and would require the worker either to sit or lie on the unit base to reach the equipment. Investigators observed no repair work in the units during the survey. No oil absorbent material was in use since this material would clog the drains around the perimeter of the machines. It was reported that a flushing system had been used in the past to remove excess oil, but was discontinued because of difficulty in starting machines after its use. No alternatives have been tried. The hydraulic fluid is used directly from the drums as it comes from the manufacturer.

Oil mist appeared to be effectively controlled by putting small cloth sacks over hydraulic exhaust valves, but many such sacks were missing and replacement was reported to be sporadic.

IV. METHODS AND MATERIALS

A. Environmental

Personal sampling for welding fume and zinc oxide exposures were conducted by locating sampling cassettes in the breathing-zone of sub-assembly and fine wire welders. In the sub-assembly area, the welding exposures resulting from work on galvanized parts was of major interest. Area samples for oil mist were taken in the automation area near the control panels and near the break area. Personal samples were not obtained because employees were permitted to smoke in the area - cigarette smoke being a known interference. Bulk samples of hydraulic fluid (oil) were obtained from automation unit base areas for pH determination and fungal culturing. A fresh sample was also collected. Work practice of welders was observed, however, as noted previously, no repair or maintenance of the automation units was done during the survey.

Oil Mist: Area samples for oil mist were collected on 37 mm cellulose membrane filters and analyzed using NIOSH Method P & CAM 159. A set of standards were prepared from the fresh oil. The limit of detection was 20 micrograms (µg) of oil per filter. Oil was prepared for pH measurement by vigorously shaking 1 milliliter (ml) of the sample with 20 ml of deionized water, then filtering. The pH was determined on the filtrate with a glass electrode using a Corning pH Meter 130.

Hydraulic Fluid Cultures: Four hydraulic samples, one fresh and three used, were cultured for fungi of the genera Microsporum, Epidermophyton, and Trichophyton.

Welding Fumes: Tared poly vinyl chloride (PVC) filters were used in sampling for welding fumes so that in addition to determining copper (Cu), iron (Fe), manganese (Mn), and zinc (Zn) exposures, a total welding fume concentration could also be measured. Four filters were analyzed by inductively coupled plasma-atomic emission spectroscopy for trace metal content to obtain an indication of relative fume concentrations. Tare and gross weightings of filters were done in duplicate with an instrumental precision of 0.01 mg. Fume samples on tared filters were analyzed for specific metals using atomic absorption spectroscopy (NIOSH Method P & CAM 173). Limits of detection per sample were: Copper, .002 mg; Iron, .003 mg; Manganese, .001 mg; and Zinc, .002 mg.

Zinc Oxide: Environmental samples for zinc oxide (ZnO) were taken for employees welding on galvanized body components. All personal samples were taken in the breathing-zone by attaching them to the collar of induction welders (who wore no welding helmet) and for those from the fine wire line, where welding helmets were worn, the cassettes were placed high on the collar and periodically checked for location inside the helmet during welding. Open face membrane filters were analyzed for zinc oxide using X-ray diffraction. Samples were scanned to check for direct interferences. Filters were dissolved in acetone and the residue collected on silver membrane filters. Standards and samples were analyzed concurrently and an external calibration curve was prepared from the integrated intensities. The lower limit of quantitation is 0.03 mg ZnO.

B. Medical

All workers with skin problems were invited to participate in the study. A NIOSH contract dermatologist evaluated participants by obtaining a dermatologic and general medical history, examining the skin, and microscopically examining selected skin and nail scrapings (treated with potassium hydroxide) for fungi. Scrapings negative for fungi were cultured for fungi.

V. EVALUATION CRITERIA

The criteria used to evaluate the potential hazards associated with toxic substances found in the employee's work environment were obtained from the following sources: NIOSH recommendations for Occupational Health Standards; the American Conference of Governmental Industrial Hygienists (ACGIH): Threshold Limit Values (TLV's) for Chemical Substances in Workroom Air 1980; and OSHA General Industry Safety and Health Standards. These exposure limits are derived from existing human and animal data and industrial experience.

The values for each contaminant are designed to permit an occupational exposure over an 8- to 10-hour workday, 40-hour work week, throughout an individual's normal worklife without adverse effect. Because of wide variations in individual susceptibility, a small percentage of workers may experience discomfort or adverse health effects from some substances at or below the applicable criteria. Contributions to the overall exposure by skin contact, in this instance with mineral oil, are not included in the criteria, zero skin absorption being assumed.

The occupational exposure criteria for airborne contaminants is presented in Table I.

VI. RESULTS

A. Environmental

The results of sampling conducted during the survey didn't demonstrate any overexposures to welding fumes or hydraulic fluid. All environmental samples, both personal and area, revealed very low or non-detectable levels of the welding-associated trace metals sampled and of the airborne oil mist from the automation units. The following table summarizes the environmental values obtained.

Contaminant	Mean Exposure and Standard Deviation in mg/M^3*	Range of Values mg/M^3	Number of Samples above the Analytical Limit of Detection (%)	Evaluation Criteria** mg/M^3
Oil Mist	0.30 ± 0.14	0.13-0.45	6 of 6 (100%)	5
Zinc Oxide***	None Detected	-----	0 of 10 (0%)	5
Welding Fumes (total weight)	0.99 ± 1.0	0.25-3.1	10 of 10 (100%)	5
Copper Fumes	0.04 ± 0.02	0.02-0.06	3 of 10 (30%)	0.1
Iron Oxide Fumes	0.76 ± 0.93	0.15-3.0	10 of 10 (100%)	14.3
Manganese Fumes	0.06 ± 0.07	0.003-0.18	6 of 10 (60%)	1
Zinc Oxide Fumes***	0.09 ± 0.12	0.01-0.35	8 of 10 (80%)	5

* mg/M^3 = milligrams of substance per cubic meter of air

** See Table I

*** Samples taken specifically for zinc oxide were all below the analytical limit of detection (0.03 mg per sample), whereas the presence of zinc was demonstrated by the method used to analyze for trace metals in the welding fume samples (with a detection limit of 0.002 mg per sample).

Skin contact with the hydraulic fluid was reportedly limited to maintenance workers repairing the automation units. During the survey no repair of the units was required, therefore, observation of the procedures where direct skin contact occurs was not possible.

Results for workers at various locations in the assembly area are presented in Tables II-V. Table V presents the results from four filters analyzed by inductively coupled plasma-atomic emission spectroscopy for trace metals. The four metals present in greatest quantities determined by this analysis (Cu, Fe, Mn, Zn) were also determined on the remaining samples.

B. Medical

Seven maintenance and support workers participated in the dermatologic evaluation; an eighth was interviewed by telephone. Participants ranged in age from 36 to 58 with a median of 49. The worker interviewed by phone and three others had a history suggestive of hand eczema.

Of the participants in the dermatologic evaluation, the following conditions were observed:

- -2 cases of hand eczema were observed out of 4 workers having suggestive histories;
- -6 workers, including 2 with a history of hand eczema, had fungal infections of the feet (tinea pedis and/or onychomycosis);
- -2 of the workers without hand eczema had a fungal infection of the fingernails, and a third member of this group had a non-fungal disorder of the fingernails.

Cultures of all hydraulic fluid bulk samples (including samples fresh from the drum and collected from pools in the automation units) were negative for dermatophytes (fungi which grow in or on the epidermis or its derivatives, hair, and nails). The pH of the emulsion fluid was essentially neutral (with 7.4 ± 0.1 for the fresh fluid sample and 7.7 ± 0.1 for the used fluid sample).

Information obtained from the manufacturer of Irus Fluids F and M (direct communication) indicated that these hydraulic fluids were emulsions in water (approximately 40% water). The product (95%) consists mostly of water and petroleum hydrocarbons (i.e., mineral oil), and the toxicological properties are considered to be those of oil hydrocarbons.

VII. CONCLUSIONS

Results of environmental sampling conducted during the survey showed that concentrations of copper, iron, manganese, and zinc associated with welding fumes on galvanized and nongalvanized mild steel, by both inductive and fine wire welding processes, are well below the applicable exposure criteria. Based on environmental information, no health hazard was indicated for the welding processes.

The data from this study is insufficient to determine whether, in general, hydraulic fluid contributed to the occurrence, exacerbation, or persistence of the dermatologic problems identified. Fungal cultures of hydraulic fluid did not demonstrate the presence of fungal skin pathogens.

VIII. RECOMMENDATIONS

The company should explore methods of cleaning up hydraulic fluid spills. One possibility would be to use flushing equipment prior to a repair procedure, thereby reducing worker contact with the fluid. This would reduce the frequency of equipment start-up problems compared to routine flushing.

IX. REFERENCES

1. Method P & CAM 159, NIOSH Manual of Analytical Methods, Vol. 1. DHEW (NIOSH) Publication No. 77-157A, 1977.

2. Method P & CAM 173, NIOSH Manual of Analytical Methods, Vol. 5. DHEW (NIOSH) Publication No. 79-141, 1979.

3. Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1980. American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio, 1980.

4. OSHA Safety and Health Standards (29 CFR 1910) General Industry. U.S. Department of Labor, OSHA 2206, November 7, 1978.

5. NIOSH Criteria for a Recommended Standard: Occupational Exposure to Zinc Oxide, DHEW (NIOSH) Publication No. 76-104, 1976.

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available, upon request, from NIOSH, Division of Technical Services, Publications Dissemination, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia 22161.

Copies of this report have been sent to:

1. U.A.W. Local 2000, Avon Lake, Ohio
2. U.A.W. International, Detroit, Michigan
3. Ford Motor Company-Ohio Truck Plant, Avon Lake, Ohio
4. U.S. Department of Labor (OSHA), Region V
5. NIOSH, Region V
6. Michigan Department of Labor
7. Michigan Department of Public Health

TABLE I

Environmental Evaluation Criteria

Ford Motor Company
Avon Lake, Ohio
HE 80-129

Substance	ACGIH[1] Recommendation (mg/M^3)	OSHA[2] Standard (mg/M^3)	NIOSH[3] Recommendation (mg/M^3)
Copper Fume	0.2	0.1	-----
Iron Oxide Fume (Fe_2O_3, as Fe)	5	10	-----
Iron Oxide Fume[4]	14.3	28.6	-----
Manganese Fume (as Mn)	1	C[5] 5	-----
Oil Mist, Mineral	5	5	-----
Welding Fumes (NOC)[6]	5	-----	-----
Zinc Oxide	5	5	5

1 American Conference of Governmental Industrial Hygienists: TLV's for chemical substances in workroom air, 1980.

2 OSHA Safety and Health Standards (29 CFR 1910), November 7, 1978. Standards given for purpose of comparison.

3 NIOSH Criteria for a Recommended Standard: Occupational Exposure to ______.

4 Values for iron oxide fume itself are calculated by multiplying 2.86 X standard. ($\frac{Fe_2O_3}{Fe}$ X standard for Fe_2O_3 as Fe).

5 C denotes a ceiling concentration which should not be exceeded, even briefly, during the exposure period.

6 NOC denotes "not otherwise classified." Chemical composition of welding fumes varies with the welding process, alloys, and electrodes used. Conclusions cannot be based on total fume concentration without giving consideration to the previously stated factors and the potential presence of metals for which individual standards exist.

TABLE II

Area Oil Mist Concentrations

Ford Motor Plant
Avon Lake, Ohio
HE 80-129

August 19-20, 1980

Sample Description Date	Location	Duration (min.)	Volume (M^3)	Oil Mist Concentration (mg/M^3)
8/19	D-8, pillar, area sample	473	0.946	0.45
8/19	D-7, Stage 2 LH body area	472	0.944	0.43
8/19	E-8, A-pillar area	471	0.942	0.37
	Blank	---	-----	N.D.*
8/20	E-7, top of power station	385	0.770	0.13
8/20	D-7, automated control panel	381	0.762	0.24
8/20	D-8 top lockers, break area	384	0.768	0.17

Evaluation Criteria: (See Table I) 5 mg/M^3

* N.D. = None Detected

TABLE III

Personal Samples for Zinc Oxide Exposure

Ford Motor Company
Avon Lake, Ohio
HE 80-129

August 19-20, 1980

Date	Sample Description Job Description/Location	Duration (min.)	Volume (M^3)	Analysis of Zinc Oxide Per Sample (mg)
8/19	Fine wire welder, welding booth	448	0.672	N.D.*
8/19	Fine wire welder, welding booth	453	0.680	N.D.
8/19	RH body side subassembly welder, E-12	237	0.356	N.D.
8/19	Extra welder subassembly, A-5	352	0.528	N.D.
8/19	Underbody subassembly welder, B-4	123	0.185	N.D.
	Blank	---	-----	N.D.
8/20	Floor pan subassembly welder, B-5	243	0.365	N.D.
8/20	LH-B pillar welder, E-6	150	0.225	N.D.
8/20	RH rockerpanel assembly welder, f-13	220	0.330	N.D.
8/20	Fine wire welder, welding booth	381	0.572	N.D.
8/20	Sliding door panel panel assembly, F-13	200	0.300	N.D.

* N.D. = None Detected - less than .03 mg per sample.

TABLE IV

Personal Trace Metal and Total Welding Fume Exposure

Ford Motor Company
Avon Lake, Ohio
HE 80-129

August 19-20, 1980

Sample Description				Welding Fume Trace Metal Concentration (mg/M^3)				
Date	Job Description/Location	Duration (min.)	Volume (M^3)	Cu Fume	Iron Oxide[1]	Mn Fume	Zinc Oxide[2]	Total Welding Fume (mg/M^3)
8/19	Welder, fine wire booth	433	.650	0.02	1.7	0.10	0.11	2.6
8/19	Repair welder, weld pit F-17	424	.636	N.D.[3]	0.90	0.04	0.04	1.1
8/19	Welder, subassembly RH side F-13	391	.587	N.D.	0.19	0.01	0.02	0.29
8/19	Welder, subassembly RH side F-13	335	.503	N.D.	0.25	0.01	0.03	0.36
8/19	Welder, subassembly LH side E-6	137	.206	0.06	0.15	N.D.	0.14	0.68
	Blank	---	----	N.D.	N.D.	N.D.	N.D.	0.00
8/20	Welder, subassembly LH side E-6	152	.228	N.D.	0.28	N.D.	N.D.	0.44
8/20	Welder, B pillar LH side E-6	417	.626	N.D.	0.25	N.D.	N.D.	0.32
8/20	Welder, B pillar RH side E-13	266	.399	N.D.	0.16	N.D.	0.01	0.25
8/20	Welder, B pillar RH side E-13	254	.381	N.D.	0.69	0.003	0.01	0.73
8/20	Welder, fine wire booth	407	.611	0.03	3.0	0.18	0.35	3.1
Evaluation Criteria: (See Table I-most stringent criteria applied.)				0.2 mg/M^3	14.3 mg/M^3	1 mg/M^3	5 mg/M^3	5 mg/M^3

[1] Analytical values for iron (Fe) were multiplied by 2.86 to obtain the concentration of iron oxide (Fe_2O_3).
[2] Analytical values for zinc (Zn) were multiplied by 1.25 to obtain the concentration of zinc oxide (ZnO).
No grinding done by welders in area.
[3] N.D. = None Detected

TABLE V

Welding Fume Trace Metal Analysis

Ford Motor Company
Avon Lake, Ohio
HE 80-129

August 19-20, 1980

Sample Description[1]				Trace Metal Content[2] (mg/M^3)												
Date	Location/Task	Duration (min.)	Volume (M^3)	Al	Cu	Fe[3]	Mg	Mn	Ni	P	Pb	Se	Sn	Te	Tl	Zn
8/19	C-5, Underbody ladder subassembly, no welding helmet	283	.425	.008	.1	1.86	.005	.008	N.D.[4]	N.D.	.002	.002	N.D.	.001	.002	.4
8/19	F-13, Rt. hand body, C-pillar subassembly, no welding helmet	357	.536	.009	.002	.093	.003	.007	N.D.	.003	.001	.001	N.D.	.002	N.D.	.02
8/20	Fine wire welding, welding helmet	379	.569	.002	.04	.96	.002	.2	.002	N.D.	.001	.001	.002	N.D.	N.D.	.2
8/20	B-4, Underbody subassembly, no welding helmet	238	.357	.005	.002	.078	.003	N.D.	N.D.	.004	N.D.	N.D.	N.D.	N.D.	N.D.	.004

1 All samples are personal, breathing-zone samples. The frequent flipping up and down of fine wire welders' helmets necessitated mounting cassettes on their coverall collars.

2 The following elements were included in the analysis, but were below the analytical limit of detection (0.5 µg/filter): Ag, As, Be, Ca, Cd, Co, Cr, Li, Mo, Na, Pt, Ti, V, W, Y, Zr.

3 The concentration presented is for Fe_2O_3 as Fe.

4 N.D. = None Detected, (0.5 µg/filter).

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