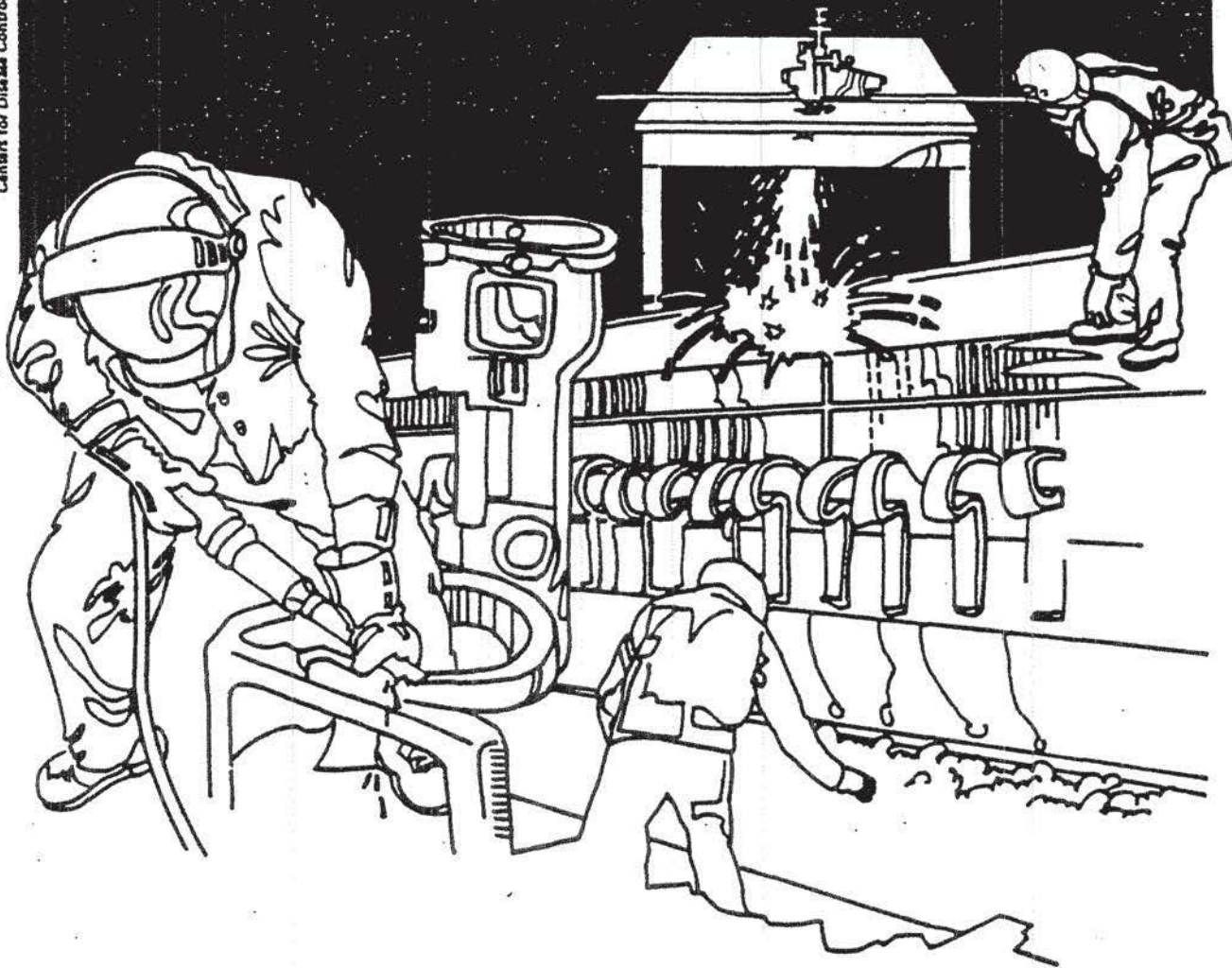


# NIOSH



## Health Hazard Evaluation Report

HETA 85-120-1616  
DAWSON AUTO TRANSMISSION  
GILMORE CITY, IOWA

## 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.

## Introduction

On December 4, 1984, the Iowa State Department of Health, Division of Disease Prevention, received a request through Mr. Sam Townsend, a sanitarian with Iowa State University, asking the Department to investigate a recently diagnosed case of arsenic poisoning which may have been occupationally related.

A request for a health hazard evaluation was submitted to NIOSH in Cincinnati, Ohio. On January 11, 1985, the Iowa State Department of Health received approval from NIOSH to investigate this problem per the Iowa/HHE Cooperative Agreement.

An on-site environmental health evaluation was conducted on January 22, 1985, by Bob Thureau, Industrial Hygienist, and Tom Schlfe, Sanitarian, both representing the Iowa State Department of Health. Their initial efforts were primarily directed at collecting bulk and wipe samples, epidemiological information and a copy of the employees medical history from the Iowa City Veterans Administration Hospital.

## Background

Dawson Auto Transmission is a small family owned business operated on the site of a previous gasoline filling station. As such, it consists of an office, a two-car garage and a small storage area. The business was opened in August, 1982. The shop repairs car and pick up truck transmissions for farmers around the small rural town of Gilmore City. In a typical year it repairs about 250 transmissions. Three workers usually perform the shop work. Work includes removing the transmission, spray washing the case, disassembling it and those parts are put into a hot tub wash. The parts are then removed from the hot tub, repaired and the transmission is reassembled. In this procedure, one person performed the removal from the vehicle portion and also the high pressure wash. Another person, the affected worker, performed the repair and reassembling.

## Epidemiological Information

The affected repair operator began getting ill during May, June and July 1984; and in July became so disabled the individual has not been able to work and has since become confined to a wheelchair because of difficulty in walking or standing. Symptoms included headaches, vomiting, numbness and burning sensations in the fingers and toes and difficulty using the hands and legs. No dermatitis was observed on the hands or face during the year by the patient. According to the patient's medical history, the patient had reported monthly vomiting from approximately the summer of 1983 to November 1984. Vomiting is one of the symptoms of arsenic poisoning. The patient supposedly did little shop work since July 1984, but was hospitalized twice for continued arsenic poisoning. The November 19, 1984, Iowa City Veterans Administration Hospital admission indicated the patient was excreting 113 mg of arsenic per 24 hours and diagnosed as a case of arsenic toxicity. The episodes of apparent arsenic-caused vomiting do not appear to totally correspond to possible exposures in the shop. The arsenic lab test of 113 mg indicates that the patient either had a chronic arsenic poisoning involving



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#### SUMMARY

In December, 1984, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation from Dawson Auto Transmission in Gilmore City, Iowa to investigate a case of arsenic poisoning which occurred to a worker. NIOSH assigned the evaluation to the Iowa State Department of Health (ISDH) under the NIOSH-Iowa HHE Cooperative Agreement.

On January 22, 1985, the Iowa State Department of Health, Work Related Disease Program, collected environmental samples for arsenic in the vehicle transmission repair shop.

Samples collected at the facility were analyzed for arsenic by the University Hygienic Laboratory, Des Moines, Iowa. Samples consisted of one air sample, four surface dust samples, two samples from cleaning tanks and one aluminum cleaner sample. The investigators also obtained four urine samples from employees who worked in the shop. Results of those samples were all negative for arsenic.

It is concluded that the conditions observed in the Dawson Auto Transmission Shop at the time of our health hazard evaluation would not be expected to result in arsenic poisoning in any worker. However, since measureable levels of arsenic were detected from environmental samples, it is conceivable that higher levels could have been present in the past and subsequently decontaminated. Our investigation was unable to determine the source of the arsenic contamination.

KEYWORDS: SIC 7539 (Automotive Repair Shops), Arsenic

In addition, the affected worker used the following chemicals at his home:

1. Ortho Klor 10 (chlordan dust) (label indicating no arsenic)
2. Ortho Diazinon Granules (label indicating no arsenic)
3. Ortho Tomato/Vegetable Dust (label indicating no arsenic)

There were two agricultural sprayer units brought to the shop during 1984. A commercial spraying company's unit was brought in on March 9, 1984. It was used to spray for mosquitos and weeds in road ditches. This unit was also repaired in September, 1984. Information on the other sprayer units could not be obtained. The spraying company was contacted and a copy of all the chemical components of their pesticides were obtained for reviewing. None contained arsenic.

#### Methods and Materials

Samples consisted of one air sample, four surface dust samples, two samples from cleaning tanks and one aluminum cleaner sample. Four urine samples were also taken from the persons who indicated that they may have had arsenic poisoning symptoms in the past.

The air sample was collected on a mixed cellulose ester filter. The dust wipe samples were performed on a standard filter paper (with one piece of filter paper analyzed separately as a control). Analysis was gaseous hydride (arsine generation) using atomic absorption spectroscopy according to NIOSH Method # P&CAM-139.

#### Environmental Samples

<u>Sample Number</u>	<u>Sample Type and Location</u>	<u>Arsenic Analysis Results</u>
1	Acid aluminum cleaner	0.05 mg/liter (0.05 ppm)
2	Hot water wash tub	0.28 mg/liter (0.28 ppm)
3	Mineral spirits wash tub	Not detectable (less than 0.02 mg/liter)
4	Wipe sample of dust from light fixture above hot tub	0.0015 mg/wipe
5	Wipe sample of dust from light fixture above lathe	0.0030 mg/wipe
6	Wipe sample of dust from top of restroom	Not detectable (less than 0.0002 mg/wipe)
7	Wipe sample of dust from floor under work table	Not detectable (less than 0.0002 mg/wipe)

intake of approximately 100 mg of arsenic per day or a one-time acute arsenic intake of 350 mg (based on a maximum of 30 percent excreting of total body arsenic burden) which occurred approximately within one week before the lab tests. In either event, the patient was absorbing arsenic in amounts much greater than that found in the Iowa State Department of Health's samples (0.28 mg/liter maximum) or the shop's own samples (19 and 44 mg/liter).

In July 1984 the repair operator became completely disabled and was consequently unable to repair transmissions. The repair work was then done by two other workers who stated that they both had headaches and nausea during the summer while they worked in the shop. This fall a number of part-time people worked in the shop. None of the eight people hired complained of any symptoms.

On December 31, 1984, two bulk samples from the shop waste pit and wash tank were submitted by a physician of the Iowa City Veterans Administration Hospital for arsenic analysis. These samples were subsequently sent to the University Hygienic Laboratory for analysis. The results are:

Arsenic Concentration

Mineral spirits solvent from  
wash tank

19 milligrams/liter or ppm

Floor drainage pit

44 milligrams/liter or ppm

Shop Conditions

During the summer the garage door is left open. This appears to provide good ventilation for the small one room shop. In the winter, the doors are kept closed and heated with a small heater located in the corner of the shop. The heater burns waste transmission oil from the shop and waste engine oil from the gasoline station across the street. The heater is vented to the outside.

If arsenic is present in the shop the following conditions could contribute to airborne exposures:

1. Fans used in the shop for cooling employees.
2. Sweeping dust on floor.
3. Mist created when using sprayer to wash transmissions with soap/water solution.
4. Air hose cleaning of parts.
5. Mist from hot wash tub (mixture of hot water and soap used for washing parts).

The following chemicals have been used at the shop:

1. Acid aluminum solution - used in hot tub
2. Mineral spirits - used in solvent with tub
3. Sprayer soap
4. Soap for hot tub
5. Waste oil from transmissions and engines
6. Insecticides sprayer in shop for mosquitos and flies.

conduction velocity. Symptoms of tingling (paresthesias) and numbness have been reported.

Chronic absorption of arsenic in high doses can cause toxicity to the liver and occasionally cirrhosis. Arsenic has been shown to cause a rare form of liver cancer, angiosarcoma of the liver. Inorganic arsenic, and especially arsenic trioxide, is a potent irritant of the respiratory tract. Chronic exposure results in inflammation of the eyes and nose, nosebleeds, and occasionally perforation of the nasal septum. Chronic exposure to arsenic in the smelting and pesticide formulating industries has been shown to cause excessive deaths from cancer of the lungs and bronchi. The lung cancer mortality rate in workers chronically exposed to arsenic has been shown to increase with the duration and intensity of exposure.

The NIOSH recommended standard for occupational exposure to inorganic arsenic in air is  $2 \text{ ug/M}^3$  based on a 15-minute ceiling measurement. The OSHA standard is  $10 \text{ ug/M}^3$  measured as an eight-hour time-weighted average. No specific exposure standard exists for arsenic trioxide, but in view of its ability to cause cancer, exposure to arsenic trioxide (in both vapor and particulate forms) should be reduced to the lowest level feasible.

### Results

As stated in the evaluation criteria section, the main routes of arsenic absorption into the body are by inhalation and ingestion. Arsenic is not easily absorbed through the skin and skin contact will often result in a local hyperemia and later vesicular or pustular eruption. The affected repair operator was not found to have such a skin condition on the hands or lower arms (areas of most likely contact) or on the face (as perhaps from mist from the hot water wash tank). On the November 19, 1984, Iowa City Veterans Administration Hospital admissions indicated some scattered pustules were noted on the right upper arm only. Skin pustules may also result from inhalation or ingestion of arsenic.

The human body is able to clear arsenic from the body fairly rapidly. The medical literature shows that about 30% of the arsenic has been excreted by the fifth day (assuming a one time arsenic dose). Symptoms of acute arsenic poisoning develop within one half hour to four hours following ingestion. Symptoms of chronic arsenic poisoning occur more gradually over an extended period of time (on the order of months.)

For chronic arsenic poisoning by inhalation, the second phase of symptoms consist of the following:

The worker complains of conjunctivitis (of the eyes), a catarrhal state of the mucous membranes of the nose, larynx, and respiratory passage. Coryza, hoarseness, and mild tracheobronchitis may occur. Perforation of the nasal septum is common, and is probably the most typical lesion of the upper respiratory tract in occupational exposure to arsenical dust. Skin lesions, eeylmatoid and allergic in type, are common.



<u>Sample Number</u>	<u>Sample Type and Location</u>	<u>Arsenic Analysis Results</u>
8	Filter paper wipe wetted with office water (used as a control)	Not detectable (less than 0.0002 mg/wipe)
9	Air sample in shop	Not detectable (less than 0.001 mg/m <sup>3</sup> )

<u>Sample Number</u>	<u>Sample Type</u>	<u>Arsenic Analysis (mg/liter)</u>
1	Urine Sample - Person A	Not detectable
2	Urine Sample - Person M	Not detectable
3	Urine Sample - Person N	Not detectable
4	Urine Sample - Person D	Not detectable

The minimum detection limit was 0.025 mg/liter.

### Evaluation Criteria

#### Inorganic Arsenic

Occupational exposure to inorganic arsenic occurs primarily through inhalation of arsenic-containing airborne particulates. Inhalation of arsenic trioxide vapor can also occur. Non-occupational arsenic absorption results almost entirely from eating food which contains traces of arsenic, seafood in particular, or from drinking contaminated water.

Excretion of arsenic occurs mainly via the urine. Most of a dose of arsenic is excreted within 30 hours; arsenic does not accumulate in the body as do lead and cadmium. Human absorption of arsenic has been assessed through measurement of arsenic concentration in blood, hair, and urine. Of these, the urine arsenic concentration appears to be the best measure of recent absorption (past 1-3 days). In virtually all persons without occupational or other unusual exposures to arsenic, urine arsenic concentrations are below 50 micrograms (ug) per liter. Thus, a urine arsenic concentration of 50 ug per liter or above reflects increased absorption of inorganic arsenic.

Arsenic toxicity among workers is almost always caused by chronic inhalation of arsenic or arsenic trioxide. Dermatitis (skin rash) is the most common sign of occupational arsenic toxicity and may be associated with development of areas of increased skin pigmentation or skin thickening ("arsenical warts"). Chronic exposure to arsenic has been shown to cause skin cancer.

Chronic exposure to arsenic in high doses can also cause damage to the nerves of the arms and legs (peripheral neuropathy). This neuropathy primarily affects the sensory nerves and has been associated with slowed sensory nerve



The Veterans Administration Hospital examinations did not report any of these symptoms which would tend to indicate the arsenic was not absorbed by inhalation.

The air samples on the day of investigation showed no detectable airborne arsenic dust. This could have been expected since there was only a small amount of work being performed at the Transmission Shop. The space heater was operating on waste engine oil that day. The outside air temperature was in the mid 40's and shop doors were kept closed. There was no smell of combustion gases produced by the space heater, thus it appeared to be properly vented to the outside.

The dust wipe samples from under the work table and the top of the restroom had no detectable arsenic dust indicating there had ever been significant airborne concentration of arsenic dust wipspread throughout the shop.

The wipe samples taken from the top of two light fixtures showed apparent trace levels of arsenic dust. The probable interpretation was that some of the steam from the hot water wash tub mist from the sprayer may have carried some arsenic to these light fixtures. Generally mist is more likely to carry dust than the steam.

The acid aluminum cleaner fluid was found to have small amounts of arsenic and a red oil (probably transmission oil). There was also some unidentified powder in the bottom of the container. The concentration of arsenic did not exceed the EPA safety level of arsenic for drinking water.

The mineral spirits wash tank had no detectable arsenical though the solution had not apparently been changed since the shop submitted a similar sample showing 19 mg/liter of arsenic.

The hot water wash tank did show 0.28 mg/liter of arsenic. This is still considered a low concentration as far as potential occupational exposures are concerned. Also this arsenic concentration cannot be solely contributed to be from the aluminum acid cleaner since its concentration of arsenic is greater than that in the aluminum cleaner.

#### Summary of Conclusions

1. Absorption of arsenic through the skin is unlikely to have occurred to a significant degree and was not consistent with skin rashes stated in the medical literature.
2. Inhalation of arsenic was not consistent with nasal and upper respiratory tract symptoms predicted in the medical literature.
3. Since arsenic is readily excreted from the body (30% is excreted within five days after a single arsenic dose), each nausea symptom probably indicated arsenic exposure during the preceding week.
4. The patient's repeated vomiting symptoms did not appear to be related to any particular periodic events in the workplace and continued after the patient was replaced with hired help in the transmission repair shop.

Air samples on the day of investigation showed no detectable airborne arsenic dust. Dust wipe samples from under the work table and the top of the restroom had no detectable arsenic dust indicating there had never been a significant airborne concentration of arsenic dust widespread throughout the shop. Wipe samples taken from the top of two light fixtures showed only apparent trace levels of arsenic dust.

Based on analysis, the hot water wash or "hot tub" did show 0.28 mg/liter of arsenic. This is still considered a low concentration as far as potential occupational exposures are concerned. Recommendations are to remove the existing material and replace with a clean solvent.

It is concluded that the conditions observed in the auto transmission shop at the time of our health hazard evaluation would not be expected to result in arsenic poisoning in any worker. However, since measurable levels of arsenic were detected from environmental samples, it is conceivable that higher levels could have been present in the past and subsequently decontaminated.

#### AUTHORSHIP AND ACKNOWLEDGEMENTS

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1. Dawson Auto Transmission
2. Iowa Health Department
3. NIOSH, Region VII
4. OSHA, Region VII

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