TYPES OF MERCURY

There are three important types of mercury:

1. The pure element,
2. Inorganic compounds (such as mercuric chloride) and
3. Organic mercury compounds (such as phenyl mercuric propionate).

Each type poses a different health hazard.

**Elemental mercury** is a liquid and gives off mercury vapor at room temperature. This vapor can be inhaled into the lungs and passed into the blood stream. Elemental mercury can also pass through the skin and into the blood stream. If swallowed, however, this form of mercury is not absorbed out of the stomach, and usually passes out of the body without harm.

**Inorganic mercury compounds** can also be inhaled and absorbed through the lungs, and may pass through the skin. But the compounds can also be absorbed through the stomach if swallowed. Many inorganic mercury compounds are irritating or corrosive to the skin, eyes and mucus membranes as well.

**Organic mercury compounds** can enter the body readily through all three routes-lungs, skin and stomach.

ACUTE HEALTH EFFECTS

Very high exposures to mercury vapor in the air can cause acute poisoning. Symptoms usually begin with cough, chest tightness, trouble breathing and upset stomach. This may go on to pneumonia, which can be fatal.

If the inorganic mercury compounds are swallowed, nausea, vomiting diarrhea and severe kidney damage can occur.
CHRONIC HEALTH EFFECTS

Exposure to any form of mercury on a repeated basis, or even from a single, very high exposure can lead to the disease of chronic mercury poisoning. There are three main symptoms:

1. Gum problems. The gums become soft and spongy, the teeth get loose, sores may develop, and there may be increased saliva.

2. Mood and mental changes. People with chronic mercury poisoning often have wide swings of mood, becoming irritable, frightened, depressed or excited very quickly for no apparent reason. Such people may become extremely upset at any criticism, lose all self-confidence, and become apathetic. Hallucinations, memory loss and inability to concentrate can occur.

3. Nervous system. The earliest and most frequent symptom is a fine tremor (shaking) of the hand. A tremor may also occur in the tongue and eyelids. Eventually this can progress to trouble balancing and walking.

OTHER HEALTH EFFECTS

There are a number of other symptoms that may be caused by exposure to mercury and mercury-containing compounds.

- A skin allergy may develop. If this happens, repeated exposure causes rash and itching.
- Exposure to mercury vapor can cause the lens of the eye to discolor.
- Some of the inorganic mercury compounds can cause burns or severe irritation of the skin and eyes on contact.

EFFECTS ON THE REPRODUCTIVE SYSTEM

Some organic mercury compounds (methylmercury) are known to cause birth defects in children born of exposed mothers. It is not known whether inorganic compounds or elemental mercury have this effect.

TESTS FOR MERCURY EXPOSURE

There are two tests available to measure mercury in the body:

The **Mercury Blood Test** measures exposure to all three types of mercury, but because mercury remains in the bloodstream for only a few days after exposure, the test must be done soon after exposure. Most non-exposed people have mercury levels of 0 to 2 (all blood measurements are in micrograms of mercury per deciliter of blood, or ug/dl). Levels above 2.8 ug/dl are required to be reported to the Health Department. This test can be influenced by eating fish, because fish (particularly certain deep sea fish) may contain mercury.

The **Urine Mercury Test** only measures exposure to elemental and inorganic mercury. Organic mercury is not passed out the body in the urine and thus cannot be measured this way. A person with no exposure to mercury would probably have a urine mercury level of 0 to 20 ug/L. The Health Department requires reporting of levels above 20.

APPENDIX
RECOMMENDED MEDICAL MONITORING FOR WORKERS EXPOSED TO METALLIC AND INORGANIC MERCURY

Medical monitoring is the periodic evaluation of exposed workers to insure that they are experiencing no adverse effects of potentially hazardous workplace exposures. It serves as back-up for a program of routine air and biologic monitoring, which are the primary means for insuring that exposure levels are below those associated with adverse health effects. A medical monitoring program should be designed to detect adverse effects of exposure as early as possible, at a stage where they are still reversible, so that exposures can be controlled and serious permanent adverse effects prevented.

Baseline and periodic examinations

An initial medical examination should be performed on all employees exposed to potentially hazardous levels of mercury. The purpose of this examination is to provide a baseline for future health monitoring.

The examination should include a complete medical history and symptom questionnaire, with emphasis on the nervous system (target organ for chronic exposure), the kidneys (target organ for acute and chronic exposure), the oral cavity (target organ for chronic exposure), the lungs (target organ for acute exposure), the eyes (affected by chronic exposure), and the skin (since mercury is a known skin sensitizer). Signs and symptoms of the earliest signs of mercury intoxication should be elicited; these include personality changes, weight loss, irritability, fatigue, nervousness, loss of memory, indecision, and intellectual deterioration. Complaints of tremor and loss of coordination should also be sought. Physical examination should focus on the target organs described above. A baseline handwriting sample should be obtained. Laboratory evaluation should include at minimum a complete urinalysis (see below).

This examination should be repeated annually. Results should be compared with the findings on the baseline examination for changes suggestive of mercury toxicity. Handwriting samples should be compared to the baseline sample for evidence of tremor. Interim evaluations should be conducted if symptoms suggestive of mercury intoxication are occurring.

Confidentiality of Medical Information

Questionnaire and physical examination results for periodic examination should be compared to the baseline examination to detect any change which might be attributed to mercury intoxication. The results should be conveyed in detail to the worker. The employer should be informed by the examining physician if mercury intoxication is suspected on the basis of symptoms or results of the physical examination or laboratory tests. If intoxication is suspected, the worker should be removed from exposure and expert medical consultation should be sought. Otherwise, the results of the physical exam should be kept confidential, and no management personnel other than health professionals should have access to the medical records.

Importance of evaluating group results

The results of the questionnaire and physical examination should also be evaluated on a group basis. This is important because early mercury poisoning might cause only very mild, clinically insignificant increases in symptomatology in each individual which, when seen in the aggregate, might provide an important clue that toxic exposure to mercury is taking place.

Who should perform the medical examinations
All medical monitoring of exposed employees should be conducted by a physician knowledgeable in occupational medicine. In particular, interpretation of the group data should be undertaken only by a trained occupational health physician or other physician with expertise in performing such analyses.

**Using more sensitive medical tests**

Several studies have shown that some special tests may be useful in detecting early signs of mercury toxicity.

Neurobehavioral tests, designed to detect early changes in concentration, response time, memory, and hand-eye coordination, can be useful on both an individual and a group basis in detecting early nervous system effects of mercury exposure.

Early kidney damage may be detected by looking for the presence of low molecular weight proteins in the urine. The presence of these proteins in the urine indicates that kidney damage has occurred long before a routine urinalysis indicates an abnormality. Beta2 microglobulin and N-acetyl-B-D glucosaminidase (NAG) are two of the proteins which can be measured in the urine. The tests are useful on both an individual and group basis.

These special tests should be arranged and interpreted by a trained occupational physician or other physician with special expertise in these areas.

**BIOLOGIC MONITORING**

Biologic monitoring is the measurement of a chemical agent in the blood, urine, or other body tissue of exposed individuals to determine how much of the chemical has been absorbed into the body. It serves as a back-up to environmental exposure measurements, since air measurements cannot assess skin exposure or the effects of protective equipment and work practices. Since it measures the amount of an agent actually absorbed into the body, it is usually a better estimate of risk for adverse health effects than air monitoring.

There is no ideal biologic monitor for evaluating the risks of mercury intoxication from metallic or inorganic mercury. Mercury can be measured in both blood and urine. Individual levels may vary greatly from day to day and even within a given day. While proper interpretation of the results can be difficult, the measurements can nevertheless provide information on potential overexposure. Measurements should be carried out regularly (several times per year) in chronically exposed workers, and individual as well as group results should be evaluated. Baseline levels should be obtained before exposure begins for comparison purposes.

**Mercury in Urine**

Measurement of mercury in urine is the recommended biologic monitor for workers exposed to metallic and inorganic mercury. Ideally, the collection should be over 24-hours, but this is seldom feasible. Spot urine samples may also be taken, but care must be taken to always collect them at the same time of day near the end of the work week after several months of steady exposure. Overnight samples may also be collected; this collection extends from the time the employee goes to bed through the first urination of the morning.

Samples must be collected in containers provided by the laboratory, since a preservative must be added.
At least 25 cc of urine must be collected. Great care must be taken to prevent contamination of the sample containers or the urine with mercury from the skin or workplace air.

When results are interpreted, the urine values should be corrected for grams of creatinine in the sample, and should be expressed as ug Hg/gram creatinine. In persons not occupationally exposed to mercury, urine levels rarely exceed 5 ug/g creatinine.

While many laboratories indicate that only levels above 150 ug/L should be considered toxic, there is strong evidence that early signs of mercury intoxication can be seen in workers excreting more than 50 ug Hg/L of urine (standardized for a urinary creatinine of 1 gram/L). This value of 50 ug/g creatinine is proposed by many experts as a biological threshold limit value for chronic exposure to mercury vapor, and in 1980 this was endorsed by a World Health Organization study group.

Exposed individuals with levels above 50 ug/g creatinine should be placed in a non-exposed job until the reason for their overexposure has been identified and corrected and their urine levels have fallen below the biologic threshold limit value.

**Mercury in blood**

The concentration of mercury in blood reflects exposure to organic mercury as well as metallic and inorganic mercury; thus it can be influenced by the consumption of fish containing methylmercury.

Samples should always be taken at the same time of day near the end of the work week after several months of steady exposure. The blood should be collected in mercury-free heparinized tubes after careful skin cleansing.

In unexposed individuals, the amount of mercury in blood is usually less than 2 ug/100 ml. According to some experts, an average airborne concentration of 50 ug/m3 corresponds to a mercury concentration in blood of about 3-3.5 mg/100 ml. Early effects of mercury toxicity have been found when the blood concentration exceeds 3 ug/100 ml. Any worker exceeding this level should be placed in a non-exposed job until dietary and workplace exposures have been evaluated and blood levels have returned to baseline.

**Removing Employees from Exposure**

An individual who must be removed from mercury exposure because of elevated blood or urine mercury levels or physical examination results suggesting early mercury intoxication should be given alternative work with no exposure. His or her wages, benefits and seniority should be maintained. No employee should be terminated or otherwise punished because of overexposure to mercury.

In the event that no job without mercury exposure is available, the employee may continue to work using a supplied air respirator, provided that biological monitoring results and/or symptoms display a satisfactory decline over time.