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## Chapter 296-800 WAC Safety Standards for Beryllium

This book contains rules for Safety Standards for beryllium, as adopted under the Washington Industrial Safety and Health Act of 1973 (Chapter 49.17 RCW).

The rules in this book are effective December 2018. A brief promulgation history, set within brackets at the end of each section, gives statutory authority, administrative order of promulgation, and date of adoption of filing.

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## Chapter 296-850 WAC Safety Standards for Beryllium

Effective: 12/12/2018

<b>WAC 296-850-090</b>	<b>Definitions.....</b>	<b>1</b>
<b>WAC 296-850-100</b>	<b>Scope and application.....</b>	<b>4</b>
<b>WAC 296-850-110</b>	<b>Permissible exposure limits.....</b>	<b>5</b>
<b>WAC 296-850-115</b>	<b>Exposure assessment.....</b>	<b>6</b>
<b>WAC 296-850-120</b>	<b>Beryllium work areas and regulated areas.....</b>	<b>8</b>
<b>WAC 296-850-125</b>	<b>Competent person.....</b>	<b>9</b>
<b>WAC 296-850-130</b>	<b>Methods of compliance.....</b>	<b>10</b>
<b>WAC 296-850-135</b>	<b>Respiratory protection.....</b>	<b>12</b>
<b>WAC 296-850-140</b>	<b>Personal protective clothing and equipment.....</b>	<b>13</b>
<b>WAC 296-850-145</b>	<b>Hygiene areas and practices.....</b>	<b>15</b>
<b>WAC 296-850-150</b>	<b>Housekeeping.....</b>	<b>17</b>
<b>WAC 296-850-155</b>	<b>Medical surveillance.....</b>	<b>19</b>
<b>WAC 296-850-160</b>	<b>Medical removal.....</b>	<b>24</b>
<b>WAC 296-850-165</b>	<b>Communication of hazards.....</b>	<b>25</b>
<b>WAC 296-850-170</b>	<b>Recordkeeping.....</b>	<b>27</b>
<b>WAC 296-850-175</b>	<b>Dates.....</b>	<b>29</b>
<b>WAC 296-850-180</b>	<b>Appendix A—Control strategies to minimize beryllium exposure of this standard is nonmandatory.....</b>	<b>1</b>
<b>WAC 296-850-190</b>	<b>Appendix B—Considerations when using the blood beryllium lymphocyte proliferation test in the screening and evaluation of beryllium sensitization—Nonmandatory. Purpose:.....</b>	<b>1</b>

## **WAC 296-850-090 Definitions.**

For the purposes of this section the following definitions apply:

**Action level.** 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.** The exposure to airborne beryllium that would occur if the employee were not using a respirator.

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

**Beryllium work area.** Any work area:

- (a) Containing a process or operation that can release beryllium and involves material that contains at least 0.1 percent beryllium by weight; and
- (b) Where employees are, or can reasonably be expected to be, exposed to airborne beryllium at any level or where there is the potential for dermal contact with beryllium.

**CBD diagnostic center.** A medical diagnostic center that has an on-site pulmonary specialist and on-site facilities to perform a clinical evaluation for the presence of chronic beryllium disease (CBD). This evaluation must include 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 twenty-four hours. The on-site pulmonary specialist must be able to interpret the biopsy pathology and the BAL diagnostic test results.

**Chronic beryllium disease (CBD).** A chronic granulomatous (inflammatory) disease primarily of the lung, caused by exposure to beryllium, that meets the diagnostic criteria published in the department of labor and industries clinical guideline for the *Diagnosis of Beryllium Sensitization and Chronic Beryllium Disease*.

**Competent person.** An individual who is capable of identifying existing and foreseeable beryllium hazards in the workplace and who has authorization to take prompt corrective measures to eliminate or minimize them. The competent person must have the knowledge, ability, and authority necessary to fulfill the responsibilities set forth in WAC 296-850-125. This term is applicable in construction work conducted under contract with a building or facility owner or other building representative.

**Confirmed positive.** The person tested has beryllium sensitization, as indicated by two abnormal BeLPT test results, an abnormal and a borderline test result, or three borderline test results, or any cases confirmed by the criteria published in the department of labor and industries clinical guideline for the *Diagnosis of Beryllium Sensitization and Chronic Beryllium Disease*. It also means the result of a more reliable and accurate test indicating a person has been identified as having beryllium sensitization.

**Construction work.** All or any part of excavation, construction, erection, alteration, repair, demolition, and dismantling, of buildings and other structures and all operations in connection therewith; the excavation, construction, alteration and repair of sewers, trenches, caissons, conduits, pipe lines, roads and all operations pertaining thereto; the moving of buildings and other structures, and to the construction, alteration, repair, or removal of wharfs, docks, bridges, culverts, trestles, piers, abutments or any other construction, alteration, repair or removal work related thereto.

**Contaminated with beryllium and beryllium-contaminated.** 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.** Skin exposure to:

- (a) Soluble beryllium compounds containing beryllium in concentrations greater than or equal to 0.1 percent by weight;
- (b) Solutions containing beryllium in concentrations greater than or equal to 0.1 percent by weight; or
- (c) Dust, fumes, or mists containing beryllium in concentrations greater than or equal to 0.1 percent by weight.

**Emergency.** 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 unintended release of airborne beryllium that presents a significant hazard.

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

**Objective data.** 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.

**Physician or other licensed health care professional (PLHCP).** 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 WAC 296-850-155.

**Regulated area.** An area, including temporary work areas where maintenance or nonroutine 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).

**Ship breaking.** Breaking down a vessel's structure to scrap the vessel, including the removal of gear, equipment or any component part of a vessel.

**Ship building.** Construction of a vessel, including the installation of machinery and equipment.

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**Ship repairing.** Repair of a vessel including, but not limited to, alterations, conversions, installations, cleaning, painting, and maintenance.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 18-17-156 (Order 17-07), § 296-850-099, filed 08/21/2018, effective 12/12/2018.]

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## ***WAC 296-850-100 Scope and application.***

This standard applies to occupational exposure to beryllium in all forms, compounds, and mixtures, except:

- (1) This standard does not apply to articles, as defined in chapter [296-901](#) WAC, Globally harmonized system for hazard communication, that contain beryllium and that the employer does not process.
- (2) 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.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 18-17-156 (Order 17-07), § 296-850-100, filed 08/21/2018, effective 12/12/2018.]

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## ***WAC 296-850-110 Permissible exposure limits.***

- (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 fifteen minutes.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 18-17-156 (Order 17-07), § 296-850-110, filed 08/21/2018, effective 12/12/2018.]

## **WAC 296-850-115 Exposure assessment.**

- (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 subsection (2) of this section or the scheduled monitoring option in subsection (3) of this section.
- (2) **Performance option.** The employer must assess the 8-hour TWA exposure and the fifteen-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.
- (3) **Scheduled monitoring option.**
  - (a) 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.
  - (b) The employer must perform initial monitoring to assess the short-term exposure from fifteen-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.
  - (c) 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 subsection. In representative sampling, the employer must sample the employee(s) expected to have the highest airborne exposure to beryllium.
  - (d) 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.
  - (e) 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.
  - (f) 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.
  - (g) Where the most recent (noninitial) 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 seven 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 subsection (4) of this section, reassessment of exposure.



- (h) 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 seven 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 subsection (4) of this section, reassessment of exposure.
- (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 this subsection are evaluated by a laboratory that can measure beryllium to an accuracy of plus or minus twenty-five percent within a statistical confidence level of ninety-five percent for airborne concentrations at or above the action level.
- (6) **Employee notification of assessment results.**
  - (a) Within fifteen working days after completing an exposure assessment in accordance with this subsection, 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.
  - (b) 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.**
  - (a) 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).
  - (b) 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.
  - (c) The employer must ensure that each observer follows all other applicable safety and health procedures.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 18-17-156 (Order 17-07), § 296-850-115, filed 08/21/2018, effective 12/12/2018.]

## **WAC 296-850-120 Beryllium work areas and regulated areas.**

(1) **Establishment.**

- (a) The employer must establish and maintain a beryllium work area wherever the criteria for a “beryllium work area” set forth in WAC 296-850-090 Definitions, are met.

***Exception:***

*It is not required to establish a work area for construction work, ship breaking, ship building or ship repairing.*

- (b) 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.

***Exception:***

*It is not required to establish a regulated area for construction work.*

(2) **Demarcation.**

- (a) 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.
- (b) The employer must identify each regulated area in accordance with WAC 296-850-165(2) warning signs, of this rule.

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

- (a) Persons the employer authorizes or requires to be in a regulated area to perform work duties;
- (b) Persons entering a regulated area as designated representatives of employees for the purpose of exercising the right to observe exposure monitoring procedures under WAC 296-850-115(7) observation of monitoring; and
- (c) 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:

- (a) Respiratory protection in accordance with WAC 296-850-135 Respiratory protection, of this rule; and
- (b) Personal protective clothing and equipment in accordance with WAC 296-850-140 Personal protective clothing and equipment, of this rule.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 18-17-156 (Order 17-07), § 296-850-120, filed 08/21/2018, effective 12/12/2018.]]

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## **WAC 296-850-125 *Competent person.***

For construction and maintenance projects, wherever employees are, or can reasonably be expected to be, exposed to airborne beryllium at levels above the TWA PEL or STEL, the employer must designate a competent person to:

- (1) Make frequent and regular inspections of job sites, materials, and equipment;
- (2) Implement the written exposure control plan under WAC 296-850-130 Methods of compliance, of this rule;
- (3) Ensure that all employees use respiratory protection in accordance with WAC 296-850-135 Respiratory protection, of this rule; and
- (4) Ensure that all employees use personal protective clothing and equipment in accordance with WAC 296-850-140 Personal protective clothing and equipment, of this rule.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 18-17-156 (Order 17-07), § 296-850-125, filed 08/21/2018, effective 12/12/2018.]

## **WAC 296-850-130 Methods of compliance.**

### **(1) Written exposure control plan.**

- (a) The employer must establish, implement, and maintain a written exposure control plan, which must contain:
  - (i) A list of operations and job titles reasonably expected to involve airborne exposure to or dermal contact with beryllium;
  - (ii) A list of operations and job titles reasonably expected to involve airborne exposure at or above the action level;
  - (iii) A list of operations and job titles reasonably expected to involve airborne exposure above the TWA PEL or STEL;
  - (iv) Procedures for minimizing cross-contamination, including preventing the transfer of beryllium between surfaces, equipment, clothing, materials, and articles within beryllium work areas;
  - (v) Procedures for keeping surfaces as free as practicable of beryllium;
  - (vi) Procedures for minimizing the migration of beryllium from beryllium work areas to other locations within or outside the workplace;
  - (vii) A list of engineering controls, work practices, and respiratory protection required by subsection (2) of this section engineering and work practice controls, of this rule;
  - (viii) A list of personal protective clothing and equipment required by WAC 296-850-140 Personal protective clothing and equipment, of this rule;
  - (ix) Procedures for removing, laundering, storing, leaning, repairing, and disposing of beryllium-contaminated personal protective clothing and equipment, including respirators; and
  - (x) For construction work, procedures used to restrict access to work areas when airborne exposures are, or can reasonably be expected to be, above the TWA PEL or STEL, to minimize the number of employees exposed to airborne beryllium and their level of exposure, including exposures generated by other employers or sole proprietors.
- (b) The employer must review and evaluate the effectiveness of each written exposure control plan at least annually and update it, as necessary, when:
  - (i) 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;
  - (ii) The employer is notified that an employee is eligible for medical removal in accordance with WAC 296-850-160, referred for evaluation at a CBD diagnostic center, or shows signs or symptoms associated with airborne exposure to or dermal contact with beryllium; or
  - (iii) The employer has any reason to believe that new or additional airborne exposure is occurring or will occur.

- (c) 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 chapter [296-802](#) WAC, Employee medical and exposure records.

(2) **Engineering and work practice controls.**

- (a) 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 using respiratory protection in accordance with WAC 296-850-135 Respiratory protection.
- (b) Where exposures are, or can reasonably be expected to be, at or above the action level, the employer must ensure that at least one of the following is in place to reduce airborne exposure:
  - (i) Material and/or process substitution;
  - (ii) Isolation, such as ventilated partial or full enclosures;
  - (iii) Local exhaust ventilation, such as at the points of operation, material handling, and transfer; or
  - (iv) Process control, such as wet methods and automation.
- (c) An employer is exempt from using these controls to the extent that:
  - (i) The employer can establish that such controls are not feasible; or
  - (ii) 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 seven 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.

[Statutory Authority RCW 49.17.010, .040, .050, and .060. 18-17-156 (Order 17-07), § 296-850-130, filed 08/21/2018, effective 12/12/2018.]]

## ***WAC 296-850-135 Respiratory protection.***

- (1) **General.** The employer must provide respiratory protection at no cost to the employee and ensure that each employee uses respiratory protection:
  - (a) 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;
  - (b) During operations, including maintenance and repair activities and nonroutine 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;
  - (c) 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;
  - (d) During emergencies; and
  - (e) When an employee who is eligible for medical removal under WAC 296-850-160(1) chooses to remain in a job with airborne exposure at or above the action level, as permitted by WAC 296-850-160 (2)(b).
- (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 chapter [296-842](#) WAC, Respirators.
- (3) The employer must provide at no cost to the employee a powered air-purifying respirator (PAPR) instead of a negative pressure respirator when:
  - (a) Respiratory protection is required by this standard;
  - (b) An employee entitled to such respiratory protection requests a PAPR; and
  - (c) The PAPR provides adequate protection to the employee in accordance with subsection (2) of this section, respiratory protection program of this rule.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 18-17-156 (Order 17-07), § 296-850-135, filed 08/21/2018, effective 12/12/2018.]

## **WAC 296-850-140 Personal protective clothing and equipment.**

- (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 subsection (1) of this section and other applicable requirements for personal protective equipment. (WAC [296-800-160](#) Summary personal protective equipment (PPE). Chapter [296-155](#) WAC, Part C, Personal protective and lifesaving equipment. WAC [296-304-090](#) Personal protective equipment (PPE)—General requirements.):
  - (a) Where airborne exposure exceeds, or can reasonably be expected to exceed, the TWA PEL or STEL; or
  - (b) Where there is a reasonable expectation of dermal contact with beryllium.
- (2) **Removal and storage.**
  - (a) 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 tasks involving beryllium, or when personal protective clothing or equipment becomes visibly contaminated with beryllium, whichever comes first.
  - (b) 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 WAC 296-850-130(1).
  - (c) 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 WAC 296-850-130(1).
  - (d) 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.
  - (e) 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 WAC 296-850-165(3) and chapter [296-901](#) WAC, Globally harmonized system for hazard communication.
- (3) **Cleaning and replacement.**
  - (a) 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.

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- (b) 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.
  - (c) 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 airborne exposure to and dermal contact with beryllium and that the personal protective clothing and equipment must be handled in accordance with this standard.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 18-17-156 (Order 17-07), § 296-850-140, filed 08/21/2018, effective 12/12/2018.]



## **WAC 296-850-145 Hygiene areas and practices.**

- (1) **General.** For each employee working in a beryllium work area or required to use personal protective clothing or equipment by this rule in construction work, ship breaking, ship building, or ship repairing, the employer must:
  - (a) Provide readily accessible washing facilities in accordance with this standard and other applicable sanitation standards (WAC [296-800-230](#) Summary (drinking water, bathrooms, washing facilities and waste disposal); WAC [296-155-140](#) Sanitation; WAC [296-304-06002](#) Sanitation) to remove beryllium from the hands, face, and neck; and
  - (b) 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 subsection (1)(a) of this section, the employer must provide employees who work in a beryllium work area with a designated change room in accordance with this standard and other applicable sanitation standards (WAC [296-800-230](#) Summary (drinking water, bathrooms, washing facilities and waste disposal); WAC [296-155-140](#) Sanitation; WAC [296-304-06002](#) Sanitation) where employees are required to remove their personal clothing.
- (3) **Showers.**
  - (a) The employer must provide showers in accordance with other applicable sanitation standards (WAC [296-800-230](#) Summary (drinking water, bathrooms, washing facilities and waste disposal); WAC [296-155-140](#) Sanitation; WAC [296-304-06002](#) Sanitation) where:
    - (i) Airborne exposure exceeds, or can reasonably be expected to exceed, the TWA PEL or STEL; and
    - (ii) Employees' hair or body parts other than hands, face, and neck can reasonably be expected to become contaminated with beryllium.
  - (b) Employers required to provide showers must ensure that each employee showers at the end of the work shift or work activity if:
    - (i) The employee reasonably could have had airborne exposure above the TWA PEL or STEL; and
    - (ii) 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:
  - (a) Beryllium-contaminated surfaces in eating and drinking areas are as free as practicable of beryllium;

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- (b) No employees enter any eating or drinking area with beryllium-contaminated personal protective clothing or equipment unless, prior to entry, surface beryllium has been removed from the clothing or equipment by methods that do not disperse beryllium into the air or onto an employee's body; and
  - (c) Eating and drinking facilities provided by the employer are in accordance with other applicable sanitation standards (WAC [296-800-230](#) Summary (drinking water, bathrooms, washing facilities and waste disposal); WAC [296-155-140](#) Sanitation; WAC [296-304-06002](#) Sanitation).
- (5) **Prohibited activities.** The employer must ensure that no employees eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas and other work areas where there is a reasonable expectation of exposure above the TWA PEL or STEL.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 18-17-156 (Order 17-07), § 296-850-145, filed 08/21/2018, effective 12/12/2018.]

## **WAC 296-850-150 Housekeeping.**

### **(1) General.**

- (a) 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 WAC 296-850-130(1) and the cleaning methods required under this subsection;
- (b) In construction work, ship breaking, ship building or ship repairing, when cleaning beryllium-contaminated areas, the employer must follow the written exposure control plan required under WAC 296-850-130(1); and
- (c) 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 WAC 296-850-130(1) and the cleaning methods required under this subsection.

### **(2) Cleaning methods.**

- (a) 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.
- (b) The employer must not allow dry sweeping or brushing for cleaning surfaces in beryllium-work areas or regulated areas unless HEPA-filtered vacuuming or other methods that minimize the likelihood and level of airborne exposure are not safe or effective.
- (c) 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.
- (d) 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 WAC 296-850-135 Respiratory protection, and WAC 296-850-140 Personal protective clothing and equipment.
- (e) 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 reentrainment of airborne beryllium in the workplace.

### **(3) Disposal and recycling.** For materials that contain beryllium in concentrations of 0.1 percent by weight or more or are contaminated with beryllium, the employer must ensure that:

- (a) Materials designated for disposal are disposed of in sealed, impermeable enclosures, such as bags or containers, that are labeled in accordance with WAC 296-850-165(3) warning labels.

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- (b) Materials designated for recycling are cleaned to be as free as practicable of surface beryllium contamination and labeled in accordance with WAC 296-850-165(3), or placed in sealed, impermeable enclosures, such as bags or containers, that are labeled in accordance with WAC 296-850-165(3).

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 18-17-156 (Order 17-07), § 296-850-150, filed 08/21/2018, effective 12/12/2018.]

## **WAC 296-850-155 Medical surveillance.**

(1) **General.**

- (a) The employer must make medical surveillance required by this section available at no cost to the employee, and at a reasonable time and place, to each employee:
  - (i) Who is or is reasonably expected to be exposed at or above the action level for more than thirty days per year;
  - (ii) Who shows signs or symptoms of CBD or other beryllium-related health effects;
  - (iii) Who is exposed to beryllium during an emergency; or
  - (iv) Whose most recent written medical opinion required by this section recommends periodic medical surveillance.
- (b) 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.
- (c) When requested by an employee who provides the employer with an abnormal or borderline finding for a single blood BeLPT or two borderline blood BeLPT, the employer must arrange for medical examinations and procedures to be performed at a CBD diagnostic center that is mutually agreed upon by the employer and the employee, or at the CBD diagnostic center requested by the employee, when the center is recognized by the department as a center for research and clinical assessment of chemically related illness (see RCW 51.32.360).

(2) **Frequency.** The employer must provide a medical examination:

- (a) Within thirty days after determining that:
  - (i) An employee meets the criteria of subsection (1)(a)(i) of this section, unless the employee has received a medical examination, provided in accordance with this standard, within the last two years; or who shows signs or symptoms of CBD or other beryllium-related health effects;
  - (ii) An employee meets the criteria of subsection (1)(a)(ii) or (iii) of this section.
- (b) At least every two years thereafter for each employee who continues to meet the criteria of subsection (1)(a)(i), (ii), or (iv) of this section.
- (c) At the termination of employment for each employee who meets any of the criteria of subsection (1)(a) of this section 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.

(3) **Contents of examination.**

- (a) 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.
- (b) The employer must ensure that the employee is offered a medical examination that includes:
  - (i) 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;
  - (ii) A physical examination with emphasis on the respiratory system;
  - (iii) A physical examination for skin rashes;
  - (iv) 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);
  - (v) 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, follow-up BeLPT testing must be offered within thirty days, unless the employee has been confirmed positive or unless the employee requests a medical examination as according to subsection (1)(c) of this section. Samples must be analyzed in a laboratory certified under the College of American Pathologists/Clinical Laboratory Improvement Amendments (CLIA) guidelines to perform the BeLPT;
  - (vi) 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
  - (vii) Any other test deemed appropriate by the PLHCP.

(4) **Information provided to the PLHCP.** The employer must ensure that the examining PLHCP (and the evaluating CBD diagnostic center, if an evaluation is required under subsection (7) of this section) has a copy of this rule and must provide the following information, if known:

- (a) A description of the employee's former and current duties that relate to the employee's airborne exposure to and dermal contact with beryllium;
- (b) The employee's former and current levels of airborne exposure;
- (c) 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
- (d) 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.

(5) **Licensed physician's written medical report for the employee.**

***Exception:***

*When the PLHCP assists the worker in filing a claim under Title 51 RCW, Industrial insurance, the PLHCP does not need to prepare a separate report for the employee if all the information required in this section is entered into the claim record, the report is directly shared with the employee, and the PLHCP explains the results of the examination to the employee. The PLHCP may provide additional reports or notes to make sure the employee understands the results of the examination and recommendations.*

The employer must ensure that the employee receives a written medical report from the licensed physician within forty-five days of the examination (including any follow-up BeLPT required under subsection (3)(b)(v) of this section) and that the PLHCP explains the results of the examination to the employee. The written medical report must contain:

- (a) A statement indicating the results of the medical examination, including the licensed physician's opinion as to whether the employee has:
  - (i) Any detected medical condition, such as CBD or beryllium sensitization (i.e., the employee is confirmed positive, as defined in WAC 296-850-090), that may place the employee at increased risk from further airborne exposure; and
  - (ii) Any medical conditions related to airborne exposure that require further evaluation or treatment.
- (b) Any recommendations on:
  - (i) The employee's use of respirators, protective clothing, or equipment; or
  - (ii) Limitations on the employee's airborne exposure to beryllium.
- (c) 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.
- (d) If the employee is confirmed positive or diagnosed with CBD, the written report must also contain a recommendation for continued periodic medical surveillance.
- (e) 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 WAC 296-850-160.

(6) **Licensed physician's written medical opinion for the employer.**

***Exception:***

*When a claim has been initiated the PLHCP does not need to prepare a separate report for the employer if all information required in this section is entered into the claim record. As part of initiating a claim, the employee agrees to share all of the relevant medical records, and the limits on information reported to the employer in this section do not apply.*

- (a) The employer must obtain a written medical opinion from the licensed physician within forty-five days of the medical examination (including any follow-up BeLPT required under subsection (3)(b)(v) of this section). The written medical opinion must contain only the following:
    - (i) The date of the examination;
    - (ii) A statement that the examination has met the requirements;
    - (iii) Any recommended limitations on the employee's use of respirators, protective clothing, or equipment; and
    - (iv) 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.
  - (b) If the employee provides written authorization, the written opinion must also contain any recommended limitations on the employee's airborne exposure to beryllium.
  - (c) 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.
  - (d) 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.
  - (e) 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 WAC 296-850-160.
  - (f) The employer must ensure that each employee receives a copy of the written medical opinion described in this subsection within forty-five days of any medical examination (including any follow-up BeLPT required under subsection (3)(b)(v) of this section) performed for that employee.
- (7) **CBD diagnostic center.**
- (a) 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, or at the CBD diagnostic center requested by the employee, when the center is recognized by the department as a center for research and clinical assessment of chemically related illness (see RCW 51.32.360). The examination must be provided within thirty days of:
    - (i) The employer's receipt of a physician's written medical opinion to the employer that recommends referral to a CBD diagnostic center; or
    - (ii) 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.



- (b) The employer must ensure that the employee receives a written medical report from the CBD diagnostic center that contains all the information required in subsection (5)(a), (b), (c), and (e) of this section and that the PLHCP explains the results of the examination to the employee within thirty days of the examination.
- (c) The employer must obtain a written medical opinion from the CBD diagnostic center within thirty days of the medical examination. The written medical opinion must contain only the information in subsection (6)(a) of this section, 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 subsection (6)(b), (d), and (e) of this section, if applicable.
- (d) The employer must ensure that each employee receives a copy of the written medical opinion from the CBD diagnostic center described in this subsection within thirty days of any medical examination performed for that employee.
- (e) After an employee has received the initial clinical evaluation at a CBD diagnostic center described in (a) of this subsection, the employee may choose to have any subsequent medical examinations for which the employee is eligible under this section performed at a CBD diagnostic center mutually agreed upon by the employer and the employee, or at the CBD diagnostic center requested by the employee, when the center is recognized by the department as a center for research and clinical assessment of chemically related illness (see RCW 51.32.360). The employer must provide such examinations at no cost to the employee.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 18-17-156 (Order 17-07), § 296-850-155, filed 08/21/2018, effective 12/12/2018.]

## **WAC 296-850-160 Medical removal.**

- (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:
  - (a) The employee provides the employer with:
    - (i) An abnormal or borderline finding for a single blood BeLPT test, until confirmatory testing is completed; or
    - (ii) A written medical report indicating a confirmed positive finding or CBD diagnosis; or
    - (iii) A written medical report recommending removal from airborne exposure to beryllium in accordance with WAC 296-850-155 (5)(e) or (7)(b); or
  - (b) The employer receives a written medical opinion recommending removal from airborne exposure to beryllium in accordance with WAC 296-850-155 (6)(e) or (7)(c).
- (2) If an employee is eligible for medical removal, the employer must provide the employee with the employee's choice of:
  - (a) Removal as described in subsection (3) of this section; or
  - (b) 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 WAC 296-850-135 Respiratory protection, of this rule whenever airborne exposures are at or above the action level.
- (3) **If the employee chooses removal:**
  - (a) 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.
  - (b) 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 (a) of this subsection 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.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 18-17-156 (Order 17-07), § 296-850-160, filed 08/21/2018, effective 12/12/2018.]

## **WAC 296-850-165 Communication of hazards.**

(1) **General.**

- (a) Chemical manufacturers, importers, distributors, and employers must comply with all requirements of chapter [296-901](#) WAC, Globally harmonized system for hazard communication, for beryllium.
- (b) 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.
- (c) 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 chapter [296-901](#) WAC, Globally harmonized system for hazard communication, and subsection (4) of this section.

(2) **Warning signs.**

- (a) **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.
- (b) **Sign specification.**
  - (i) The employer must ensure that the warning signs required by (a) of this subsection are legible and readily visible.
  - (ii) The employer must ensure each warning sign required by (a) of this subsection bears the following legend:

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

- (3) **Warning labels.** Consistent with chapter [296-901](#) WAC, Globally harmonized system for hazard communication, the employer must label each bag and 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 and training.**

- (a) For each employee who has, or can reasonably be expected to have, airborne exposure to or dermal contact with beryllium:
  - (i) The employer must provide information and training in accordance with chapter [296-901](#) WAC, Globally harmonized system for hazard communication;
  - (ii) The employer must provide initial training to each employee by the time of initial assignment; and
  - (iii) The employer must repeat the training required under this standard annually for each employee.
- (b) 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:
  - (i) The health hazards associated with airborne exposure to and contact with beryllium, including the signs and symptoms of CBD;
  - (ii) 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;
  - (iii) The purpose, proper selection, fitting, proper use, and limitations of personal protective clothing and equipment, including respirators;
  - (iv) Applicable emergency procedures;
  - (v) Measures employees can take to protect themselves from airborne exposure to and contact with beryllium, including personal hygiene practices;
  - (vi) The purpose and a description of the medical surveillance program required by WAC 296-850-155 including risks and benefits of each test to be offered;
  - (vii) The purpose and a description of the medical removal protection provided under WAC 296-850-160;
  - (viii) The contents of the standard; and
  - (ix) The employee's right of access to records under chapter [296-802](#) WAC, Employee medical and exposure records.
- (c) 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.
- (d) Employee information. The employer must make a copy of this rule and its appendices readily available at no cost to each employee and designated employee representative(s).

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 18-17-156 (Order 17-07), § 296-850-165, filed 08/21/2018, effective 12/12/2018.]

## **WAC 296-850-170 Recordkeeping.**

### **(1) Air monitoring data.**

- (a) The employer must make and maintain a record of all exposure measurements taken to assess airborne exposure as prescribed in WAC 296-850-115 Exposure assessment.
- (b) This record must include at least the following information:
  - (i) The date of measurement for each sample taken;
  - (ii) The task that is being monitored;
  - (iii) The sampling and analytical methods used and evidence of their accuracy;
  - (iv) The number, duration, and results of samples taken;
  - (v) The type of personal protective clothing and equipment, including respirators, worn by monitored employees at the time of monitoring; and
  - (vi) The name, Social Security number, and job classification of each employee represented by the monitoring, indicating which employees were actually monitored.
- (c) The employer must ensure that exposure records are maintained and made available in accordance with chapter [296-802](#) WAC, Employee medical and exposure records.

### **(2) Objective data.**

- (a) Where an employer uses objective data to satisfy the exposure assessment requirements under WAC 296-850-115, the employer must make and maintain a record of the objective data relied upon.
- (b) This record must include at least the following information:
  - (i) The data relied upon;
  - (ii) The beryllium-containing material in question;
  - (iii) The source of the objective data;
  - (iv) A description of the process, task, or activity on which the objective data were based; and
  - (v) Other data relevant to the process, task, activity, material, or airborne exposure on which the objective data were based.
- (c) The employer must ensure that objective data are maintained and made available in accordance with chapter [296-802](#) WAC, Employee medical and exposure records.

### **(3) Medical surveillance.**

- (a) The employer must make and maintain a record for each employee covered by medical surveillance under WAC 296-850-155.
- (b) The record must include the following information about each employee:
  - (i) Name, Social Security number, and job classification;

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- (ii) A copy of all licensed physicians' written medical opinions for each employee; and
  - (iii) A copy of the information provided to the PLHCP as required by WAC 296-850-155(4).
- (c) The employer must ensure that medical records are maintained and made available in accordance with chapter [296-802](#) WAC, Employee medical and exposure records.
- (4) **Training.**
- (a) At the completion of any training required by this standard, the employer must prepare a record that indicates the name, Social Security number, and job classification of each employee trained, the date the training was completed, and the topic of the training.
  - (b) This record must be maintained for three years after the completion of training.
- (5) **Access to records.** The employer shall ensure records are maintained and made available in accordance with chapter [296-802](#) WAC, Employee medical and exposure records.
- (6) **Transfer of records.** The employer must comply with the requirements involving transfer of records set forth in chapter [296-802](#) WAC, Employee medical and exposure records.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 18-17-156 (Order 17-07), § 296-850-170, filed 08/21/2018, effective 12/12/2018.]

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## **WAC 296-850-175 *Dates.***

- (1) **Effective date.** This standard shall become effective December 12, 2018.
- (2) **Compliance dates.** All obligations of this standard commence and become enforceable on December 12, 2018, except:
  - (a) Change rooms and showers required by WAC 296-850-145 of this standard must be provided by March 11, 2019; and
  - (b) Engineering controls required by WAC 296-850-130 Methods of compliance, of this rule must be implemented by March 10, 2020.

[Statutory Authority: RCW 49.17.010, .040, .050, and .060. 18-17-156 (Order 17-07), § 296-850-175, filed 08/21/2018, effective 12/12/2018.]

**WAC 296-850-180 Appendix A—Control strategies to minimize beryllium exposure of this standard is nonmandatory.**

WAC 296-850-130(2) of this chapter requires employers to use one or more of the control methods listed in WAC 296-850-130(2) to minimize worker exposure in each operation in a beryllium work area, unless the operation is exempt under WAC 296-850-130 (2)(b). This appendix sets forth a nonexhaustive list of control options that employers could use to comply with WAC 296-850-130(2) for a number of specific beryllium operations.

**Table A.1: Exposure Control Recommendations**

Operation	Minimal Control Strategy*	Application Group
Beryllium Oxide Forming (e.g., pressing, extruding)	<p>For pressing operations:                      (1) Install local exhaust ventilation (LEV) on oxide press tables, oxide feed drum brakes, press tumblers, powder rollers, and die set disassembly stations;                      (2) Enclose the oxide presses; and                      (3) Install mechanical ventilation (make-up air) in processing areas.</p> <p>For extruding operations:                      (1) Install LEV on extruder powder loading hoods, oxide supply bottles, rod breaking operations, centerless grinders, rod laydown tables, dicing operations, surface grinders, discharge end of extrusion presses;                      (2) Enclose the centerless grinders; and                      (3) Install mechanical ventilation (make-up air) in processing areas.</p>	Primary Beryllium Production; Beryllium Oxide Ceramics and Composites
Chemical Processing Operations (e.g., leaching, pickling, degreasing, etching, plating)	For medium and high gassing operations: (1) Perform operation with a hood having a maximum of one open side; and (2) Design process so as to minimize spills; if accidental spills occur, perform immediate cleanup.	Primary Beryllium Production; Beryllium Oxide Ceramics and Composites; Copper Rolling, Drawing and Extruding



<b>Table A.1: Exposure Control Recommendations</b>		
<b>Operation</b>	<b>Minimal Control Strategy*</b>	<b>Application Group</b>
Finishing (e.g., grinding, sanding, polishing, deburring)	(1) Perform portable finishing operations in a ventilated hood. The hood should include both downdraft and backdraft ventilation, and have at least two sides and a top. (2) Perform stationary finishing operations using a ventilated and enclosed hood at the point of operation. The grinding wheel of the stationary unit should be enclosed and ventilated.	Secondary Smelting; Fabrication of Beryllium Alloy Products; Dental Labs
Furnace Operations (e.g., Melting and Casting)	(1) Use LEV on furnaces, pelletizer; arc furnace ingot machine discharge; pellet sampling; arc furnace bins and conveyors; beryllium hydroxide drum dumper and dryer; furnace rebuilding; furnace tool holders; arc furnace tundish and tundish skimming, tundish preheat hood, and tundish cleaning hoods; dross handling equipment and drums; dross recycling; and tool repair station, charge make-up station, oxide screener, product sampling locations, drum changing stations, and drum cleaning stations. (2) Use mechanical ventilation (make-up air) in furnace building.	Primary Beryllium Production; Beryllium Oxide Ceramics and Composites; Nonferrous Foundries; Secondary Smelting
Machining	Use: (1) LEV consistent with ACGIH® ventilation guidelines on deburring hoods, wet surface grinder enclosures, belt sanding hoods, and electrical discharge machines (for operations such as polishing, lapping, and buffing); (2) High velocity low volume hoods or ventilated	Primary Beryllium Production; Beryllium Oxide Ceramics and Composites; Copper Rolling, Drawing, and Extruding; Precision Turned Products

**Table A.1: Exposure Control Recommendations**

Operation	Minimal Control Strategy*	Application Group
	enclosures on lathes, vertical mills, CNC mills, and tool grinding operations; (3) For beryllium oxide ceramics, LEV on lapping, dicing, and laser cutting; and (4) Wet methods (e.g., coolants).	
Mechanical Processing (e.g., material handling (including scrap), sorting, crushing, screening, pulverizing, shredding, pouring, mixing, blending)	(1) Enclose and ventilate sources of emission; (2) Prohibit open handling of materials; and (3) Use mechanical ventilation (make-up air) in processing areas.	Primary Beryllium Production; Beryllium Oxide Ceramics and Composites; Aluminum and Copper Foundries; Secondary Smelting
Metal Forming (e.g., rolling, drawing, straightening, annealing, extruding)	(1) For rolling operations, install LEV on mill stands and reels such that a hood extends the length of the mill; (2) For point and chamfer operations, install LEV hoods at both ends of the rod; (3) For annealing operations, provide an inert atmosphere for annealing furnaces, and LEV hoods at entry and exit points; (4) For swaging operations, install LEV on the cutting head; (5) For drawing, straightening, and extruding operations, install LEV at entry and exit points; and (6) For all metal forming operations, install mechanical ventilation (make-up air) for processing areas.	Primary Beryllium Production; Copper Rolling, Drawing, and Extruding; Fabrication of Beryllium Alloy Products
Welding	For fixed welding operations: (1) Enclose work locations around the source of fume generation and use local exhaust ventilation; and (2) Install close capture hood enclosure designed so as to minimize fume emission from	Primary Beryllium Production; Fabrication of Beryllium Alloy Products; Welding

<b>Table A.1: Exposure Control Recommendations</b>		
<b>Operation</b>	<b>Minimal Control Strategy*</b>	<b>Application Group</b>
	the enclosure welding operation.  For manual operations: (1) Use portable local exhaust and general ventilation.	

\* All LEV specifications should be in accordance with the ACGIH® Publication No. 2094, “Industrial Ventilation – A Manual of Recommended Practice” wherever applicable.

## **WAC 296-850-190 Appendix B—Considerations when using the blood beryllium lymphocyte proliferation test in the screening and evaluation of beryllium sensitization—Nonmandatory. Purpose:**

The purpose of this appendix is to provide medical information and recommendations to aid physicians and other licensed health care professionals (PLHCPs) regarding compliance with the medical surveillance provisions of the beryllium standard. Appendix B is for informational and guidance purposes only and none of the statements in Appendix B should be construed as imposing a mandatory requirement on employers that is not otherwise imposed by the beryllium standard (chapter 296-850 WAC, Beryllium). The complete medical surveillance requirements for examinations and procedures under this chapter are described in WAC 296-850-155.

### **Chronic Beryllium Disease and Beryllium Sensitization:**

Chronic beryllium disease (CBD) is a chronic granulomatous (inflammatory) disease primarily of the lung, caused by exposure to beryllium that meets the diagnostic criteria published in the *Department of Labor and Industries Clinical Guideline for the Diagnosis of Beryllium Sensitization and Chronic Beryllium Disease*. Some patients diagnosed with CBD remain free of symptoms following diagnosis, while others develop progressive worsening of clinically significant disease. (Balmes et al. 2014. Page e54) "Medical therapy of CBD is directed at suppressing the immune response to beryllium and subsequent granuloma formation and fibrosis." (Ibid)

Summarizing their review of the development of beryllium sensitization, the Federal Occupational Safety and Health Administration (OSHA) described how the immune systems of sensitized workers have been activated to react to beryllium exposures such that subsequent exposure to beryllium can progress to serious lung disease. (OSHA 2017, page 2492) According to this rule, sensitized workers are considered to be confirmed positive if supported by two abnormal BeLPT test results, an abnormal and a borderline test result, or three borderline test results, or any cases confirmed by the criteria published in the *Department of Labor and Industries Clinical Guideline for the Diagnosis of Beryllium Sensitization and Chronic Beryllium Disease*. It also means the result of a more reliable and accurate test indicating a person has been identified as having beryllium sensitization.

It is prudent to remove sensitized workers from further exposure to beryllium. (Balmes et al. 2014; OSHA 2017)

Additional information regarding beryllium sensitization and chronic beryllium disease are included in the *Department of Labor and Industries Clinical Guideline for the Diagnosis of Beryllium Sensitization and Chronic Beryllium Disease*, which may be requested from the department.

### **The Beryllium Lymphocyte Proliferation Test:**

The beryllium lymphocyte proliferation test is performed by taking lymphocytes from either bronchoalveolar lavage fluid (the BAL BeLPT) or peripheral blood (the blood BeLPT), culturing them *in vitro*, and exposing them to beryllium sulfate to stimulate lymphocyte proliferation. The observation of beryllium-specific proliferation indicates beryllium sensitization.

While test results from either the blood BeLPT or the BAL BeLPT can be used to confirm sensitization to beryllium, (L&I Clinical Beryllium Guideline) it is the blood BeLPT that is typically used when screening for beryllium sensitization. Abnormal and borderline test results are considered "other than normal" in that they form the basis for diagnosing beryllium sensitization according to the diagnostic criteria used by this rule. Under these diagnostic criteria, no single blood BeLPT result can be used to diagnose beryllium sensitization.

The sensitivity of the BeLPT refers to its ability to correctly yield an other than normal result (i.e., abnormal or borderline) in those who are truly sensitized to beryllium. The specificity of the test refers to its ability to correctly yield a normal result in those who are not sensitized to beryllium.

Per Stange et al. (2004) and Middleton et al. (2006), for a single blood BeLPT the sensitivity is 0.723, and the specificity is 0.9737.

Abnormal or borderline results in workers who are in fact not sensitized to beryllium are considered false positives. Normal results in workers who are truly sensitized to beryllium are considered false negatives.

The diagnostic criteria for confirmed positive beryllium sensitization used by this rule requires any single abnormal or borderline blood BeLPT result be confirmed, which reduces the risk of unsensitized workers being falsely labeled as sensitized by false positive results of the blood BeLPT.

With a sensitivity of 0.723, a single blood BeLPT would be expected to falsely yield a negative result in nearly thirty percent of truly sensitized workers who undergo the test. Testing algorithms have been published that use multiple blood BeLPTs to reduce false negative results while continuing to control the risk of false positives. (Middleton et al. 2006, L&I Clinical Beryllium Guideline)

**Thus, by controlling the sequence and number of blood BeLPTs he or she orders, the ordering provider exerts significant control over the risk that workers who are truly sensitized to beryllium could be falsely labeled as unsensitized due to false negative results of the blood BeLPT.** The following is designed to provide information to assist the ordering provider who tailors these decisions to the needs of the population and individuals being tested.

These published testing algorithms reduce the risk of false negatives by using split-sample blood beryllium lymphocyte proliferation testing, which is the measurement of blood lymphocyte proliferation in two laboratory tests when a single sample of blood is split into two samples and sent to two independent laboratories, whereupon the lymphocytes are challenged with a soluble beryllium salt and two results returned. (Welch et al. 2004; Middleton et al. 2006; Balmes et al. 2014, OSHA 2017)

The highest sensitivity for performing beryllium sensitization testing using the blood BeLPT (86%) described in NIOSH beryllium rulemaking testimony (NIOSH page 32) relies upon a testing algorithm that requires either one or two rounds of testing, where split-sample blood BeLPTs are performed at each round. Thus, a minimum of two initial blood BeLPTs are obtained from independent laboratories in this testing algorithm, followed if needed by a second simultaneously-obtained pair. (Middleton et al. 2006)

An alternative algorithm with a lower sensitivity (65.7%) uses a single blood BeLPT for the initial round of testing. If the initial result is abnormal or borderline, this triggers a second round of testing with a split-sample blood BeLPT. (Ibid)

### **Round two split-sample testing:**

Although not required by this rule, providers should consider the advantages of using split-sample testing for the second round of blood BeLPT testing, compared to single-sample testing:

- If only a single blood BeLPT is performed during a second round of testing, nearly thirty percent of truly sensitized workers would be expected to have a false negative test result and additional evaluation recommended.
- Split-sample testing for the second round decreases the risk of such false-negative results
- Based on published blood BeLPT performance characteristics (Stange et al. 2004; Middleton et al. 2006) false negative tests are more common than false positives (unless beryllium sensitization is sufficiently rare in the screened population.)
- For some result patterns, split-sample testing may be a faster way to arrive at a sensitization determination, which may be particularly relevant for workers who are receiving medical removal protection benefits while the diagnostic evaluation proceeds
- The risk of false-positives is low with either algorithm that uses split-sample testing (Middleton et al. 2006)

Per WAC 296-850-155 (3)(b)(v) and (vii), employers must make split-sample testing available to workers if requested by the provider who is determining whether an employee is sensitized to beryllium. In addition, WAC 296-850-155 (3)(b)(v) and (vii) requires employers to make multiple rounds of blood BeLPT testing available if requested by the provider. Providers need not cease testing if an initial abnormal or borderline result is followed by single- instead of split-sample testing and a single negative blood BeLPT results, for example.

Per WAC 296-850-155 (5)(c) and (6)(c) providers may at any time choose to refer workers to their choice of either a chronic beryllium disease diagnostic center that is mutually agreed upon by the employer and the employee, or to a facility recognized by the department as a center for research and clinical assessment of chemically related illness (see RCW 51.32.360).

### **Round one split-sample testing:**

Although not required by this rule, providers should also consider circumstances under which split-sample testing at the time of the initial evaluation may be advantageous:

- This achieves the highest sensitivity (86%) of any screening algorithm described in this appendix, while controlling the risk of false-positive test results. (Middleton et al. 2006)
- Except in populations where beryllium sensitization is sufficiently rare, this increase in sensitivity compared to performing the first round of testing with just a single blood BeLPT significantly reduces the number of false negative test results relative to the increase in false positives.
- Patient-specific considerations include the risk of loss-to-follow-up, the expected time to next screening examination, provider index of suspicion, and the consequences of sustaining ongoing exposure to beryllium in the case of a missed diagnosis.

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**Additional considerations:**

The tests used to diagnose beryllium sensitization may have been performed at any time following exposure. (L&I Clinical Beryllium Guideline) Thus, there may be a need to gather additional records of tests that have yielded abnormal or borderline results, but that may not be in the possession of the employer or provided to the provider at the start of the screening examination.

Diagnostic criteria used in the rule anticipate the possibility of false-negative testing: If deemed appropriate, sensitization can be confirmed by bronchoalveolar lavage BeLPT (BAL BeLPT). (L&I Clinical Beryllium Guideline)

Diagnosing chronic beryllium disease using the secondary diagnostic pathway requires all criteria be met and requires the performance of both the blood BeLPT and BAL BeLPT (unless medically contraindicated), but does not require sensitization be confirmed as described in the primary diagnostic pathway. (L&I Clinical Beryllium Guideline)

**Concluding recommendations:**

Providers should consider providing split-sample blood BeLPTs in nearly all circumstances where round two testing is indicated or required.

Providers should consider whether patient- and population-based considerations warrant using split-sample testing for the first round of blood BeLPT testing.

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