



GUIDANCE FOR COMPLIANCE
OSHA BERYLLIUM STANDARD
29 CFR 1910.1024





PREAMBLE

Materion is an advanced materials supplier and is the world's only fully integrated developer and supplier of beryllium, beryllium alloys and beryllium composites. For over 80 years we have been at the forefront of developing and implementing comprehensive health and safety procedures and techniques related to occupational beryllium exposure.

On January 9, 2017 the Occupational Safety and Health Administration (OSHA) issued a comprehensive standard covering beryllium and beryllium compounds. On April 24, 2018, the Occupational Safety and Health Administration (OSHA) and Materion along with other petitioners signed an important agreement where OSHA will initiate rulemaking to make changes to the OSHA Beryllium Standard for General Industry ([29 CFR 1910.1024](#)) issued January 9, 2017. Materion strongly recommends you review and use the [redline version](#), which contains the proposed changes to the OSHA Beryllium Standard, available on the Materion website until such time as the proposed changes become final. As a result of the rulemaking process, the final content of OSHA's regulatory changes could end up being different than this redline version. We believe, however, following this redline version will place you in the best possible position to be in compliance with the final changes to the OSHA Standard.

For more information review [OSHA and Materion Sign Settlement Agreement to Change the Final Beryllium Standard](#)

The guidance provided in this Guide is based on the proposed changes to the OSHA Beryllium Standard.

Applying the knowledge and techniques provided in this Guide will help prevent chronic beryllium disease (CBD) and other potential adverse health effects in workers occupationally exposed to beryllium. CBD results when the immune system in the lungs of susceptible individuals reacts to inhaled beryllium-containing particulate resulting in inflammation. CBD can be a serious and sometimes fatal lung disease. Because the amount of beryllium needed to cause disease in susceptible persons is very small, it is important to identify and control all exposure pathways by which beryllium-containing particulate may enter the lungs. Our experience has shown that worker protection is best provided by a comprehensive exposure control program, such as Materion's Beryllium Worker Protection Model, available online at: www.berylliumsafety.com.

This Guide has been prepared using information and data from sources considered to be technically reliable and is believed to be correct. Materion makes no warranties, expressed or implied, as to the accuracy of the information contained herein. Materion cannot anticipate all conditions under which this information and the subject products may be used and the actual conditions of use are beyond its control. The user is responsible for evaluating all available information when using the subject product for any particular use and complying with all federal, state, provincial and local laws, directives, statutes and regulations.

If you have questions or need additional assistance do not hesitate to contact us:

Product Safety Hotline at 1-800-862-4118 (in the U.S.) or +1-216-383-4019 (outside the U.S.).



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Instructional Notes:

1. OSHA Beryllium Standard Final Rule 1910.1024 text is **Black** in body of document.
2. Clicking [Blue](#) links will navigate to specific paragraphs of OSHA's Final Rule
3. Note: some links require an internet connection.
4. Click Alt + left arrow anytime, to return to previous positions in the document.

(a) Scope and application

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1. Applies to beryllium in all forms, compounds, and mixtures in general industry, except those articles and materials exempted by paragraphs [\(a\)\(2\)](#) and [\(a\)\(3\)](#) of this standard.
2. Does not apply to articles, as defined in the Hazard Communication standard (HCS) ([§ 1910.1200\(c\)](#)), that contain beryllium and that the employer does not process.
3. This standard does not apply to materials containing less than 0.1% beryllium by weight where the employer has objective data demonstrating that employee exposure to beryllium will remain below the action level as an 8-hour TWA under any foreseeable conditions.

RESOURCES

Click the following the link for the definition of “article” under OSHA’s 1910.1200(c):

Excerpt [Definition of Article](#)

(b) Definitions. As used in this standard:

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Action level means a concentration of airborne beryllium of 0.1 micrograms per cubic meter of air ($\mu\text{g}/\text{m}^3$) calculated as an 8-hour time-weighted average (TWA).

Airborne exposure and **airborne exposure to beryllium** mean the exposure to airborne beryllium that would occur if the employee were not using a respirator.

Assistant Secretary means the Assistant Secretary of Labor for Occupational Safety and Health, United States Department of Labor, or designee.

Beryllium lymphocyte proliferation test (BeLPT) means the measurement of blood lymphocyte proliferation in a laboratory test when lymphocytes are challenged with a soluble beryllium salt.

Beryllium sensitization means a response in the immune system of a specific individual who has been exposed to beryllium. There are no associated physical or clinical symptoms and no illness or disability with beryllium sensitization alone, but the response that occurs through beryllium sensitization can enable the immune system to recognize and react to beryllium. While not every beryllium-sensitized person will develop CBD, beryllium sensitization is essential for development of CBD.

Beryllium work area means any work area where materials that contain at least 0.1% beryllium by weight are processed either: (1) during any of the operations listed in Appendix A of this Standard; or (2) where employees are, or can reasonably be expected to be, exposed to airborne beryllium at or above the action level.



CBD Diagnostic Center means a medical diagnostic center that has a pulmonologist or pulmonary specialist on staff and on-site facilities to perform a clinical evaluation for the presence of chronic beryllium disease (CBD). The CBD diagnostic center must have the capacity to perform pulmonary function testing (as outlined by the American Thoracic Society criteria), bronchoalveolar lavage (BAL), and transbronchial biopsy. The CBD diagnostic center must also have the capacity to transfer BAL samples to a laboratory for appropriate diagnostic testing within 24 hours. The pulmonologist or pulmonary specialist must be able to interpret the biopsy pathology and the BAL diagnostic test results. **NOTE:** This can be any pulmonary specialist knowledgeable in interpreting biopsy pathology and BAL diagnostic testing results.

Chronic beryllium disease (CBD) means a chronic granulomatous lung disease caused by inhalation of airborne beryllium by an individual who is beryllium-sensitized.

Confirmed Positive means the person tested has had two abnormal BeLPT test results, an abnormal and a borderline test result, or three borderline test results obtained within the 30 day follow-up test period required after a first abnormal or borderline BeLPT test result. It also means the result of a more reliable and accurate test indicating a person has been identified as having beryllium sensitization.

Contaminated with beryllium and beryllium-contaminated means contaminated with dust, fumes, mists, or solutions containing beryllium in concentrations greater than or equal to 0.1 percent by weight.

Dermal contact with beryllium means skin exposure to soluble beryllium compounds or solutions containing beryllium in concentrations greater than or equal to 0.1 percent by weight or to visible dust, fumes, or mists containing beryllium in concentrations greater than or equal to 0.1 percent by weight. The handling of beryllium materials in non-particulate solid form that are free from visible dust containing beryllium in concentrations greater than or equal to 0.1 percent by weight is not considered dermal contact under the standard.

Director means the Director of the National Institute for Occupational Safety and Health (NIOSH), U.S. Department of Health and Human Services, or designee.

Emergency means any occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment which may or does result in an uncontrolled and unexpected release of beryllium that presents a significant hazard.

High-efficiency particulate air (HEPA) filter means a filter that is at least 99.97 percent efficient in removing particles 0.3 micrometers in diameter.

Objective data means information, such as air monitoring data from industry-wide surveys or calculations based on the composition of a substance, demonstrating airborne exposure to beryllium associated with a particular product or material or a specific process, task, or activity. The data must reflect workplace conditions closely resembling or with a higher airborne exposure potential than the processes, types of material, control methods, work practices, and environmental conditions in the



employer's current operations. [Note: Although the standard permits the use of objective data when performing an exposure assessment, it is prudent to collect air samples from jobs/tasks processing beryllium-containing materials in your own shop environment, to verify the proper exposure judgements are being made.](#)

Physician or other licensed health care professional (PLHCP) means an individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows the individual to independently provide or be delegated the responsibility to provide some or all of the health care services required by paragraph [\(k\)](#) of this standard.

Regulated area means an area, including temporary work areas where maintenance or non-routine tasks are performed, where an employee's airborne exposure exceeds, or can reasonably be expected to exceed, either the time-weighted average (TWA) permissible exposure limit (PEL) or short term exposure limit (STEL).

This standard means this beryllium standard, 29 CFR 1910.1024.

(c) Permissible Exposure Limits (PELs)

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1. Time-weighted average (TWA) PEL. The employer must ensure that no employee is exposed to an airborne concentration of beryllium in excess of $0.2 \mu\text{g}/\text{m}^3$ calculated as an 8-hour TWA.
2. Short-term exposure limit (STEL). The employer must ensure that no employee is exposed to an airborne concentration of beryllium in excess of $2.0 \mu\text{g}/\text{m}^3$ as determined over a sampling period of 15 minutes.

[Note: If an 8-hour TWA exposure is less than \$0.06 \mu\text{g}/\text{m}^3\$, it is unlikely the STEL of \$2.0 \mu\text{g}/\text{m}^3\$ was exceeded over any 15-minute duration the shift the TWA represents.](#)

(d) Exposure assessment

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1. *General* - The employer must assess the airborne exposure of each employee who is or may reasonably be expected to be exposed to airborne beryllium in accordance with either the performance option in paragraph [\(d\)\(2\)](#) or the scheduled monitoring option in paragraph [\(d\)\(3\)](#) of this standard.
2. *Performance option* - The employer must assess the 8-hour TWA exposure and the 15-minute short-term exposure for each employee on the basis of any combination of air monitoring data and objective data sufficient to accurately characterize airborne exposure to beryllium.

[Note: Although the standard permits the use of objective data when performing an exposure assessment, it is prudent to collect air samples from jobs/tasks processing beryllium-containing](#)



materials in your own shop environment, to verify the proper exposure judgements are being made.

3. *Scheduled monitoring option*

- i. The employer must perform initial monitoring to assess the 8-hour TWA exposure for each employee on the basis of one or more personal breathing zone air samples that reflect the airborne exposure of employees on each shift, for each job classification, and in each work area.
- ii. The employer must perform initial monitoring to assess the short-term exposure from 15-minute personal breathing zone air samples measured in operations that are likely to produce airborne exposure above the STEL for each work shift, for each job classification, and in each work area.
- iii. Where several employees perform the same tasks on the same shift and in the same work area, the employer may sample a representative fraction of these employees in order to meet the requirements of this paragraph (d)(3). In representative sampling, the employer must sample the employee(s) expected to have the highest airborne exposure to beryllium.
- iv. If initial monitoring indicates that airborne exposure is below the action level and at or below the STEL, the employer may discontinue monitoring for those employees whose airborne exposure is represented by such monitoring.
- v. Where the most recent exposure monitoring indicates that airborne exposure is at or above the action level but at or below the TWA PEL, the employer must repeat such monitoring within six months of the most recent monitoring.
- vi. Where the most recent exposure monitoring indicates that airborne exposure is above the TWA PEL, the employer must repeat such monitoring within three months of the most recent 8-hour TWA exposure monitoring.
- vii. Where the most recent (non-initial) exposure monitoring indicates that airborne exposure is below the action level, the employer must repeat such monitoring within six months of the most recent monitoring until two consecutive measurements, taken 7 or more days apart, are below the action level, at which time the employer may discontinue 8-hour TWA exposure monitoring for those employees whose exposure is represented by such monitoring, except as otherwise provided in paragraph (d)(4) of this standard.
- viii. Where the most recent exposure monitoring indicates that airborne exposure is above the STEL, the employer must repeat such monitoring within three months of the most recent short-term exposure monitoring until two consecutive measurements, taken 7 or more days apart, are below the STEL, at which time the employer may discontinue short-term exposure monitoring for those employees whose exposure is represented by such monitoring, except as otherwise provided in paragraph (d)(4) of this standard.

4. *Reassessment of exposure* - The employer must reassess airborne exposure whenever a change in the production, process, control equipment, personnel, or work practices may reasonably be expected to result in new or additional airborne exposure at or above the action level or STEL, or when the employer has any reason to believe that new or additional airborne exposure at or above the action level or STEL has occurred.

5. *Methods of sample analysis* - The employer must ensure that all air monitoring samples used to satisfy the monitoring requirements of paragraph (d) of this standard are evaluated by a laboratory



that can measure beryllium to an accuracy of plus or minus 25 percent within a statistical confidence level of 95 percent for airborne concentrations at or above the action level.

6. *Employee notification of assessment results*

- i. Within 15 working days after completing an exposure assessment in accordance with paragraph (d) of this standard, the employer must notify each employee whose airborne exposure is represented by the assessment of the results of that assessment individually in writing or post the results in an appropriate location that is accessible to each of these employees.
- ii. Whenever an exposure assessment indicates that airborne exposure is above the TWA PEL or STEL, the employer must describe in the written notification the corrective action being taken to reduce airborne exposure to or below the exposure limit(s) exceeded where feasible corrective action exists but had not been implemented when the monitoring was conducted.

7. *Observation of monitoring*

- i. The employer must provide an opportunity to observe any exposure monitoring required by this standard to each employee whose airborne exposure is measured or represented by the monitoring and each employee's representative(s).
- ii. When observation of monitoring requires entry into an area where the use of personal protective clothing or equipment (which may include respirators) is required, the employer must provide each observer with appropriate personal protective clothing and equipment at no cost to the observer and must ensure that each observer uses such clothing and equipment.
- iii. The employer must ensure that each observer follows all other applicable safety and health procedures.

RESOURCES

Industrial Hygiene Consultants – the following links provide contact information for industrial hygiene consultants

[Beryllium Consultant Network](#)

[American Industrial Hygiene Association \(AIHA\) - Consultants Listing](#)

[American Board of Industrial Hygiene \(ABIH\) - Certified Industrial Hygienists](#)

Analytical Laboratory selection:

The laboratory should be accredited by the AIHA and should have analytical method capabilities that can detect beryllium at low levels. Inductively coupled plasma-mass spectrometry (ICP-MS) is the method of choice for most analytical needs with method reporting limits (MRL) as low as 0.005 microgram (μg) of beryllium. The laboratory should be notified when high fired beryllium oxide (BeO) ceramics, are present in the air sample, as special sample digestion techniques are required for accurate analytical results.

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| Resource links to laboratory services: |
| Analytics Corporation |
| Galson Laboratory |
| Travelers Industrial Hygiene Laboratory |
| Bureau Veritas North America |
| Complete list of: AIHA Accredited Laboratories |

(e) Beryllium work areas and regulated areas

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1. Establishment

- i. The employer must establish and maintain a beryllium work area wherever the criteria for a “beryllium work area” set forth in paragraph (b) of this standard are met.
- ii. The employer must establish and maintain a regulated area wherever employees are, or can reasonably be expected to be, exposed to airborne beryllium at levels above the TWA PEL or STEL.

2. Demarcation

- i. The employer must identify each beryllium work area through signs or any other methods that adequately establish and inform each employee of the boundaries of each beryllium work area.
- ii. The employer must identify each regulated area in accordance with paragraph (m)(2) of this standard.

3. Access. The employer must limit access to regulated areas to:

- i. Persons the employer authorizes or requires to be in a regulated area to perform work duties;
- ii. Persons entering a regulated area as designated representatives of employees for the purpose of exercising the right to observe exposure monitoring procedures under paragraph (d)(7) of this standard; and
- iii. Persons authorized by law to be in a regulated area.

4. Provision of personal protective clothing and equipment, including respirators. The employer must provide and ensure that each employee entering a regulated area uses:

- i. Respiratory protection in accordance with paragraph (g) of this standard; and
- ii. Personal protective clothing and equipment in accordance with paragraph (h) of this standard.

(f) Methods of compliance

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I. Written exposure control plan

- i. The employer must establish, implement, and maintain a written exposure control plan, which must contain:
 - A. A list of operations and job titles reasonably expected to involve airborne exposure to or dermal contact with beryllium;
 - B. A list of operations and job titles reasonably expected to involve airborne exposure at or above the action level;
 - C. A list of operations and job titles reasonably expected to involve airborne exposure above the TWA PEL or STEL;
 - D. Procedures for minimizing cross-contamination, including the transfer of beryllium between surfaces, equipment, clothing, materials, and articles within beryllium work areas;
 - E. Procedures for keeping surfaces as free as practicable of beryllium;
NOTE: Under the beryllium standards, the employer is required to keep surfaces in beryllium work areas, materials designated for recycling in general industry, and eating and drinking areas as free as practicable of beryllium. As OSHA explained in a [2003 letter of interpretation](#) concerning the meaning of "as free as practicable", OSHA evaluates whether a surface is "as free as practicable" of a contaminant by the rigor of the employer's program to keep surfaces clean. A sufficient housekeeping program may include a routine cleaning schedule and the use of effective cleaning methods to minimize the possibility of exposure from accumulation of beryllium on surfaces. The intent of the "as-free-as-practicable" requirement is to ensure that accumulations of beryllium dust do not become sources of employee beryllium exposures. Therefore, any method that achieves this end is acceptable. OSHA further intends for this term to be broad and performance-oriented, so as to allow employers in a variety of industries flexibility to decide what type of enclosures (e.g., bags or other containers) are best suited to their workplace and the nature of the beryllium-containing materials they are disposing or designating for reuse outside the facility. (Source [OSHA FAQ](#)) Cleaning frequencies should be defined by area on a daily, weekly, and monthly basis. Examples of practicable cleaning methods include HEPA vacuuming, wet floor scrubbing, and wet mopping, washing, and wiping.
 - F. Procedures for minimizing the migration of beryllium from beryllium work areas to other locations within or outside the workplace;
 - G. A list of engineering controls, work practices, and respiratory protection required by paragraph (f)(2) of this standard;
 - H. A list of personal protective clothing and equipment required by paragraph (h) of this standard; and

- I. Procedures for removing, laundering, storing, cleaning, repairing, and disposing of beryllium-contaminated personal protective clothing and equipment, including respirators.
 - ii. The employer must review and evaluate the effectiveness of each written exposure control plan at least annually and update it, as necessary, when:
 - A. Any change in production processes, materials, equipment, personnel, work practices, or control methods results, or can reasonably be expected to result, in new or additional airborne exposure to beryllium;
 - B. The employer is notified that an employee is eligible for medical removal in accordance with paragraph [\(l\)\(1\)](#) of this standard, referred for evaluation at a CBD diagnostic center, or shows signs or symptoms associated with exposure to beryllium; or
 - C. The employer has any reason to believe that new or additional airborne exposure is occurring or will occur.
 - iii. The employer must make a copy of the written exposure control plan accessible to each employee who is, or can reasonably be expected to be, exposed to airborne beryllium in accordance with OSHA's Access to Employee Exposure and Medical Records (Records Access) standard ([§ 1910.1020\(e\)](#)).
2. *Engineering and work practice controls*
 - i. The employer must use engineering and work practice controls to reduce and maintain employee airborne exposure to beryllium to or below the PEL and STEL, unless the employer can demonstrate that such controls are not feasible. Wherever the employer demonstrates that it is not feasible to reduce airborne exposure to or below the PELs with engineering and work practice controls, the employer must implement and maintain engineering and work practice controls to reduce airborne exposure to the lowest levels feasible and supplement these controls by using respiratory protection in accordance with paragraph [\(g\)](#) of this standard.
 - ii. For each operation in a beryllium work area that releases airborne beryllium, the employer must ensure that at least one of the following is in place to reduce airborne exposure:
 - A. Material and/or process substitution;
 - B. Isolation, such as ventilated partial or full enclosures;
 - C. Local exhaust ventilation, such as at the points of operation, material handling, and transfer; or
 - D. Process control, such as wet methods and automation.
 - iii. An employer is exempt from using the controls listed in paragraph [\(f\)\(2\)\(i\)](#) of this standard to the extent that:
 - A. The employer can establish that such controls are not feasible; or
 - B. The employer can demonstrate that airborne exposure is below the action level, using no fewer than two representative personal breathing zone samples taken at least 7 days apart, for each affected operation.
3. *Prohibition of rotation.* The employer must not rotate employees to different jobs to achieve compliance with the PELs.

(g) Respiratory protection

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- I. *General.* The employer must provide respiratory protection at no cost to the employee and ensure that each employee uses respiratory protection:
 - i. During periods necessary to install or implement feasible engineering and work practice controls where airborne exposure exceeds, or can reasonably be expected to exceed, the TWA PEL or STEL;
 - ii. During operations, including maintenance and repair activities and non-routine tasks, when engineering and work practice controls are not feasible and airborne exposure exceeds, or can reasonably be expected to exceed, the TWA PEL or STEL;
 - iii. During operations for which an employer has implemented all feasible engineering and work practice controls when such controls are not sufficient to reduce airborne exposure to or below the TWA PEL or STEL;
 - iv. During emergencies; and
 - v. When an employee who is eligible for medical removal under paragraph [\(l\)\(1\)](#) chooses to remain in a job with airborne exposure at or above the action level, as permitted by paragraph [\(l\)\(2\)\(ii\)](#) of this standard.

2. *Respiratory protection program.* Where this standard requires an employer to provide respiratory protection, the selection and use of such respiratory protection must be in accordance with the Respiratory Protection standard [\(§ 1910.134\)](#).

3. The employer must provide at no cost to the employee a powered air-purifying respirator (PAPR) instead of a negative pressure respirator when;
 - i. Respiratory protection is required by this standard;
 - ii. An employee entitled to such respiratory protection requests a PAPR; and
 - iii. The PAPR provides adequate protection to the employee in accordance with paragraph [\(g\)\(2\)](#) of this standard.

RESOURCES

The following link can assist the employer in developing a Respiratory Protection Program that complies with 29 CFR 1910.134

[Respiratory Protection eTool - OSHA website](#)

(h) Personal protective clothing and equipment

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1. *Provision and use* – The employer must provide at no cost, and ensure that each employee uses, appropriate personal protective clothing and equipment in accordance with the written exposure control plan required under paragraph [\(f\)\(1\)](#) of this standard and OSHA's Personal Protective Equipment standards [\(subpart I of this part\)](#):
 - i. Where airborne exposure exceeds, or can reasonably be expected to exceed, the TWA PEL or STEL; or
 - ii. Where there is a reasonable expectation of dermal contact with beryllium.

2. *Removal and storage*
 - i. The employer must ensure that each employee removes all beryllium-contaminated personal protective clothing and equipment at the end of the work shift, at the completion of all tasks involving beryllium, or when personal protective clothing or equipment becomes visibly contaminated with beryllium, whichever comes first.
 - A. At the end of the work shift or at the completion of tasks involving beryllium, whichever comes first, or
 - B. When protective clothing or equipment becomes visibly contaminated with beryllium.
 - ii. The employer must ensure that each employee removes beryllium-contaminated personal protective clothing and equipment as specified in the written exposure control plan required by paragraph [\(f\)\(1\)](#) of this standard.
 - iii. The employer must ensure that each employee stores and keeps beryllium-contaminated personal protective clothing and equipment separate from street clothing and that storage facilities prevent cross-contamination as specified in the written exposure control plan required by paragraph [\(f\)\(1\)](#) of this standard.
 - iv. The employer must ensure that no employee removes beryllium-contaminated personal protective clothing or equipment from the workplace, except for employees authorized to do so for the purposes of laundering, cleaning, maintaining or disposing of beryllium-contaminated personal protective clothing and equipment at an appropriate location or facility away from the workplace.
 - v. When personal protective clothing or equipment required by this standard is removed from the workplace for laundering, cleaning, maintenance or disposal, the employer must ensure that personal protective clothing and equipment are stored and transported in sealed bags or other closed containers that are impermeable and are labeled in accordance with paragraph [\(m\)\(3\)](#) of this standard and the HCS [\(§ 1910.1200\)](#).

3. *Cleaning and replacement*
 - i. The employer must ensure that all reusable personal protective clothing and equipment required by this standard is cleaned, laundered, repaired, and replaced as needed to maintain its effectiveness.
 - ii. The employer must ensure that beryllium is not removed from beryllium-contaminated personal protective clothing and equipment by blowing, shaking or any other means that disperses beryllium into the air.

- iii. The employer must inform in writing the persons or the business entities who launder, clean or repair the personal protective clothing or equipment required by this standard of the potentially harmful effects of exposure to beryllium and that the personal protective clothing and equipment must be handled in accordance with this standard.

(i) Hygiene areas and practices

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1. *General.* For each employee working in a beryllium work area or who can reasonably be expected to have dermal contact with beryllium, the employer must:
 - i. Provide readily accessible washing facilities in accordance with this standard and the Sanitation standard ([§ 1910.141](#)) to remove beryllium from the hands, face, and neck; and
 - ii. Ensure that employees who have dermal contact with beryllium wash any exposed skin at the end of the activity, process, or work shift and prior to eating, drinking, smoking, chewing tobacco or gum, applying cosmetics, or using the toilet.
2. *Change rooms.* In addition to the requirements of paragraph [\(i\)\(1\)\(i\)](#) of this standard, the employer must provide employees who are required to use personal protective clothing or equipment under paragraph [\(h\)\(1\)\(ii\)](#) of this standard with a designated change room in accordance with this standard and the Sanitation standard ([§ 1910.141](#)) where employees are required to remove their personal clothing.

NOTE: The general sanitation standard, at 29 CFR 1910.141(e), provides that, "whenever employees are required by a particular standard to wear protective clothing because of the possibility of contamination with toxic materials, change rooms equipped with storage facilities for street clothes and separate storage facilities for the protective clothing shall be provided." In the preamble to the Beryllium standard, OSHA has indicated that personal protective clothing may be worn over street clothes unless if doing so could reasonably result in contamination of the workers' street clothes. (Please note that such contamination can occur both during the work operation and at the time the worker removes the personal protective clothing.) In situations where street clothes could reasonably become contaminated, employers must select and ensure the use of appropriate personal protective clothing that is worn in lieu of street clothes, and must provide change rooms per the requirements of the sanitation standard. In those situations where removal of street clothes is not necessary, change rooms are not required.

3. *Showers*
 - i. The employer must provide showers in accordance with the Sanitation standard ([§ 1910.141](#)) where:
 - A. Airborne exposure exceeds, or can reasonably be expected to exceed, the TWA PEL or STEL; and

- B. Employees' hair or body parts other than hands, face, and neck can reasonably be expected to become contaminated with beryllium.
 - ii. Employers required to provide showers under paragraph [\(i\)\(3\)\(i\)](#) of this standard must ensure that each employee showers at the end of the work shift or work activity if:
 - A. The employee reasonably could have had airborne exposure above the TWA PEL or STEL; and
 - B. The employee's hair or body parts other than hands, face, and neck could reasonably have become contaminated with beryllium.
4. *Eating and drinking areas* - Wherever the employer allows employees to consume food or beverages at a worksite where beryllium is present, the employer must ensure that:
- i. Beryllium-contaminated surfaces in eating and drinking areas are as free as practicable of beryllium;
 - ii. No employees enter any eating or drinking area with beryllium-contaminated personal protective clothing or equipment unless, prior to entry, it is cleaned, as necessary, to be as free as practicable of beryllium by methods that do not disperse beryllium into the air or onto an employee's body; and
 - iii. Eating and drinking facilities provided by the employer are in accordance with the Sanitation standard ([§ 1910.141](#)).
5. *Prohibited activities* - The employer must ensure that no employees eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas.

(j) Housekeeping

[\(Table of Contents\)](#)

- 1. *General*
 - i. The employer must maintain all surfaces in beryllium work areas and regulated areas as free as practicable of beryllium and in accordance with the written exposure control plan required under paragraph [\(f\)\(1\)](#) and the cleaning methods required under paragraph [\(j\)\(2\)](#) of this standard; and
 - ii. The employer must ensure that all spills and emergency releases of beryllium are cleaned up promptly and in accordance with the written exposure control plan required under paragraph [\(f\)\(1\)](#) and the cleaning methods required under paragraph [\(j\)\(2\)](#) of this standard.
- 2. *Cleaning methods*
 - i. The employer must ensure that surfaces in beryllium work areas and regulated areas are cleaned by HEPA-filtered vacuuming or other methods that minimize the likelihood and level of airborne exposure.



- ii. The employer must not allow dry sweeping or brushing for cleaning surfaces in beryllium work areas and regulated areas unless HEPA-filtered vacuuming or other methods that minimize the likelihood and level of airborne exposure are not safe or effective.
- iii. The employer must not allow the use of compressed air for cleaning beryllium-contaminated surfaces unless the compressed air is used in conjunction with a ventilation system designed to capture the particulates made airborne by the use of compressed air.
- iv. Where employees use dry sweeping, brushing, or compressed air to clean beryllium-contaminated surfaces, the employer must provide, and ensure that each employee uses, respiratory protection and personal protective clothing and equipment in accordance with paragraphs (g) and (h) of this standard.
- v. The employer must ensure that cleaning equipment is handled and maintained in a manner that minimizes the likelihood and level of airborne exposure and the re-entrainment of airborne beryllium in the workplace.

3. *Disposal, recycling, and reuse -*

- i. When the employer transfers materials that contain at least 0.1% beryllium by weight or are contaminated with beryllium to another party for disposal, recycling, or reuse, the employer must label the materials in accordance with paragraph (m)(3) of this standard;
- ii. Except for intra-plant transfers, materials designated for disposal that contain at least 0.1% beryllium by weight or are contaminated with beryllium must be cleaned to be as free as practicable of beryllium or placed in enclosures that prevent the release of beryllium-containing particulate or solutions under normal conditions of use, storage, or transport, such as bags or containers; and
- iii. Except for intra-plant transfers, materials designated for recycling or reuse that contain at least 0.1% beryllium by weight or are contaminated with beryllium must be cleaned to be as free as practicable of beryllium or placed in enclosures that prevent the release of beryllium-containing particulate or solutions under normal conditions of use, storage, or transport, such as bags or containers.

(k) Medical surveillance

[\(Table of Contents\)](#)

1. General

- i. The employer must make medical surveillance required by this paragraph available at no cost to the employee, and at a reasonable time and place, to each employee:
 - A. Who is or is reasonably expected to be exposed at or above the action level for more than 30 days per year;
 - B. Who shows signs or symptoms of CBD or other beryllium-related health effects;
 - C. Who is exposed to beryllium during an emergency; or
 - D. Whose most recent written medical opinion required by paragraph [\(k\)\(6\)](#) or [\(k\)\(7\)](#) of this standard recommends periodic medical surveillance.
- ii. The employer must ensure that all medical examinations and procedures required by this standard are performed by, or under the direction of, a licensed physician.

2. Frequency - The employer shall provide a medical examination:

- i. Within 30 days after determining that:
 - A. An employee meets the criteria of paragraph [\(k\)\(1\)\(i\)\(A\)](#), unless the employee has received a medical examination, provided in accordance with this standard, within the last two years; or
 - B. An employee meets the criteria of paragraph [\(k\)\(1\)\(i\)\(B\)](#).
- ii. At least every two years thereafter for each employee who continues to meet the criteria of paragraph [\(k\)\(1\)\(i\)\(A\)](#), [\(B\)](#), or [\(D\)](#) of this standard.
- iii. At the termination of employment for each employee who meets any of the criteria of paragraph [\(k\)\(1\)\(i\)](#) of this standard at the time the employee's employment terminates, unless an examination has been provided in accordance with this standard during the six months prior to the date of termination.
- iv. At least one year but no more than two years after an employee meets the criteria of paragraph [\(k\)\(1\)\(i\)\(C\)](#).

3. Contents of examination

- i. The employer must ensure that the PLHCP conducting the examination advises the employee of the risks and benefits of participating in the medical surveillance program and the employee's right to opt out of any or all parts of the medical examination.
- ii. The employer must ensure that the employee is offered a medical examination that includes:
 - A. A medical and work history, with emphasis on past and present airborne exposure to or dermal contact with beryllium, smoking history, and any history of respiratory system dysfunction;
 - B. A physical examination with emphasis on the respiratory system;
 - C. A physical examination for skin rashes;
 - D. Pulmonary function tests, performed in accordance with the guidelines established by the American Thoracic Society including forced vital capacity (FVC) and forced expiratory volume in one second (FEV₁);



- E. A standardized BeLPT or equivalent test, upon the first examination and at least every two years thereafter, unless the employee is confirmed positive. If the results of the BeLPT are other than normal, a follow-up BeLPT must be offered within 30 days, unless the employee has been confirmed positive. Samples must be analyzed in a laboratory certified under the College of American Pathologists/Clinical Laboratory Improvement Amendments (CLIA) guidelines to perform the BeLPT.
- F. A low dose computed tomography (LDCT) scan, when recommended by the PLHCP after considering the employee's history of exposure to beryllium along with other risk factors, such as smoking history, family medical history, sex, age, and presence of existing lung disease; and
- G. Any other test deemed appropriate by the PLHCP.

RESOURCES

The following links are to websites for BeLPT testing laboratories.

[Cleveland Clinic; Cleveland, OH](#)

[National Jewish Health; Denver, CO](#)

[Oak Ridge Institute for Science and Education \(ORISE\)](#)

4. *Information provided to the PLHCP* - The employer must ensure that the examining PLHCP (and the agreed-upon CBD diagnostic center, if an evaluation is required under paragraph (k)(7) of this standard) has a copy of this standard and must provide the following information, if known:
- i. A description of the employee's former and current duties that relate to the employee's airborne exposure to and dermal contact with beryllium;
 - ii. The employee's former and current levels of airborne exposure;
 - iii. A description of any personal protective clothing and equipment, including respirators, used by the employee, including when and for how long the employee has used that personal protective clothing and equipment; and
 - iv. Information from records of employment-related medical examinations previously provided to the employee, currently within the control of the employer, after obtaining written consent from the employee.

NOTE: Your site specific lists of operations and job titles with beryllium exposure, respiratory protection and personal protective equipment required under paragraph (f) Methods of compliance and specific to the employee being medically evaluated can form the basis for the information you must provide to the PLHCP.

5. *Licensed physician's written medical opinion* - The employer must ensure that the employee receives a written medical report from the licensed physician within 45 days of the examination (including any follow-up BeLPT required under paragraph (k)(3)(ii)(E) of this standard) and that the PLHCP explains the results of the examination to the employee. The written medical report must contain:
 - i. A statement indicating the results of the medical examination, including the licensed physician's opinion as to whether the employee has
 - A. Any detected medical condition, such as CBD or beryllium sensitization (i.e., the employee is confirmed positive, as defined in paragraph (b) of this standard), that may place the employee at increased risk from further airborne exposure, and
 - B. Any medical conditions related to airborne exposure that require further evaluation or treatment.
 - ii. Any recommendations on:
 - A. The employee's use of respirators, protective clothing, or equipment; or
 - B. Limitations on the employee's airborne exposure to beryllium.
 - iii. If the employee is confirmed positive or diagnosed with CBD or if the licensed physician otherwise deems it appropriate, the written report must also contain a referral for an evaluation at a CBD diagnostic center.
 - iv. If the employee is confirmed positive or diagnosed with CBD the written report must also contain a recommendation for continued periodic medical surveillance.
 - v. If the employee is confirmed positive or diagnosed with CBD the written report must also contain a recommendation for medical removal from airborne exposure to beryllium, as described in paragraph (l) of this standard.

6. *Licensed physician's written medical opinion for the employer*
 - i. The employer must obtain a written medical opinion from the licensed physician within 45 days of the medical examination (including any follow-up BeLPT required under paragraph (k)(3)(ii)(E) of this standard). The written medical opinion must contain only the following:
 - A. The date of the examination;
 - B. A statement that the examination has met the requirements of this standard;
 - C. Any recommended limitations on the employee's use of respirators, protective clothing, or equipment; and
 - D. A statement that the PLHCP has explained the results of the medical examination to the employee, including any tests conducted, any medical conditions related to airborne exposure that require further evaluation or treatment, and any special provisions for use of personal protective clothing or equipment;
 - ii. If the employee provides written authorization, the written opinion must also contain any recommended limitations on the employee's airborne exposure to beryllium.

 - iii. If the employee is confirmed positive or diagnosed with CBD or if the licensed physician otherwise deems it appropriate, and the employee provides written authorization, the written opinion must also contain a referral for an evaluation at a CBD diagnostic center.
 - iv. If the employee is confirmed positive or diagnosed with CBD and the employee provides written authorization, the written opinion must also contain a recommendation for continued periodic medical surveillance.



- v. If the employee is confirmed positive or diagnosed with CBD and the employee provides written authorization, the written opinion must also contain a recommendation for medical removal from airborne exposure to beryllium, as described in paragraph (l) of this standard.
- vi. The employer must ensure that each employee receives a copy of the written medical opinion described in paragraph (k)(6) of this standard within 45 days of any medical examination (including any follow-up BeLPT required under paragraph (k)(3)(ii)(E) of this standard) performed for that employee.

RESOURCES

The following links are to websites for select CBD diagnostic centers in the US
(Not an all-inclusive list.)

[Cleveland Clinic; Cleveland, OH](#)

[National Jewish Health; Denver, CO](#)

[University of California San Francisco](#)

[School of Medicine University of Pennsylvania; Philadelphia, PA](#)

7. CBD diagnostic center

- i. The employer must provide an evaluation at no cost to the employee at a CBD diagnostic center that is mutually agreed upon by the employer and the employee. The employer must also provide, at no cost to the employee and within a reasonable time after the initial consultation with the CBD diagnostic center, any of the following tests if deemed appropriate by the examining physician at the CBD diagnostic center: pulmonary function testing (as outlined by the American Thoracic Society criteria), bronchoalveolar lavage (BAL), and transbronchial biopsy. The initial consultation with the CBD diagnostic center must be provided within 30 days of:
 - A. The employer's receipt of a physician's written medical opinion to the employer that recommends referral to a CBD diagnostic center; or
 - B. The employee presenting to the employer a physician's written medical report indicating that the employee has been confirmed positive or diagnosed with CBD, or recommending referral to a CBD diagnostic center.
- ii. The employer must ensure that the employee receives a written medical report from the CBD diagnostic center that contains all the information required in paragraph (k)(5)(i), (ii), (iv), and (v) of this standard and that the PLHCP explains the results of the examination to the employee within 30 days of the examination.
- iii. The employer must obtain a written medical opinion from the CBD diagnostic center within 30 days of the medical examination. The written medical opinion must contain only the information in paragraph (k)(6)(i), as applicable, unless the employee provides written authorization to release additional information. If the employee provides written



- authorization, the written opinion must also contain the information from paragraphs [\(k\)\(6\)\(ii\)](#), [\(iv\)](#), and [\(v\)](#), if applicable.
- iv. The employer must ensure that each employee receives a copy of the written medical opinion from the CBD diagnostic center described in paragraph [\(k\)\(7\)](#) of this standard within 30 days of any medical examination performed for that employee.
 - v. After an employee has received the initial clinical evaluation at a CBD diagnostic center described in paragraph [\(k\)\(7\)\(i\)](#) of this standard, the employee may choose to have any subsequent medical examinations for which the employee is eligible under paragraph [\(k\)](#) of this standard performed at a CBD diagnostic center mutually agreed upon by the employer and the employee, and the employer must provide such examinations at no cost to the employee.

(I) Medical removal

[\(Table of Contents\)](#)

1. An employee is eligible for medical removal, if the employee works in a job with airborne exposure at or above the action level and either:
 - i. The employee provides the employer with:
 - A. A written medical report indicating a confirmed positive finding or CBD diagnosis;
or
 - B. A written medical report recommending removal from airborne exposure to beryllium in accordance with paragraph [\(k\)\(5\)\(v\)](#) or [\(k\)\(7\)\(ii\)](#) of this standard; or
 - ii. The employer receives a written medical opinion recommending removal from airborne exposure to beryllium in accordance with paragraph [\(k\)\(6\)\(v\)](#) or [\(k\)\(7\)\(iii\)](#) of this standard.
2. If an employee is eligible for medical removal, the employer must provide the employee with the employee's choice of:
 - i. Removal as described in paragraph [\(l\)\(3\)](#) of this standard; or
 - ii. Remaining in a job with airborne exposure at or above the action level, provided that the employer provides, and ensures that the employee uses, respiratory protection that complies with paragraph [\(g\)](#) of this standard whenever airborne exposures are at or above the action level.
3. If the employee chooses removal:
 - i. If a comparable job is available where airborne exposures to beryllium are below the action level, and the employee is qualified for that job or can be trained within one month, the employer must remove the employee to that job. The employer must maintain for six months from the time of removal the employee's base earnings, seniority, and other rights and benefits that existed at the time of removal.
 - ii. If comparable work is not available, the employer must maintain the employee's base earnings, seniority, and other rights and benefits that existed at the time of removal for six



months or until such time that comparable work described in paragraph [\(l\)\(3\)\(i\)](#) becomes available, whichever comes first.

4. The employer's obligation to provide medical removal protection benefits to a removed employee shall be reduced to the extent that the employee receives compensation for earnings lost during the period of removal from a publicly or employer-funded compensation program, or receives income from another employer made possible by virtue of the employee's removal.

(m) Communication of hazards

[\(Table of Contents\)](#)

1. General

- i. Chemical manufacturers, importers, distributors, and employers shall comply with all requirements of the HCS ([§ 1910.1200](#)) for beryllium.
- ii. In classifying the hazards of beryllium, at least the following hazards must be addressed: cancer; lung effects (CBD and acute beryllium disease); beryllium sensitization; skin sensitization; and skin, eye, and respiratory tract irritation.
- iii. Employers must include beryllium in the hazard communication program established to comply with the HCS. Employers must ensure that each employee has access to labels on containers of beryllium and to safety data sheets, and is trained in accordance with the requirements of the HCS ([§ 1910.1200](#)) and paragraph [\(m\)\(4\)](#) of this standard.

2. Warning signs

- i. *Posting.* The employer must provide and display warning signs at each approach to a regulated area so that each employee is able to read and understand the signs and take necessary protective steps before entering the area.
- ii. *Sign specification.*
 - A. The employer must ensure that the warning signs required by paragraph [\(m\)\(2\)\(i\)](#) of this standard are legible and readily visible.
 - B. The employer must ensure each warning sign required by paragraph [\(m\)\(2\)\(i\)](#) of this standard bears the following legend:

DANGER
REGULATED AREA
BERYLLIUM
MAY CAUSE CANCER
CAUSES DAMAGE TO LUNGS
AUTHORIZED PERSONNEL ONLY
WEAR RESPIRATORY PROTECTION AND PROTECTIVE CLOTHING AND
EQUIPMENT IN THIS AREA



3. *Warning labels.* Consistent with the HCS ([§ 1910.1200](#)), the employer must label each immediate container of clothing, equipment, and materials contaminated with beryllium, and must, at a minimum, include the following on the label:

DANGER
CONTAINS BERYLLIUM
MAY CAUSE CANCER
CAUSES DAMAGE TO LUNGS
AVOID CREATING DUST
DO NOT GET ON SKIN

4. *Employee information*
 - i. For each employee who has, or can reasonably be expected to have, airborne exposure to or dermal contact with beryllium:
 - A. The employer must provide information and training in accordance with the HCS ([§ 1910.1200\(h\)](#));
 - B. The employer must provide initial training to each employee by the time of initial assignment; and
 - C. The employer must repeat the training required under this section annually for each employee.
 - ii. The employer must ensure that each employee who is, or can reasonably be expected to be, exposed to airborne beryllium can demonstrate knowledge and understanding of the following:
 - A. The health hazards associated with airborne exposure to and dermal contact with beryllium, including the signs and symptoms of CBD;
 - B. The written exposure control plan, with emphasis on the location(s) of beryllium work areas, including any regulated areas, and the specific nature of operations that could result in airborne exposure, especially airborne exposure above the TWA PEL or STEL;
 - C. The purpose, proper selection, fitting, proper use, and limitations of personal protective clothing and equipment, including respirators;
 - D. Applicable emergency procedures;
 - E. Measures employees can take to protect themselves from airborne exposure to and dermal contact with beryllium, including personal hygiene practices;
 - F. The purpose and a description of the medical surveillance program required by paragraph ([k](#)) of this standard including risks and benefits of each test to be offered;
 - G. The purpose and a description of the medical removal protection provided under paragraph ([l](#)) of this section;
 - H. The contents of the standard; and
 - I. The employee's right of access to records under the Records Access standard ([§ 1910.1020](#)).
 - iii. When a workplace change (such as modification of equipment, tasks, or procedures) results in new or increased airborne exposure that exceeds, or can reasonably be expected to exceed, either the TWA PEL or the STEL, the employer must provide additional training to those employees affected by the change in airborne exposure.

- iv. *Employee information.* The employer must make a copy of this standard and its appendices readily available at no cost to each employee and designated employee representative(s).

(n) Recordkeeping

[\(Table of Contents\)](#)

1. *Air monitoring data*

- i. The employer must make and maintain a record of all exposure measurements taken to assess airborne exposure as prescribed in paragraph [\(d\)](#) of this standard.
- ii. This record must include at least the following information:
 - A. The date of measurement for each sample taken;
 - B. The task that is being monitored;
 - C. The sampling and analytical methods used and evidence of their accuracy;
 - D. The number, duration, and results of samples taken;
 - E. The type of personal protective clothing and equipment, including respirators, worn by monitored employees at the time of monitoring; and
 - F. The name and job classification of each employee represented by the monitoring, indicating which employees were actually monitored.
- iii. The employer must ensure that exposure records are maintained and made available in accordance with the Records Access standard [\(§ 1910.1020\)](#).

2. *Objective data*

- i. Where an employer uses objective data to satisfy the exposure assessment requirements under paragraph [\(d\)\(2\)](#) of this standard, the employer must make and maintain a record of the objective data relied upon.
- ii. This record must include at least the following information:
 - A. The data relied upon;
 - B. The beryllium-containing material in question;
 - C. The source of the objective data;
 - D. A description of the process, task, or activity on which the objective data were based; and
 - E. Other data relevant to the process, task, activity, material, or airborne exposure on which the objective data were based.
- iii. The employer must ensure that objective data are maintained and made available in accordance with the Records Access standard [\(§ 1910.1020\)](#).

3. *Medical surveillance*

- i. The employer must make and maintain a record for each employee covered by medical surveillance under paragraph [\(k\)](#) of this standard.
- ii. The record must include the following information about each employee:
 - A. Name and job classification;
 - B. A copy of all licensed physicians' written medical opinions for each employee; and



- C. A copy of the information provided to the PLHCP as required by paragraph [\(k\)\(4\)](#) of this standard.
- iii. The employer must ensure that medical records are maintained and made available in accordance with the Records Access standard [\(§ 1910.1020\)](#).
- 4. *Training*
 - i. At the completion of any training required by this standard, the employer must prepare a record that indicates the name, and job classification of each employee trained, the date the training was completed, and the topic of the training.
 - ii. This record must be maintained for three years after the completion of training.
- 5. *Access to records* - Upon request, the employer must make all records maintained as a requirement of this standard available for examination and copying to the Assistant Secretary, the Director, each employee, and each employee's designated representative(s) in accordance the Records Access standard [\(§ 1910.1020\)](#).
- 6. *Transfer of records* - The employer must comply with the requirements involving transfer of records set forth in the Records Access standard [\(§ 1910.1020\)](#).

(o) Dates

[\(Table of Contents\)](#)

- 1. *Effective dates* - This standard shall become effective March 10, 2017.
- 2. *Compliance dates* - All obligations of this standard commence and become enforceable on May 11, 2018, except:
 - i. Change rooms and showers required by paragraph [\(i\)](#) of this standard must be provided by March 11, 2019; and
 - ii. Engineering controls required by paragraph [\(f\)](#) of this standard must be implemented by March 10, 2020.

1. Appendix A to § 1910.1024 - Operations for Establishing Beryllium Work Areas

Paragraph (b) of this standard defines a beryllium work area as any work area where materials that contain at least 0.1 percent beryllium by weight are processed (1) during any of the operations listed in Appendix A of this Standard, or (2) where employees are, or can reasonably be expected to be, exposed to airborne beryllium at or above the action level. Table A.1 in this appendix sets forth the operations that, where performed under the circumstances described in the column heading above the particular operations, trigger the requirement for a beryllium work area.

Table A.1: Operations for Establishing Beryllium Work Areas Where Processing Materials Containing at Least 0.1 Percent Beryllium by Weight

| Beryllium Metal Alloy Operations (generally < 10 % beryllium by weight) | Beryllium Composite Operations (generally > 10% beryllium by weight) and Beryllium Metal Operations | Beryllium Oxide Operations |
|---|---|-----------------------------------|
| Abrasive Blasting | Abrasive Blasting | Abrasive Blasting |
| Abrasive Processing | Abrasive Processing | Abrasive Processing |
| Abrasive Sawing | Abrasive Sawing | Abrasive Sawing |
| Annealing | Annealing | Boring |
| Bright Cleaning | Atomizing | Brazing (> 1,100° C) |
| Brushing | Attritioning | Broaching with green ceramic |
| Buffing | Blanking | Brushing |
| Burnishing | Bonding | Buffing |
| Casting | Boring | Centerless grinding |
| Centerless Grinding | Breaking | Chemical Cleaning |
| Chemical Cleaning | Bright Cleaning | Chemical Etching |
| Chemical Etching | Broaching | CNC Machining |
| Chemical Milling | Brushing | Cold Isostatic Pressing (CIP) |
| Dross Handling | Buffing | Crushing |
| Deburring (grinding) | Burnishing | Cutting |
| Electrical Chemical Machining (ECM) | Casting | Deburring (grinding) |
| Electrical Discharge Machining (EDM) | Centerless Grinding | Deburring (non-grinding) |
| | Chemical Cleaning | Destructive Testing |
| | Chemical Etching | Dicing |

| Beryllium Metal Alloy Operations (generally < 10 % beryllium by weight) | Beryllium Composite Operations (generally > 10% beryllium by weight) and Beryllium Metal Operations | Beryllium Oxide Operations |
|---|--|--|
| <p>Extrusion</p> <p>Forging</p> <p>Grinding</p> <p>Heat Treating (in air)</p> <p>High Speed Machining (>10,000 rpm)</p> <p>Hot Rolling</p> <p>Lapping</p> <p>Laser Cutting</p> <p>Laser Machining</p> <p>Laser Scribing</p> <p>Laser Marking</p> <p>Melting</p> <p>Photo-Etching</p> <p>Pickling</p> <p>Point and Chamfer</p> <p>Polishing</p> <p>Torch Cutting (i.e., oxy-acetylene)</p> <p>Tumbling</p> <p>Water-jet Cutting</p> <p>Welding</p> <p>Sanding</p> <p>Slab Milling</p> | <p>Chemical Milling</p> <p>CNC Machining</p> <p>Cold Isostatic Pressing</p> <p>Cold Pilger</p> <p>Crushing</p> <p>Cutting</p> <p>Deburring</p> <p>Dicing</p> <p>Drawing</p> <p>Drilling</p> <p>Dross Handling</p> <p>Electrical Chemical Machining (ECM)</p> <p>Electrical Discharge Machining (EDM)</p> <p>Extrusion</p> <p>Filing by Hand</p> <p>Forging</p> <p>Grinding</p> <p>Heading</p> <p>Heat Treating</p> <p>Honing</p> <p>Hot Isostatic Pressing (HIP)</p> <p>Lapping</p> <p>Laser Cutting</p> <p>Laser Machining</p> <p>Laser Scribing</p> <p>Laser Marking</p> | <p>Drilling</p> <p>Dry/wet Tumbling</p> <p>Extrusion</p> <p>Filing by Hand</p> <p>Firing of green ceramic</p> <p>Firing of refractory metallization (> 1,100° C)</p> <p>Grinding</p> <p>Honing</p> <p>Hot Isostatic Pressing (HIP)</p> <p>Lapping</p> <p>Laser Cutting</p> <p>Laser Machining</p> <p>Laser Scribing</p> <p>Laser Marking</p> <p>Machining</p> <p>Milling</p> <p>Piercing</p> <p>Mixing</p> <p>Plasma Spray</p> <p>Polishing</p> <p>Powder Handling</p> <p>Powder Pressing</p> <p>Reaming</p> <p>Sanding</p> <p>Sectioning</p> <p>Shearing</p> <p>Sintering of green ceramic</p> |

| Beryllium Metal Alloy Operations (generally < 10 % beryllium by weight) | Beryllium Composite Operations (generally > 10% beryllium by weight) and Beryllium Metal Operations | Beryllium Oxide Operations |
|---|--|---|
| | Machining Melting Milling Mixing Photo-Etching Pickling Piercing Pilger Plasma Spray Point and Chamfer Polishing Powder Handling Powder Pressing Pressing Reaming Roll Bonding Rolling Sanding Sawing (tooth blade) Shearing Sizing Skiving Slitting Snapping Sputtering Stamping Spray Drying Tapping Tensile Testing | Sintering of refractory metallization (>1,100° C) Snapping Spray Drying Tape casting Turning Water jet cutting |



| Beryllium Metal Alloy Operations (generally < 10 % beryllium by weight) | Beryllium Composite Operations (generally > 10% beryllium by weight) and Beryllium Metal Operations | Beryllium Oxide Operations |
|---|--|----------------------------|
| | Torch Cutting (i.e., oxy acetylene) Trepanning Tumbling Turning Vapor Deposition Water-jet Cutting Welding | |