

# FACSIMILE COVER SHEET



## CALIFORNIA DEPARTMENT OF HEALTH SERVICES ENVIRONMENTAL HEALTH INVESTIGATIONS BRANCH

5900 HOLLIS STREET, SUITE E  
EMERYVILLE, CALIFORNIA 94608

PHONE: (510) 540-3657

FAX: (510) 540-2673

Date: 7 / 26 / 94

Total number of pages (including cover sheet): 16

Deliver to: Dr. Robert Mason

Fax Number: (513) 533-8588

Urgent       Confidential

Sender: D. Newton

Comments: Per your Request

**HOW TO PREVENT  
MERCURY POISONING  
IN THE  
QUICKSILVER  
MINING INDUSTRY**

**OFFERED BY**

*State of California*

**DEPARTMENT OF INDUSTRIAL RELATIONS  
DIVISION OF INDUSTRIAL SAFETY  
455 Golden Gate Avenue, San Francisco, Calif. 94102  
3460 Wilshire Boulevard, Los Angeles, Calif. 90005**

**AND**

**DEPARTMENT OF PUBLIC HEALTH  
BUREAU OF OCCUPATIONAL HEALTH  
2151 Berkeley Way, Berkeley, Calif. 94704  
1930 Beverly Boulevard, Los Angeles, Calif. 90057**

California, Division of Industrial Safety.

HOW TO PREVENT MERCURY POISONING  
in the  
QUICKSILVER MINING INDUSTRY

offered by

Division of Industrial Safety  
P. O. Box 603, San Francisco

and

Bureau of Occupational Health  
2151 Berkeley Way, Berkeley

of the

STATE OF CALIFORNIA

RA1231  
M5  
C1532h  
1968

How to Prevent Mercury Poisoning  
in the  
Quicksilver Mining Industry

The absorption and retention of mercury vapor and dusts in the human body is a definite health hazard. Recent surveys of numerous California quicksilver mines have shown that mill workers were being exposed to excessive concentrations of mercury vapor. In addition, medical tests of 89 such workers showed that 62 had excessive absorption, of which 14 were definite cases of poisoning.

Mercury can enter the body either by breathing the vapor (including smoking with contaminated hands), by breathing mercury-bearing dust, by eating mercury contaminated food, or by absorption of mercury through the skin. Mercury vaporizes even at temperatures below freezing. California law requires that normal work atmosphere must not contain more than 0.1 milligrams of mercury vapor per cubic meter ( $\text{mg}/\text{M}^3$ ) of air. (This is equivalent to about 0.01 parts per million.)

Employers are required to provide protection for their employees against excessive mercury exposure. Adequate protection can be obtained if sincere and conscientious efforts are made by both employer and employee. The following is offered as a guide to accomplish such protection.

A. PROCESSING CONTROLS

1. Construct, operate, and maintain all mercury mill processing equipment to control spillages of mercury and to control mercury vapor and mercury-bearing mud or dust from entering the work area. For example:

FURNACE

Maintain adequate negative pressure within the furnace to prevent escape of mercury vapor through seal rings and ore feeder.

RETORT

Maintain tight seals of the charge and discharge doors.

HOE TABLE

Equip hoe table with a hood enclosure and mechanical exhaust ventilation of sufficient capacity to prevent the escape of mercury vapor and dust. (Minimum air velocity of 100 linear feet per minute through the entire hood opening should be provided.)

### MERCURY SPILLS

Mercury accumulates in cracks and in porous floors. Hard, smooth, and impervious surfaces should be provided where mercury and mercury-bearing dust and mud are handled. Floors should be sloped and have gutters and drains to facilitate and control cleaning (wash-downs).

Mercury bottling areas should be provided with a basin to contain spillages.

### MERCURY STORAGE

Store mercury and mercury-bearing mud or dust in containers that are either air-tight, have a layer of water over the material, or vented to a location outside the work area.

### EXHAUSTS

Discharge all mercury-contaminated exhaust gases from process equipment to a location where they will not reenter work areas.

## B. PERSONAL PROTECTION PRACTICES

1. Provide employees with respiratory protection, acceptable to the Division and require its use where the control of mercury vapor concentrations to within  $0.1 \text{ mg/m}^3$  is impracticable and exposures are brief. Locations or operations where this condition may exist include:
  - a. Loading, hauling, and dumping hot rock;
  - b. manually washing down and cleaning out condensers;
  - c. loading and unloading retorts;
  - d. loading and unloading of hoe tables;
  - e. other handling of dust and mud;
  - f. bottling mercury;
  - g. maintenance and repair operations on equipment contaminated with mercury or mercury-bearing mud or dust.
2. When filter-type respirators are provided, each employee shall have one for his own exclusive use. Provide means for cleaning respirators and, when not in use, store them in reasonably dust-tight containers.
3. Use suitable hand protection such as smooth, impervious, and durable gloves, when engaged in operations where there is hand contact with mercury or mercury-bearing mud or dust. Such operations include:

- a. Manually washing down and cleaning out condenser systems;
- b. manual handling of mercury and mercury-bearing mud or dust;
- c. loading and unloading hoe tables;
- d. charging retort and furnace with mercury-bearing dust;
- e. maintenance and repair of equipment involving mercury and mercury-bearing mud or dust.

#### C. HOUSEKEEPING

1. Clean up all spillages of mercury and mercury-bearing mud or dust without delay. This may be done by the use of a suitable vacuum cleaner, by washing down the area, or by other suitable methods.
2. Wash down mill floors as needed.
3. Apply mercury deactivating solution to floors and other horizontal surfaces which become contaminated. (Information on this solution can be obtained from the Division of Industrial Safety or Bureau of Occupational Health.)
4. Clean contaminated work implements when necessary.

#### D. PERSONAL HYGIENE

1. Work clothes and shoes of all mill workers should be changed and a shower taken before leaving the job site at the end of each shift. Adequate facilities for clothes changing and showering should be provided.
2. Separate work clothing worn by persons exposed to mercury from other persons' work clothing and from street clothing. Work clothes should be hung up in baskets or other open-type method since closed lockers can become contaminated with mercury vapor.
3. Provide laundry facilities to wash work clothes of all mill workers. Work clothes should be frequently washed. Clothes contaminated from spills or other mishaps should be removed without delay and washed.
4. Provide an uncontaminated area near the mill for cleaning and maintenance of personal protective equipment.
5. Food and tobacco, stored or consumed in the mill may be contaminated by mercury vapor and mercury-bearing dust settling out from the air or by the handling with mercury-contaminated hands. To reduce the hazard of eating contaminated food or smoking contaminated tobacco, the storage and use of food and tobacco in the mill area should be discouraged.

**E. DETECTION FOR MERCURY VAPOR**

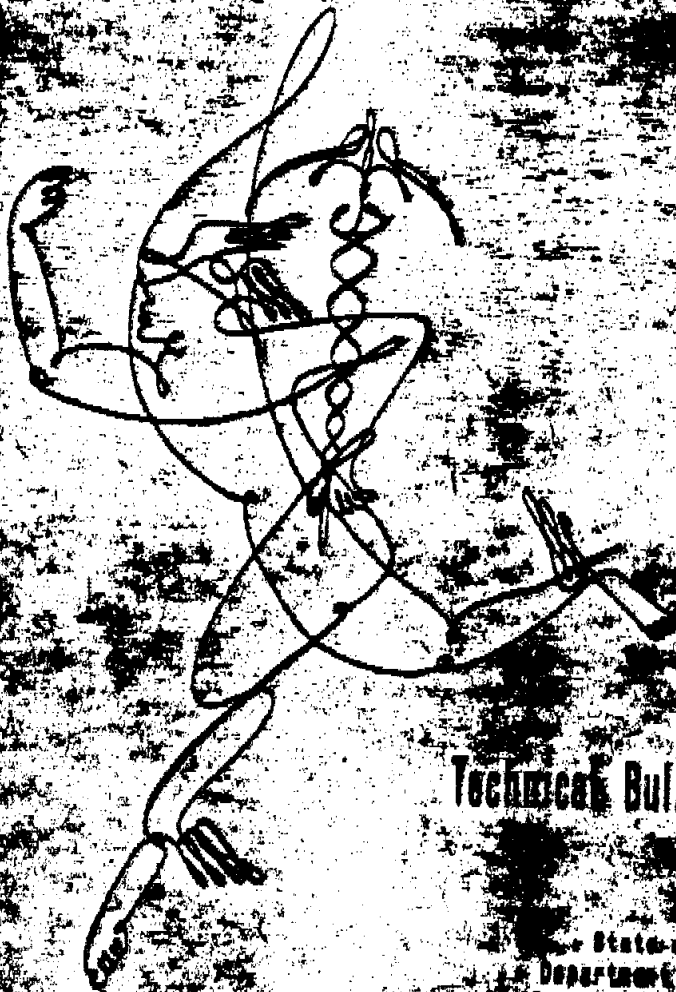
1. Frequent tests for mercury vapor, using a suitable detecting device, of the work atmosphere and for possible leaks in processing equipment should be conducted to insure employee protection against mercury-vapor exposure at all times.

**F. MEDICAL SURVEILLANCE PROGRAM**

1. To protect the health of employees who are normally exposed to mercury vapor, the employer should engage the services of a licensed physician to provide a medical surveillance program. The purpose of the program is to prevent mercury poisoning to employees by detecting early evidence of mercury absorption. The interval between examinations should be decided upon by the physician. The physician's recommendations should be followed.
2. The source of employee mercury exposure should be corrected without delay to prevent additional poisoning. Effective controls of mercury vapor exposure to employees will reduce the frequency for employee medical examination and thus reduce the cost.
3. The name and address of the physician should be supplied to the State Department of Public Health, Bureau of Occupational Health, 2151 Berkeley Way, Berkeley, California, who will be glad to assist the physician with the medical program.

/az  
7/30/68  
500

# MEDICAL SUPERVISION for EMPLOYEES in MERCURY MINES and MILLS



Technical Bulletin For Physicians

State of California  
Department of Public Health  
Bureau of Occupational Health  
San Francisco, California



California. Bureau of Occupational Health.

MEDICAL SUPERVISION FOR EMPLOYEES IN MERCURY MINES AND MILLS

Technical Bulletin for Physicians

August 1967

RA1231

M5

C1531m

1967

Bureau of Occupational Health  
State of California Department of Public Health  
2151 Berkeley Way  
Berkeley, California 94704

263713

## MEDICAL SUPERVISION FOR EMPLOYEES IN MERCURY MINES AND MILLS

### A Guide to Physicians

Studies conducted by Federal and State Occupational Health Agencies have shown that excessive exposure to mercury in the mills of California's mercury mines is prevalent and that many workers show high levels of mercury excretion. Cases of mercury poisoning are being reported.

Prevention of mercury poisoning consists of four steps: (1) reduction of mercury vapor in the air of the mills through proper industrial hygiene engineering controls, such as enclosed processes and local exhaust ventilation; (2) meticulous housekeeping of the work environment with prompt cleanup of spills; (3) adequate personal cleanliness of workers, with provision for showering and changing to clean clothing after work each day; and (4) medical supervision for each worker. This bulletin will be concerned only with medical supervision.

#### PURPOSE OF MEDICAL SUPERVISION

The purpose of the program is to prevent mercury poisoning by detecting early evidence of excessive mercury absorption.

Once detected, the source of overexposure in the work environment can be identified and corrected, and any employee in danger of poisoning can be transferred to another work area where the excessive exposure is not present. The medical program checks on the effectiveness of the environmental measures to control exposure to mercury. A licensed physician retained by the employer directs the program. The employer pays for the medical program which is a legitimate cost of an industrial operation involving a health hazard such as mercury. The physician and the employer should agree on services and costs

- 2 -

beforehand. (Whenever a diagnosis of occupational disease is made, workmen's compensation insurance coverage applies.)

The medical program for each worker exposed to mercury includes an initial medical appraisal and initial and periodic laboratory examinations, usually including determination of the mercury content of urine. During the first visit, an occupational history, particularly regarding previous mercury exposure, is of value. Screening for conditions which could make working with mercury unwise is important (central nervous system disease, poor renal function, diseases affecting the gingivae and teeth, and chronic dermatitis are examples of such conditions).

#### THE MEDICAL PROGRAM

The components of the medical examination and the interval between medical and laboratory examinations are determined by the physician, and depend upon the extent of mercury exposure at the workplace, the duration of the exposure, and the results of the medical and laboratory examinations conducted previously. Where exposure is excessive and workers are showing evidence of increased mercury absorption, medical examinations, laboratory checks, or both, every one to three months are desirable. Where exposure is less intense, every six months or longer may be adequate. Proper control of exposures to mercury at the workplace will reduce the cost of the medical program because the interval between examinations and tests will be longer.

It is recommended that the report to the employer and the individual worker consist of an interpretation of the findings plus whatever recommendations are indicated, rather than actual results of laboratory tests and medical examinations. The physician informs the employer and employee promptly when there is evidence of excessive mercury absorption. The employer then finds and

- 3 -

corrects the source of excessive exposure. If the level of exposure is high, the physician recommends that the employee be transferred to another job location until he has returned to normal. The employer should keep a written record of the physician's recommendations and the action taken. The physician arranges for the laboratory tests and receives the reports. The collection of urine must be carried out in such a manner that contamination of the specimen by mercury is avoided; this should be done preferably after a shower or at least following hand washing. Special mercury-free containers and stopper must be used. Specimens collected during or at the end of the work day are preferred. Twenty-four-hour specimens are recommended when they can be obtained, but spot determinations are acceptable for monitoring purposes. Specimens must be over 200 ml in quantity.

**INTERPRETATION OF URINE MERCURY DETERMINATIONS** In the individual, the mercury in the urine may not be consistently proportional to the exposure, but for groups of workers, the average for the group is a reliable indicator of the environmental hazard. Group average levels above 50 micrograms per liter of urine should arouse suspicion, and levels above 100 micrograms/liter call for correction of the faulty work situation. An individual who shows over 200 micrograms per liter on two successive tests should be removed from exposure until the level has fallen below 50 micrograms per liter. (Clinical poisoning does not usually occur with levels below 300 micrograms per liter unless kidney function is impaired.)

Table 1 is a tentative guideline of how urine mercury levels might be interpreted. It is subject to change as new information dictates. The physician with experience may work out another scheme which better suits his group of workers. The objective is to detect excessive exposure and to curtail it before

- 4 -

mercury poisoning is evident clinically.

Table 1

Guide for Workers Exposed to Inorganic Mercury*	Level of Mercury in Urine Micrograms/Liter
Normal	below 10
Increased absorption	above 50
Warning level	above 100
Hazardous level--remove from further exposure	above 200
Symptoms of poisoning may appear	above 300

\* Do not use these standards for workers using organic mercury compounds where excretion of over 50 micrograms per liter is the hazardous level. Organic mercury is used commonly as a fungicide. Exposures in California mines and mills are limited to inorganic mercury.

REPORTS BY  
PHYSICIAN TO  
MANAGEMENT

Examples of how physicians' reports to a management might read are:

- (1) Mr. J.D., Mr. A.C., and Mr. L.F., employed at the \_\_\_\_\_ mill, were examined January 7, 1967. The results of all their tests were satisfactory. They should report to this office for urine test in six months.
- (2) Mr. B.A., Mr. D.F., and Mr. H.C., mill furnace men at \_\_\_\_\_ mill, were examined January 8, 1967. The results of their physical

- 5 -

examinations were within normal limits. Repeated laboratory tests revealed that they have experienced a marked increase in mercury exposure since their last tests six months ago. Since these men work together, it is necessary that their operations be checked promptly to determine what has gone wrong and correct it. These men should report to me for another examination and laboratory test on

\_\_\_\_\_ date. Another employee, Mr. T.J., who works with these men, should report for his examination as soon as possible.

- (3) Mr. B.T., who states he is a new employee for the mill, was examined January 8, 1967. The results of his tests were satisfactory except for a temporary rash on his hands and arms which should be healed before he is put to work in the mill. (Note: mercury can be absorbed through the skin, particularly the inflamed skin.) He should be examined at my office again in six months.

#### MERCURY ABSORPTION

Workers below ground in the mercury mine itself are not likely to receive exposure to mercury vapor unless the mercury runs "free", or as quicksilver. Mercury ore, cinnabar ( $Hg_2S$ ), does not release mercury liquid or vapor until it is processed at the mill where the workers are most likely to be exposed to high levels. Mercury is readily absorbed by inhalation, ingestion, and through the skin.

#### MERCURY POISONING

Industrial mercury poisoning among mill workers is usually chronic and of gradual onset with fatigue, loss of strength, sore mouth, gingivitis, stomatitis, loosening of the teeth, salivation and metallic taste being noted first. Nausea, loss of appetite, vomiting, diarrhea,

- 6 -

and weight loss may be present. Fatigue, irritability, insomnia, vertigo, and tingling and fine tremors of the tongue and extremities may then appear.

Peripheral neuritis, personality changes, and motor and sensory abnormalities, including unsteady gait, may be present in severe cases, along with other nervous system abnormalities.

**TREATMENT  
OF MERCURY  
POISONING**

Removal from exposure to mercury, symptomatic treatment and medical observation until mercury excretion has returned to acceptable limits are the principles of treatment. Dimercaprol (British antilewisite, BAL) and calcium disodium versenate (EDTA) have produced contradictory results in treatment of chronic occupational mercury poisoning. More clinical experience is needed before their efficacy can be determined. Another chelating agent, N-acetylpenicillamine, has also been suggested as useful in treatment of mercury poisoning. Again, clinical evidence on which to determine its value in chronic occupational mercury poisoning is lacking.

**FURTHER  
INFORMATION  
AND ASSISTANCE**

For more information about occupational mercury poisoning, please note the attached list of references, or make contact with the Bureau of Occupational Health, California State Department of Public Health, 2151 Berkeley Way, Berkeley, California 94704, telephones (Area Code 415) 843-7900, Extensions 381 or 375. The Air and Industrial Hygiene Laboratory of the California State Department of Public Health, Extension 595, offers assistance to laboratories with respect to mercury determinations, including the checking of results by splitting samples. For help in Santa Clara County make contact with the Bureau of Occupational Health in the County Health Department, Cypress 7-1636.

## REFERENCES ON MERCURY POISONING

- Black, D.A.K.: Metals and the Kidney. Ann. Occup. Hyg. 8:17, 1965.
- Browning, Ethel: Toxicity of Industrial Metals. Chapter 24 "Mercury", pp 197-211, London, England: Butterworths, 1961.
- Goldwater, L.J., Jacobs, M.B., and Ladd, A.C.: Absorption and Excretion of Mercury in Man: I. Relationship of Mercury in Blood and Urine. Arch. Environ. Health 5:537, 1962
- Goldwater, L.J., Jacobs, M.B., and Ladd, A.C.: Absorption and Excretion of Mercury in Man. IV. Tolerance to Mercury. Arch. Environ. Health 7:568, 1963.
- Goldwater, L.J., Ladd, A.C., and Jacobs, M.B.: Absorption and Excretion of Mercury in Man: VII. Significance of Mercury in Blood. Arch. Environ. Health 9:735, 1964.
- Goldwater, L.J., and Nicolau, A.: Absorption and Excretion of Mercury in Man. IX. Persistence of Mercury in Blood and Urine Following Cessation of Exposure. Arch. Environ. Health 12: 196, 1966.
- Hoover, A.W., and Goldwater, L.J.: Absorption and Excretion of Mercury in Man. X. Dental Amalgams as a Source of Urinary Mercury. Arch. Environ. Health 12:506, 1966.
- Jacobs, M.B., Ladd, A.C., and Goldwater, L.J.: Absorption and Excretion of Mercury in Man. III. Blood Mercury in Relation to Duration of Exposure. Arch. Environ. Health 6:634, 1963.
- Jacobs, M.B., Ladd, A.C., and Goldwater, L.J.: Absorption and Excretion of Mercury in Man: VI. Significance of Mercury in Urine. Arch. Environ. Health 9:454, 1964.
- Kazantzis, G.: Chronic Mercury Poisoning--Clinical Aspects. Ann. Occup. Hyg. 8:65-71 (March) 1965.
- Ladd, A.C., Goldwater, L.J., and Jacobs, M.B.: Absorption and Excretion of Mercury in Man: II. Urinary Mercury in Relation to Duration of Exposure. Arch. Environ. Health 6:480, 1963.
- Ladd, A.C., Goldwater, L.J., and Jacobs, M.B.: Absorption and Excretion of Mercury in Man: V. Toxicity of Phenylmercurials. Arch. Environ. Health 9:43, 1964.
- Molynaux, M.K.B. Observations on the Excretion Rate and Concentration of Mercury in Urine. Ann. Occup. Hygiene 9:95, 1966.
- Patty, F.: Industrial Hygiene and Toxicology, Vol. II. Second Revised Edition Chapter on Mercury, p. 1090. New York, N.Y.: Interscience Publishers, 1962.