

**Advisory 12.5 Prevention of Adverse Health Effects from Exposure to
Beryllium and Beryllium Compounds**

Beryllium is a light, stiff, strong, hard metal that is found in nature especially in beryl and bertrandite rock. It is lighter than aluminum yet stiffer than steel, non-magnetic, transparent to X-rays, a good conductor of electricity and heat, and is easy to shape. Beryllium metal and ceramics made with beryllium were originally used primarily in the nuclear industry in reactors and nuclear weapons. However, the use of beryllium has expanded over time to include: metal working with pure beryllium metal and alloyed with copper or aluminum, in aerospace components, ceramics used in semi-conductor chips and jet engine blades, dental alloys for crowns and bridges, and sporting goods such as bicycle frames and golf clubs, plus many other uses. Beryllium and its compounds may be used or studied in chemistry, geology, physics, environmental health, medical/dental, and engineering laboratories.

In 1970 the Occupational Safety and Health Administration (OSHA) established the current eight-hour time-weighted average (TWA) permissible exposure limit (PEL) to beryllium and its compounds of 0.2 micrograms per cubic meter of air (29 CFR 1910.1000, Table Z-2). OSHA has recently received information indicating that this exposure limit may not be adequate to prevent the occurrence of chronic beryllium disease (CBD), a disabling and often fatal lung disease, among exposed workers.

The American Conference of Governmental Industrial Hygienists (ACGIH) has recently published a Notice of Intended Change for its Threshold Limit Value (TLV) for beryllium that would lower the TLV from the current level of 0.2 micrograms per cubic meter of air to **0.2 micrograms** per cubic meter of air averaged over an 8-hour work period.

(Note: 2.0 micrograms per cubic meter of air has been described as roughly equivalent to pulverizing a marble-size piece of material and dispersing it into an area that is 1 mile x 1 mile x 6 ft. The TLV is one-tenth times smaller of this amount in the same area.)

Chronic beryllium disease (CBD), caused by an allergic reaction to beryllium, usually has a slow onset. Even brief exposures to small amounts of beryllium dust or fumes from beryllium metal, metal oxides, alloys, ceramics, or salts can cause it. The likelihood of acquiring CBD increases with the level and length of exposure to these dusts or fumes. CBD can cause cough, shortness of breath, fatigue, loss of appetite, weight loss, fevers, heavy sweating during the night, as well as other symptoms and can be debilitating or fatal. Skin exposed to beryllium dust can develop a disease characterized by poor wound healing and a rash or wart-like bumps.

The International Agency for Research on Cancer (IARC) has concluded that exposure to beryllium can also cause lung cancer in humans.

OSHA's Hazard Information Bulletin issued in September 1999 recommends the following measures to reduce exposure to beryllium in the workplace:

- Engineering controls
- Work practices to reduce beryllium exposure
- Hygiene and personal protective clothing
- Respiratory protection
- Training
- Health screening for beryllium sensitization and chronic beryllium disease

ENGINEERING CONTROLS

Supervisors in University departments where beryllium and/or beryllium compounds are used, or their properties are studied shall use appropriate engineering controls and work practices to ensure that worker exposures to beryllium are maintained below the current OSHA PEL of 2.0 micrograms per cubic meter of air and shall work toward reducing exposures to the ACGIH-recommended TLV level of 0.2 micrograms per cubic meter of air. The following engineering controls and practices should be used:

- 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 (or other persons) who have access to areas where there is a potential for beryllium exposure
- Monitor employee exposure to airborne beryllium dust and fume, using personal sampling techniques, on a regular basis to ensure that exposures are below the PEL's and that proper respiratory protection is being used where necessary.

WORK PRACTICES TO REDUCE BERYLLIUM EXPOSURE

Supervisors in University departments where beryllium and/or beryllium compounds are used, or their properties are studied shall insure 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 work areas
- Insure that a film of dust is not present on the floor after the water dries if a wet mop is used for cleaning
- Do not use long vacuum hoses and do not loop the hoses that are used
- Do not disconnect or disable the vacuum system during machining operations at any time
- Never use compressed air to clean parts or working surfaces
- Avoid prolonged skin contact with beryllium particulate
- Do not permit workers to eat, drink, smoke, or apply cosmetics in areas where beryllium or beryllium compounds are used.

Contact Environmental Health & Safety (556-4968) for assistance in implementing engineering controls and/or developing work practices to reduce exposures.

HYGIENE AND PERSONAL PROTECTIVE CLOTHING

CBD cases have occurred among family members of beryllium-exposed workers. Sanderson, et.al. found beryllium contamination inside vehicles and homes of machine shop workers.

Supervisors in University departments where beryllium and/or beryllium compounds are used, or their properties are studied shall insure that personnel shower facilities, clean work clothes, and clean areas for storing street clothes are available and used to prevent "carry-home" exposures. Persons who work in areas where beryllium-containing powders are used and where there is a potential for spills are to be provided with protective clothing.

Supervisors shall ensure that employees:

- Change into protective work clothes and shoes before entering the work area
- Keep work clothes as clean as possible during the work period and wipe off shoes before leaving the work area
- Eat, smoke, or apply cosmetics outside of the work area and wash their hands, forearms, and face before engaging in these activities
- Place work clothes in a covered container at the end of the work period
- Shower and change into street clothes prior to leaving the area where beryllium is used and do not wear protective work clothing or work shoes outside of the work area.

RESPIRATORY PROTECTION

Supervisors in University departments where beryllium and/or beryllium compounds are used shall refer to Advisory 11.1, Respiratory Protection Guidelines, for the procedures to follow for respiratory protection. After it has been determined that employees can wear respirators, OSHA recommends that workers exposed to beryllium be issued 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.

Contact Environmental Health & Safety (556-4968) for assistance in recommending appropriate hygiene practices or selecting protective clothing or respirators.

TRAINING

Supervisors in University departments where beryllium and/or beryllium compounds are used shall give training and information about the following items to employees who may be exposed to beryllium:

- Material safety data sheets (MSDS) for beryllium
- The fatal lung disease that may occur as a result of exposure
- The availability of the Beryllium Lymphocyte Transformation blood test (BeLPT) 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 being used by the University department 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 OSHA's Hazard Information Bulletin on this subject which can be accessed at: www.osha-slc.gov/dts/hib/hib_data/hib19990902.html

Contact Environmental Health & Safety (556-4968) for assistance in developing appropriate training.

HEALTH SCREENING FOR BERYLLIUM SENSITIZATION AND CHRONIC BERYLLIUM DISEASE.

Supervisors in University departments where beryllium and/or beryllium compounds are used are required to make all necessary arrangements for all employees who have been exposed to beryllium to be screened for Chronic Beryllium Disease (CBD) at UC Health at no cost to the employee. New employees in University departments where beryllium and/or beryllium compounds are used should receive a baseline physical exam and annual screening for CBD at UC Health. The screening examination for CBD usually includes a chest X-ray and a blood test for beryllium sensitization (BeLPT) plus any further examination considered appropriate. Contact UC Health at 513-585-6600.

REFERENCES:

- a) OSHA's Hazard Information Bulletin- Preventing Adverse Health Effects from Exposure to Beryllium on the Job. This bulletin is available on-line at:
www.osha-slc.gov/dts/hib/hib_data/hib19990902.html
- b) Sanderson, W., Henneberger, P., Martyny, J., Ellis, K., Mroz, M., and Newman, L.: Beryllium Contamination Inside Vehicles of Machine Shop Workers. *Applied Occupational and Environmental Health*, 14: 223-230, 1999.
- c) BE Symposium Advances Latest Health Effects Data, *ACGIH Today*, Vol. 7, No. 6, November, 1999.
- d) Wald, M.: Energy Dept. Will Cut Standard for Its Workers' Exposure to a Metal Tied to Lung Disease. *New York Times* on-line edition, December 8, 1999.