

Welcome to the Hard Hat Training Series!



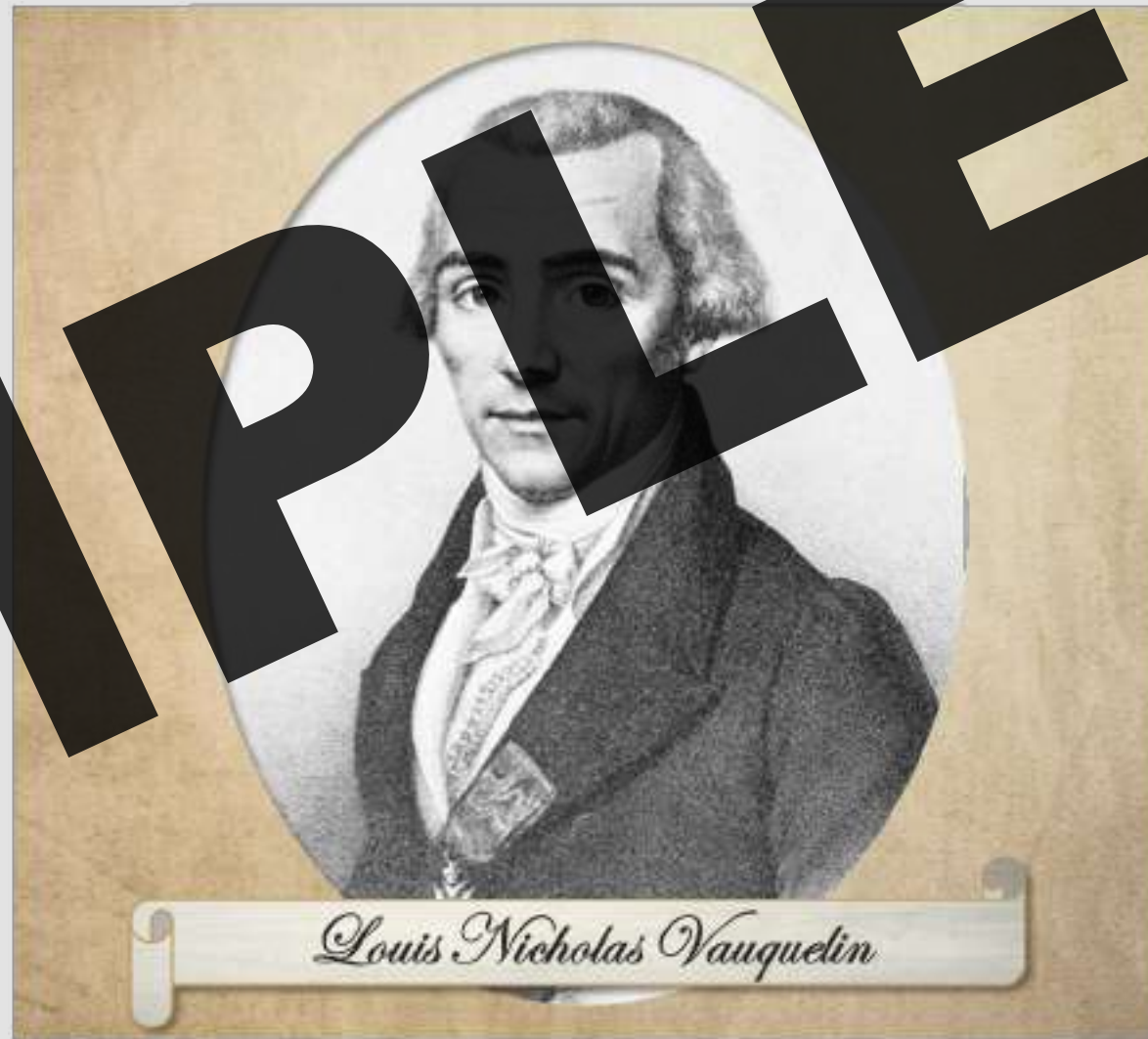
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Welcome to the Hard Hat Training Series. Today we will discuss a few principles regarding beryllium, including where you will find it, the threats it poses to your body, and how to avoid exposure to it.

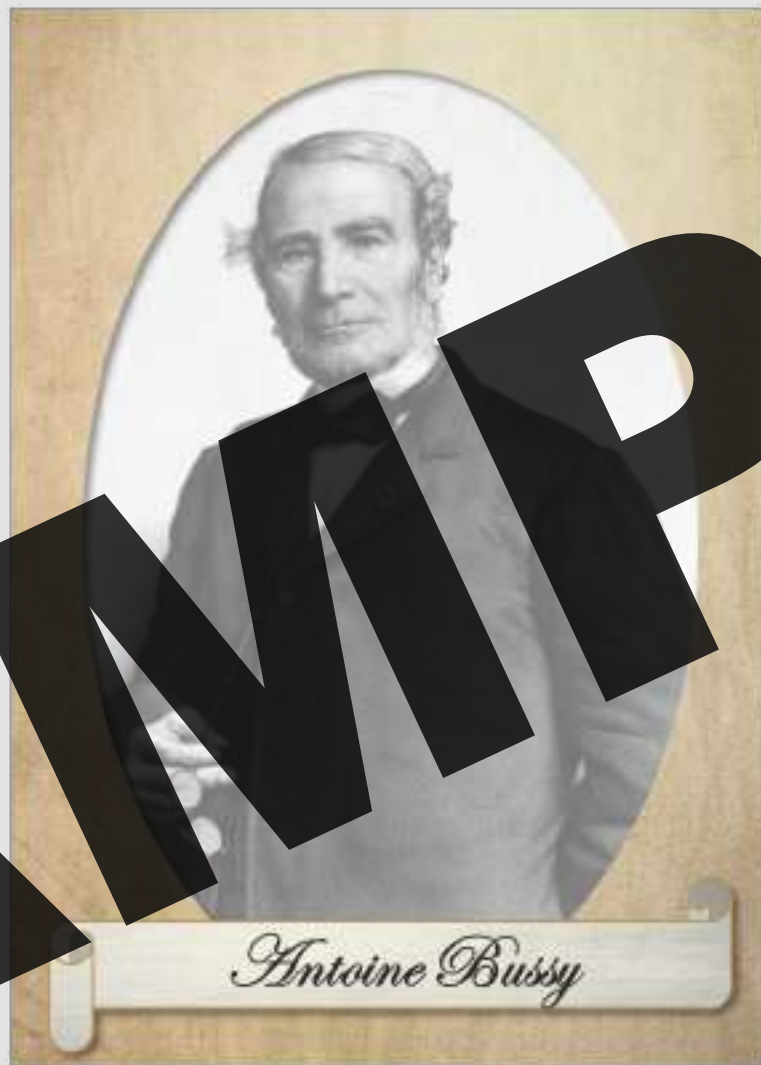
In the late 18th century, Louis Nicholas Vauquelin was studying beryl and emerald. A colleague believed that these gemstones could contain a new element, so Vauquelin analyzed them and found a new metal, though he didn't figure out how to isolate it. He announced his discovery at the French Academy in 1798 and named it glaucinium after the Greek word, *glykys*, because its compounds tasted sweet. Other chemists proposed the name "beryllium" instead.



Image Courtesy of Rob Lavinsky (CC 3.0)

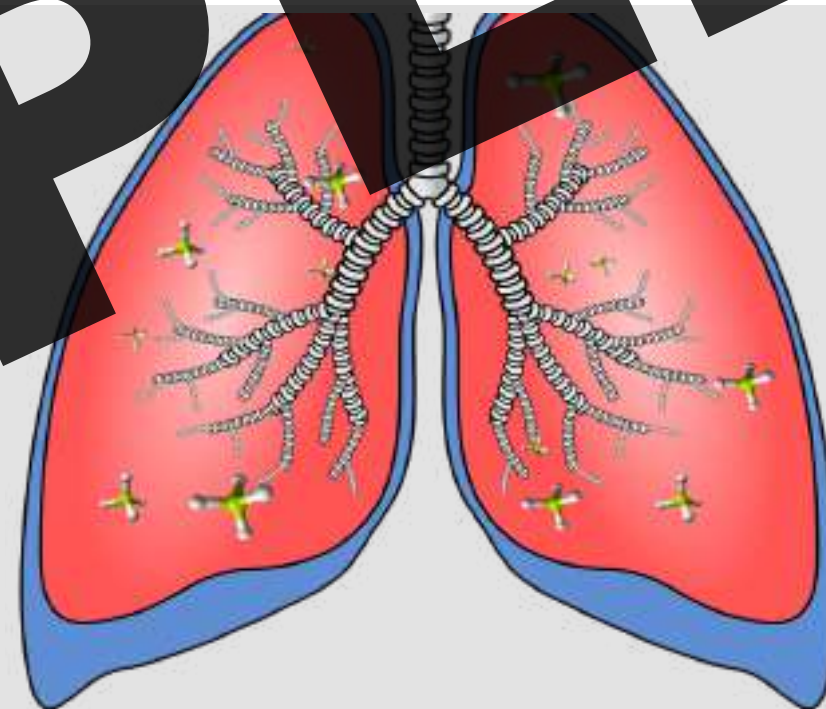


In 1828, Antoine Bussy and Friedrich Wöhler figured out how to isolate beryllium from beryllium chloride. After careful study, scientists discovered that beryllium is incredibly versatile; it has a high melting point, high heat capacity, and high heat conductivity. It earned the name “the miracle metal.”





In spite of its versatility, beryllium dust and fumes are incredibly toxic to the lungs. Inhaling this substance causes the body's immune system to become sensitized. When a sensitized individual is repeatedly exposed to beryllium, their condition can eventually develop into severe lung disease or even cancer.



What is Beryllium?

Beryllium is a steel-gray metal that is fairly soft and low density. It is one of the core elements you can find in the Earth's crust in small concentrations. However, as we just mentioned, beryllium does not occur on its own in nature. It has to be extracted from minerals such as beryl and bertrandite.



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Image Courtesy of Erich Berger (CC 3.0)

Beryllium ore processing produces beryllium metal, beryllium oxide, and beryllium alloys. Each form of the element have different applications, which we will discuss briefly as we look its useful properties.



INDUSTRIES USING BERYLLIUM:

- + Aerospace
- + Automotive
- + Ceramic
- + Defense
- + Dental Labs
- + Electronics
- + Energy
- + Medicine
- + Nuclear Energy
- + Sporting goods
- + Telecommunications



Useful Properties

Before scientists discovered the harmful effects of beryllium exposure, it became a vital material used by industries pictured on the left. Industries found the metal to live up to its name when they learned it is stronger than steel and lighter than aluminum. Now, beryllium is used as a pure metal, a beryllium oxide, and an alloy with copper, aluminum, magnesium, or nickel.

The United States is the largest global producer of beryllium. It is extracted from bertrandite ore in the U.S. and from beryl ore throughout the rest of the world. Because of its strength and light weight, it is often used in high tech items.



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Beryllium Metal Products

As we've already emphasized, beryllium is extremely lightweight and strong. These properties make it ideal structural components in high-speed aircraft, guided missiles, spacecraft, nuclear weapons, and satellites.

Beryllium has a low atomic weight, which allows it to transmit X-rays. Because of this property, it is nearly transparent to X-rays and can be used to create windows in X-ray tubes. It is also used to produce gyroscopes, accelerometers, and computer parts used on missiles, aircrafts, and rockets. Beryllium acts as a great heat sink, allowing it to work in heavy-duty brake drums.

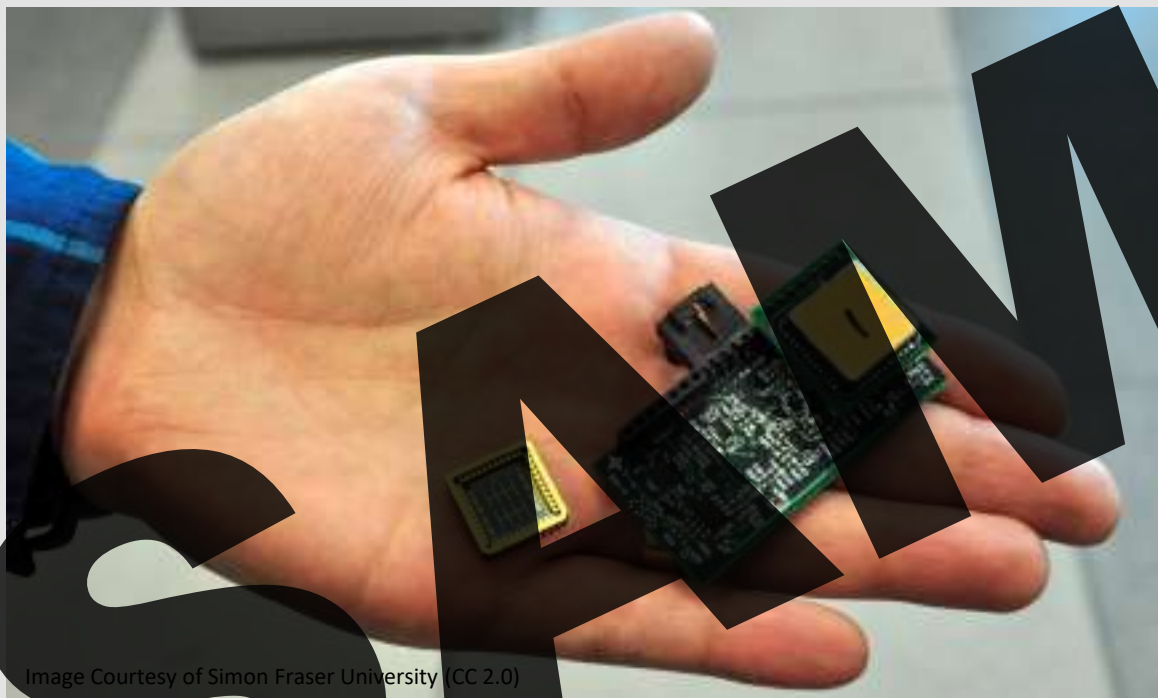


Image Courtesy of Simon Fraser University (CC 2.0)

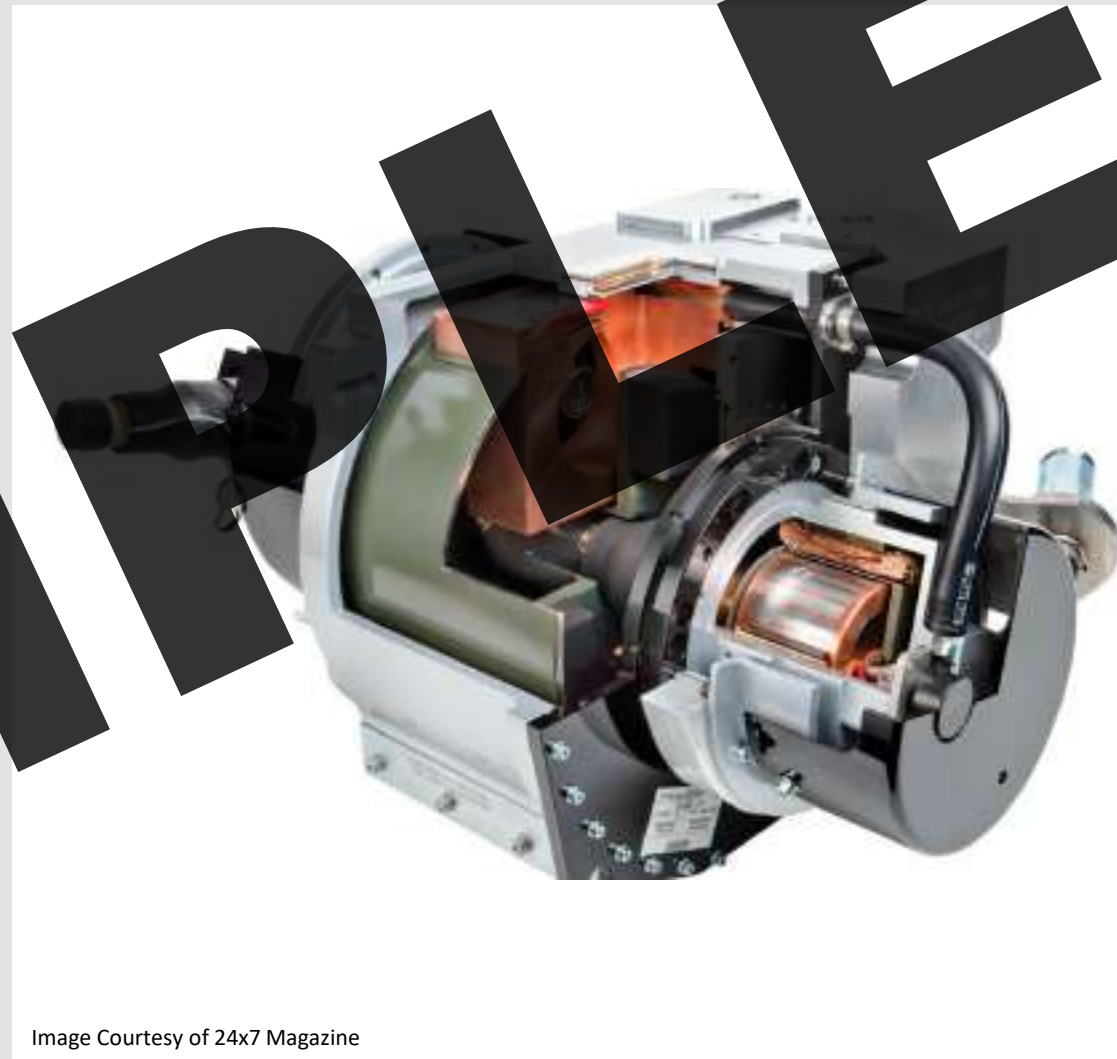
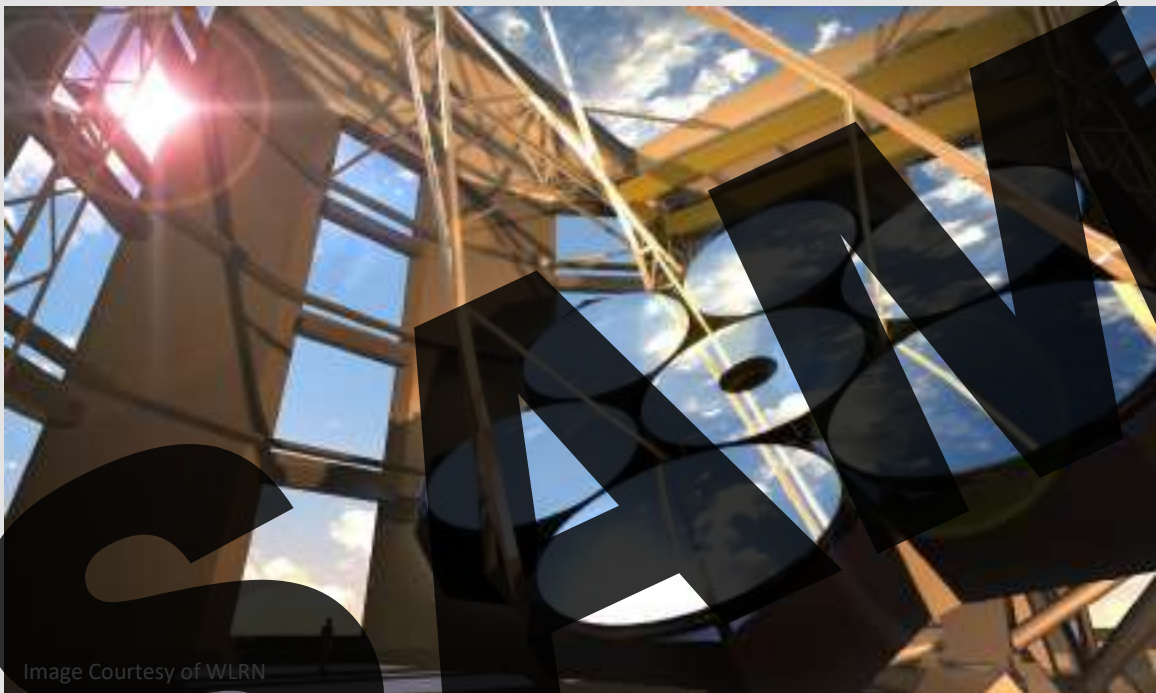


Image Courtesy of 24x7 Magazine

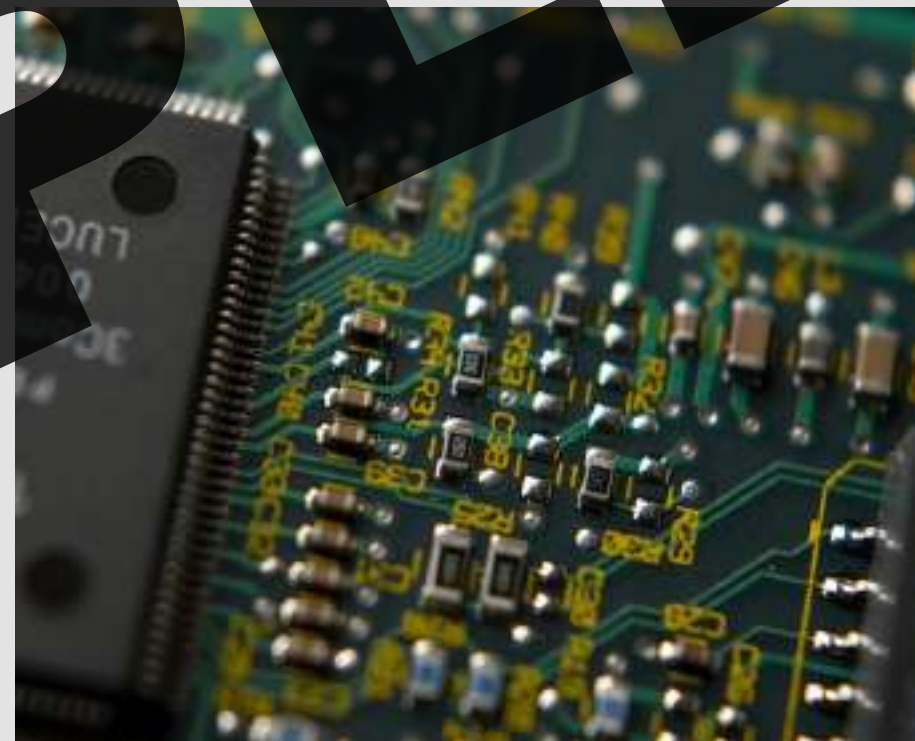
Beryllium Oxide Products

Beryllium oxide occurs in nature as bromelite. In its solid state, it looks like a white powder. Its main application is in ceramics. For example, it is used in rocket engines as a transparent coating on telescope mirrors.





Beryllium oxide has a high melting point. This makes it very handy in the nuclear industry. It can slow down fast neutrons in nuclear reactors. It is also useful in creating items like semiconductor parts used in electronics and microelectronics.



Beryllium Alloy Products

The most common beryllium alloy you will come across is beryllium copper (BeCu). It is sometimes referred to as copper beryllium, beryllium bronze, and spring copper. Because it is the most common alloy, we will focus on this one in particular. It is used in various parts that must endure repeated stress without becoming deformed or weakened.



Beryllium copper is the ideal material for tools used in explosive environments such as oil rigs, coal mines, and grain elevators. It is also used in percussion instruments like tambourines and triangles, molds for plastic containers, armor piercing bullets, and more.

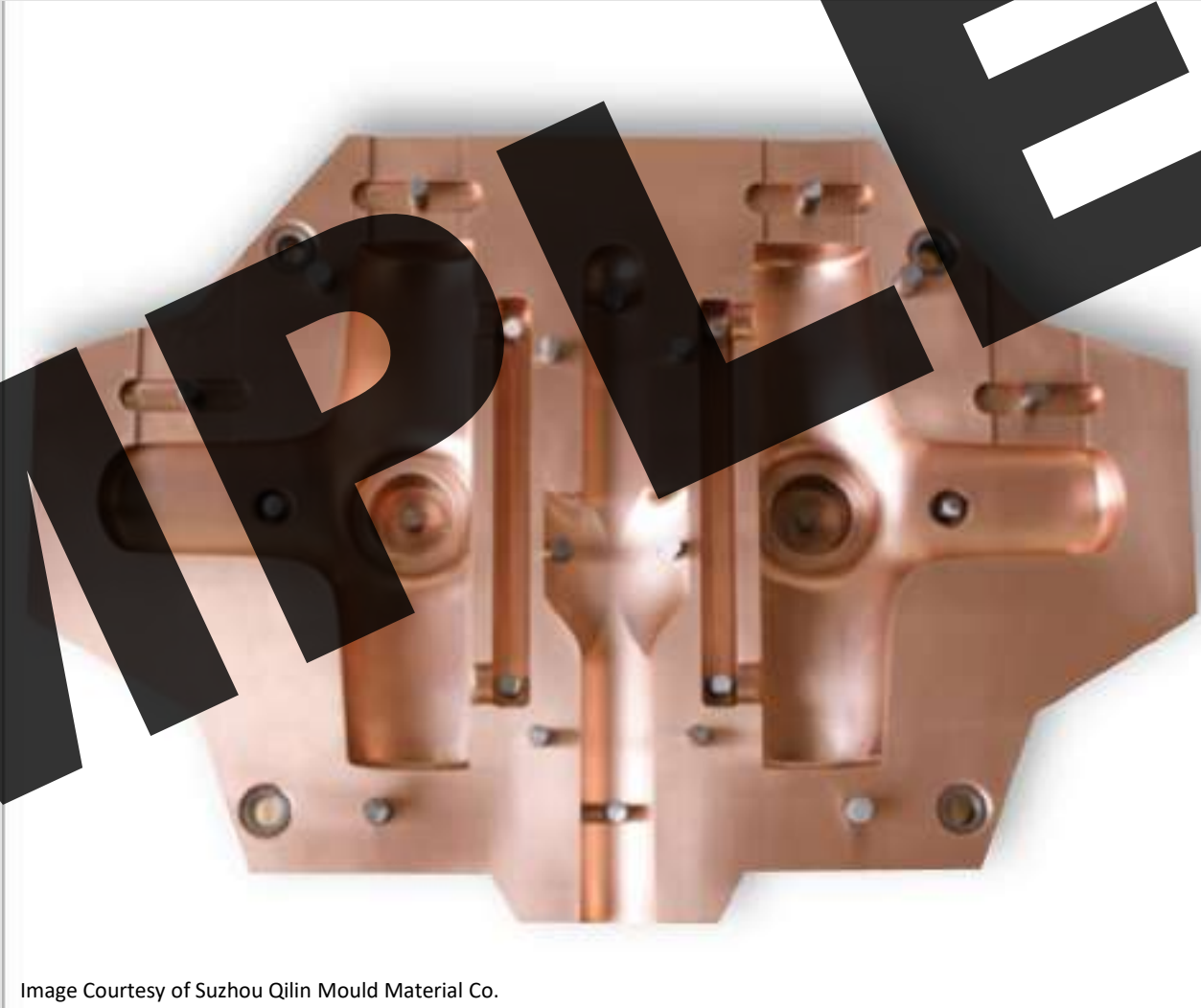


Image Courtesy of Suzhou Qilin Mould Material Co.

Regulations

Dating back to the 1940s, industries recognized the risks beryllium posed to employees. In fact, doctors first identified acute beryllium disease in the United States in 1943. Back then, beryllium-copper alloys were used in fluorescent lights. A survey conducted in 1949 revealed that 5% of the employees working in that industry had beryllium-related lung diseases.



The U.S. Department of Defense classified beryllium as a strategic and critical material in 2014. Most recently, OSHA issued a final rule on beryllium exposure in the workplace. It mandates employers in construction, maritime, and general industry to take specific protective measures to ensure their employees' health and safety.



The occupations with beryllium exposure hazards are wide-ranging, affecting a surprising number of employees, including welders and dental technicians. These employees can be exposed through inhalation or contact with beryllium dust that is found on working surfaces.



Did You Know?

OSHA approximates that 62,000 employees are exposed to beryllium in more than 7,000 workplaces around the United States.

OCCUPATIONS WITH POTENTIAL BERYLLIUM DUST EXPOSURE

- Primary Beryllium Production Workers
- Foundry Workers
- Furnace Tenders
- Machine Operators
- Machinists
- Metal Fabricators
- Welders
- Dental Technicians
- Secondary Smelting & Refining (recycling electronic & computer parts, metals)
- Abrasive Blasters (slags)



DANGER

CONTAINS BERYLLIUM

MAY CAUSE CANCER

CAUSES DAMAGE TO LUNGS

AVOID CREATING DUST

DO NOT GET ON SKIN

Helpful Terms

Before proceeding, let's take the time to define a few terms that will be helpful as you navigate this course. The first is **permissible exposure limit (PEL)**. This is the legal limit to which a worker can be exposed to a particular substance. For beryllium, the PEL is 0.2 micrograms per cubic meter of air ($\mu\text{g}/\text{m}^3$) calculated as an eight-hour time-weighted average (TWA).



Action level refers to the minimum concentration of a toxic substance that requires employers to take preventative action. For airborne beryllium, the action level is $0.1 \mu\text{g}/\text{m}^3$ calculated as an eight-hour TWA. The **short-term exposure limit (STEL)** is the maximum permissible exposure to a toxic substance over a short period of time. For beryllium, the STEL is $2.0 \mu\text{g}/\text{m}^3$ as determined over a 15-minute sampling period.



Beryllium work areas include any space where there's a process or operation that may release at least $0.1 \mu\text{g}/\text{m}^3$ beryllium. They also entail any places on site where employees are or could possibly be exposed to beryllium dust or have skin contact with it. For our purposes in this training, we will simply refer to these as "work areas."



Regulated Areas are areas that are marked off and designated by the employer where beryllium is or might be present. These zones should have appropriate warning signs. Only workers who have been properly trained should ever enter a regulated area.





STANDARDS

General Industry

29 CFR 1910.1024 – Beryllium
29 CFR 1910. 1000 – Air Contaminants
29 CFR 1910.94 – Ventilation
29 CFR 1910.1000 Table Z2

Maritime Industry

29 CFR 1915.1024 – Beryllium
29 CFR 1915. 1000 – Air Contaminants
29 CFR 1915.34 – Mechanical Paint Removers

Construction Industry

29 CFR 1926.1124 – Beryllium
29 CFR 1926.57 – Ventilation
29 CFR 1926.55 – Gases, Vapors, Dusts, and Mists

These are some of the main standards concerning beryllium safety. Many states have additional standards, as do some industries. We have provided these as a guide, but it's your responsibility to know all federal, local, and company rules that apply to your job.

Why Training?

No matter the situation, it is common to hear workers and even employers ask, “Where does it state we need to be trained?” Can’t a worker also be deemed “qualified” based on experience? The answer is “no.” Experience helps, yes, but regulations are very clear that employees must be trained (no matter how long they’ve been on the job) and that it is the employer who is responsible for overseeing that safety training and evaluating employees to confirm that they have the understanding, knowledge, and skills needed for safe operations.



Initial training and refresher training, as well as any written and practical evaluations, must be documented and filed. At the very least, in the case of an investigation, OSHA will want to see proof of proper and consistent training (in the way of training outlines, class lists, training goals, tests, certificates, and so on.) These documents should include the name of the person who taught the class or conducted the evaluation.



HARD HAT
TRAINING SERIES

SAFETY
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WORKERS MUST RECEIVE REFRESHER TRAINING WHEN...

1. There are changes in their assigned duties.

2. There are changes regarding potential exposure to hazards, for which the employee has not received training.

3. If any deficiency has been noted in an employee's work performance that is related to the safety and health of themselves or other workers.

4. If an accident has occurred, or anytime an employee is injured or nearly injured during operations.

Note: In some areas, refresher training is required at least every three years (if not sooner).

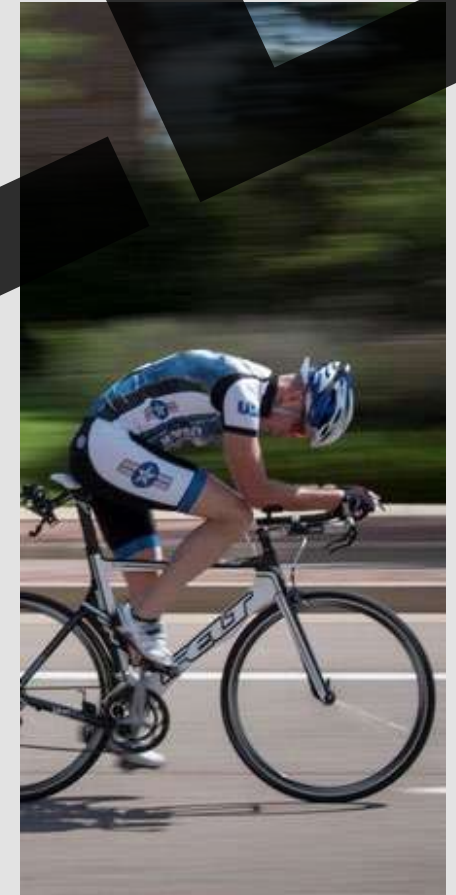
Training is not just a one-and-done occurrence; it is on-going. In fact, similar to the guidelines set down for when initial training is required, OSHA is also specific when it comes to "refresher training." More specifically, OSHA acknowledges the need for "refresher" or "follow up" training whenever there is a demonstrated need for it. Listed here are some common instances when retraining is required. Can you think of any others?



The extent of training will be determined by the employer, but at the very least it should include classroom instruction followed by written and practical examinations that prove continued competency.



In the following sections of our training, we will look at how employees can become exposed to beryllium and the diseases that result from prolonged exposure. We will examine where employees are most likely to identify beryllium hazards in the workplace.





We will go over monitoring and testing procedures to determine whether beryllium hazards are present. We will also cover medical surveillance guidelines to control employee exposure. Then we will learn about safe work practices that employees can adopt to protect themselves.



Finally, we will spend time going over the PPE that you should wear when there are beryllium hazards present. This section will include information about how to properly care for your PPE.

Exposure

Be

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9.012

SAMPLE



Beryllium



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