



MATERION

Materion Brush Inc.

Beryllium
Health and Safety
Update

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Materion Brush Inc.

- Fully integrated producer of beryllium and beryllium-containing materials
- Primary beryllium-containing Products
 - Metallic Beryllium (Be)
 - AlBeMet® and Beryllium Oxide Ceramic (BeO)
 - Alloys Containing small amounts of Beryllium (CuBe, NiBe, AlBe)
- This presentation relates to pure beryllium used at CERN
 - Beampipes
 - Support structures
 - X-Ray Windows



Beryllium in the Environment

- Beryllium is naturally occurring in the environment, with an average concentration in the Earth's crust of 2.6ppm, the 44th most abundant element in the Earth's crust¹
- Typical concentration in topsoil is 0.6mg Be per kg soil²
- Median air concentration of Be in US cities is 0.2ng/m³, and greater than 0.1ng/m³ in 50 US cities³

- Beryllium in foods →

Foods ⁴	Value
Rice	0.08 mg/kg
Potatoes	0.17 mg/kg
Tomatoes	0.24 mg/kg
Head Lettuce	0.33 mg/kg
Mushrooms	0.12 mg/kg
Nuts	0.01-0.47 mg/kg
Cigarettes ²	0.74 µg / Cigarette

***In other words,
beryllium is found
everywhere!***

Footnotes:

1 = IARC 1993, 2 = WHO 1990
3=ATSDR 1993, 4=HSDB 1997

The Real Risk with Beryllium

- Chronic Beryllium Disease (CBD) Conditions
 - Individual must be sensitive or allergic to beryllium
 - Respirable particulate less than 10 microns in size, roughly 1/10th the diameter of a human hair
 - Exposure to beryllium particulate in the form of a dust, fume or mist

All three conditions are required!

- CBD is primarily a disease affecting the lung – **not** ingestion or skin contact
- CBD is treatable but not curable
- No special health risks with Be in solid form

Most end users, such as the engineers and technicians at CERN, will never handle beryllium in ways which generate dust, mist or fume. Beryllium is not a fire hazard since it has no flashpoint, melts at 1,285°C, and evaporates at 2,970°C

How does an individual get CBD?

Individual
born
susceptible

- From 1940-1990, studies indicate that <2% exposed population developed CBD. It is believed that genetics plays a role in sensitization and CBD

Exposure

- Individuals exposed to airborne beryllium and inhales particulate <10 μ m in size

Sensitization

- Individual becomes sensitized to beryllium, autoimmune system will react after additional exposures

Inflammation

- Immune response causes inflammation and damage to lungs

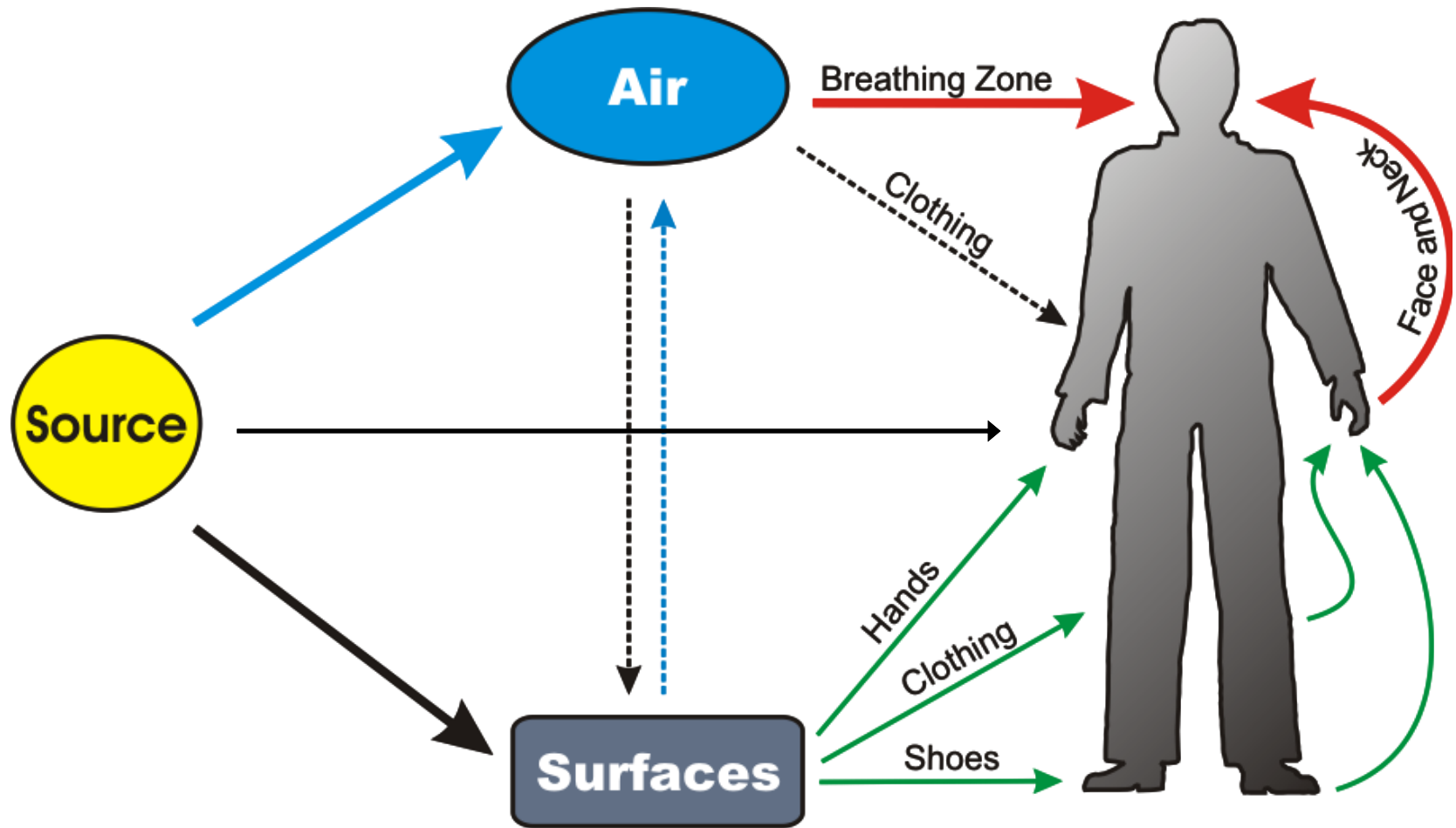
Subclinical
CBD

- Diagnosis based on detection of sensitization and presence of granulomas (nodules) in lungs. No noticeable impact on health

CBD

- Individual loses noticeable lung capacity
- Treatable, not curable, potentially fatal

Migration Pathways



Recommended Maximum Exposure to Airborne Beryllium Guideline

- Materion Brush Inc. recommends $0.2 \mu\text{g}/\text{m}^3$ airborne Be as an 8-hr time weighted average – this means that an individual is exposed to an average of no more than $0.2 \mu\text{g}/\text{m}^3$ in 8 hours, or no more than $0.4 \mu\text{g}/\text{m}^3$ in 4 hours, or no more than $0.8 \mu\text{g}/\text{m}^3$ in 2 hours.
- At Materion facilities, where people might work around airborne Be for an entire shift, our goal is less than $0.2 \mu\text{g}/\text{m}^3$ at all times
- Basis for Recommended Exposure Guideline (REG)
 - The Johnson study demonstrates the Cardiff preventive model, using a TLV of $2.0 \mu\text{g}/\text{m}^3$ prevents clinical chronic beryllium disease.
 - Studies by Cummings, Thomas, Madl, Schuler and Johnson all support the adoption of an OEL of no lower than $0.2 \mu\text{g}/\text{m}^3$ from a risk assessment perspective

Skin Contact with Beryllium

- No effect on contact or temporary embedding
- Like iron, aluminum, and zinc, granuloma possible if left embedded in skin (a granuloma is a nodule produced in response to a foreign body or other causes – it can be removed, but should be avoided)
- Solvents will not generate small beryllium particles, but *some* acids will. In general, don't use acid with beryllium.



- Wear clean gloves to protect the skin and, most importantly, to protect the beryllium (verify gloves are clean before touching beryllium!)

- Product shipped to CERN is cleaned inside and outside prior to delivery to remove dust or particulate

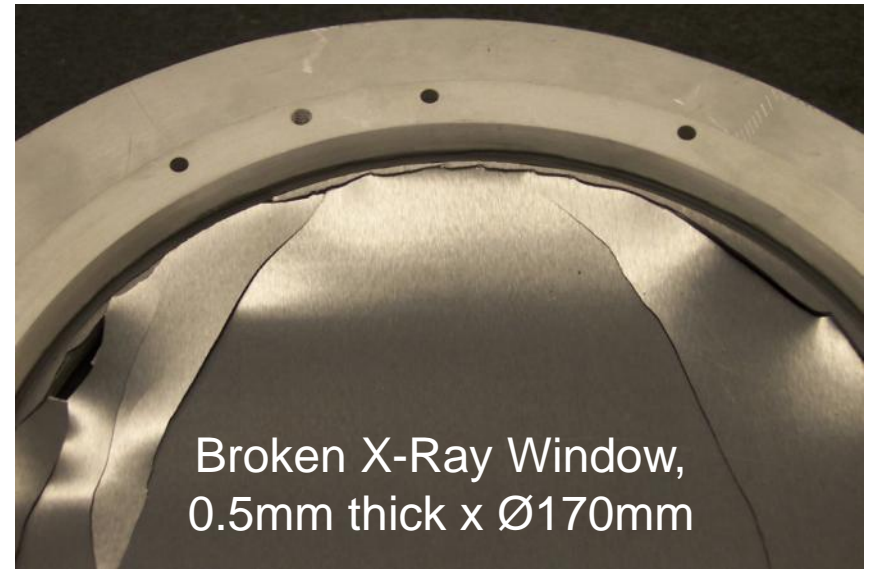


Broken Beryllium?

- If beryllium breaks, it does not shatter
- Long cracks
- Large pieces
- No respirable particles



Intentionally broken 50 μ m thick
Be speaker dome



Materion's Best Practices in Case of Broken Beryllium

- Pieces are generally much larger than $10\mu\text{m}$ and therefore not a respirable danger
- Wash skin if contacted with beryllium
- Limit access to the area until the beryllium has been removed
- Put large pieces in a sealed plastic bag and put bag in designated area
- Remove smaller loose pieces with a HEPA vacuum and put HEPA filter in designated area
 - HEPA = High Efficiency Particulate Air; filters out 99.97% of particulate larger than $0.3\mu\text{m}$ in diameter*
- Wipe the area with a damp cloth and properly dispose of the cloth in designated area
- If needed, perform a wipe sample on the affected area and compare to a wipe sample on a non-affected area to validate the cleaning process

Beryllium: The Cancer Question

- Beryllium is listed by IARC (International Agency for Research of Cancer) and NTP (National Toxicology Program) as a carcinogen by inhalation; and, by the European Union as a Carcinogen Category 1B – "Presumed to have carcinogenic potential for humans," under Regulation 1272/2008 (Classification, Labeling and Packaging)
- The only studies that conclude beryllium causes cancer were carried out on the same group of beryllium production workers in the United States when exposures were 100 to 1000 times the US OSHA PEL (United States Occupational Safety and Health Administration Permissible Exposure Limit)
- Cancer risk varied depending on study and authors. Studies that suggest beryllium metal is linked with cancer are flawed and have very serious methodological errors in data analysis, according to scientists with a high level of expertise in cancer studies. The studies did not factor in smoking as a risk factor and did not correctly and they did not adjust for year of birth or year of hire

Other Resources for Best Practices: Materion Interactive Guide

- The Interactive Guide to Working Safely with Beryllium and Beryllium-containing Material (Interactive Guide)
- Primarily intended for users who will be performing operations that may generate dust, mist, or fumes
- The purpose of the Interactive Guide is to provide users with important information about beryllium health and safety and to help users learn how to safely work with beryllium and beryllium-containing materials
- Available online at www.berylliumsafety.com
- Upon completion of the Interactive Guide, users are provided with a printable action plan and information to address most types of operations and tasks performed on beryllium-containing materials in an industrial environment.
- Also available on CD and operates from most personal computers

Available Resources

- Publications
 - Material Safety Data Sheets
 - Safety Facts
 - Frequently Asked Questions
 - Health and Safety updates
- Product Stewardship Hotline at +1 216.383.4019
- Terence Civic, Director, Health, Safety and Regulatory Affairs, Terence.Civic@Materion.com
- www.materion.com
- beryllium.eu
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Backup Slides only after this point

Update on Current Product Stewardship Issues

■ REACH

- Registration of Beryllium and Beryllia was completed in December, 2010.
- Beryllium is not on the Candidate List issued by the European Chemical Agency (ECHA).
- Materion continues to advocate for the cancer reclassification of beryllium.

■ RoHS Recast

- RoHS Recast in the EU was completed in 2011 and does not include restrictions on beryllium.
- Beryllium was considered along with many other substances but ultimately excluded.
- Materion advocated to exclude Beryllium.

Materion Control Strategies When Fabricating with Beryllium

Beryllium Worker Protection Model (BWPM)

- Technical interventions for the effective control of beryllium focus on achieving 8 operational goals:
- Keep Beryllium:
 - out of the lungs
 - off of the skin
 - off of the clothing
 - at the source
 - in the work area
 - on the plant site
 - work areas & processes clean
 - workers prepared

Supportive assessments Be does not cause cancer

Depending on the study and the authors, the risk of cancer varied. The studies that suggest beryllium metal is linked with cancer (Ward, Sanderson, Schubauer-Berigan), have been found to be flawed and have very serious methodological errors according to scientists with a high level of expertise in cancer studies.



Supportive assessments Be does not cause cancer

Recent studies by experts in epidemiology support the need to reclassify beryllium:

(Rothman K.J., Mosquin P.L. Confounding after Risk-set Sampling in the Beryllium Study of Sanderson et al. Ann Epidemiol 21(10): 773-779 2011)

- This study concluded that “Simulations and reanalysis show that much of the reported association with lagged exposure is attributable to confounding by year of birth and year of hire. Lagging changes the exposure variable and can thus lead to changes in the amount of confounding.”
- The study suggests that the previous studies that indicated a cancer risk did not account for factors that could influence the study conclusions



Supportive assessments Be does not cause cancer

Recent studies by experts in epidemiology support the need to reclassify beryllium:

(Levy, P.S., Roth H.D., Deubner D.C. Exposure to Beryllium and Occurrence of Lung Cancer: Findings from a Cox Proportional Hazards Analysis of Data from a Retrospective Cohort Mortality Study. J Occup Environ Med 51: 480-486 2009).

- This study concluded “ The patterns observed provide little support for an association of lung cancer with beryllium work factors. This result is likely due to the absence in the original study of a significant overall excess of lung cancer after smoking adjustment.”



Supportive assessments Be does not cause cancer

Recent studies by experts in epidemiology support the need to reclassify beryllium:

(Boffetta P. International Prevention Research Institute, Lyon, France, *Occupational exposure to beryllium and cancer risk: a review of the epidemiologic evidence. Critical Reviews in Toxicology 42(2): 107-118 2012*)

- “The studies of beryllium disease patients do not provide independent evidence and the results from other studies do not support the hypothesis of an increased risk of lung cancer or any other cancer. Overall, the available evidence does not support a conclusion that a causal association has been established between occupational exposure to beryllium and the risk of cancer.”

