

Preventing beryllium disease in the workplace

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Brush Wellman Inc

Beryllium

Light gray metal extracted from beryl (emerald, aquamarine) and other ores

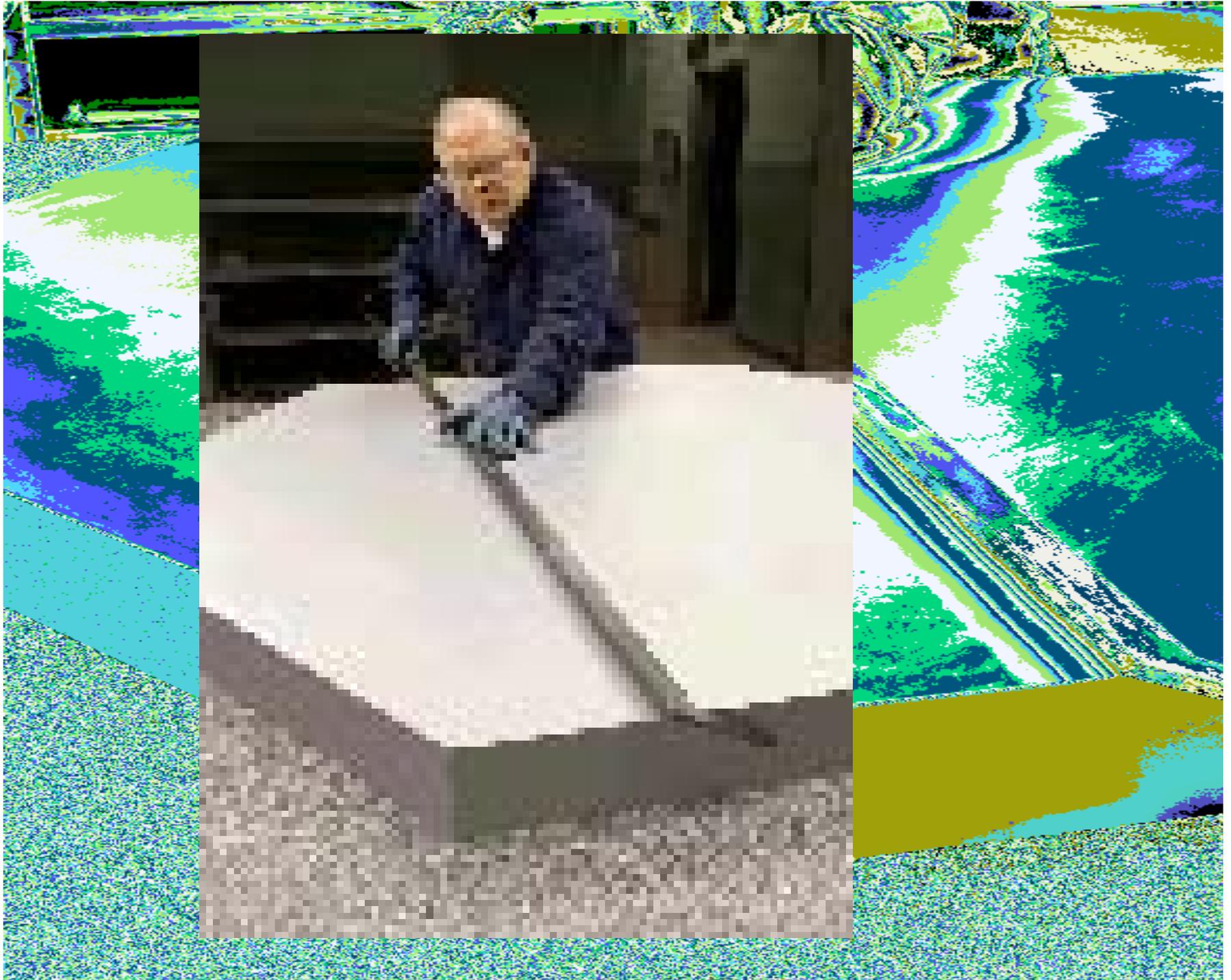
- Density $2/3$ that of aluminum, stiff, low thermal expansion
 - aerospace (space and air craft components)
 - Acoustics (speakers)
- Reflects slow neutrons
 - Nuclear weapons, physics experimentation
- Transparent to x-rays
 - X-ray windows, e.g. Mammograms
- Low atomic weight
 - Nuclear fusion reactor liner

NGST JWST Full Scale Mockup

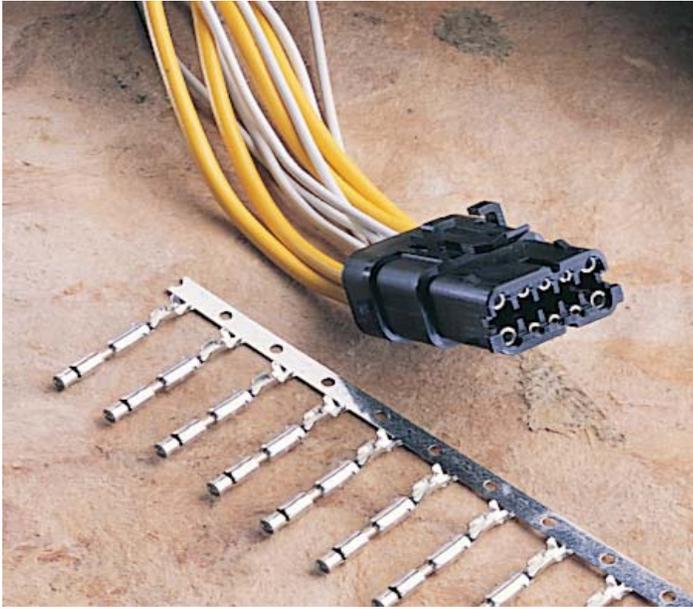
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- Alloys: adding beryllium gives strength, spring to copper, nickel
 - Properties of copper in hard, strong, springy metal
 - Electrical conductivity: electrical contacts
 - Non-galling: bearings and bushings
 - Thermal conductivity: molds for plastics
 - Corrosion resistance: oil and gas, undersea
 - Non-sparking: tools for explosive environments
- BeO ceramics
 - Thermal conductivity: electronic chips, laser bores



Goals

- Describe beryllium work setting
- Describe preventive model
- Describe leading measures
- Describe lagging measures

Beryllium work setting: three plants

- Elmore: receives $\text{Be}(\text{OH})_2$, uses chemical and metallurgical processes to produce beryllium alloys, beryllium metal and BeO powder: 600 workers
- Reading: receives copper-beryllium strip and wire and finishes: 150 workers
- Tucson: receives BeO powder and produces finished beryllia ceramic parts: 150 workers

Beryllium safety model

- Comprehensive exposure prevention
 - At work
 - Home
 - Community
- Health and safety management system
 - Top down, line management run
 - Everyone accountable
 - Enabling factors
 - Detailed implementation

Comprehensive exposure prevention

- Keep beryllium
 - Work areas clean and shipshape
 - Out of lungs
 - Off of Skin
 - Off of clothing
 - At the source (in the work process)
 - In the work area
 - On the plant site
 - Employees prepared to work safely

Keep beryllium Work areas clean and shipshape

- Basis for all industrial hygiene
 - 5S program for workplace productivity and organization
 - Sort
 - Set in order
 - Standardize
 - Shine: attractive, visibly clean
 - Sustain

Keep beryllium Out of the lungs

- “Protect first, *then* solve the problem”
- Respirators with seat belt mentality
 - If an air level *could* be high, have a respirator on
- Air level control: action level < 0.2 $\mu\text{g}/\text{m}^3$ 8h TWA
 - Control of upward variation
 - Process capability
 - Usual and special variation
 - Conservative statistical model 1% exceedence, 95% confidence
 - Process engineering, work practices, ventilation

Keep beryllium off the skin

- Mechanical protection: skin does not come in contact with dusts or solutions potentially containing beryllium in salt or small particle forms
- Whatever it takes to achieve this
 - Long sleeves, wrist covers, impervious gloves, rubber boots, etc.
- May touch clean material (solid, large particles)

Keep beryllium Off clothing

- Clothing is means of beryllium migration, re-suspension
- Standard is visibly clean
- Plan ahead and cover up – what ever it takes, from Tyvek to chemical suit protection, doff before leaving area
- If mistake, shower and change

Keep beryllium in work process (at source)

- Ideal: Process engineering, work practices, effective ventilation
 - Never perfect
 - Barriers breached, systems fail
 - Relative value
 - Standard for new construction
 - Priority for upgrade

Keep beryllium in the work area

- Prevent beryllium migration from work area
 - On product, people, equipment, via air or fluids
 - To where
 - personal protection is removed
 - others may be needlessly exposed

Keep beryllium on the plant site

- Prevent exposure off work, to family, friends and community
- Prevent movement on product, people, equipment, via air or fluids

Keep beryllium

Workers prepared to work safely

- Prepared: Motivation, knowledge, skills
- Exposure begins on day 1, workers must be protected on day 1
 - Formal education and training
 - Job/training matrices
 - Two levels, awareness and competent person
 - Pre-task analysis, briefings
 - Tool box talks

Leading measures

- Safety management capability
 - Corporate audits: commitment, organization, communication, education and training, measurement
- Program elements
 - Corporate audits
- Detailed compliance
 - Work area audits with worker involvement

Leading measures results

- Organizational competence
 - Corporate audits: commitment, organization, communication, education and training, measurement: all sites audit to “good”
- Program elements
 - Corporate audits: All sites audit to good, which means programs are in place and working, not necessarily finished. Adequate on lungs, skin, clothing, workers prepared; Work in progress in other elements
- Detailed compliance
 - Work area audits with worker involvement
 - Example: Respirators worn where required: 100%

Lagging measures

- BeBLPT in new hires
 - Prior surveillance highest prevalence of positive tests was at 4-8 months of work = 18%
 - New hires tested prior to starting work (0), and 3,6,12, 24 months, now 0, 6, 24 months
 - New hire rate of positives at time 0 = ~ 2%, confirmed ~ 1.5%, no known history of likely Be exposure = ~ 1 %

Lagging measure: BeBLPT results

- Before
 - 1997 Elmore highest risk area, workers with < 3 years employment ($6/35 = 17\%$)
 - 1998-2000 Three plants, workers at 4-8 months employment ($9/50 = 18\%$)
- After

New Hires	6 months	24 months
2000-3	2.3 %	4.1 %
2004-5	1.1 %	1.1 %

Conclusion

- **Comprehensive beryllium exposure reduction program** introduced using **health and safety management system**
 - Worker protection first priority: whatever it takes
- **Leading measures** demonstrate capability to manage safety and achievement of skin and lung exposure reduction goals
- **Lagging measures** demonstrate gratifying reduction in new positive BeBLPTs in newly hired workers