U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. HE 78-63-574

INTERNATIONAL HARVESTER
SPRINGFIELD, OHIO
MARCH 1979

I. TOXICITY DETERMINATION

A survey team from the National Institute for Occupational Safety and Health (NIOSH) performed a health hazard evaluation at International Harvester Plant, Lagonda Avenue, Springfield, Ohio on April 11, May 30-June 1, June 22, and August 28-31, 1978. The following determinations are based upon environmental measurements of airborne nuisance dust and welding fumes, evaluation of non-directive medical questionnaires, observations of employees' work practices and engineering controls.

Airborne nuisance particulate (personal and area) samples were collected from the metal finishing department (Table I). None of the samples exceeded the Occupational Safety and Health Administration (OSHA) Standard of 15 milligrams of nuisance dust per cubic meter of air (mg/m^3); consequently, a health hazard for this contaminant does not exist.

Personnel samples collected during the aluminum metal inert gas (MIG) welding operation (Table II) indicate that a health hazard does not exist. Only one of the samples exceeded the breathing zone threshold limit value (TLV) for welding fumes not otherwise classified (NOC), and one sample exceeded the TLV for aluminum welding fumes. The TLV recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) for total welding fumes NOC and aluminum welding fumes are each 5.0 mg/m^3. Additionally, the samples were simultaneously analyzed for possible exposure to the following metals and/or fumes: copper, manganese, iron, magnesium, zinc, total chromium and hexavalent chromium. None of these metals exceeded the OSHA standard, the NIOSH recommended criteria, or the TLV.

The ACGIH recommends that for a mixture of harmful dusts, fumes, vapors or gases, the sum of the ratios of individual concentrations divided by individual threshold limit values should not exceed unity (one). In this instance, the additive effects of four samples for total welding fumes NOC and aluminum welding fumes did exceed unity, therefore, a health hazard does exist.

Ozone measurements were made during the MIG welding operation. None of the samples exceeded the ACGIH short-term exposure limit of 0.3 parts of ozone per million parts of contaminated air (ppm).

A non-directed medical questionnaire was administered to 32 of the MIG welders. A majority of these workers (66%) indicated that they occasionally experienced flashburns to the face and/or eyes.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. 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 Harvester Company, Springfield, Ohio
2. Authorized representatives of Local 402, United Auto Workers of America
3. International Union of United Auto Workers, Detroit, Michigan
4. U.S. Department of Labor - Region V
5. NIOSH - Region V

For the purpose of informing the approximately 190 "affected employees", the employer shall promptly "post" for a period of 30 calendar days, this Determination Report in a prominent place(s) near where exposed employees work.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S. Code 669(a)(6) authorizes the Secretary of Health, Education, and Welfare, following a written request by 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 National Institute for Occupational Safety and Health received such a request from an authorized representative of employees regarding workers' alleged exposure to particulates and/or fumes generated along the truck assembly line and the metal finishing line. Furthermore, it was alleged that truck production rates have doubled during the past year, and no additional exhaust ventilation has been installed.

IV. HEALTH HAZARD EVALUATION

A. Facility and Process-Description

International Harvester is a truck manufacturer which employs about 2,200 personnel; however, only 190 of these employees work in Building 9 or Building 98, Department 27, which are interconnected. All of the employees (190) work eight hours per day five days per week during the hours of 0700-1530.

The truck cab assembly line operation is situated in Building 9 along with many other operations. Building 9 is about 67,800 square feet (ft^2) with an estimated average ceiling height of 25 feet. The 1.7 million cubic feet (ft^3) building has three roof-mounted exhaust fans which each operate at 6,000 cubic feet per minute (cfm), and three ceiling-mounted exhaust fans which each operate at 9,000 cfm. There are also three gas fired make-up air units which each operate at 20,000 cfm and 16-32 inch pedestal or wall-mounted propeller fans. All of the ventilation rates are based upon optimum efficiency of each unit.

Approximately 75 welders perform aluminum metal-argon shielded gas welding at either a fixture or station. A fixture is where aluminum parts are welded together to form subassemblies. These subassemblies are assembled at any one of 15 stations. The various fixtures and stations are grouped into one of the several major operations: underbody subassembly, framing assembly, skinning fixture, and tilt tables. Depending upon the station of fixture, there may be as few as one or as many as six welders.

There are several truck cab sizes manufactured; (e.g., conventional cab - 59 inches wide, sleeper cab - 88 inches wide). Regardless of the truck size, each cab is at a station for a prescribed amount of time; after which, the cab is hoisted and transferred to the next station. Once the cab has been assembled, it is transferred to another assembly line where the major doors, radiator doors, luggage compartment doors, etc. are mounted.

The truck cabs are loaded onto a chain conveyor belt and taken to the metal finishing booth in Building 99. This booth is approximately 2,000 ft^2 with a ceiling height of 15 feet. The exhaust fans recirculate 80% of the air at the rate of 36,000 cfm. (The sanding booth was disassembled in August 1978 in order to extend the MIG welding line). Metal finishing consists of sanding and grinding of spot welds or other blemishes by hand or with a pneumatic sander. Once the truck has been sanded, it is inspected and sent to another department to be sealed, primed, painted and shipped.

B. Evaluation Sequence

4/11/78: Company was visited by NIOSH staff. The health hazard evaluation program was explained to the company and union officials. A walk-through inspection was made in Department 27.

5/30-6/1/78: Follow-up survey was conducted. Evaluation of work areas included collecting air samples, process-description, appraisal of ventilation system, administering non-directed medical questionnaires to workers, discussion of interim findings with company and union officials.

6/8/78: Conduct evaluation of breathing zone ozone levels. Equipment malfunctioned; therefore, a return visit was scheduled.

6/15/78: Performed evaluation of ozone levels.

8/28-31/78: Additional sampling was performed since it was determined that the personal samples collected on 5/30-6/1/78 were not representative of breathing zone exposures. The filter cassettes continually dropped outside of the welding helmet thus causing excessive particulate loading. The earlier samples were beneficial in that it allowed us to determine that total chromium and hexavalent chromium were below the limit of detection (3.0 and 0.10 micrograms of contaminant per cubic meter of air μ_g/m^3 respectively.

C. Evaluation Methods

The following metals, metal oxides, fumes, and gas were measured using personal and work area sampling techniques and a direct reading instrument: aluminum metal or oxide, copper, manganese, magnesium, iron, zinc, total chromium, hexavalent chromium, ozone gas and total particulate.

Personal and work area samples were collected for total particulates using a 37 millimeter (mm), three-piece filter holder[1]. The contaminant was collected on a 37-mm diameter, 0.8 micrometer pore size, mixed cellulose ester membrane filter. The filter is connected to a MSA* pump which should operate at 1.5 liters per minute (lpm) for as much of an eight-hour work day as possible. All the filters were initially analyzed gravimetrically to determine total milligrams (mg) of particulate.

The filters collected from the metal finishing area were each dispersed ultrasonically in isopropanol. The suspension was transferred to a polyvinyl chloride filter and analyzed by X-ray

*Mention of commercial names or products does not constitute endorsement by NIOSH.

diffraction from 8-96° 2θ. The X-ray diffraction pattern essentially identified aluminum metal as the only constituent.

The filters collected from the MIG welding operation were analyzed for metals according to the NIOSH Physical and Chemical Analytical Method #173[2]. In addition to nitric acid, perchloric acid was used in the ashing process to assure total dissolution of the samples. The limit of detection was 20.0 micrograms (μg) per sample for aluminum, 3.0 μg per sample for iron and total chromium, 2.0 μg per sample for copper, manganese, magnesium and zinc, and 0.1 μg for hexavalent chromium. The total welding fumes NOC is obtained by subtracting all of the welding fumes contaminants from the total milligrams of particulate.

Ozone gas measurements were made at the welders breathing zone with a direct reading AID ozone analyzer. The data listed in Table III is representative of 1.5-2.0 minute samples because the MIG welders work on each cab for approximately two minutes.

C. Evaluation Ciriteria

1. Environmental Assessment

There are several criteria used to evaluate the toxic air contaminants of an employees' work environment: (1) NIOSH Criteria Documents for a Recommended Occupational Health Standard, (2) Proposed and Recommended Threshold Limit Values (TLV's), as suggested by the American Conference of Governmental Industrial Hygienists (ACGIH), 1976, (3) the OSHA Standards.

The concentration for each contaminant is based upon the current state of knowledge concerning toxicity of these substances. The concentration is designed to allow an occupational exposure for up to a 10-hour work day, 40-hour work week as a time-weighted average (TWA) over a normal lifetime without the worker experiencing discomfort. In some instances, a few employees may experience discomfort at or below the TWA.

There are some airborne contaminants for which this TWA is inappropriate; consequently, the substance may be proceeded by the letter "C". This letter indicates a ceiling value for an interval of 30 minutes or less. The ceiling value is used to identify hazardous substances which are fast acting.

The criteria mentioned above has been tabulated, footnoted, and compared to the OSHA Standard listed in the Code of Federal Regulations (CFR), (1978) Title 29, Part 1910, Subpart Z, Section .1000.

The OSHA Standard has been cited so that the reader may see which of the Standards have been exceeded.

TIME WEIGHTED AVERAGE

Substance	8-Hour	10-Hour	Ceiling Value	Minutes
Welding Fumes (Not otherwise classified)[1]	5.0 mg/m^3 [a]			
Aluminum metal and oxide[2]	10.0 mg/m^3		20 mg/m^3	15
Aluminum Welding Fume[3]	5.0 mg/m^3			
Copper Fume[4]	0.1 mg/m^3			
Manganese[5]	5.0 mg/m^3			
Iron Oxide Fume[6]	5.0 mg/m^3			
Magnesium Oxide Fume[7]	5.0 mg/m^3			
Zinc Oxide Fume[8]	5.0 mg/m^3		10 mg/m^3	15
Hexavalent Chromium[9]		0.025 mg/m^3	0.5 mg/m^3	15
Total Chromium[10]	.05 mg/m^3			
Ozone[11]	0.1 ppm[b]		0.3 ppm	15
Nuisance Particulate[12]	10.0 mg/m^3			

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a) mg/m^3 - Milligrams of particulate per cubic meter of air

b) ppm - parts of vapor or gas per million parts of contaminated air by volume at 25°c and 760mm Hg. pressure

1) ACGIH TLV Document (1978). The current OSHA Standard for total dust is 15.0 mg/m^3 (1978)

2) ACGIH TLV Document (1978). The ACGIH has proposed this value for the first time. The current OSHA Standard for total particulates is 15.0 mg/m^3. (1978, Table Z-3)

3) ACGIH TLV Document (1978). This value is being proposed for the first time. OSHA uses the Total Particulate Standard (15.0 mg/m^3).

4) OSHA Standard (1978, Table Z-1)

5) The ACGIH TLV Document (1978) and the OSHA Standard (1978) both use the same value. The ACGIH has proposed that this value be changed to 1.0 mg/m^3. (1978)

6) The ACGIH TLV Document (1978). The current OSHA Standard is 10.0 mg/m^3. (1978)

7) The ACGIH TLV Document (1978). The current OSHA Standard is 15.0 mg/m^3. (1978)

8) The ACGIH TLV Document (1978) and the OSHA Standard (1978) are the same.

9) NIOSH Criteria Document (1975). The OSHA Standard is 1.0 mg/m^3 (1978).

10) The ACGIH TLV Document (1978). The OSHA Standard is 1.0 mg/m^3 (1978).

11) The ACGIH TLV Document (1978) and OSHA use the same 8-hour TWA (1978).

12) The ACGIH TLV Document (1978) and OSHA use an 8-hour TWA (1978) of 10.0 mg/m^3 and 15.0 mg/m^3 respectively.

2. Toxicological Effects

The environmental results listed in Tables I-III indicate that some of the chemicals were either not detected or at extremely low concentrations with respect to their criteria. Therefore, these chemicals (copper, manganese, iron and zinc) will not receive a toxicological discussion. The contaminants (aluminum metal, oxides and fumes, magnesium fume, welding fumes NOC and ozone gas) were identified to be at significant concentrations to warrant a brief toxicological discussion. Additionally, a short discussion has been presented on ultraviolet (UV) radiation exposure because of the employees' concern with flashburns to the face, eyes and/or neck.

a. Aluminum metal, oxides and fumes[3] - There is no specific Federal standard for metallic aluminum; consequently OSHA uses a nuisance dust standard to evaluate this particulate.

Aluminum particles deposited in the eye may cause corneal necrosis. The effects of inhaling aluminum dust and fumes are unknown with certainty to date. Present data suggests pneumoconiosis might be a possible outcome. In most of the cases investigated, exposure was not to aluminum dust alone, but to a mixture of aluminum, silica fume, iron dust and other materials.

b. Magnesium oxide fume[3] - Magnesium and its compounds are mild irritants to the conjuctiva and nasal mucosa, but these are not specifically toxic. Magnesium in the form of magnesium oxide can cause metal fume fever if it is inhaled in sufficient quantity. Symptoms are similar to those caused by zinc oxide: cough, tightness of chest, fever and leucocytoses.

c. Welding fumes NOC[4] - These particulates consist of silicate organic binders and resins which produce a biological effect similar to respirable nuisance particulate. Nuisance particulate have little adverse effects on the lungs, and they do not produce significant organic disease or toxic effect when exposures are kept under reasonable control. However, excessive exposure to nuisance particulate may reduce visibility or leave unpleasant deposits in the eyes, ears and nasal passages.

d. Ozone [3] - This gas is an irritant to the eyes and mucous membranes. Symptoms of exposure to this gas include: dryness of upper respiratory passages, irritation to the mucous membranes of the nose and throat; choking, coughing and severe fatigue, bronchial irritation, substernal soreness and cough. Signs of subacute exposure include headache, malaise, shortness of breath, drowsiness, reduced ability to concentrate, and slowing of heart and respiration rate.

e. Ultraviolet radiation is an invisible radiant energy produced naturally by the sun and artificially by arcs operating at high temperatures. The eyes and skin readily absorb UV, therefore, they are very vulnerable to injury. Eye exposure to UV radiation can cause conjunctivitis (commonly called "ground glass eyeball" or "welder's flash"). Sunburn (erythema) is a common example of the effect of UV radiation on the skin. Normal sunburn occurs at a radiation wavelength spectrum of 290-320 nanometers (nm) with a maximum reaction at 297-307nm. Artificial light sources produce wave length ranges from 250-320 nm with a maximum reaction at 250 nm. Ultraviolet caranogenesis most readily occurs at 290-320 nm with a maximum reaction of 290-310 nm[3].

E. Discussion of Survey Findings

Thirteen personal and area samples (Table I) were collected from the metal finishing department. The personal aluminum metal dust concentration ranged from 0.50-5.52 mg/m^3. The metal-grinding was performed in a booth not specifically designed for this purpose; however, the booth was dismantled in August 1978 in order to accommodate the expansion of the MIG welding line. It should be noted that none of these employees complained of any symptoms associated with aluminum dust exposure.

The MIG welders were sampled on several occasions for potential exposure to numerous metals: total welding fumes NOC, aluminum, copper, manganese, iron, magnesium, zinc, total chromium and hexavalent chromium. The 26 personal samples, collected during the first survey, were attached to the lapel and directed up into the welders breathing zone. However, each time the welder bent over in an awkward position, the cassette would fall to the side of the lapel thereby heavily loading the filter with particulate which were not believed to be indicative of a breathing zone sample. Even though the filters were overloaded, it was decided to evaluate the filters to determine if total chromium, copper, or hexavalent chromium was on the filter. None of these contaminants were identified on the filters.

During the follow-up survey, personal breathing zone and lapel sampling was performed simultaneously (Table II). The purpose of the comparative sampling procedure was to determine if there was a numerical correlation between the samples. No correlation could be identified.

The filter samples for the follow-up survey were analyzed for the following fumes: total welding fumes NOC, aluminum, copper, manganese, iron, magnesium and zinc. Of the 32 samples collected, one personal sample exceeded the aluminum welding fume TLV, and one sample exceeded the total welding fume NOC threshold limit value. The TLV used to assess the aluminum welding fume is being proposed for the first time, otherwise the aluminum concentration would have been calculated as part of the total welding fume concentration. It was, therefore, decided to determine whether or not the additive effects of the welding fumes exceeded unity. When two or more hazardous substances are present, their combined effect rather than the individual effects would be given consideration. The formula recommended by the ACGIH to evaluate the additive effects of dusts, fumes, vapors or gases is as follows:

$$\frac{C1}{T1} + \frac{C2}{T2} + \ldots \frac{Cn}{Tn} < 1.0$$

where C_1 = indicates the observed atmospheric concentration

T_1 = the corresponding threshold limit

Only four of the personal samples did exceed this recommended threshold limit value.

Ozone air levels (Table III) were measured using a direct reading instrument. Since the ozone is generated by the high electric current during the welding process, it was decided to characterize the short-term exposures. A wand, held by the industrial hygienist, was extended up into the welders breathing zone during the welding process which averaged approximately 1.5-2.0 minutes. The ozone concentrations ranged from 0.004-0.8ppm. Since the employees are continually moving, it was impossible to keep the probe within the welder's helmet; therefore, these ozone levels do not reflect personal breathing zone levels. Consequently, all of the samples should be regarded as below the short-term exposure limit of 0.3ppm for a maximum period of 15 minutes.

The ventilation system in Building 9 consisted of several types of devices. The ventilation system is primarily a dilution system i.e., the fumes are pushed throughout the rest of the department instead of exhausting the fumes at the source of production. There are two 20,000 cfm gas fired make-up air units positioned above the welding line; however, these units were either not operational or not turned on. There were 16-32 inch fans which were strategically positioned along the line, and two heater fans which were used to push the fumes away from the welding line. It should be noted that a majority of the fans that were mounted above the welding line were operational. The louvered bay windows were only occasionally used because the window-actuating devices were old and replacement parts were difficult to obtain. During the initial survey, the bay windows were closed, whereas during the follow-up survey in August, the bay windows were open.

The fume burden was quite noticeable by mid-morning even though the windows were open and the majority of the fans were being utilized. It is suspected that the fume concentration would be considerably higher during the winter thereby warranting further investigation of the work area fume concentration. Furthermore, production rate has increased by one-third, and no additional exhaust ventilation has been added to the existing system.

It should be noted that the company purchased a Hobart Clean Air unit, on a trial basis, in order to reduce the welding fume concentration. This unit was not well-accepted by the workers for a number of reasons.

A non-directive medical questionnaire was administered by NIOSH industrial hygienists to the welders to determine if any employees were experiencing any occupationally related health problems. Nineteen of the 27 welders indicated that they received flashburns to the face, eyes and/or neck and 17 welders indicated occasional flashburn exposure. The welders were not queried about specific health conditions until the 5th or 6th welders indicated that they experienced no health difficulty. When the welders were asked if they experienced flashburns, the response was yes. It was realized that the welders didn't mention this exposure because welders' attitudes reflected acceptance of flashburn exposures as part of their job. The welders did not use an ultraviolet radiation blocking solution such as a protective barrier cream because no barrier cream was readily available. Several welders indicated that flashburns have increased during the past six months because production rates have increased by one-third thereby requiring more welders to work in proximity to one another.

It was observed that the welders were not using similar safety glasses with side shields. Some of the side shields were clear plastic, some dark colored, some shields had black electrical tape and some workers had no side shields.

It should be noted that the two NIOSH investigators experienced ultraviolet radiation exposure to their face, neck and/or ears. No sun-screen solution was initially recommended or offered to the investigators. The investigators had to ask for a UV blocker solution in order to protect their skin from exposure. The Director of Safety obtained the lotion from the medical facility.

Although there is no data to indicate the artificial electrically generated ultraviolet radiation can cause skin cancer, there is data to indicate that continual exposure to natural UV radiation is carcinogenic. Since the skin cannot differentiate between natural or artificially produced UV radiation, it is preferred that employee exposure be minimized.

F. Recommendations

1. All employees who are either temporarily or permanently assigned to Department 27 as MIG welders should be issued standardized glasses and side shields to help prevent eye damage from UV radiation.

2. Employees should be educated as to the hazards of ultraviolet radiation exposure.

3. Proper protective skin barriers should be readily available to welders so that the cream or lotion may be routinely applied to unprotected skin surfaces thereby reducing flashburns.

4. Since production rates have increased by approximately one-third, the work force has increased and thus the potential exposure to UV radiation has increased. It is recommended that either the assembly line be extended so that the men do not work in proximity to one another, or that a second shift be added.

5. Ultraviolet radiation barriers, such as curtains, should be installed along the assembly line to eliminate exposure to employees working at fixtures adjacent to the line.

6. A training program should be implemented to educate the workers as to the importance of a fume-extracting device.

7. The fume-extracting device used by one worker reduced total fume exposure. This fume-extracting device could be used at fixtures where the worker does not climb or work in crowded conditions. Exhausting welding fumes at the MIG tip appears to be the most efficient and inexpensive way to reduce exposure.

8. A routine maintenance and servicing program should be established for the fume-extraction device.

9. The actuating devices for the louvered bay windows should be repaired so that the windows can be opened as frequently as needed, without difficulties.

10. The ventilation system in general should be re-evaluated to determine the dilution ventilation requirements at present (or increased) production rates. The present system is under-rated/sized and is not capable of handling the smoke/fume.

11. The make-up air units (fans, etc.) should receive routine maintenance and it should be insured that the make-up air units are turned on daily.

12. The plant should perform sampling during the winter months to determine the particulate loading problem when all windows are closed and ventilation is minimal.

13. Although ozone levels did not exceed the short-term exposure limit, it is recommended that 8-hour time weighted average exposures be determined.

V. REFERENCE

1. NIOSH Manual of Sampling Data Sheets, (1977), DHEW (NIOSH) Publication No. 77-159

2. Physical and Chemical Analytical Methods No. 173, NIOSH Manual of Analytical Methods, HEW Publication No. (NIOSH), 77-157A, 1977

3. Occupational Diseases, A Guide to Their Recognition, U.S. Department of Health, Education and Welfare, Public Health Service Publication No. 77-181, June 1977.

4. Threshold Limit Values for Chemical Substances in Workroom Air with Supplements for 1977. American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio 45202

5. U.S. Department of Labor, Occupational Safety and Health Administration. Occupational Safety and Health Standards, Part 1910, Title 29 of the Code of Federal Regulations.

6. International Labour Office, Encyclopedia of Occupational Health and Safety, McGraw-Hill, N.Y., 1972

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10. The Welding Environment, 1973. The American Welding Society, 2501 NW 7th Street, Miami, FL 33125

11. Nonionizing Radiation Protection Special Study No. 42-0312-77 Evaluation of the Potential Retinal Hazards From Optical Radiation Generated by Electric Welding and Cutting Arcs, December 1975 - April 1977

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Table I

Airborne Nuisance Particulate (Alumina)

International Harvester
Springfield, Ohio

Date	Job Classification and/or Sampling Location	Sample Number	Type Sample	Sampling Period (Hrs)	Sampling Volume (Liters)	Aluminum Metal and Oxide Concentration (mg/M^3)[1]
5/31	Metal Finishing	5	P[2]	6.9	621	1.72
5/31	Grinder/Metal Finishing	4	P	6.9	621	0.60
5/31	Grinder/Metal Finishing	2	P	6.7	603	0.91
5/31	Metal Finishing	6	P	6.9	621	1.08
6/1	Grinder/Metal Finishing	10	P	6.3	567	1.75
6/1	Metal Finishing	7	P	6.9	621	0.50
6/1	Metal Finishing	12	P	6.6	594	0.88
6/1	Grinder/Metal Finishing	11	P	7.0	630	0.95
6/1	Welder/Grinder (Side Panels)	8	P	6.9	621	5.52
6/8	Sanding Booth	16	A[3]	2.9	296	0.00
6/8	Sanding Booth	17	A	2.9	296	0.30
6/8	Sanding Booth	15	A	2.9	296	0.00
6/8	Sanding Booth	18	A	2.9	296	0.51

A.C.G.I.H. THRESHOLD LIMIT VALUE - 10.0 mg/M^3

1. mg/M^3 - Milligrams of contaminant per cubic meter of air.
2. P - Personal samples collected in the workers' breathing zone.
3. A - Area samples collected in proximity to the workers.

Table II

Summary of Personal Monitoring Data
Collected During Mig Welding Operation

International Harvester
Springfield, Ohio

Date	Job Classification and/or Sampling Location	Sample Number	Type Sample	Sampling Period (Hrs)	Sampling Volume (Liters)	Total Welding Fume (NOC)[1] Concentration (mg/M³)[2]	Welding Fumes (mg/M³) Alumina	Copper	Manganese	Iron	Magnesium	Zinc
8/29	Second Tilt-Station #20	753*	B[3]	6.9	621	3.79	5.48	N.D.[5]	.005	.029	.60	.016
8/29	Second Tilt-Station #20	566	L[4]	6.9	621	5.84	6.92	N.D.	N.D.	.027	.82	.014
8/29	First Tilt-Station #19	829	L	6.6	594	2.77	2.36	N.D.	N.D.	.020	.32	.007
8/29	First Tilt-Station #19	555*	B	6.6	594	2.71	2.36	N.D.	.005	.020	.35	.007
8/29	Skinning Buck	788	L	6.4	576	1.93	0.92	N.D.	N.D.	.014	.35	.005
8/29	Skinning Buck	787	B	6.4	576	1.63	1.25	N.D.	N.D.	.014	.35	.005
8/29	Skinning Buck	864	L	6.4	576	1.64	1.18	N.D.	N.D.	.014	.35	.005
8/29	Skinning Buck	688	B	6.4	576	1.58	1.44	N.D.	N.D.	.014	.38	.005
8/29	Rails	751	L	6.4	576	2.01	1.56	N.D.	N.D.	.012	.29	.003
8/29	Rails	490	B	6.4	576	2.05	1.49	N.D.	N.D.	.017	.28	.005
8/29	Floor & Mounting Brackets Stand	678	B	6.2	558	0.96	2.15	N.D.	N.D.	.007	.41	N.D.
8/29	Floor & Mounting Brackets Stand	789	L	6.2	558	2.48	2.51	N.D.	.005	.009	.45	.004
8/29	Major Buck	850	B	6.2	558	1.47	1.29	N.D.	N.D.	.014	.27	.88
8/29	Underbody	511	L	5.6	504	2.96	2.38	N.D.	N.D.	.008	.44	N.D.
8/29	Underbody	547	B	5.6	504	2.44	2.18	N.D.	N.D.	.012	.40	N.D.
8/30	Second Tilt-Station #20	534	L	7.0	630	2.93	2.70	N.D.	N.D.	.08	.24	.008
8/30	Second Tilt-Station #20	561*	B	7.0	630	3.00	2.70	N.D.	N.D.	.01	.22	.003
8/30	First Tilt-Station #19	760	B	6.9	621	2.19	1.08	N.D.	N.D.	.008	.27	.003
8/30	First Tilt-Station #19	495	L	6.9	621	2.39	1.46	N.D.	N.D.	.006	.32	.005
8/30	Tilt Table-Fixture #18	784	B	6.8	612	0.93	0.64	N.D.	N.D.	N.D.	.10	N.D.
8/30	Tilt Table-Fixture #18	666	L	6.8	612	0.74	0.59	N.D.	N.D.	N.D.	.09	N.D.
8/30	Skinning Buck	518	B	6.8	612	1.75	1.52	N.D.	N.D.	.011	.34	.003
8/30	Skinning Buck	777	L	6.8	612	2.81	2.29	N.D.	.003	.015	.51	.005
8/30	Rails	550*	B	6.6	594	5.08	3.37	N.D.	.005	.015	.64	.005
8/30	Rails	790	L	6.6	594	5.81	4.04	N.D.	.007	.013	.84	.005
8/30	Rails (Clean-up Welds)	498	B	6.4	576	2.28	2.60	N.D.	N.D.	N.D.	.36	N.D.
8/30	Rails (Clean-up Welds)	696	L	6.4	576	3.26	2.43	N.D.	N.D.	.009	.40	.003
8/30	Underbody	781	L	6.1	549	2.48	2.37	N.D.	N.D.	N.D.	.36	.004
8/30	Underbody	818	B	6.1	549	2.20	2.37	N.D.	N.D.	.009	.31	N.D.
8/30	Major Buck-Right Side	494	L	6.4	576	2.33	1.00	N.D.	N.D.	.010	.31	.003
8/30	Major Buck-Right Side	663	B	6.4	576	1.38	1.27	N.D.	N.D.	.007	.23	N.D.
8/30	Door Fixture	779	B	4.9	441	2.04	2.49	N.D.	N.D.	.011	.45	N.D.

1. N.O.C. - Not otherwise classified (see text)
2. mg/M³ - Milligrams of contaminant per cubic meter of air.
3. B - Filter placed in breathing zone under welding helmet.
4. L - Filter attached to shirt lapel outside of welding helmet.
5. N.D.-Non-Detectable
6. TLV proposed for the first time.

*The additive effects of these personal breathing zone samples exceeded unity (one).

A.C.G.I.H. THRESHOLD LIMIT VALUES

1. Welding Fumes (NOC) - 5.0 mg/M³
2. Aluminum Fumes[6] - 5.0 mg/M³
3. Copper Fume - 0.2 mg/M³
4. Manganese - 5.0 mg/M³
5. Iron Oxide Fume - 5.0 mg/M³
6. Magnesium Oxide Fume - 10.0 mg/M³
7. Zinc Oxide Fume - 5.0 mg/M³

Table III

Summary Record of Ozone Levels Measured for 1.5-2.0 Minutes Using an AID Ozone Analyzer

International Harvester
Springfield, Ohio

Date	Approx. Time	Location and/or Description	Type Sample	Concentration (ppm)[1]
5/31/78	9:48	Ambient level outside of office	A[2]	.01
5/31/78	9:56	Last tilt table	B[3]	.20
5/31/78	10:00	First tilt table	B	.20
5/31/78	10:15	Left door frame	B	.25
5/31/78	10:20	Rails	B	<.01
5/31/78	10:30	Mounting bracket (floor panel)	B	.01
5/31/78	10:35	Clean-up station	B	.05
5/31/78	10:40	Left-side (door frames)	B	.40
5/31/78	10:50	Major Buck	B	.10
6/1/78	13:19	Ambient level at second tilt table	A	.004
6/1/78	13:21	Second tilt table	B	.04
6/1/78	13:23	Second tilt table	B	.80
6/1/78	13:26	Second tilt table	B	.50
6/1/78	13:29	First tilt table	B	.08
6/1/78	13:33	Skinning buck	B	.01
6/1/78	13:44	Rail welder	B	.14
6/1/78	13:52	Stand fixture (#14)	B	.4
6/1/78	13:56	Stand fixture (#14)	B	.6
6/1/78	14:17	Stand fixture (#14)	B	.08
6/1/78	14:21	Stand fixture (#14)	B	.1
6/1/78	14:40	Major Buck	B	.16
6/22/78	10:45	Ambient level outside of office	A	.002
6/22/78	11:00	Fixture #1	B	.08
6/22/78	11:15	Fixture #9	B	.04
6/22/78	11:25	Fixture #10	B	.04
6/22/78	11:35	Fixture #6	B	.12
6/22/78	13:00	Fixture #6 Clean air unit connected	B	.03
6/22/78	13:08	Fixture #6 Clean air unit disconnected	B	.08
6/22/78	13:14	Fixture #7	B	.02
6/22/78	13:17	Fixture #7	B	.08
6/22/78	13:21	Fixture #7	B	.02

1. ppm - parts of gas per million parts of contaminated air by volume.
2. A - Area sample
3. B - Approximate Breathing Zone Sample (See Text)
4. TWA - Time weighted average exposure

ACGIH Threshold Limit Value

1. Ozone - 0.1 ppm-8 hr. TWA[4]
2. Ozone - 0.3 ppm-15 minute exposure