



U. S. Department of Labor  
Occupational Safety and Health Administration  
Directorate of Science, Technology and Medicine  
Office of Science and Technology Assessment

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## Preventing Adverse Health Effects From Exposure to Beryllium on the Job

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Hazard Information Bulletin

**WARNING!**  
**INHALING BERYLLIUM DUST OR FUMES MAY CAUSE SERIOUS,  
CHRONIC LUNG DISEASE AMONG EXPOSED WORKERS;  
THIS LUNG DISEASE CAN BE FATAL.  
BERYLLIUM CAN ALSO CAUSE LUNG CANCER.**

September 2, 1999

The Occupational Safety and Health Administration (OSHA) has recently obtained information suggesting that OSHA's current 2 micrograms per cubic meter of air (micrograms/m<sup>3</sup>) eight-hour time-weighted average (TWA) permissible exposure limit (PEL) for beryllium in the workplace may not be adequate to prevent the occurrence of chronic beryllium disease (CBD), a disabling and often fatal lung disease, among exposed workers.

OSHA is publishing this Hazard Information Bulletin to alert employees working with beryllium about the hazards associated with their work. It describes engineering controls, work practices, and personal protective equipment recommended for controlling exposures to beryllium through inhalation and skin contact. It also suggests health surveillance methods to identify workers who may have become sensitized to beryllium, or who may have CBD.

### Background

Beryllium is a metal that is found in nature, especially in beryl and bertrandite rock. It is extremely lightweight and hard, is a good conductor of electricity and heat, and is non-magnetic. These properties make beryllium suitable for many industrial uses, including: *metal working* (pure beryllium, copper and aluminum alloys, jet brake pads, aerospace components); *ceramic manufacturing* (semi-conductor chips, ignition modules, crucibles, jet engine blades, rocket covers); *electronic applications* (transistors, heat sinks, x-ray windows); *atomic energy applications* (heat shields, nuclear reactors, nuclear weapons); *laboratory work* (research and development, metallurgy, chemistry); *extraction* (ore and scrap metal); and *dental alloys* (crowns, bridges, dental plates); and *sporting goods* (golf clubs, bicycle frames).

### Current Exposure Limits

The current OSHA PELs for beryllium are 2 micrograms/m<sup>3</sup> as an 8-hour TWA, 5 micrograms/m<sup>3</sup> as a ceiling not to be exceeded for more than 30 minutes at a time, and 25 micrograms/m<sup>3</sup> as a peak exposure never to be exceeded. The OSHA limits have been in place for nearly 30 years and have not been revised in that time. The American Conference of Governmental Industrial Hygienists (ACGIH) current Threshold Limit Value (TLV)<sup>\*</sup>

## POTENTIAL ADVERSE HEALTH EFFECTS FROM EXPOSURE TO BERYLLIUM

for beryllium is 0.05 micrograms/m<sup>3</sup> averaged over an 8-hour work shift [*updated 02/23/2010*].

### **Potential Adverse Health Effects From Beryllium Exposure**

#### **Chronic Beryllium Disease**

Chronic beryllium disease (CBD) primarily affects the lungs. CBD may occur among people who are exposed to the dust or fumes from beryllium metal, metal oxides, alloys, ceramics or salts. It occurs when people inhale beryllium in these forms. CBD usually has a very slow onset, and even very small amounts of exposure to beryllium can cause the disease in some people. In some cases, CBD develops while workers are still on the job, but in others it may not develop until many years after a person has stopped working in the beryllium industry, or has been transferred to a job that does not involve beryllium exposure. The amount or length of exposure to beryllium necessary to cause a specific individual to develop CBD is not known, but recent information suggests that exposure below OSHA's 2 micrograms/m<sup>3</sup> TWA PEL over a very short time (weeks or months) can lead to CBD in some workers.

#### ***Signs and Symptoms of Chronic Beryllium Disease***

Workers with advanced CBD may have one or more of the following symptoms: unexplained cough; shortness of breath, especially with activity; fatigue; weight loss or loss of appetite; fever; or night sweats. However, because the disease may develop slowly over a period of many years, workers may have the disease for a long time without knowing it.

#### **Beryllium Sensitization**

CBD only develops in workers who have become sensitized to beryllium. A sensitized worker is one who has developed an allergic reaction to beryllium. A worker may become sensitized at any point during job exposure, or in some cases may not become sensitized until after leaving a job where there has been beryllium exposure. Beryllium sensitization can be detected through the use of a blood test called the BeLPT, which stands for beryllium lymphocyte proliferation test. This test measures how specific white blood cells called lymphocytes react to beryllium. A positive test result means that a worker is sensitized.

#### **Acute Beryllium Disease**

Acute beryllium disease usually has a quick onset and has symptoms that resemble those of pneumonia or bronchitis. The acute form of the disease is believed to occur as a result of exposures well above the current PEL. This form of beryllium disease is now rare.

#### **Cancer**

Studies of workers exposed to beryllium have demonstrated significantly elevated risks of lung cancer. The International Agency for Research on Cancer (IARC), the expert cancer agency of the World Health Organization, has concluded that exposure to beryllium can cause lung cancer in humans.

#### **Skin disease**

A skin disease, which is characterized by poor wound healing and a rash or wart-like bumps, can occur as a result of the skin being exposed to beryllium dust.

#### **Recommendations**

OSHA recommends the following measures to reduce exposure to beryllium in the workplace and to determine whether workers have beryllium sensitization or CBD.

#### **1. Engineering Controls**

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Employers should use appropriate engineering controls and work practices to ensure that worker exposures to beryllium are maintained below the current OSHA PELs to the extent feasible. The following engineering controls and practices should be used by employers:

- enclose processes;
- design and install appropriate local exhaust ventilation;
- use vacuum systems in machining operations;
- use pellets instead of powders wherever possible;
- use product substitution where possible;
- minimize the number of workers who have access to areas where there is a potential for beryllium exposure;
- monitor employee exposures to airborne beryllium dust and fume, using personal sampling techniques, on a regular basis to ensure that exposures are below the PELs and that proper respiratory protection is being used where necessary.

### **2. Work Practices to reduce beryllium exposure**

Employers should ensure that employees use the following safe practices to reduce their exposure to beryllium:

- use high-efficiency particulate air (HEPA) vacuums to clean equipment and the floor around their work areas;
- do not leave a film of dust on the floor after the water dries if a wet mop is used to clean;
- do not use long vacuum hoses and do not loop the hoses that are used;
- do not disconnect or disable the vacuum system during any machining operation;
- never use compressed air to clean parts or working surfaces;
- avoid prolonged skin contact with beryllium particulate; and
- do not allow workers to eat, drink, smoke, or apply cosmetics at their work stations.

### **3. Hygiene and Personal Protective Clothing**

OSHA is aware of CBD cases that have occurred among family members of beryllium-exposed workers. To reduce "carry-home" exposures, employers should provide showers, clean work clothes, and clean areas for storing street clothes. Protective clothing should be provided to employees who work in areas where beryllium-containing powders are used and where there is a potential for spills. In addition, employers should ensure that employees:

- change into work uniforms before entering their work area;
- place their uniforms in a labeled bin with a cover at the end of the work shift;
- shower and change into street clothes prior to leaving the facility;
- wash their face, hands, and forearms before eating, smoking, or applying cosmetics;
- keep their work clothes as clean as possible during the workshift;
- wipe off their shoes before leaving the work area; and
- do not wear their work uniform (including their work shoes) outside of the facility.

### **4. Respiratory Protection**

Recent data suggest that exposures to beryllium even at levels below the 2 micrograms/m<sup>3</sup> PEL may have caused CBD in some workers. Therefore, employers should consider providing their beryllium-exposed workers with air-purifying respirators equipped with 100-series filters (either N-, P-, or R-type) or, where appropriate, powered air-purifying respirators equipped with HEPA filters, particularly in areas where material containing beryllium can become airborne.

### **5. Training**

## POTENTIAL ADVERSE HEALTH EFFECTS FROM EXPOSURE TO BERYLLIUM

Employers should give employees exposed to beryllium training and information about the following items:

- material safety data sheets (MSDSs) for beryllium;
- the fatal lung disease that may occur as a result of exposure;
- the availability of the BeLPT blood test to determine whether an exposed worker has become sensitized to beryllium;
- the potential for developing lung cancer as a result of exposure;
- the importance of avoiding skin contact;
- the engineering controls the employer is using to reduce worker exposures to beryllium;
- specific work practices that can be used to reduce exposure to beryllium;
- the use of appropriate protective equipment, including the use of respirators;
- the results of any industrial hygiene sampling for levels of beryllium in the workplace; and
- a copy of this Hazard Information Bulletin.

### **6. Health screening methods for beryllium sensitization and chronic beryllium disease**

#### ***To the Employer:***

Employers should consider sending beryllium-exposed employees to a physician or other licensed health care professional to be evaluated for beryllium sensitization or the presence of CBD. The screening examination for CBD usually begins with a chest x-ray and a blood test for beryllium sensitization, namely, the BeLPT, plus any further evaluation considered appropriate by the health care professional. The blood test can detect an adverse health response to beryllium exposure earlier than breathing tests or chest x-rays can. The BeLPT is not routinely done in most medical laboratories; however, the health care professional may order this test from any laboratory that has overnight courier service to one of the Medical Research Centers listed below. If a worker is sent to a health care professional for health screening, a copy of this Hazard Information Bulletin should accompany the employee.

#### ***To the Employee:***

If you work in a place where beryllium is used and have developed any of the symptoms listed below, you should inform your health care professional of your past beryllium exposure, or seek information from a health care professional who specializes in occupational lung diseases to determine whether you may have developed CBD:

- unexplained cough,
- shortness of breath,
- fatigue,
- weight loss or loss of appetite,
- fevers, and/or
- skin rash.

If you do not have any of the above symptoms but are concerned that you may have become sensitized to beryllium, you should inform your health care professional that you would like to be tested with the blood BeLPT. Take a copy of this Hazard Information Bulletin with you.

#### **Blood testing for beryllium sensitization**

Only the three medical research centers and the one laboratory listed below currently offer the blood test to identify beryllium-sensitized workers as indicated by a positive blood BeLPT. As other research centers and laboratories develop the capacity to screen workers for beryllium sensitization, they will be added to the list.

#### ***Medical Research Centers***

Cleveland Clinic Foundation

## POTENTIAL ADVERSE HEALTH EFFECTS FROM EXPOSURE TO BERYLLIUM

9500 Euclid Avenue, L-15  
Cleveland, Ohio 44195  
phone: (800) 628-6816

Division of Environmental and Occupational Health Sciences  
National Jewish Medical and Research Center  
Denver, Colorado 80206  
phone: (303) 398-1722

Pulmonary Immunology Laboratory  
Hospital of the University of Pennsylvania  
421 Curie Blvd.  
844 BRB II/III  
Philadelphia, Pennsylvania 19104  
phone: (215) 573-9875

### *Testing Laboratory*

Specialty Laboratories, Inc.  
2211 Michigan Avenue  
Santa Monica, California 90404-3900  
phone: (800) 421-4449

\*ACGIH TLV, American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Value (TLV) - 2009. Includes Biological Exposure Indices (BEIs), Sensitization, and Skin notations. For additional information, references, and footnotes, see the yearly printed ACGIH TLV® and BEIs® Booklet.