



**Report Re the Occupational Safety and Health Administration’s (OSHA’s)  
proposed rule to revoke the ancillary provisions to the Final Rule on worker  
exposure to beryllium (“final rule”) adapted on January 9, 2017, for the  
construction and the shipyard sectors**

**Renee M. Kalmes, CIH Principal Scientist Exponent  
Michael Posson, CIH Managing Scientist Exponent**

This report has been prepared by Exponent on behalf of Abrasive Blasting Manufacturers Alliance (“ABMA” or the “Alliance”) to address technical issues associated with the adoption of ancillary provisions of the final Be rule (adopted on January 9, 2017) for the construction and shipyard industries. Our report focuses on several scientific aspects as follows:

1. No scientific literature showing any disease associated with the beryllium mineral form used in abrasive blasting industry.
2. Feasibility of sampling method to evaluate beryllium action level and PELs for abrasive blasting operations and implications to the ancillary provisions of the beryllium rule.
3. Although beryllium is found in many abrasive blast media products at trace levels below 0.1%, demonstrating that materials are exempt may be technically infeasible.
4. Technical feasibility to meet the new exposure limits using only engineering and work practice controls.
5. Redundancy of ancillary provisions with overlapping protections or other standards that do not improve worker protection.
6. Medical surveillance.

**1. No scientific literature showing any disease associated with the beryllium mineral form used in abrasive blasting industry**

We have found no link in any published study between the mineral form of beryllium present in the abrasive blast media and the medical conditions being targeted in the Beryllium Rule (BeS, CBD and lung cancer). The 16 epidemiological studies that OSHA cites for the basis of sensitization and CBD confirm that the mineral form of beryllium as a causative agent for beryllium disease is not reported in the literature. Materion Brush Inc. has provided extensive comments that attest to its experience that acute beryllium lung reactions have only been associated with beryllium extraction operations involving soluble beryllium compounds. There is no empirical evidence in the form of epidemiology, research studies, or health hazard evaluations in the record that demonstrates that exposure to materials containing trace levels of beryllium, such as those found in abrasive blasting materials, results in clinical CBD, and the detection of beryllium sensitization or lung cancer. There is no evidence for any significant risk from beryllium in

abrasive blasting beyond that already controlled by the engineering controls, administrative controls, and PPE required by the preexisting OSHA standards regulating abrasive blasting.

## **2. Feasibility of sampling method to evaluate beryllium action level and PELs for abrasive blasting operations and implications to ancillary provisions of the beryllium rule**

Although OSHA acknowledges that challenges with monitoring exposures to dust during abrasive blasting are well recognized, OSHA minimizes the implications that affect the abrasive blasting industry with regard to the use of air monitoring as the basis for the ancillary provisions requirements in the construction and shipyard regulations.

U.S. Occupational Safety and Health Administration (OSHA), the National Institute of Occupational Safety and Health (NIOSH), and several peer-reviewed articles have noted that the collection of representative exposure samples during abrasive blasting operations is not reliable using current mandated approaches that govern compliance. OSHA's letters of interpretation (OSHA 1999) and Field Manual (OSHA 2017) state that the sampling device must be placed outside of the personal protective equipment (e.g., blasting shroud) to determine compliance. However, studies by NIOSH (2007; 2012; 1994) and the peer-reviewed literature (Ceballos et al., 2013) indicate that a long-term (i.e., full shift) reliable sample cannot be collected under many abrasive blasting operations. Specifically, Ceballos et al. (2013) notes that "the presence of large loose particulate inside the 37-mm cassettes verifies that noninhalable particulates can enter the sampler during abrasive blasting using coal slag." This is typically due to overloading by inertia-driven particulate that enters the sampling device during blasting operations. Further, these particulates are not relevant to inhalation-based beryllium exposures, for which the AL and PEL are intended to limit; yet these large particles can significantly contribute to beryllium concentrations when analyzed at the laboratory.

Alternative sampling methods using protective screens over the samplers and alternative sampler placement (e.g., behind the head or body) did not improve the reliability of sample collection. Investigators also noted that pumps frequently failed or the sampling train was detached due to the harsh conditions of the abrasive blasting operations (Ceballos et al. 2013; NIOSH 2012). Furthermore, many studies have limited their sampling times to very short durations (less than 30 minutes) to avoid overloading samples with particulate (NIOSH/KTA-Tator 1998a, 1998b, 1999; Spear et al. 2002; Stephenson et al. 2002). Such short-term sampling periods are not likely to be an efficient means of evaluation without impacting the productivity of the abrasive blasting operation, which would compromise the representativeness of the sample. NIOSH has concluded that particulates tend to overestimate exposures by stating that all results "were likely to overestimate air concentrations because of the inertia-driven particulate found in the samplers." (NIOSH 2012). This has also been concluded in several additional studies commissioned by government agencies (NIOSH 1994; NIOSH 1998; OSHA 1999).

Specifically as stated by NIOSH,

“Current PBZ air sampling techniques are not effective in assessing employee exposures during abrasive blasting. Therefore, sampling methods that can more accurately estimate exposures during abrasive blasting operations are needed. We are not aware of any PBZ sampling methods that are suitable to accurately measure exposures during abrasive blasting outside the blasting hood. Identification of alternative methods for assessing worker exposure during abrasive blasting operations is still needed” (Ceballos et al., 2013).

OSHA indicates that there are “acceptable” sampling and analytical methods that can achieve detection limits to comply with the AL in the Rule preamble (p. 2638). However, these currently available sampling methods are not reliable for evaluating exposures during abrasive blasting operations to evaluate compliance with either the AL or PEL based on the numerous studies conducted during these operations discussed above. Further, the primary data relied upon by OSHA in the development of the exposure profile (including 8-hour TWA concentrations) offers little context around the sampling events, activities, and potential limitations (e.g., overloading of samplers). Therefore, a full assessment of these data is not possible.

OSHA is requiring an assessment of exposure against an Action Level and PEL that if exceeded requires numerous ancillary provisions. However, because OSHA does not allow for alternative methods to evaluate worker exposures during blasting operations (i.e., inside the blasting hood) and due to the inherent sampling issues discussed above, it will be technically infeasible to demonstrate exposure below the AL and PELs outside the blast hood even though existing abrasive blasting controls (i.e., respiratory protection) is in fact already effectively controlling worker exposures to well below the AL and PEL.

### **3. Although beryllium is found in many abrasive blast media products at trace levels below 0.1%, demonstrating that materials are exempt may be technically infeasible.**

Beryllium is present in abrasive materials due to contributions from naturally occurring sources, at concentrations well below 0.1%. Two studies commissioned by NIOSH demonstrate that multiple abrasive blasting media materials contain beryllium. NIOSH (2007) reported that concentrations of 1.7 ppm (~0.0002%) beryllium were found in a coal slag abrasive.<sup>1</sup> NIOSH/KTA-Tator (1998a, 1998b, 1999) reported detectable levels of beryllium in several other abrasive blast media, including: coal slag, nickel slag, staurolite, specular hematite, silica sand, copper slag, garnet, and steel grit.

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<sup>1</sup> This level is consistent with information presented in ABMA’s November 2015 submission

Although present in trace amounts, it may be technically infeasible to demonstrate the material exemption under 1915.1024 (a)(3) and 1926.1124 (a)(3). In addition to the complications with collecting reliable samples, as noted in Comment 2 above, personal air sample results collected during various blasting operations report that significant matrix interferences exist. These interferences result in an elevated limit of detection and do not allow for reliable comparisons to the AL exemption. The primary interfering compound is likely from the base material that is being abrasively blasted (e.g., iron) or could originate from the media itself. OSHA (2016) stated that personal samples collected during abrasive blasting operations using garnet media resulted in elevated detection limits ( $8 \mu\text{g}/\text{m}^3$  to  $35 \mu\text{g}/\text{m}^3$ ) which is likely due to matrix interferences from iron that required significant sample dilutions ( $> 40$  times) for the analysis (NIOSH 1993a, NIOSH 1994) and that detection limits were so high in those 4 personal samples that compliance relative to not only the proposed AL, but also the PEL could not be completed with this data set.

In another study, NIOSH noted that significant dilutions of samples were required to account for iron interferences from blasting on stainless steel (NIOSH 1993a, 1993b). These studies demonstrate that the media being blasted may also contribute to analytical interference making it technically infeasible to document compliance with the material exemption.

OSHA cited studies show that most abrasive blasting media sampled may not meet the AL or the PEL. Specifically, OSHA cites in Table IV.68 that the mean or median airborne concentration for garnet, glass bead, mineral coal slag, organic media, and steel grit/shot exceed the AL of  $0.1 \mu\text{g}/\text{m}^3$  (OSHA 2016, NIOSH 1983, 2007; OSHA 2005; US Navy 2003, 2006). Additionally, other studies show low beryllium content abrasive categories, such as garnet and crushed glass, still result in airborne concentrations above  $0.1 \mu\text{g}/\text{m}^3$ . For example, studies with garnet report airborne concentrations up to  $2.289 \mu\text{g}/\text{m}^3$ , while the use of crushed glass abrasives result in airborne concentrations up to  $0.13 \mu\text{g}/\text{m}^3$  (NIOSH/KTA-Tator 1999).

The significant sampling limitations and analytical interferences inherent in the collection of air samples during abrasive blasting processes limit the ability to: 1) exempt low beryllium containing materials from the regulation; 2) demonstrate compliance with the AL and PELs with existing OSHA sampling methods; and 3) therefore, inappropriately lead to implementing ancillary provisions that are redundant with existing regulations for the abrasive industry and provide no further benefit to the health of the workers.

#### **4. Technical feasibility to meet the new exposure limits using only engineering and work practice controls**

Practical limitations of the abrasive blasting operation suggest that feasible engineering and work practices controls alone will be inadequate or impracticable for reducing exposures below the beryllium PEL for abrasive blast workers using current air sampling methods. More importantly, PPE is already required to protect abrasive blast workers to a variety of other metal dusts and health hazards. Engineering controls are often limited due to space constraints within interior vessel compartments. Recommended potential control measures are discussed in OSHA's guidance document for Abrasive Blasting Hazards in Shipyard Employment (OSHA 2006). However, abrasive blasting operations already require the use of respiratory protection to meet several other metal specific PELs (i.e., arsenic, lead, hexavalent chromium) and to be compliant with existing respiratory protection regulations in the construction and maritime industry for abrasive blasting including 29 CFR 1926.57(f)(5)(ii) and 29 CFR 1915.34. Due to the nature of abrasive blasting, employers must ultimately utilize PPE to ensure worker health and safety regardless of the new beryllium PEL.

#### **4. Redundancy of ancillary provisions with overlapping protections or other standards that do not improve worker protection**

Abrasive blasting is already heavily regulated, and the potential hazards have been effectively controlled through a number of existing regulations. It is recognized in the industry that employees who engage in abrasive blasting are at increased risk of potential exposure to high levels of dust, noise, and other health and safety hazards. The sources of the potential air contaminants include the base materials, surface coatings, and abrasive blasting media. As proposed, the ancillary provisions will apply to all abrasive blast operations regardless of the abrasive blasting media as base materials and some surface coatings may also contribute to beryllium dust levels.

However, the rules governing abrasive blasting currently in effect for both the construction and shipyard industries already require engineering and administrative controls and personal protective equipment, including an air supply respirator and a hood or blasting helmet. Furthermore, abrasive blasting involves potential exposure to a number of other hazardous metals (e.g., lead, chromium, cadmium, and arsenic), minerals (e.g., crystalline silica), and particulates not otherwise classified (PNOC) - (respirable and total dust) that already have chemical-specific requirements requiring regulated areas, respiratory protection, personal protective clothing and equipment, hygiene and work practices, housekeeping, communication of hazards, and recordkeeping

With regard to respiratory protection, OSHA stated in their FEA that the implementation of dust controls sufficient to maintain PNOC's exposure levels at or below 15 mg/m<sup>3</sup> would result in beryllium exposures well below the final PEL of 0.2 µg/m<sup>3</sup> (p IV-636). Additionally, OSHA

concluded that workers who perform abrasive blasting using mineral grit (i.e., coal slag) will already be protected by all feasible controls as required by 1910.1000(e) and 1926.55(b) or are already required to wear respirator protection (p IV-641).

Table 1 lists existing regulations that are currently in place to meet respiratory protection provisions for abrasive blast workers. The following outline some other ancillary provisions that are redundant with existing abrasive blasting regulations and provide no additional benefit to worker protection:

**Hazard communication** requirements will effectively be met through existing requirements of 1910.1200 (h)(1) that require employers to train on the hazardous chemicals in their work area at the time of initial assignment and whenever new chemical hazards are introduced. Additionally, current OSHA (2006) guidance lists potential health impacts from beryllium to include CBD, increased risk of lung disease, and allergic skin reactions. Therefore, this information is already being conveyed as part of hazard training, regardless of the new beryllium PEL.

**Personal protective clothing and equipment** requirements are addressed through existing regulations for hexavalent chromium, lead, arsenic, and lead that specify that where the possibility of skin or eye irritation exists, appropriate protective work clothing shall be provided (1910.1025(g), 1915.1026(g), 1910.1018. OSHA (2006) addresses other PPE provisions. Furthermore, 1915.152(b) and 1915.157 address hand and bod protection and requires that the employer provide and shall ensure that each affected employee uses the appropriate personal protective equipment (PPE) for the eyes, face, head, extremities, torso, and respiratory system, including protective clothing, protective shields, protective barriers, personal fall protection equipment, and lifesaving equipment, meeting the applicable provisions of this subpart wherever employees are exposed to work activity hazards that require the use of PPE. Therefore, employers currently must utilize protective equipment to control inhalation and skin hazards regardless of the new beryllium PEL.

**Hygiene practices**, including provisions for washing, change rooms, and eating and drinking areas, are addressed through existing lead, hexavalent chromium, cadmium, and arsenic regulation that, in addition to other requirements, requires employees to wash their hands and faces at end of a work shift and prior to eating, drinking, smoking, chewing tobacco or gum, applying cosmetics, and using the toilet. Personal hygiene practices that limit exposure to abrasive blasting dust are also provided in OSHA (2006) guidance. Therefore, hygiene practices are already being utilized as part of the nature of the abrasive blasting process regardless of the new beryllium PEL.

**Specific warning sign language** is contained in lead, cadmium, and arsenic regulations. However, OSHA recognizes that abrasive blasting may expose workers to a variety of chemicals. Therefore, OSHA's abrasive guidance (2006) provides much more practical guidance with regard

to abrasive blasting signage that sufficiently conveys the necessary information regarding abrasive blasting hazards to many dusts before entering an area.

**Housekeeping requirements** are addressed through existing requirements, including 1926.57(f)(7), in which dust shall not be permitted to accumulate on the floor or on ledges outside of an abrasive-blasting enclosure, and dust spills shall be cleaned up promptly, and aisles and walkways shall be kept clear of steel shot or similar abrasive which may create a slipping hazard. Therefore, housekeeping practices are already required as part of the nature of the abrasive blasting process regardless of the new beryllium PEL.

Although OSHA indicates that some of the new ancillary provisions will provide increased protection to workers (p. 2639), these ancillary Be provisions are already being met through existing regulations, are redundant with procedures already in place, and provide no added benefit.

## 5. Medical surveillance

The medical surveillance provision is burdensome and there is no evidence that it will provide abrasive blaster worker with any benefit. As indicated in the above comments, there are significant challenges with obtaining meaningful abrasive blasting worker airborne exposures. These sampling limitations are unique to abrasive blasting industry. Even though only trace amounts of beryllium are detected in abrasive blast materials, it is unlikely that reliable air sampling data can be consistently obtained using OSHA mandated sampling approaches to demonstrate air concentrations below  $0.1 \mu\text{g}/\text{m}^3$  when using coal slag, or most other commonly used blasting media; this is due to sampling and analytical limitations, such as elevated analytical limits of detection, analytical interferences, and the inherent overloading from particulate matter. Therefore, use of the AL as the criteria for requiring ancillary provisions, including medical surveillance and BeLPT, is not scientifically justified, especially when considering the unique nature of this process. Abrasive blasters have been wearing full body protection and supplied air respirators for many years, regardless of the abrasive media used (Shipbuilders Council of America Document ID 1618) that effectively reduce their beryllium exposure to well below  $0.1 \mu\text{g}/\text{m}^3$ . Use of the AL as a trigger for medical surveillance using currently mandated OSHA sampling procedures will essentially require all abrasive blast workers to be included in the BeLPT testing even when using low Be content materials and having insignificant exposures due to the required use of respirators (29 CFR 1926.57(f) and 29 CFR 1915.34).

OSHA's rationale for using the action level of  $0.1 \mu\text{g}/\text{m}^3$  to trigger medical surveillance is that "it will encourage employees to maintain low exposures and it provides reasonable assurance that exposure will not exceed PEL on days when exposures are not measured." OSHA also states "The action level is achievable for many employers, and those employers are likely to maintain exposures below the action level to avoid the costs associated with exposure assessment and offering medical surveillance." However, this rationale is not relevant to the abrasive

blasting operation as compliance with the Be AL and PEL, as well as other metal PELs, cannot be achieved without respiratory work practice controls that reduce beryllium exposure to levels well below the action level. Furthermore, OSHA indicates that it is concerned with offering medical exams when they may not be beneficial. “As a result, offering medical surveillance to all potentially exposed employees would result in some low risk employees receiving medical examinations when they have very little likelihood of benefiting from those examinations. OSHA is especially concerned by this because some medical examination components, such as the BeLPT, are invasive.”(p 2698). Materion has commented extensively regarding the reliability of BeLPT and its utility as a screening tool especially in asymptomatic individuals. We have similar strong concerns with the benefit versus the harm of using BeLPT as a widespread screening tool for the abrasive blasting industry especially when exposures are already controlled through required extensive personal protective equipment and for workers that are asymptomatic.

There are several technical issues regarding the use of the beryllium action level of  $0.1 \mu\text{g}/\text{m}^3$  as the inclusion criteria for medical surveillance and BeLPT for abrasive blast workers in the construction and maritime industries. Additionally, there is no scientific information that indicates additional beryllium specific medical surveillance requirements will result in any benefit to the workers that are not already offered through existing abrasive blasting medical surveillance regulations that includes assessment of the respiratory system and skin.

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**Table 1: Existing Abrasive Blasting Regulations Pertaining to respiratory protection requirements**

<b>CFR 1915.34</b>	<b>Occupational Safety and Health Standards for Shipyard Employment: Mechanical paint removers</b>
<b>1915.34(c)</b>	<b>Abrasive blasting</b>
1915.34(c)(i)	abrasive blasters working in closed spaces shall be protected by hoods and airline respirators or by air helmets of positive pressure
1915.34(c)(ii)	abrasive blast workers in open shall be protected as indicated 1915.34(c)(i), unless 1% silica used. Administration for protection of lead dust with proper eye, face and head protection may be used
1915.34(c)(iii)	Employees, other than blasters, including machine tenders and abrasive recovery men, working in areas where unsafe concentrations of abrasive materials and dusts are present shall be protected by eye and respiratory protective equipment in accordance with the requirements of subpart I of this part
1915.34(c)(iv)	The blaster shall be protected against injury from exposure to the blast by appropriate protective clothing, including gloves.
<b>1926.57</b>	<b>Safety and Health Regulations for Construction: Ventilation</b>
<b>1926.57(f)(5)</b>	<b>Personal protective equipment</b>
1926.57(f)(5)(i)	Employers must use only respirators approved by NIOSH under 42 CFR part 84 for protecting employees from dusts produced during abrasive-blasting operation
1926.57(f)(5)(ii)	Abrasive-blasting respirators shall be worn by all abrasive-blasting operators, When working inside of blast-cleaning rooms, or When using silica sand in manual blasting operations where the nozzle and blast are not physically separated from the operator in an exhaust ventilated enclosure, or Where concentrations of toxic dust dispersed by the abrasive blasting may exceed the limits set in 1926.55 or other pertinent sections of this part and the nozzle and blast are not physically separated from the operator in an exhaust-ventilated enclosure.
1926.57(f)(5)(iii)	Properly fitted particulate-filter respirators, commonly referred to as dust-filter respirators, may be used for short, intermittent, or occasional dust exposures such as cleanup, dumping of dust collectors, or unloading shipments of sand at a receiving point when it is not feasible to control the dust by enclosure, exhaust ventilation, or other means. The respirators used must be approved by NIOSH under 42 CFR part 84 for protection against the specific type of dust encountered.
1926.57(f)(5)(iv)	A respiratory protection program as defined and described in 1926.103, shall be established wherever it is necessary to use respiratory protective equipment
1926.57(f)(5)(v)	Operators shall be equipped with heavy canvas or leather gloves and aprons or equivalent protection to protect them from the impact of abrasives. Safety shoes shall be worn to protect against foot injury where heavy pieces of work are handled
1926.57(f)(7)	Operational procedures and general safety. Dust shall not be permitted to accumulate on the floor or on ledges outside of an abrasive-blasting enclosure, and dust spills shall be cleaned up promptly. Aisles and walkways shall be kept clear of steel shot or similar abrasive which may create a slipping hazard
1926.55(b)	Gases, vapors, fumes dusts, and mists Exposure of employees to inhalation, ingestion, skin absorption, or contact with any material or substance at a concentration above those specified in the "Threshold Limit Values of Airborne Contaminants for 1970" of the American Conference of Governmental Industrial Hygienists, shall be avoided. See appendix A to this section. To achieve compliance with paragraph (a) of this section, administrative or engineering controls must first be implemented whenever feasible. When such controls are not feasible to achieve full compliance, protective equipment or other protective measures shall be used to keep the exposure of employees to air contaminants within the limits prescribed in this section. Any equipment and technical measures used for this purpose must first be approved for each particular use by a competent industrial hygienist or other technically qualified person. Whenever respirators are used, their use shall comply with §1926.103.