1910.1024 App A

- **Title:**

Appendix A to § 1910.1024 Control Strategies To Minimize Beryllium Exposure (Non-Mandatory)

Paragraph (f)(2)(i) of this standard requires employers to use one or more of the control methods listed in paragraph (f)(2)(i) to minimize worker exposure in each operation in a beryllium work area, unless the operation is exempt under paragraph (f)(2)(ii). This appendix sets forth a nonexhaustive list of control options that employers could use to comply with paragraph (f)(2)(i) 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).	For pressing operations:	Primary Beryllium Production; Beryllium Oxide Ceramics and Composites.
	1. Install local exhaust ventilation (LEV) on oxide press tables, oxide feed drum breaks, 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	
	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.	
	For medium and high gassing operations:	

Operation	Minimal control strategy *	Application group
Chemical Processing Operations (*e.g.*, leaching, pickling, degreasing, etching, plating).	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.
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);	Primary Beryllium Production; Beryllium Oxide Ceramics and Composites; Copper Rolling, Drawing, and

Operation	Minimal control strategy *	Application group
	2. high velocity low volume hoods or ventilated 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).	Extruding; Precision Turned Products.
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:	Primary Beryllium Production; Fabrication

~~Operation~~	~~Minimal control strategy *~~	~~Application group~~
	~~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 the enclosure welding operation.~~ ~~For manual operations:~~ ~~1. Use portable local exhaust and general ventilation~~	~~of Beryllium Alloy Products; Welding.~~

~~* All LEV specifications should be in accordance with the ACGIH® Publication No. 2094, "Industrial Ventilation—A Manual of Recommended Practice" wherever applicable.~~

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.

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
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).
Extrusion.	Chemical Cleaning.	Destructive Testing.
Forging.	Chemical Etching	Dicing.

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
Grinding.	Chemical Milling.	Drilling.
Heat Treating (in air).	CNC Machining	Dry/wet Tumbling.
High Speed Machining (>10,000 rpm).	Cold Isostatic Pressing.	Extrusion.
Hot Rolling.	Cold Pilger.	Filing by Hand.
Lapping.	Crushing.	Firing of Green Ceramic.
Laser Cutting.	Cutting.	Firing of Refractory Metallization (>1,100 °C).
Laser Machining.	Deburring.	Grinding.
Laser Scribing.	Dicing.	Honing.
Laser Marking.	Drawing.	Hot Isostatic Pressing (HIP).
Melting.	Drilling.	Lapping.
Photo-Etching.	Dross Handling.	Laser Cutting.
Pickling.	Electrical Chemical Machining (ECM).	Laser Machining.
Point and Chamfer.	Electrical Discharge Machining (EDM).	Laser Scribing.
Polishing.	Extrusion.	Laser Marking.
Torch Cutting (i.e., oxy-acetylene).	Filing by Hand.	Machining.
Tumbling.	Forging.	Milling.

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
Water-jet Cutting.	Grinding.	Piercing.
Welding.	Heading.	Mixing.
Start Printed Page 42628		
Sanding.	Heat Treating.	Plasma Spray.
Slab Milling.	Honing.	Polishing.
	Hot Isostatic Pressing (HIP).	Powder Handling.
	Lapping.	Powder Pressing.
	Laser Cutting.	Reaming.
	Laser Machining.	Sanding.
	Laser Scribing.	Sectioning.
	Laser Marking.	Shearing.
	Machining.	Sintering of Green Ceramic.
	Melting.	Sintering of Refractory Metallization (>1,100 °C).
	Milling.	Snapping.
	Mixing.	Spray Drying.
	Photo-Etching.	Tape Casting.

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
	Pickling.	Turning.
	Piercing.	Water Jet Cutting.
	Pilger.	
	Plasma Spray.	
	Point and Chamfer.	
	Polishing.	
	Powder Handling.	
	Powder Pressing.	
	Pressing.	
	Reaming.	
	Roll Bonding.	
	Rolling.	
	Sanding.	
	Sawing (tooth blade).	
	Shearing.	
	Sizing.	

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
	Skiving.	
	Slitting.	
	Snapping.	
	Sputtering.	
	Stamping.	
	Spray Drying.	
	Tapping.	
	Tensile Testing.	
	Torch Cutting (i.e., oxy acetylene).	
	Trepanning.	
	Tumbling	
	Turning.	
	Vapor Deposition.	
	Water-Jet Cutting.	
	Welding.	

End Supplemental Information

Footnotes

1. In the 2017 final rule, OSHA issued three separate beryllium standards—general industry, shipyards, and construction. This final rule amends only the general industry standard. Therefore, neither this Events Leading to the Final Rule section nor the remainder of the preamble will include information about the other two standards

2. OSHA stated in the NPRM that the agency believed that the standard as modified by the proposal would provide equivalent protection to the existing standard; and OSHA would therefore accept compliance with the standard, as modified by the proposal, as compliance with the standard while the rulemaking was pending.

3. Assuming that this initial analysis does not result in a confirmed positive diagnosis, that employee would not be confirmed positive until a second test two years later under the current rule.

4. As discussed in Section XI, Summary and Explanation of the Final Rule, OSHA also redesignated previous paragraphs (k)(7)(ii), (iii), (iv), and (v) as paragraphs (k)(7)(iii), (iv), (v), and (vi), respectively. This redesignation in paragraph (k) also affects a reference in paragraph (l)(1)(ii). These changes are merely administrative and do not have any substantive or monetary effect.

5. As discussed in the Summary and Explanation for paragraph (k), Medical Surveillance, OSHA never intended to limit the required tests to the three tests listed in the previous definition of the term CBD diagnostic center.

6. Document ID OSHA-H005C-2006-0870-0637 provides some information from the NJH website, which provides an overview of the types of tests performed.

7. OSHA also notes that it has always intended for employers to make available any additional tests deemed appropriate by the examining physician (see the discussion of paragraph (k), Medical Surveillance, in Section XI, Summary and Explanation of the Final Rule, of this preamble). The economic analysis of the 2017 final rule did not explicitly account for these rare cases where a test recommended by the examining physician of the CBD diagnostic center was not available at the same center. Hence, there would be a de minimis cost adjustment increase of the total cost of the 2017 final rule due to this consideration. This is not a change in people's behavior, simply a methodological change. The current final rule could affect people's behavior and be a true change (decrease) in costs. This change merely provides employers with a more flexible, potentially less expensive, manner to provide those tests in the rare situation where they are not available at the original CBD diagnostic center.

8. Although the agency did not receive any comments questioning the economic or technological feasibility of the proposed changes, at least one stakeholder argued that the previous standard was not economically or technologically feasible and that the proposed provisions remedied some of that stakeholder's concerns with feasibility (Document ID 0038, pp. 13, 21-22, 43). Because the feasibility of the January 2017 final rule

as a whole is not at issue in this rulemaking, OSHA considers these comments indicating that these changes provide both economic and technological feasibility relief as support for the economic and technological feasibility of the proposed revisions.

9. OSHA notes that Materion also argued that the State Plans that have already adopted the original OSHA standard should be required to adopt the changes OSHA previously adopted in the 2018 direct final rule, as well as the changes that result from the current rulemaking (Document ID 0038-A5, p. 1). Whether OSHA should require State Plans to adopt the changes made in the 2018 direct final rule is out of the scope of this rulemaking and, thus, will not be considered here.

10. Table A.1 is divided into three categories: (1) Beryllium Metal Alloy Operations (generally <10% beryllium by weight); (2) Beryllium Composite Operations (generally >10% beryllium by weight) and Beryllium Metal Operations; and (3) Beryllium Oxide Operations.

11. The agency notes that DOD's comment suggests there might be some confusion as to whether beryllium alloys and beryllium composites are analogous. In fact, these materials have different structures and should be treated differently from a control strategy point of view. A metal alloy is a metal which is a homogeneous mixture of two or more metals or of a metal and another element to provide unique characteristics or properties (see https://www.thefreedictionary.com/Metal+alloy). A "beryllium composite," on the other hand, is a metal matrix composite or (MMC) which typically contain at least two distinct constituent parts (see https://www.azom.com/article.aspx?ArticleID=9843).

12. In the preamble to the 2017 final rule, OSHA found that three borderline BeLPT results recognize a change in a person's immune system with respect to beryllium exposure based on Middleton et al.'s 2011 finding that three borderline BeLPT results have a positive predictive value (PPV) of over 90 percent (82 FR at 2501), and therefore the agency included three borderline results in the criteria for confirmed positive (82 FR at 2646).

13. The ATS also asserted that the removal of the phrase "beryllium sensitization" would reduce workers' right to file for worker's compensation (Document ID 0021, p. 3). The ATS did not explain how the definition of confirmed positive in the beryllium standard could affect worker's compensation claims and at least one other commenter questioned the ATS's assertion (see Document ID 0038, p. 19). Regardless, OSHA intends the definition of confirmed positive to serve only as a trigger for certain provisions of the beryllium standard. How OSHA defines this phrase for purposes of the beryllium standard in no way limits healthcare professionals' ability or incentive to diagnose beryllium sensitization.

14. Bronchoalveolar lavage is a method of "washing" the lungs with fluid inserted via a flexible fiberoptic instrument known as a bronchoscope, removing the fluid and analyzing the content for the inclusion of immune cells reactive to beryllium exposure (82 FR at 2497).

15. NJH also asserted that "[a]ll workers in a beryllium using industry should receive beryllium education with programs tailored to specific jobs and processes" (Document ID 0022, p. 7). Mount Sinai Selikoff Centers for Occupational Health similarly advocated for "intensive training and protective gear for all workers who may be at risk of beryllium exposure" (Document ID 0032, p. 3). OSHA notes that the beryllium standard has never required all workers in a beryllium-using industry to receive training. Rather, the standard has always required training for those workers

who have or are reasonably expected to have airborne exposure to beryllium regardless of the size fraction. The standard continues to require training for all such workers.

16. Materion also asserted that the evidence in the record is insufficient to conclude that "dermal contact alone is sufficient to create a significant risk of CBD or even beryllium sensitization" (Document ID 0038, pp. 14-15). However, in the 2017 final rule, OSHA specifically found that that dermal exposure can result in sensitization (see 82 FR at 2489). The 2018 NPRM did not propose revisiting this finding.

17. Subsequent to the 2017 final rule, the 2018 direct final rule clarified that the requirements of paragraph (j)(3) do not apply to materials containing only trace amounts of beryllium (less than 0.1 percent by weight).

18. As OSHA noted in the 2018 NPRM, employees who may be exposed to these materials during intra-plant transfers will not go unprotected. On the contrary, other provisions of the beryllium standard require employers to communicate possible hazards to these employees and protect them during such transfers (see, e.g., paragraph (f), Methods of compliance; paragraph (g), Respiratory protection; paragraph (h), Personal protective clothing and equipment; paragraph (m), Communication of hazards).

19. DOD's suggestion regarding DOE's cleanliness standards is addressed below in this section of this final rule as part of the discussion of the seventh and final proposed change to paragraph (j)(3) relating to the cleaning of materials designated for disposal, recycling, or reuse.

20. OSHA notes that the standard would require additional training for workers who were exposed during an emergency who had already been trained if the employer realized that those workers were not knowledgeable about topics such as the potential medical conditions which may result from exposure to beryllium or symptoms that may trigger a medical examination (see paragraph (m)(4)(ii)(A); see also additional training requirements under paragraph (m)(4)(iii)).

21. Under paragraph (k)(6)(i)(D), the employer is to ensure that the PLHCP explains the results of the medical examination to the employee, including results of tests conducted and medical conditions related to airborne beryllium exposure that require further evaluation or treatment.

22. Document ID OSHA-H005C-2006-0870-0637 provides information from the NJH website, which provides an overview of the types of tests performed.

23. The beryllium standard for general industry, which was not published until 2017, was not listed in the SIP-IV NPRM and, therefore, the SIP-IV final rule did not affect the 2017 final rule's requirement to include employee SSNs in records.