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

NIOSH

Health Hazard Evaluation Report

HETA 86-087-1686
TAC RADIATOR
MINOT, NORTH DAKOTA

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 86-087-1686
April 1986
TAC RADIATOR
MINOT, NORTH DAKOTA

NIOSH INVESTIGATORS
Bobby J. Gunter, Ph.D.
Theodore Thoburn, M.D.

I. SUMMARY

In December, 1985, the National Institute for Occupational Safety and Health (NIOSH) received a request from the owner of TAC Radiator in Minot, North Dakota to evaluate exposures to lead in a radiator cleaning and repair shop.

On January 21 and 22, 1986, an environmental and medical evaluation was conducted by NIOSH and North Dakota State and Local Health Department personnel. The environmental evaluation consisted of measuring breathing zone and general room air concentrations of lead, copper and antimony.

Copper and antimony were only found in trace quantities and did not pose a health hazard. However, four out of eight lead samples exceeded the OSHA standard and the NIOSH recommended exposure limit of 0.05 mg/m^3. The average of all eight lead samples was 0.12 mg/m^3. Lead exposure levels ranged from 0.02 to 0.38 mg/m^3.

Medical monitoring and evaluation consisted of blood lead and free erythrocyte protoporphyrin (FEP) determinations on all four radiator shop workers and the owner's son who does janitorial work in the radiator shop on some weekends. Of the five workers tested for blood lead (PbB) levels and free erythrocyte protoporphyrin (FEP) levels, two were within the normal unexposed range (PbB less than 29 ug/dl, FEP less than 50 ug/dl). The other three had elevated FEP's, and two had blood lead levels over 40 ug/dl (but under 60 ug/dl). Comparing the current blood levels with those reported from December 1985 revealed that two of the three had increased blood lead levels and the third a slight decrease from a level over 60 ug/dl.

On the basis of the environmental and medical data, it was determined that a health hazard existed from over-exposure to lead during the cleaning and repairing of radiators. Recommendations are provided in this report that may assist in eliminating this hazard.

Keywords: SIC 3714 (motor vehicle parts and accessories, blood lead, inorganic lead.

II. INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) received a request in December of 1985 from the owner of TAC radiator shop Minot, North Dakota to evaluate lead exposure among workers that were repairing automobile radiators. The request was prompted by the owner's concern about previous excessive lead exposures and elevated blood lead levels in his shop.

The owner was telephoned upon receipt of the medical and environmental results and copies of the blood lead levels and FEPs was mailed to each worker in February of 1986.

III. BACKGROUND

The TAC Radiator Repair Shop has been in existence for over 30 years, the current owner has occupied the building for over 10 years. There are four workers in the shop including the owner.

All types of automobile, tractor, and stationary water radiators are repaired and cleaned in this shop. Most of the radiators are taken apart using an oxygen acetylene torch to melt the top and bottom parts off the radiator. The top and bottom of the radiator are attached to the radiator core with a lead-based solder. When the solder is melted with an oxygen acetylene torch the lead is heated to temperatures that are hot enough to produce lead fumes. This is where most of the workers' exposure occurs. Other lead exposures occur from brushing and skin contact with the oxidized lead. There is also some lead exposure when the radiator is assembled due to the melting and vaporization of the lead-based soldering wire.

The ventilation was very poor in this facility. The only ventilation consisted of an exhaust fan in the ceiling that was exhausting about 100 cubic feet of air per minute when it was in use. There was no local exhaust ventilation.

IV. EVALUATION DESIGN AND METHODS

A. Environmental

Four breathing zone and four general room air samples were collected for lead, copper, and antimony. These samples were collected on mixed cellulose ester filters (AA) using vacuum pumps operated at 2.0 liters per minute. The analyses for lead and copper were done according to NIOSH method P&CAM 173. The analyses for antimony was done according to NIOSH method P&CAM 261.

The local exhaust ventilation in the ceiling of the plant was evaluated with a velometer. All of the workers were interviewed.

B. Medical

All four radiator repairmen and the part time janitor had blood drawn for blood lead and FEP determination. In addition the company's blood lead monitoring data that was collected a month prior to this visit was also reviewed.

Blood leads were determined by Environmental Sciences Associates, Inc., Bedford, Massachusetts, utilizing anodic stripping voltammetry. FEPs were also determined by Environmental Sciences Associates, Inc., Bedford, Massachusetts.

V. EVALUATION CRITERIA

A. Environmental

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 workers will be protected from adverse health effects if their 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 recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (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 recommendations 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-recommended standards, 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 this report, it should be noted that industry is legally required to meet those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. 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.

	Environmental Exposure Limits 8-Hour Time-Weighted Average (TWA)	
	mg/m^3	
	(NIOSH)	(OSHA)
Lead	0.05	0.05
Copper	1.0	1.0
Antimony	0.5	0.5

mg/m^3 = milligrams of substance per cubic meter of air.

B. TOXICOLOGY AND MEDICAL CRITERIA

Lead[1,2] -- Inhalation (breathing) of lead dust and fume is the major route of lead exposure in industry. A secondary source of exposure may be from ingestion (swallowing) of lead dust deposited on food, cigarettes, or other objects. Once absorbed, lead is excreted from the body very slowly. Absorbed lead interferes with red blood cell production and can damage the kidneys, peripheral and central nervous systems, and the blood forming organs (bone marrow). These effects may be felt as weakness, tiredness, irritability, digestive disturbances, high blood pressure, kidney damage, mental deficiency, or slowed reaction times. Chronic lead exposure is associated with infertility and with fetal damage in pregnant women.

Blood lead levels below 40 micrograms/deciliter (ug/dl) whole blood are considered to be levels which may result from daily environmental exposure. However, fetal damage in pregnant women may occur at blood lead levels as low as 30 ug/dl. Lead levels between 40-60 ug/dl in lead-exposed workers indicate excessive absorption of lead and may result in some adverse health effects. Levels of 60-100 ug/dl represent unacceptable elevations which may cause serious adverse health effects. Levels over 100 ug/dl are considered to be extremely dangerous and often require hospitalization and medical treatment.

The Occupational Safety and Health Administration (OSHA) standards for lead in air is 50 ug/m^3 calculated as an 8-hour time-weighted average for daily exposure. However, blood lead and protoporphyrin levels must be monitored at least every 6 months for workers exposed to air lead levels above 30 ug/m^3 for more than 30 days per year, and at least every 2 months if the worker's last blood lead was at or exceeded 40 ug/100 g whole blood. The standard also dictates that workers with blood lead levels greater than 60 ug/100 g whole blood must be immediately removed from further lead exposure if confirmed by a follow-up test. Workers with average lead levels of 50 ug/100 g or greater must also be removed. Removal is also possible on medical grounds. Removed workers have protection for wage, benefits, and seniority for up to 18 months or until they can return to lead exposure areas.

Free Erythrocyte Protoporphyrin (FEP) can be used to measure the degree of interference with hemoglobin production at the time the red cells are made. Although some diseases and iron deficiency anemia can cause a rise in FEP, in a healthy man working with lead, lead absorption is the most likely cause for such an increase. Further the FEP levels can be related to the average blood lead concentration over the past 3-4 months (the average life span of a red cell).[3] Normal values are below 50 ug/dl. The relationship between lead exposure and FEP is not particularly evident until elevated FEP levels are found. FEP essentially measures the same thing as the zinc protoporphyrin (ZPP) called for in the OSHA standard. ZPP equals 1.3 times FEP.

VI. RESULTS AND DISCUSSION

A. Environmental

Results of the environmental samples for inorganic lead, copper and antimony are presented in table 1. Airborne concentrations ranged from 0.02 mg/m^3 to 0.38 mg/m^3. Four of the eight samples exceeded the evaluation criteria of 0.05 mg/m^3. The average for the eight samples was 0.12 mg/m^3.

There was only one exhaust fan which was located in the ceiling above the radiator repair benches. There was no local exhaust ventilation. The general exhaust fan was exhausting approximately 100 cubic feet of air per minute.

The housekeeping in the entire facility was good. An eating area was provided that was located in an area removed from the lead exposure area. Good personal hygiene was observed. Smoking and drinking were confined to the eating area. Management provided clean work clothes for each employee.

B. Medical

Of the five workers tested for blood lead (PbB) levels and free erythrocyte protoporphyrin (FEP) levels, two were within the normal unexposed range (PbB less than 29 ug/dl, FEP less than 50 ug/dl). The other 3 workers had elevated FEPs, and two of the three had blood lead levels higher than those reported in December 1985. Two of the three showed increasing blood lead levels and the third a slight decrease from a level over 60 ug/dl. These results definitely indicate that more stringent measures are needed to control the workers' exposure to lead.

VII. CONCLUSIONS

Based on the high environmental levels of lead and the elevated blood lead levels, we concluded that a health hazard does exist at this facility. Fifty percent of the environmental samples showed overexposures and three out of five workers showed elevated FEPs and two showed excessive blood lead values. All results definitely indicate that more stringent measures are needed to control worker's exposure to lead. All antimony and copper concentrations were far below the evaluation criteria.

VIII RECOMMENDATIONS

1. Local exhaust ventilation must be installed to prohibit the lead vapors entering the radiator mechanic's breathing zone.

2. All workers must have blood drawn for lead analysis each six months if their last blood lead was below 40 ug/dl and every 2 months if it was 40 ug/dl or above. For purposes of compliance with the OSHA lead standard, a blood lead concentration averaging 50 ug/dl or more represents excessive lead exposure, and the affected employee must be removed from further lead exposure until the blood lead concentration is below 40 ug/dl.

3. There should be no smoking, eating, tobacco chewing, or drinking in radiator repair area.

4. Removed workers should have protection for wage, benefits, and seniority for up to 18 months or until they can return to lead exposure areas.

IX. REFERENCES

1. Occupational Safety and Health Administration. OSHA Safety and Health Standards. 29 CFR 1910.1025., Lead. Occupational Safety and Health Administration, Revised 1983.

2. International Labor Office, Encyclopedia of Occupational Health and Safety, 3rd (Revised) Ed. Geneva: International Labor Office. 1983. pp 1200-1205.

3. Alessio, L., Bertazzi, P.A., Monelli, O., Foa, V., "Free Erythrocyte Protoporphurin as an Indicator of the Biological Effect of Lead in Adult Males. II. Comparison between Free Erythrocyte Protoporphyrin and Other Indicators of Effect." International Arch. Occup. and Environ. Health. 37: 89-105 (1976).

X. AUTHORSHIP AND ACKNOWLEDGMENTS

Report Prepared by:

Bobby J. Gunter, Ph.D.
Regional Industrial Hygienist
NIOSH, Region VIII
Denver, Colorado

Medical Assistance by:

Theodore W. Thoburn, Ph.D.
Medical Officer
NIOSH, Region VIII
Denver, Colorado

Assistance by:

Lee Huber
Industrial Hygienist
North Dakota State Health Department

Patricia Schwartz
Nurse
Minot Local Health Department

Originating Office:	Hazard Evaluation and Technical Assistance Branch (HETAB) Division of Surveillance, Hazard Evaluations, and Field Studies (DSHEFS) NIOSH, Cincinnati, Ohio
Report Typed by:	Marile Brewer NIOSH, Region VIII Denver, Colorado

XI. DISTRIBUTION AND AVAILABILITY

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, 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. TAC Radiator
2. U.S. Department of Labor/OSHA - Region VIII
3. NIOSH - Region VIII
4. North Dakota Department of Health
5. State Designated Agency

For the purpose of informing affected employees, a copy of this report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

Table 1

Breathing Zone and General Room Air Concentrations of
Lead, Copper, and Antimony at
TAC Radiator in
Minot, North Dakota
January 22 - 23, 1986

Sample #	Job	Sampling Time	mg/m^3 Pb	Copper	Antimony
100	Radiator Mechanic	9:12a - 4:05p	0.38	0.007	0.001
101	Radiator Mechanic	9:15a - 4:05p	0.04	0.002	*
102	Radiator Mechanic	9:17a - 4:05p	0.07	0.004	*
108	Radiator Mechanic	11:00a - 4:02p	0.20	0.007	*
104	General Area	9:24a - 4:00p	0.19	0.005	*
105	General Area	9:25a - 4:00p	0.02	*	*
106	General Area	9:27a - 4:01p	0.02	*	*
107	General Area	9:30a - 4:00p	0.04	*	*
Evaluation Criteria			0.05	0.2	0.5
Laboratory Limit of Detection mg/m^3			0.0004	0.0001	0.0002