

**National Institute for Occupational Safety and Health (NIOSH)**  
**Response to Public Comments Received from NIOSH Docket #120:**  
*NIOSH Alert: Preventing Sensitization and Disease from Beryllium Exposure*

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## **Background**

Beryllium is a lightweight metal with many useful properties, including heat resistance and conductance, electrical conductance, flexibility, formability, neutron moderation, x-ray transparency, and lubricity. Exposure to beryllium can lead to sensitization, a cell-mediated allergic-type response, and cause a granulomatous lung disease called chronic beryllium disease. The *NIOSH Alert: Preventing Sensitization and Disease from Beryllium Exposure* describes the nature of the lung disease that can occur from exposure to beryllium and beryllium-containing materials and recommends steps companies and workers should take to minimize the health risk to workers.

This document has followed a rigorous document development process in order to produce the highest quality information possible. NIOSH strove to reach a broad spectrum of external reviewers including academic researchers, unions, beryllium manufacturers, and government agencies.

Previously, this publication has received scientific peer review. The peer review comments and NIOSH responses are available at <http://www.cdc.gov/niosh/review/peer/default.html>.

Subsequent to peer review, NIOSH created a public docket and a notice was published in the Federal Register on March 6, 2008 announcing the availability of the draft Alert for public comment for a period of 60 days. NIOSH received over 100 comments (see, <http://www.cdc.gov/niosh/docket/NIOSHdocket0120.html>) from a range of organizations and individuals including labor representatives, industry, academia, and healthcare facilities.

NIOSH has prepared the following summary of public comments with NIOSH responses.

## Summary of Public Comments and NIOSH Responses

### **Beryllium sensitization as a health effect** (6 comments, 5 reviewers)

*Secondary themes: Remove from Alert, revise language*

Several commenters (Ex.<sup>1</sup> 5, 7, 8, 15) stated their belief that beryllium sensitization was not a health effect and, as such, should be removed from the Alert. Statements included: “beryllium sensitization is not a health effect or a material impairment of health,” “prevention of beryllium sensitization does not merit a preventive warning in a NIOSH Alert,” discussion of sensitization should not be placed in the Health Effects section, and remove sensitization from the title because it is a “biomarker of CBD [chronic beryllium disease]” and inclusion in the title may cause “casual readers [to] interpret it as implying BeS [beryllium sensitization] is a separate disease.” Another commenter (Ex. 10) did not take issue with inclusion of sensitization as a health effect, but did request revision of the first paragraph in the Sensitization section to emphasize exposure.

We agree that sensitization is not a disease. Sensitization to beryllium, as measured by the beryllium lymphocyte proliferation test, is a biomarker of effect, rather than a biomarker of exposure. Identification of sensitization provides the earliest warning that the immune system recognizes beryllium and can thus react adversely. Chronic beryllium disease generally takes years to develop, while sensitization is often found early in a worker’s tenure. Identification of sensitization allows an employer to more quickly find and correct features of a job or process that may confer higher risk thereby protecting others who may have been exposed had the employer waited until a sentinel case of chronic beryllium disease was diagnosed after disease symptoms had developed. Thus, we do not believe that beryllium sensitization should be de-emphasized in the document, or removed from the title. We also do not believe that “sensitization” can be replaced with “exposure,” as the two are not interchangeable.

NIOSH has not removed sensitization from the Alert title or a discussion of sensitization from the body of the Alert. We have placed the discussion of sensitization in a separate section and added a new section title (“Diseases”) above the chronic beryllium disease, acute beryllium disease and cancer subsections. For clarity and to emphasize the role of exposure, we have changed the title of the Alert to “Preventing Sensitization and Disease from Beryllium Exposure.” In addition, some revision of the text in the Sensitization section was made to clarify the role of exposure.

### **Use of the beryllium lymphocyte proliferation test (BeLPT) to identify sensitization** (7 comments, 3 reviewers)

*Secondary themes: Test performance issues, social issues, terminology*

Several commenters (Ex. 5, 7, 15) expressed concern regarding the adequacy of the description of the performance issues related to the beryllium lymphocyte proliferation test (BeLPT). There were suggestions to add more information regarding the reliability, sensitivity, and variations in results between clinical laboratories performing the BeLPT. One commenter (Ex. 10) noted that the Alert “does a nice job of succinctly describing potential problems with the BeLPT,” but wanted NIOSH to make a stronger endorsement of the test. The commenter (Ex. 10) went on to state that “While we would agree that on a person-by-person basis, the test can have limitations, there are sufficient literature references

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<sup>1</sup> See Exhibits at aforementioned docket website.

(Middleton 2007, Stange 2004) demonstrating the sensitivities, specificities and positive predictive values on par with other screening tests frequently used by the medical community.”

NIOSH agrees that the BeLPT, similar to other medical tests, has some performance issues that could have been better described in the Alert and has therefore amended its description to “. . . as with all medical tests, the BeLPT is not perfect.” NIOSH also agrees that additional discussion should be provided regarding the variations in results reported between laboratories that have been described in the scientific literature. The statement, “Results may also vary between clinical laboratories performing the BeLPT” has been added. We also added the statement “It has been used effectively in medical surveillance programs in both private industry and government organizations to identify sensitization among participating workers.”

NIOSH believes that the amended text sufficiently describes the notional concept of the BeLPT as a medical test with inherent limitations utilized to detect sensitization to beryllium. However, at this point in time, as we have stated in the Alert, it “is the best available tool to identify sensitization until a more reliable test is developed.” (Note that we did revise the wording of this sentence from “a more precise test” to “a more reliable test,” as the latter better describes performance.)

One reviewer (Ex. 15) suggested that we failed to “disclose the potential social, economic, psychological and legal consequences of . . . recommending that employers offer and workers take the BeBLPT.”<sup>2</sup> NIOSH appreciates the commenter’s description of the potential consequences associated with recommendations for medical testing. In our last recommendation to Employers, we included language that stated “Ensure that sensitized workers . . . receive counseling.” However, Alerts are brief publications that are intended to reduce disease and stimulate research on effective prevention measures. A full assessment of these issues is beyond the scientific emphasis of this document. In “Managing Health Effects of Beryllium Exposure,” the National Academies also briefly acknowledges these issues (Chapter 3), but recommends the BeLPT as part of a beryllium exposure- and disease-management program (Chapter 7).

One reviewer (Ex. 10) requested that we make the language to describe test results consistent, using “abnormal” and “normal” throughout the document, rather than occasionally using “positive” and “negative” to describe the same outcomes. We agree that this is appropriate and have made the language consistent.

### **Recommendation for medical surveillance (16 comments, 8 reviewers)**

*Secondary themes: Burden to employer, inclusion of BeLPT, justification, revise language, screening vs. surveillance, value to individual workers, who is exposed?*

NIOSH received a range of comments regarding the recommendation that employers should conduct medical surveillance using the BeLPT. NIOSH was urged to consider the burden to the employer (Ex. 11, 15), as the recommendation “fails to convey the protocols necessary to implement [it],” “will force employers to open their checkbook,” and “has great potential to produce misleading results.” Several commenters (Ex. 4, 10, 15) discussed the justification for recommending medical surveillance, both pro and con, stating that “surveillance also detects health effects at an early stage, which may limit impairment” and that “the current methodologies for detecting beryllium sensitization or surveillance for chronic beryllium disease are insensitive, unreliable and very expensive.” Two commenters (Ex. 8, 15) discussed the definitions of “screening” vs. “surveillance,” stating that the concept of “medical

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<sup>2</sup> “BeBLPT” (beryllium blood lymphocyte proliferation test) is the acronym used by Exhibit 15 in their comments.

surveillance” “even confuses people in the field” and that NIOSH was, in fact, recommending medical screening or medical monitoring. One (Ex. 5) thought NIOSH should not include reference to the BeLPT in the recommendation, but should be “left in the text where its limitations can be thoroughly documented.” Other commenters (Ex. 8, 10, 15) suggested that the lack of direct benefit to the individual being tested suggested against a recommendation for medical surveillance. Three commenters (Ex. 2, 7, 15) wondered who should be tested under such a medical surveillance program, especially because beryllium is an ubiquitous element (Ex. 7, 15).

We have eliminated the term “screening” from the document to minimize confusion. Medical surveillance programs are routinely implemented as part of an overall strategy to reduce occupational injury and illness. Surveillance uses regularly-collected medical test data (such as BeLPT results) to examine risk factors for disease in a workforce population. Analysis of the distribution of sensitization in a workforce can guide priorities for preventive interventions. Although sensitized workers may or may not benefit individually, ongoing medical surveillance can document whether interventions have been successful in preventing further sensitization in employees.

Historical efforts to limit airborne exposure to beryllium have not prevented beryllium disease. Medical surveillance with the BeLPT has led to interventions in some workforces that appear to be beneficial, in that sensitization in workers hired after these interventions is reduced (Cummings 2007, Thomas 2009, Bailey 2010). Employers can tailor subsequent medical surveillance based on findings in their own workforces. However, given the diversity of workplaces and work practices associated with beryllium exposure, it would be impractical to present a detailed protocol for implementing a medical surveillance program.

One commenter (Ex. 5) asked that we insert “workplace” in the recommendation “Participate in medical surveillance so that . . .” This change was made.

**Recommendation that since no safe level is known, exposure be kept as low as possible** (10 comments, 9 reviewers)

*Secondary themes: Alert not useful without a target exposure level, ambient exposure makes everyone “exposed”*

Several commenters (Ex. 3, 5, 7, 8, 10, 14, 15) wanted NIOSH to recommend a specific safe exposure level, rather than the Alert’s recommendation to “keep airborne concentrations of beryllium as low as possible, since no safe exposure limit for beryllium is known.” Some commenters (Ex. 3, 15) provided citations from the scientific literature that they believe do suggest a safe level. Others (Ex. 7, 16) stated that without a concrete target, the recommendation is “essentially valueless” and “too open for interpretation”, and that it “does not sound like science.” Another (Ex. 8) suggested that we revise the recommendation from “. . . since no safe exposure limit for beryllium is known” to “. . . since the safe exposure limit for beryllium has not yet been determined.” Another (Ex. 10) requested, in the absence of a concrete limit, more detail on one company’s comprehensive preventive program that was briefly outlined in the Prevention section for “concrete guidance.” Several commenters (Ex. 5, 11, 15) suggested that since beryllium is a naturally occurring element found in ambient air at background levels, a safe exposure level must exist.

NIOSH recognizes that there are differences of opinion and appreciates the thoughtful review of the scientific literature briefly summarized by some of the commenters. Overall, the number of studies that have attempted to estimate beryllium exposure in order to quantify an exposure-response relationship is limited. NIOSH and others continue to investigate this issue.

Given that the establishment of an exposure limit is beyond the scope of this publication and that the scientific evidence continues to evolve with respect to characterizing the relationship between exposure and response, NIOSH believes that the best approach is to recommend that airborne concentrations of beryllium be kept as low as possible. However, please note that we have included in the Alert a group of existing occupational exposure limits from the US (OSHA, NIOSH, ACGIH, DOE's action level, California OSHA), Canada (Quebec), Europe (Spain and the UK), Japan, and China. These should provide some context for readers in the absence of a new NIOSH recommended exposure limit.

In order to improve clarity, as suggested by Ex. 8 we have changed the wording of the recommendation to: "Keep airborne concentrations of beryllium as low as possible, since a safe exposure limit for beryllium has not been determined (emphasis added)."

With regard to environmental (ambient) exposures, there is limited evidence that a very small percentage of individuals with no obvious prior beryllium exposure have had abnormal BeLPT results. However, NIOSH is unaware of a significant body of evidence that shows that naturally-occurring forms of beryllium, especially in the concentrations available in ambient air, are a risk factor for sensitization or chronic beryllium disease. However, naturally-occurring forms have not been proven to be risk-free, as workers in studies of a beryllium mine and mill and cutters of beryllium-containing gemstones have had abnormal BeLPT results. Finally, it is important to note that the recommendations and guidance described in the Alert apply to occupational settings and not the broader range of environmental (ambient air) exposures.

#### **Acute Beryllium Disease** (2 comments, 2 reviewers)

*Secondary themes: Revise content, description as part of a comment on chronic beryllium disease*

One commenter (Ex. 10) suggested that NIOSH revise its description of the exposures that may lead to acute beryllium disease to delete the reference to soluble beryllium salts and to add that it occurs after exposures to high concentrations of beryllium that are "rarely seen in modern industry." A second commenter (Ex. 15) provided much additional background description for acute beryllium disease.

Nearly all cases of acute beryllium disease have occurred in settings with soluble beryllium salt exposure, and therefore NIOSH has retained that portion of its exposure description. NIOSH has recently published a manuscript that demonstrates that acute beryllium disease may develop at lower concentrations than previously reported and at concentrations that could be found in modern day industry (Cummings 2009). Consequently, NIOSH has modified its description of acute beryllium disease exposures to remove the phrase "high concentrations."

#### **Beryllium as a carcinogen** (3 comments, 3 reviewers)

*Secondary themes: Increase discussion of this issue, add a reference*

NIOSH received three comments regarding the section on beryllium as a carcinogen.

One commenter (Ex. 12) requested that NIOSH also include that the American Conference of Governmental Industrial Hygienists (ACGIH) as a group that lists beryllium as a "confirmed human carcinogen." The second commenter (Ex. 15) urged NIOSH to expand its discussion of carcinogenicity to include the most recent research findings on the potential carcinogenicity of beryllium. According to the latter commenter, "[t]he most recent scientific evidence is clearly demonstrating that beryllium is not

carcinogenic to humans.” The ensuing discussion referenced four studies for NIOSH’s consideration. A third commenter (Ex. 16) did not believe the IARC 1993 reference was “credible.”

NIOSH appreciates the suggestion to add the ACGIH to the organizations recognizing beryllium as a carcinogen; NIOSH also appreciates the thoughtful review of several recent scientific studies. The current section succinctly states that significantly elevated risks of lung cancer have been reported for workers exposed to beryllium, with supporting evidence from International Agency for Research on Cancer (IARC) and the National Toxicology Program. This section has been revised to update the IARC reference to their recent (2009) affirmation of beryllium’s status as a human carcinogen.

### **Chronic Beryllium Disease** (6 comments, 2 reviewers)

*Secondary themes: Definitions and diagnostic criteria, progression from sensitization to chronic beryllium disease, sensitization, treatment*

One commenter (Ex. 15) stated that the description of chronic beryllium disease should differentiate between the “forms of CBD,” and that the Alert should also provide a discussion of the historical changes in the diagnostic criteria in order to compare “findings of older studies to newer studies.” NIOSH has not differentiated between “subclinical CBD” and “clinical CBD” in the Alert because the distinction is not an epidemiologic issue but a clinical one based on medical treatment of the patient. NIOSH has not provided a more detailed definition of sensitization because there are varying criteria for this term, depending upon the purpose behind the testing (*e.g.*, differential diagnosis, surveillance). All epidemiologic references in the Alert are from the post-BeLPT era and, as we don’t compare findings to the previous era, discussion of such changes is unnecessary.

The same commenter (Ex. 15) wanted reference to a study showing the progression rate from sensitization to chronic beryllium disease (Newman 2005) removed, as the commenter stated that the study was “small,” comprised sensitized individuals from one industry “willing to undergo repeated bronchoscopy with lung biopsy” over a period of years, and used an outcome (“subclinical CBD”) that was “not a material impairment of health.” NIOSH has not removed from the Alert the brief statement that references this study. It is the only study to date to conduct follow-up of sensitized individuals to determine progression to chronic beryllium disease. To clarify the study size issue, we added “In one study following 55 sensitized individuals” to the beginning of the sentence in question.

One commenter (Ex. 10) requested that NIOSH add “night sweats” to the list of symptoms that may develop in some persons with chronic beryllium disease. The same commenter also requested that NIOSH add a more thorough description of the clinical evaluation for chronic beryllium disease, including a description of lung lavage. The commenter requested that NIOSH “consider adding inhaled steroids” to the listed medications used to control symptoms. NIOSH has added night sweats to the list of symptoms and has also added a statement on lung lavage. NIOSH is not aware of any data demonstrating the efficacy of inhaled steroids in treating chronic beryllium disease symptoms; inhaled steroids have not been added to the Alert as a possible treatment.

### **Exposure-response relationship** (3 comments, 2 reviewers)

*Secondary themes: Exposure characteristics, no consistent relationship*

One commenter (Ex. 10) suggested that NIOSH's contention that there is no consistent exposure-response relationship "implies . . . that there is no reason to reduce airborne exposures," and provided alternative language that included the following: "Workers . . . exposed to the highest airborne exposures . . . are at greatest risk. . . Risk does not appear to be directly related to the total mass concentration . . . Other exposure factors are also important . . . However, nearly all researchers agree that reducing . . . exposure . . . will likely result in a lower overall risk . . ." NIOSH does not agree with the validity of the first suggested sentence, as at least one large study has demonstrated otherwise (Kreiss 1997). We have, however, amended the relevant text to clarify exposure (" . . . airborne exposure (measured as mass concentration) and risk . . ."), and added two sentences to the end of the paragraph: "Other exposure factors may also be important, including chemical form and particle size [National Academies, Chapter 2]. However, reducing beryllium exposure in general will likely result in a lower overall risk."

A second commenter (Ex. 8) also disagreed with NIOSH's statement about lack of consistency and provided mean/median differences for cases of sensitization and chronic beryllium disease vs. non-cases from several studies in support of their comment. NIOSH disagrees with the commenter. Mean/median differences between cases and non-cases do not constitute an exposure-response relationship. Results from two of the studies (Kreiss 1996 and Henneberger 2001, both of the same facility) were suggestive of an exposure-response relationship, but the populations at this plant were quite small. The Kelleher 2001 findings were also suggestive, but no significant relationships were observed. Madl reconstructed the Kelleher exposure estimates, but reconstruction was limited to the cases of sensitization and chronic beryllium disease (Madl 2007); epidemiologic re-analysis cannot be conducted given this limitation. No additional revisions were made.

#### **Genetic research and beryllium sensitization and chronic beryllium disease (3 comments, 2 reviewers)**

##### *Secondary themes: State of the science, utility of testing, susceptibility*

One commenter (Ex. 10) requested that NIOSH add more information to the paragraph of general information on genetic research, specifically, that there may be a number of genes involved, and more about the issue of genetic testing and possible discrimination. The commenter also requested that we clarify "of the population" to "of the general population."

NIOSH appreciates the suggestion to provide a more detailed discussion of genetic research and beryllium health outcomes. The paragraph as written was intended to provide general information on a complex topic without providing detail specific to individual genetic markers. We believe that the current statement on the utility of genetic testing to individual workers accomplishes this objective. Therefore, NIOSH has not added information on either the number of genes or the issue of genetic testing and possible discrimination. However, we have amended the population phrase as suggested.

A second commenter (Ex. 8) requested that NIOSH revise information on genetic susceptibility in the Sensitization section to "The workers that become sensitized . . . have inherited certain genes . . . and receive a sufficient amount of exposure." NIOSH did not make this change. In several studies, one genetic marker has been found with greater frequency among those with sensitization and chronic beryllium disease. However, there are some with sensitization and chronic beryllium disease who do not have this particular genetic marker, suggesting that it is not a necessary component to development of sensitization or chronic beryllium disease.

#### **Issues related to the role of dermal exposure and sensitization (9 comments, 6 reviewers)**

*Secondary themes: Preventing exposure, scientific basis for inclusion, skin conditions*

Three commenters (Ex. 4, 10, 12) remarked on various aspects of preventing dermal exposure. One (Ex. 4) requested additional detail be added to the recommendation that skin exposure be prevented. One (Ex. 10) wanted additional emphasis in the Workforce Surveys: Skin Exposure section that “control of BOTH airborne and skin exposures are important,” and text to “insure that all cuts and abrasions are protected . . .” A third (Ex. 12) asked for more emphasis on “problems associated with dermal penetration/absorption.” All of these suggestions have merit. We believe that the additional detail on specific work practices is not necessary, as the information is subsumed under the present recommendation. We amended the text in the Skin Exposure section to state that “tight control of airborne exposure *alone* did not prevent . . .” and added a statement at the end of the paragraph to state “Although research is continuing, NIOSH recommends that employers and workers prevent skin contact with beryllium particles . . . including protecting skin cuts and abrasions.”

Two commenters (Ex. 5, 15) took issue with the scientific basis posited for the relationship between dermal exposure and sensitization. One (Ex. 5) noted that the specific recommendation did not mention that “inhalation . . . is necessary for disease,” and the other (Ex. 15) stated that the evidence relating skin exposure and sensitization is “an unproven hypothesis” that “should not be used as a primary basis upon which to recommend employers and workers prevent skin contact.”

The paragraph in the Workforce Surveys: Skin Exposure section was intended to demonstrate that research suggests that sensitization may result from skin contact with beryllium dusts, fumes and beryllium-containing solutions and suspensions. We have added more historical information to better describe this relationship: “In the 1950s, patch testing led to skin sensitization (Curtis 1951).” The recommendation to establish and maintain a skin protection program recognizes this potential exposure route and is consistent with current industry practices (Deubner and Kent 2007).

Two commenters (Ex. 8, 10) suggested that we add more information to the Alert on skin conditions related to beryllium exposure. Specifically, they requested a recommendation to “Seek medical attention for any rash or nonhealing cuts from beryllium,” a new section under Health Effects entitled “Skin Disease,” and additional information in the Workforce Surveys: Skin Exposure section on skin conditions. NIOSH has added an additional recommendation to both the tear-out sheet and the Recommendations sections to “Seek medical attention for any rash or non-healing cut or wound from beryllium.” We believe that this sufficiently addresses both commenters’ suggestions.

### **Occupational Exposure Limits section (5 comments, 5 reviewers)**

*Secondary themes: Revisions, corrections*

Several commenters (Ex. 5, 7, 10, 14, 15) suggested revisions to the Current Exposure Limits section of the Alert, relating to the mention of limits not yet adopted (Ex. 5), lack of inclusion of California’s Permissible Exposure Limit (Ex. 7), exposure limits outside the US (Ex. 14), and NIOSH’s, ACGIH’s, DOE’s and OSHA’s limits and levels (Ex. 15).

We thank the commenters for their suggestions and corrections. Since the American Conference of Governmental Industrial Hygienists (ACGIH) adopted a new threshold limit value after the Alert was posted for public comment, we have updated information related to ACGIH. We have added the California Permissible Exposure Limit and the Quebec provincial limit, and amended the OSHA statement as follows: “OSHA has stated that the current PEL [permissible exposure limit] may not



adequately protect . . .” We have added a statement on occupational exposure levels in China, Russia, Japan and various European countries. We added text to the introductory paragraph of this section: “Current beryllium exposure limits and action levels from various agencies and groups are provided below.” Mention of the DOE action levels was clarified to use the word “level” rather than “limit.” The NIOSH Recommended Exposure Limit was retained in the Alert, as it is the current REL.

#### **Recommendation for substitution** (1 comment, 1 reviewer)

##### *No secondary themes*

One commenter (Ex. 15) suggested that NIOSH’s recommendation to “substitute less-hazardous materials for those containing beryllium whenever feasible” could be misapplied since the Alert provides “no context in which to apply the recommendation.” Specifically, the commenter mentions that beryllium use is generally “limited to applications with no substitute,” that “restricting the use of beryllium . . . could have . . . negative consequences” for future innovations, that beryllium is used in “critical applications,” and that “other branches of our government recognize the need for beryllium-containing materials and the need for a continuous supply . . . as a strategic material.”

NIOSH agrees with the commenter that beryllium has unique properties and applications, which are presented in the Alert in the Background section and in the Appendix. Controlling exposures to occupational hazards is the fundamental method of protecting workers. Traditionally, a hierarchy of control has been used as a means of determining how to implement feasible and effective controls. One representation of this hierarchy can be summarized as follows:

- Elimination
- Substitution
- Engineering controls
- Administrative controls
- Personal protective equipment

The idea behind this hierarchy is that the control methods are implemented in order, top to bottom, and that each next level is added as necessary. Following the hierarchy normally leads to the implementation of inherently safer systems, ones where the risk of illness or injury has been substantially reduced. The recommendation for substitution whenever feasible is thus consistent with accepted industrial hygiene practice, and no change was made to this recommendation.

#### **Exposure-related technical issues** (11 commenters, 21 comments)

*Secondary themes: Ambient exposure, one company’s model, housekeeping, mists, particle size, personal protective equipment, sampling, simplify warning, utility of existing health and safety programs, who is exposed?, work practices*

A number of reviewers (Ex. 4, 5, 10, 12) had suggestions for improving various recommendations: housekeeping practices for “cleaning methods that may cause dust to become resuspended” and cleaning “areas outside the beryllium work zone,” particle-producing tasks, controls, and work clothing. Two commenters (Ex. 4, 5) requested that we add “mists” to the phrase used throughout the document “particles, fumes, or solutions from beryllium-containing materials.” Three commenters (Ex. 3, 10, 11) requested some revisions regarding sampling and exposure assessment, including an examination of

“chemical analysis difficulties,” use of “inhalable dust” exposure assessment, and a rewording of the recommendation about air monitoring. One commenter (Ex. 15) requested that NIOSH present more information about his company’s worker protection program. Additional comments were provided by commenters (Ex. 2, 8, 10, 13, 14, 15) regarding particle size, existing health and safety programs, identifying who is exposed, and work practices.

NIOSH agrees that the language regarding dust resuspension should be strengthened, and has revised the recommendation to state: “Do not use cleaning methods that may cause dust to become resuspended in air (dry sweeping, compressed air, and other dust-generating methods, for example). Better methods include HEPA-filtered vacuums or wet cleaning methods that do not produce splash or spray.” We have not revised the other recommendations, as the suggested revisions were either not necessary or too detailed for this document. We have added “mists” to the language throughout (“particles, fumes, mists, or solutions from beryllium-containing materials”). NIOSH has provided web addresses in the Other Resources section where the reader can access additional information on sampling and exposure assessment. NIOSH has provided information on one company’s worker protection program through a brief summary of a published article on the early success of the program in Workforce Surveys: Prevention (Cummings 2007), and in many of the recommendations. While NIOSH agrees that the program looks promising based on early analyses of the data, further and ongoing evaluation is necessary.

#### **General – content issues (6 reviewers, 24 comments)**

*Secondary themes: Language, material to be added, more detail on exposed populations, more detail on properties/uses, more detail on work processes, not useful to target audience, update/provide references, criteria for “Alert” not met, further action needed (conclusions),*

Several commenters (Ex. 6, 8, 9, 10, 14, 15) requested that various materials be added to the Alert: “manufacturers” to the list of groups in the Introduction, non-governmental resources to the list of Other Resources, various sampling and analytic methods, and removal of one web address that is subsumed under another. One commenter (Ex. 10) requested more detail on exposed populations in the Introduction. Two commenters asked for more detail on work processes (Ex. 10) and on properties of and uses for beryllium (Ex. 15) in the Introduction and Appendix. The latter also provided extensive proposed rewrites of the Introduction and Appendix. Other revisions were also suggested (Ex. 8, 10, 14, 15), such as updating references and rewording headings in the Recommendations.

NIOSH appreciates the requests for new material to be added to the Alert. We added “manufacturers and distributors of materials that contain beryllium” to the list in the Introduction. In Other Resources, the web address for sampling and analytic methods was corrected to an address that accesses more methods. NIOSH also added the following websites and addresses to Other Resources: Brush Wellman Inc. Interactive Guide to Working Safely with Beryllium and Beryllium-Containing Materials, [www.berylliumssafety.com](http://www.berylliumssafety.com); and National Jewish Health. Chronic Beryllium Disease: Overview, [www.nationaljewish.org/healthinfo/conditions/beryllium-disease/index.aspx](http://www.nationaljewish.org/healthinfo/conditions/beryllium-disease/index.aspx).

NIOSH did not extend the description of populations at risk in the Introduction because the current format (review of forms of beryllium in the Introduction, review of the epidemiology of workplaces in Workforce Surveys, and review of industries and products in the Appendix) is sufficient. We revised the Appendix to include an “Other Metals” section, but did not extend the Introduction to include work process information for reasons already stated.

NIOSH appreciates the suggested rewritten sections (Ex. 15). However, the current text has received substantial review and comment by scientific peers, stakeholders and the public. In some cases, the

suggested revisions would add more detail than necessary or provide minor changes to/reorganization of existing text. References have been revised and headings reworded to improve clarity.

One commenter (Ex. 15) stated that the criteria for an “Alert” were not met, in that the draft document is not a “brief publication, based on case reports, that (is) intended to reduce injuries and fatalities or diseases and to stimulate research on effective preventive measures,” and that the current document is not useful to the target audience.

NIOSH Alerts follow a pre-defined format to provide important occupational safety and health information to both employers and workers. This current publication follows this format and includes the use of case studies to illustrate key points of interest and English and Spanish language versions of a “tear out section” with recommendations customized for both employers and workers. The NIOSH Alert has received substantial review and comment by scientific peers, stakeholders and the public. This process is designed to optimize the quality of the final product.

#### **Format issues - General** (3 reviewers, 4 comments)

*Secondary themes: Add glossary, not user-friendly, number references, number and move references to end of sentence*

Several commenters (Ex. 4, 7, 10) made format requests, such as adding a glossary of terms, rewriting the document in a more “user-friendly format,” and numbering references and moving them to the end of each sentence to improve readability.

As stated above, NIOSH Alerts follow a pre-defined format to provide important occupational safety and health information to both employers and workers. Space limitations preclude adding a glossary of terms. Instead, NIOSH has defined all terms and acronyms directly in the text. References to the published literature have been updated, as available, and have been moved to the end of each sentence in numerical format to improve text readability.

#### **Format issues - Case Studies** (4 comments, 2 reviewers)

*Secondary themes: Not useful to this Alert, add another case study, add info on follow-through for case 2*

NIOSH received four comments from the public regarding the two case studies in the Alert. One commenter (Ex. 15) stated that the cases that were selected “add confusion” and have “little educational value,” and suggested that we remove the case studies altogether. The commenter stated that Case 1 “describes a series of events based on non-quantifiable exposure information,” and that Case 2 “may not ever progress to clinical CBD.” Another commenter (Ex. 10) suggested that we add a third case study or replace one of the existing two to “illustrate that exposure . . . can result in very serious health effects . . . (and) that CBD is potentially disabling and fatal.” The same commenter also made a specific suggestion that lessons learned from the second case be amended to show the value of medical surveillance relative to medical screening by adding information on the changes made as a result of this case’s diagnosis.

As stated previously, NIOSH Alerts follow a pre-defined format, and case studies are an essential feature of this format. Case studies illustrate key points of interest in a way that is appealing to both workers and employers.

The specific case studies were selected to demonstrate two important points: that ostensibly low-exposed workers can develop chronic beryllium disease, and that persons with chronic beryllium disease often have few symptoms at time of diagnosis and are thus identified through workplace screening/surveillance programs. Regardless of the actual exposure experienced by Case 1, the worker developed chronic beryllium disease in a job where one would not expect substantive exposure. This also reinforces the idea that unusual cases (or sentinel cases) can lead to examination of the workplace to seek more information about exposure. For Case 2, knowledge about disease status allows for better medical treatment, as symptoms can be attended to as they develop.

Since we provided information elsewhere in the Alert that chronic beryllium disease can be disabling or fatal, we elected not to add a third case to the Case Studies. We have added two sentences to the second case study to better link participation with outcomes for other workers: “His participation in medical surveillance, along with other workers’, contributed to the development of a more comprehensive preventive program at his facility.” In the Lessons Learned summary paragraph for that section of the Alert, we added: “His participation helped to guide efforts to protect his fellow workers, as well as future workers.”

#### **Supportive comments** (5 comments, 5 reviewers)

Five commenters (Ex. 1, 3, 4, 8, 10) provided statements of support for the Alert. One of them (Ex. 10) also expressed a desire for “stronger language” with respect to working “safely with beryllium.” Specific comments regarding the latter were made by this commenter elsewhere, and were answered in the appropriate summaries.

## **Conclusion**

NIOSH has followed a rigorous peer review, stakeholder review, and public comment process in order to develop the *NIOSH Alert: Preventing Sensitization and Disease from Beryllium Exposure*. NIOSH has made a number of changes to the document in response to the suggestions provided during the review process. NIOSH appreciates the time and effort taken by all of the document reviewers and believes that the guidance will be of greater value as a result of their input. NIOSH intends to issue the final document as: *NIOSH Alert: Preventing Sensitization and Disease from Beryllium Exposure*.

Codes for Reviewers for Beryllium Alert Public Comment period (March-May 2008)

<b>Commenter</b>	<b>Commenter Title/ Profession and Organization</b>	<b>Primary Commenter<sup>1</sup></b>
1	Medical Director, Center to Protect Workers' Rights: Center for Construction Research and Training	Laura Welch
2	No title provided, USEC <sup>2</sup> e-mail address	John Hobbs
3	Professor, Johns Hopkins School of Public Health	Patrick Breyse
4	Commented as private person	
5	Manager Environment and Safety, NGK Metals	Lynne Woodside
6	No title provided, AJJER LLC	Anoop Agrawal
7	No title provided, Copper and Brass Fabricators Council	John Arnett
8	Industrial hygienist, Department of Energy: Office of Health, Safety and Security	Paul Wambach
9	CEO, Caldera Pharmaceuticals, Inc.	Benjamin Warner
10	Industrial hygienist, National Jewish Medical and Research Center	Mike Vandyke
11	Industrial hygienist, Savannah River Site (Dept of Energy) e-mail address	Steven Jahn
12	No title provided, Los Alamos National Laboratory e- mail address	Robert Weeks
13	Commented as private person	
14	Commented as private person	
15	Vice President, Environmental Health and Safety, Brush Wellman Inc.	Marc Kolanz
16	Director of Technology, NGK Metals	Nate Gildersleeve

1 The primary commenter submitted the review and/or comments, but many submissions comprised collated comments from multiple persons in the organization.

2 USEC: United States Enrichment Corp, Piketon and Paducah Gaseous Diffusion Plants