

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. 76-109 -351

H. PAUL FANNING, D.D.S.  
CHEYENNE, WYOMING

DECEMBER 1976

I. TOXICITY DETERMINATION

A health hazard evaluation was conducted by the National Institute for Occupational Safety and Health (NIOSH) on October 10, 1976, at the H. Paul Fanning Dental Clinic in Cheyenne, Wyoming. At the time of this evaluation, breathing zone and general room samples were taken for inorganic mercury. A direct reading mercury vapor detector was also used. Concentrations of mercury during this evaluation were below detection limits. The NIOSH recommended standard is 0.05 milligrams per cubic meter. Since all breathing zone and direct reading measurements were well below this limit, a health hazard did not exist at the time of this evaluation.

II. DISTRIBUTION AND AVAILABILITY

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information 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:

- (a) H. Paul Fanning, D.D.S.
- (b) U.S. Department of Labor - Region VIII
- (c) NIOSH - Region VIII

For the purpose of informing the three affected employees, copies of the report shall be provided to these employees or the report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 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.

NIOSH received such a request from H. Paul Fanning, D.D.S., Cheyenne, Wyoming, to evaluate the potential hazards associated with exposures to mercury in his dental operatory.

#### IV. HEALTH HAZARD EVALUATION

##### A. Process Evaluated

Dr. Fanning performs all dental procedures in one operatory. The basic procedure used in preparing a dental filling is dispensing into a capsule a metal powder such as silver with a trace of zinc and then adding elemental mercury to this powder. The capsule is then placed in a shaker, where the mercury and metal are agitated for several seconds. Extreme caution must be taken throughout this procedure in order to prevent mercury exposure to the dentist and his employees. If the capsule containing the mercury and metal is not securely closed or has leaks, mercury contamination and vaporization will occur.

##### B. Evaluation Design

Breathing zone samples and direct reading measurements were taken on Dr. Fanning and his two assistants in the dental operatory. These samples were taken using AA filters followed by an organic vapor charcoal sampling tube treated with iodine and designed specifically for mercury collection. Direct reading samples were taken with a Bacharach mercury vapor detector.

##### C. Evaluation Methods

All breathing zone samples taken on AA filters and organic vapor sampling tubes were analyzed by atomic absorption spectroscopy. Results are presented in Table I.

##### D. Criteria for Assessing Workroom Concentrations of Air Contaminants

The three sources of criteria used to assess workroom concentrations of air contaminants in this evaluation are: (1) NIOSH recommended criteria for occupational exposures; (2) recommended and proposed threshold limit values (TLV's) and their supporting documentation as set forth by the American Conference of Governmental Industrial Hygienists (ACGIH)(1975); and (3) Occupational Safety and Health Standards (29 CFR 1910.1000), U.S. Department of Labor, as of January 1, 1976.

In the following tabulation of criteria, the most appropriate value is presented with its reference and other information footnoted.

| <u>Substance</u>               | <u>Permissible Exposures<br/>8-Hour Time-Weighted<br/>Exposure Basis</u> |
|--------------------------------|--|
| <sup>1</sup> Mercury . . . . . | 0.05 mg/M <sup>3</sup>   |

mg/M<sup>3</sup> = approximate milligrams of substance per cubic meter of air

<sup>1</sup>Reference: NIOSH recommended criteria for occupational exposures and recommended and proposed TLV's and their supporting documentation as set forth by the ACGIH (1975).

The U.S. Department of Labor legally enforceable standard is 0.1 mg/M<sup>3</sup>. This is a ceiling concentration and should never be exceeded.

#### E. Toxicology - Medical

Inorganic mercury is a general protoplasmic poison. The primary toxic action is assumed to be due to its ability to form highly undissociated linkages with sulfhydryl groups present in post proteins and with other ligands such as amine, phosphoryl, and carboxyl groups which are found in any living cell. This ability to form bonds with physiologically important chemical functional groups renders mercury a potent but nonspecific inhibitor of a wide variety of enzymes. The toxic action of mercury is the result of biotransformation of elemental mercury (Hg<sup>0</sup>) to an oxidized mercuric ion (Hg<sup>++</sup>) which is a more physiologically active form. Elemental mercury has a significant vapor pressure, is lipid soluble and neutral--properties which favor its passage across cell membranes and its localization in tissue of relatively high lipid content such as liver, brain, and kidney.

Mercury may be toxic on an acute or chronic basis. Acute poisoning is usually due to inhalation of large amounts of mercury vapor, and the toxic effects are usually limited to the bucco-pharyngeal area. The classical symptoms of chronic intoxication of mercury (mercurialism) consists of excessive salivation and gingivitis, a metallic taste in the mouth, erethism, and a tremor of the upper and/or lower extremity. Erethism is a syndrome that consists of the following symptoms: nervousness, irritability, hyperexcitability, and easy loss of temper. However, mercurialism has been associated with other signs and/or symptoms which include: depression, headache, fatigue, insomnia, impaired memory, anorexia, weight loss, loose teeth, bleeding gums, sore throat, black line on gums (mercury line), various gastrointestinal disturbances, dermatitis, stomatitis, tingling sensation of the tongue, "shakey" legs, intention tremor of lips, hands, or feet, loss of muscle strength in arms and legs, disturbances of gait, and nephrotic syndrome with edema, proteinuria, and casts in the urinary sediment.

Occupational health standards are established at levels designed to protect individuals occupationally exposed to individual toxic substances on an 8-hour per day, 40-hour per week basis over a normal working lifetime.

#### F. Evaluation Results

Breathing zone samples were below detection limit of 0.1 micrograms per charcoal tube. Direct reading samples were below the NIOSH recommended standard of 0.05 mg/M<sup>3</sup>. Confidential employee interviews failed to show any health problems. A health hazard was judged not to exist at the time of this evaluation.

#### G. Recommendations

To maintain a safe working environment, it is recommended that the following precautions and procedures be followed:

1. Use tightly closed capsules (screw type capsules other than the push-together type) during amalgamation.
2. Salvage all amalgam scraps and store in a closed container with a layer of water over the amalgam. Store mercury in an unbreakable, tightly sealed container.
3. All mercury spills should be cleaned up immediately, preferably by vacuuming. However, vacuum cleaners should be equipped with changeable charcoal filters so that mercury vapor will not escape into the air. Sweeping should be avoided because it creates dust and breaks the mercury into even smaller particles that can vaporize more quickly.

#### V. AUTHORSHIP

Report Prepared By: Bobby J. Gunter, Ph.D.  
Regional Industrial Hygienist  
NIOSH - Region VIII  
Denver, Colorado

Channing Meyer, M.D.  
Chief, Medical Section  
Hazard Evaluation and Technical  
Assistance Branch  
NIOSH - Cincinnati, Ohio

Originating Office: Jerome P. Flesch, Acting Chief  
Hazard Evaluation and Technical  
Assistance Branch  
NIOSH - Cincinnati, Ohio

TABLE I

## AIR CONCENTRATIONS OF MERCURY

Office of H. Paul Fanning, D.D.S.  
October 10, 1976

| Sample Number       | Location        | Job Classification | Time of Sample | Air Concentrations<br>MERCURY<br>(mg/M <sup>3</sup> ) | Type of Sample |
|---------------------|-----------------|--------------------|----------------|---|----------------|
| 1                   | Dental Operator | Dentist            | 8:30 - 10:30   | ND  | BZ             |
| 2                   | Dental Operator | Dental Assistant   | 8:30 - 10:30   | ND  | BZ             |
| 3                   | Dental Operator | Dentist            | 10:30 - 12:30  | ND  | BZ             |
| 4                   | Dental Operator | Dental Assistant   | 10:30 - 12:30  | ND  | BZ             |
| 5                   | Dental Operator | ---                | 11:00          | *   | Direct Reading |
| 6                   | Dental Operator | ---                | 11:00          | *   | Direct Reading |
| EVALUATION CRITERIA |                 |                    |                | 0.05  |                |
| LIMIT OF DETECTION  |                 |                    |                | 0.1 microgram per charcoal tube                       |                |

mg/M<sup>3</sup> = approximate milligrams of substance per cubic meter of air

ND = none detected; concentrations were below the detection limit of 0.1 microgram total mercury per charcoal tube

BZ = breathing zone

\* = concentrations were below the NIOSH recommended standard of 0.05 mg/M<sup>3</sup>