Biennial Refresher Training

Reading this booklet meets the biennial requirement for HS4258, Beryllium Awareness. The fact that you've received this booklet means you will receive LTRAIN credit for completing this training. Please read this booklet. If you prefer, you may receive this training by going online and taking the Beryllium Awareness web class, HS4258-W. The web class and this booklet contain the same important information.

Introduction

Beryllium is a naturally occurring metal used in aerospace, nuclear, electronics, automotive and other industries. It is used in many consumer products such as golf clubs and automotive air bags. As useful as beryllium is, it has one property that complicates its use; it can cause serious health problems to those who are exposed to airborne particles of it. The most common health problem is a respiratory disease known as Chronic Beryllium Disease or, CBD.

Because of this health risk, the Department of Energy through Title 10 of the Code of Federal Regulations Part 850 has indicated that all persons employed at a site where beryllium activities are performed shall be made aware of its presence and the associated health risks. Those Laboratory employees who are or were exposed or potentially exposed to airborne beryllium while working here or at another DOE facility must take HS4256, Beryllium Worker or HS4257, Beryllium Safety.

Course Goal

The goal is to make you aware of the presence and health risks of beryllium metal used here at LLNL and other DOE sites. This includes telling you of the controls the Lab uses to minimize these risks and providing you with resources for more information about beryllium disease and its prevention.

Objectives

Upon reading this information, you should be able to:

- Identify characteristics of beryllium.
- Indicate health hazards associated with beryllium.
- Identify beryllium regulated and beryllium work area signs.
- Identify controls used to minimize beryllium exposure.
- Recall that we have a beryllium disease prevention program here at LLNL.
- Identify where you can obtain more information on beryllium.

Chronic Beryllium Disease Prevention Program (CBDPP)

In December 1999, DOE's Chronic Beryllium Disease Prevention Program Rule became final and was published in Title 10 Part 850 of the Code of Federal Regulations (10CFR 850). The rule affects facilities such as LLNL with past, current or future beryllium operations. It requires LLNL managers to develop and implement a CBDPP that will reduce the occurrence of CBD. The program must:

- Reduce the number of people exposed to beryllium by limiting access to beryllium work and storage areas.
- Minimize worker exposures and the potential for exposure through engineering and administrative controls and personal protective equipment.
- Establish medical surveillance for exposed and potentially exposed workers to ensure early detection of the disease.
- Train workers.
- Monitor the effectiveness of the CBDPP in preventing CBD.

LLNL's Chronic Beryllium Disease Prevention Program

In September 2000, DOE approved LLNL's Chronic Beryllium Disease Prevention Program. You can review this document at the LLNL CBDPP web page.

On August 1, 2001, LLNL approved document 14.4, "Implementation of the Chronic Beryllium Disease Prevention Program Requirements," in the *ES&H Manual*. You must read the sections of this document that apply to you. The URLs for these documents are given in the "Getting More Information" section of this booklet.

What is Beryllium?

Beryllium is a silver-gray metallic element that occurs naturally in about 30 minerals. It is lightweight (lighter than aluminum), but stiffer than steel. It has a high melting point, conducts heat well, and is corrosion-resistant. Beryllium-containing minerals are found in rocks, coal, oil, soil, and volcanic dust. It is 46th in natural abundance in the earth's crust, slightly more than uranium or tin. Beryllium is a key element in gems such as blue-green aquamarine and green emeralds.

Many Products and Processes Use Beryllium's Properties

Beryllium metal has been produced for various industrial uses since the late 1950s. Both structural and instrument grade materials are manufactured, especially for use in aerospace and defense applications such as windshield frames and other structures in high-speed aircraft and space vehicles, aircraft and space shuttle brakes, satellite mirrors, space telescopes, inertial guidance systems and gyroscopes, neutron moderators or reflectors in nuclear reactors, X-ray windows, and nuclear weapons components.

Products at Home Contain Beryllium

In addition to industrial applications, beryllium alloys and compounds are used in products found at home. Some examples are: bicycles, golf clubs, jewelry, computer parts, automobile air bags, and dental bridges.

None of these products pose a health risk as long as you do nothing to create airborne beryllium particles. For example, a hand tool made of beryllium is perfectly safe to use, but if you sharpen it, beryllium particles could become airborne.

Beryllium Health Effects

The most significant disadvantage of beryllium use is its toxicity.

Unless adequate controls are used, small particles of insoluble beryllium-containing materials that break off during machining and other processes become airborne in the work area. Inhalation of these microscopic particles into your lungs may lead to serious health problems:

- Acute Beryllium Disease
- Lung Cancer
- Beryllium Sensitivity
- Chronic Beryllium Disease (CBD)

Acute Beryllium Disease

Between 1930 and 1950, it was discovered that workers who breathed air that had very high concentrations of soluble beryllium salts could develop a type of chemical pneumonia called acute beryllium disease. Its symptoms include coughing, burning and pain in the chest, and shortness of breath. Recovery could take a week to six months, with occasional recurrence of symptoms.

Generally, acute beryllium disease is a result of short-term, high-level exposure and the symptoms appear within a few days or weeks. It is very unlikely that anyone working in operations today will be exposed to concentrations high enough to cause acute beryllium disease, as engineering controls and work practices are much improved. This has not been an issue at LLNL.

Lung Cancer

While beryllium is considered a human carcinogen by several organizations, such as the American Conference of Governmental Industrial Hygienists, studies that show it can cause lung cancer involve exposure to much higher levels of beryllium than can cause CBD. Therefore, many agencies believe that controls that protect against CBD, such as those used here at LLNL, are more than enough to protect against lung cancer.

Beryllium Sensitivity

Exposure to beryllium dust may cause sensitization, an immune system response to beryllium. The beryllium proliferation test (Be-LPT) is a screening test that is used to determine if you are sensitized. Individuals who are sensitized to beryllium have white blood cells in the blood or lungs that react to beryllium. Medical studies have shown that even small amounts of beryllium particles breathed deeply into the lungs may trigger this sensitivity in 2 to 5 percent of people exposed. In studies of people in certain occupations where exposure to beryllium was greatest (for example, studies of machinists in beryllium operations), this figure rises to as much as 10 to 14 percent. Currently, there is no available test to determine who is at risk of becoming sensitive to beryllium. Blood tests can only indicate individuals who are already sensitized to beryllium.

Chronic Beryllium Disease

Chronic Beryllium Disease (CBD) occurs in individuals who have become allergic or sensitized to beryllium upon exposure. This means these individuals have white blood cells in the blood or lungs that react to beryllium. This reaction can cause the lungs to become inflamed and develop scar tissue, which can hinder the transfer of oxygen when breathing. Although current DOE medical surveillance programs are identifying more people who are sensitized to beryllium-— but not sick with CBD -—some individuals already have CBD by the time they are evaluated for beryllium sensitization or lung symptoms.

CBD Can Take Many Years To Develop

The average time from first beryllium exposure to the development of symptoms (latency period) of CBD is 10 to 15 years. This means you can be exposed to beryllium today and not suffer any health effects for decades. Health effects have appeared in some people within a few months of exposure, but as long as 30 years later in others. Doctors and researchers believe that some individuals who have had CBD lived with the disease and died from other causes without even knowing they had CBD. At this time there is no way to determine who is susceptible to beryllium prior to exposure. Therefore, DOE and LLNL assume that all workers may be susceptible, and have implemented controls to protect us all.

Symptoms of Chronic Beryllium Disease

CBD symptoms resemble those of other lung diseases, particularly a disease called sarcoidosis. Studies have found that in some cases doctors have mis-diagnosed CBD as sarcoidosis or other disease.

The most common symptoms are persistent coughing and shortness of breath with exertion. Other symptoms may include fatigue, chest and joint pain, blood in the sputum (saliva, mucus, and other discharges coughed up from the respiratory system), rapid heart rate, loss of appetite, fevers and night sweats.

Please remember that the true diagnosis of CBD can only be made through medical tests specific for beryllium disease. CBD is rare and it is unlikely that a person exhibiting the above symptoms actually has the disease.

Treatment of Chronic Beryllium Disease

CBD can be treated, but not cured. Treatment is only started when a person is having significant symptoms. Steroids, which suppress the immune system, are often used. If successful, treatment can slow the progress of CBD by reducing the buildup of scar tissue and delaying permanent lung damage. Some individuals diagnosed with CBD may never become sick enough to require treatment.

Unfortunately, many people do not respond well to or tolerate the side effects of long-term steroid treatment. Each individual's overall health and medical history will determine what is best for that person. Individuals with insufficient levels of oxygen in their blood as a result of CBD may need supplemental oxygen to protect their heart from damage and help them breathe.

Once you develop CBD, the disease is not reversible, but early diagnosis and treatment are expected to reduce adverse health effects and improve your prognosis.

Beryllium Use at LLNL

As noted earlier, beryllium is used in nuclear weapons technology, so some activities that involve its use take place at LLNL. Machining, powder pressing, laser cutting, sputtering, welding, and mechanical testing are done at LLNL. Predominantly, beryllium is used in the Engineering and the Defense and Nuclear Technologies areas. To a lesser amount, it is found in Chemistry & Material Science and Lasers. Some beryllium activities involving LLNL take place at Y-12 and Pantex, as well as other DOE sites. Employees most likely to be exposed to beryllium activities are scientists, engineers, technicians, craftsmen, maintenance workers, custodial workers, management, and support staff that work in areas where beryllium is used. To find out if beryllium is used in or near your work area, contact your ES&H team industrial hygienist.

Beryllium Monitoring at LLNL

The Beryllium Rule requires LLNL to do two things to determine potential beryllium exposure:

- Conduct a baseline inventory of areas where beryllium is used or areas with beryllium contamination and
- Conduct a hazard assessment and identify workers who may be exposed to beryllium in those locations. In areas where the inventory and hazard assessments indicate the possibility of airborne beryllium, we must monitor the air for beryllium in the workers' breathing zones.

Beryllium Air Sampling Results

Only occasionally are detectable amounts of beryllium found. Typically, personal samples are below the Rules Action Level (AL=0.2$\mu g/m^3$) and most often below the detection limit of the analytical assay. Occasionally, results are above the Action Level, and only very few exposures above the Rule's Permissible Exposure Level (PEL= 2$\mu g/m^3$).

Beryllium Medical Monitoring Results

Worker exposure data and sensitization data are reviewed regularly to identify LLNL work groups who are at risk for beryllium sensitization and CBD, Medical monitoring results as of December 2003,are shown below.

- Former employees:

Of the 1,750 who have taken the tests, 53 are sensitized and there is one confirmed case of CBD.

- Current Employees:

  Of the 482 who have taken the tests 9 are sensitized, and there is one confirmed case of CBD.

Controlling Beryllium Exposure

LLNL and the Department of Energy both have mandated that exposure to beryllium particles, dust, and fumes be minimized to the greatest extent possible. For those of us who do not normally work with or around beryllium, the best defense is simply to not enter beryllium work areas. LLNL uses the following types of controls to ensure employee safety and minimize beryllium exposure to all employees entering beryllium work areas or working around beryllium. These controls are applied in the order listed below.

- Engineering controls
- Administrative controls
- Personal protective equipment

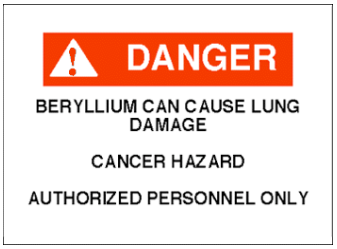
Engineering Controls

Engineering controls are designed to physically prevent any beryllium particles from entering the atmosphere. Some examples are:

- Enclosing all beryllium work.
- Employing exhaust hoods and high efficiency particulate air (HEPA) filters.
- Capturing beryllium dust at the machine-tool interface.
- Employing wet machining techniques and sticky coolants.
- Performing wet grinding in a ventilated negative-pressure enclosure.

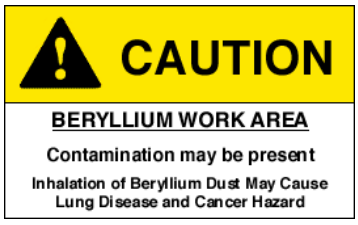
Administrative Controls

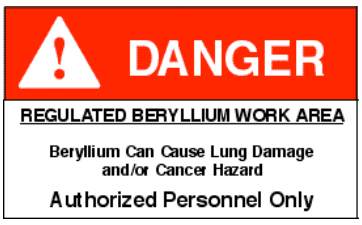
Some administrative controls are employed to minimize exposure. Examples are signs posted where beryllium is used. You should always obey these signs.



Beryllium Regulated Area Signs

Below are signs indicating Beryllium Work and Beryllium Regulated areas. If you see such signs, do not enter the area unless you are authorized to do so.





Beryllium Content Sign

This is a label you might see on a container of beryllium, beryllium compounds, or beryllium-contaminated clothing, equipment, scraps, or debris. Obviously, you

would not handle something like this unless it was part of your job and you received special training on the proper controls to do the work.

Personal Protective Equipment

Personal Protective Equipment, or PPE, is not only used to protect workers, but helps prevent taking beryllium outside the work area and potentially exposing other workers or their families. Some examples are:

- Respirators
- Gloves
- Lab coats

Beryllium Prevention Program

You can find the LLNL CBDPP web page at:

http://www.llnl.gov/Be-prevention/home.html

There you will find information on the following topics:

- Facts about beryllium.
- Beryllium controls employed at LLNL.
- A beryllium occupational exposure survey.
- Frequently asked questions (FAQs).
- Other useful web links.

If you wish more information regarding beryllium at LLNL, consult this site. It is the definitive source of information on beryllium here at the Laboratory.

Getting More Information

For more information on beryllium, first consult LLNL's Chronic Beryllium Disease Prevention Program web page. If you wish to know more about beryllium disease, you may contact Health Services. If you think you may have been exposed to beryllium here at LLNL or at a previous job, you should contact Health Services.

At the following web sites you can find other perspectives as well as both historical and current information on beryllium, beryllium-related activities, and Chronic Beryllium Disease.

- LLNL Beryllium Disease Prevention Program http://www.llnl.gov/Be-prevention/home.html
- LLNL Lessons Learned http://www-r.llnl.gov/es_and_h/lessons/lessons.shtml
- Document 14.4, Implementation of the Chronic Beryllium Disease Prevention Program requirements in the *ES&H Manual* http://www.llnl.gov/es_and_h/hsm/doc_14.04/doc14-04.html
- DOE Chronic Beryllium Disease Prevention Program http://tis-nt.eh.doe.gov/be/)
- Occupational Disease Benefits for Energy Workers Initiative http://www.eh.doe.gov/benefits/
- OSHA Hazard Information Bulletins http://www.osha-slc.gov/dts/hib/hib_data/hib19990902.html
- Brush Wellman http://www.brushwellman.com/index.asp
- Brush Wellman Health and Safety Information http://www.brushwellman.com/ehs/bhsi.nsf
- Brush Wellman Beryllium Facts http://www.befacts.com/

Summary

Beryllium is a naturally occurring metal used in industrial, aerospace, and nuclear weapons applications. It is used at LLNL.

Inhaling fine beryllium particles can lead to beryllium sensitization and chronic beryllium disease (CBD). The symptoms of CBD may not become evident for years.
Signs are posted in all areas where beryllium activities take place. Always obey these signs.

LLNL uses engineering controls, administrative controls, and personal protective equipment to minimize exposure to beryllium. These controls include exhaust ventilation, contained milling and grinding, training, signs, air monitoring, gloves, and respiratory protection.

There is a chronic beryllium disease prevention program (CBDPP) here at LLNL.

Other resources available to you for obtaining more information about beryllium include the CBDPP web page here at LLNL, DOE's web site, LLNL Health Services, and the Hazards Control ES&H Team assigned to your area.