

Administrative
Requirements (AR)AR Section 6:
Hazardous Materials

Beryllium

Introduction

Laboratory operations often use beryllium and produce beryllium aerosols that must be controlled to minimize exposure to personnel and the public. This administrative requirement (AR) specifies the air quality requirements for beryllium aerosol emissions, the surface swipe requirements for beryllium-contaminated work surfaces, and the other general requirements for beryllium operations at the Laboratory.

The air quality requirements for beryllium emissions are specified in the regulations implementing the Clean Air Act and the New Mexico Air Quality Control Act. The requirements for employee protection from airborne exposure are found in "Occupational Safety and Health Standards," 29 CFR 1910, and "Industrial Hygiene," Department of Energy Order 5480.1B.

For further information on the control of beryllium exposure at the Laboratory, see Technical Bulletin 607, "Beryllium," and AR 9-1, "Air Pollution Control."

Definitions

Air Emissions Limit—The federal limit for beryllium emissions as specified in "National Emissions Standards for Hazardous Air Pollutants," 40 CFR 61 is

- 10 g/day (emission limit), or
- 0.01 $\mu\text{g}/\text{m}^3$ (30-day average in ambient air).

The New Mexico Environment Department sets the source's beryllium emission limit based on the permit application. (See Administrative Requirement 9-1, "Air Pollution Control.")

Anti-C Clothing—Clothing worn in radiation areas to prevent contamination of a person's body.

Beryllium—In general, beryllium includes beryllium metal, beryllium oxide, alloys containing 0.1% or more of beryllium, and beryllium compounds (such as beryllium sulfate). However, for machining operations, beryllium alloys containing 5% or more are considered to be beryllium.

Beryllium Operations Area—A location in which Laboratory activities involving work with beryllium take place. This area has a potential for (1) production of aerosols containing beryllium or (2) beryllium-contaminated work surfaces. Beryllium operations areas may include but are not limited to the following activities: welding, melting, molding, casting, sawing, machining, electroplating, grinding, polishing, and destructive testing.

Beryllium Worker—An employee who routinely works more than 30 days per year with beryllium that could become aerosolized and enter the work environment, or an employee involved with nonroutine (less than 30 days per year) and routine beryllium operations where airborne concentrations of beryllium are greater than 0.5 $\mu\text{g}/\text{m}^3$. Janitorial personnel in beryllium areas are included in the beryllium worker category.

Limited Access Beryllium Operations Area—An enclosed area, such as a hood around a machine cutting tool, in which a beryllium operation takes place. Usually, this area is completely covered by heavy plastic sheeting or similar material and may not be entered by beryllium workers without respiratory protection. The beryllium worker may insert a hand into the area to perform required activities.

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Non-Beryllium Operations Area—A work space in which no beryllium operations take place, adjacent to or near a beryllium operations area such as a hallway, changing room, or terminated beryllium operations location. (This work space must be surveyed for beryllium contamination because of its location.)

Nonroutine Beryllium Operation—A short-term operation such as a repair, unique fabrication, or experiment that is conducted in a facility not normally used for beryllium work.

Occupational Exposure Limit (OEL)—The concentration of airborne substances or level of physical agents to which a worker may be exposed for a working lifetime without probable adverse health effects. For beryllium, the OEL has been established at $2.0 \mu\text{g}/\text{m}^3$ for the time-weighted average concentration with a ceiling of $5.0 \mu\text{g}/\text{m}^3$.

Routine Beryllium Operation—A long-term or repetitive operation, such as recurrent machining or fabrication, or a repetitious experiment.

Surface Swipe Limit—The concentration of beryllium observed on a surface that is used as an index of surface cleanliness and does not necessarily indicate a beryllium hazard.

Overall Responsibility

Unless otherwise stated in this document, line managers must ensure that the requirements specified herein are met.

New Beryllium Operations

Standard Operating Procedures (SOPs) and Special Work Permits (SWPs). New beryllium operations require an approved SOP or SWP before operations begin. For further clarification of SOPs and SWPs, see Administrative Requirement (AR) 1-3, "Standard Operating Procedures and Special Work Permits."

Air Quality. Line managers must contact the Environmental Protection Group (EM-8) during the planning stages of a beryllium operation to ensure that the necessary air quality permits are obtained from the Air Quality Bureau of the New Mexico Environment Department and appropriate control measures are in effect when the operation begins.

Monitoring Ongoing Beryllium Operations

Air Quality. Beryllium operations that produce airborne emissions must comply with federal and state regulations cited above and the conditions of the air quality permit. (See AR 9-1, "Air Pollution Control," for additional information.) Line managers must evaluate their beryllium operations and establish and maintain measures to ensure that personnel exposures and environmental releases are below regulatory limits. The Industrial Hygiene Group (HS-5) collects air samples to ensure that worker exposure levels to airborne beryllium are below the occupational exposure limit (OEL).

Emissions Testing. Stack emissions must be measured initially and as requested by the state of New Mexico to ensure compliance with state air quality permits and Environment Department regulations. All testing costs must be paid for by the operating group. EM-8 will provide the names of qualified emission sampling consultants.

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Ventilation and Dust Control. Special exhaust ventilation systems and air-cleaning devices are needed during beryllium operations to minimize the spread of beryllium aerosols. Generation of airborne beryllium can be minimized by using water or oil as a coolant during machining, polishing, and grinding operations.

Personnel Exposure. Beryllium operations areas are monitored *initially* to determine the adequacy of control measures and *periodically* as necessary to ensure that work place controls continue to function effectively.

Surface Cleanliness. HS-5 evaluates surface cleanliness periodically by collecting the surface swipes and comparing the results with the Laboratory-adopted criteria below.

Surface Swipe Limits. The Laboratory has adopted surface swipe limits for beryllium contamination. The specific actions to be taken if these limits are exceeded are found in Table I.

| Location | Maximum Swipe Limit $\mu\text{g}/\text{ft}^2$ | Action Required if Maximum is Exceeded |
|---|---|--|
| Beryllium Operations Area | <25 | No action |
| Beryllium Operations Area | 26-100 | Action level 1 |
| Beryllium Operations Area | >100 | Action level 2 |
| Limited Access Beryllium Operations Area | <250 | No action |
| Limited Access Beryllium Operations Area | >250 | Action level 2 |
| Non-Beryllium Operations Area | <2 | No action |
| Non-Beryllium Operations Area | >2 | Action level 1 |

Actions Required for Readings that Exceed Surface Swipe Limits.

- Action Level 1—Re-evaluate the operation to determine (1) what factors are causing the excessive readings and (2) what appropriate corrective measures, in addition to cleaning the area, must be taken.
- Action Level 2—Operations are terminated and cleaning activities begin. Operations may not resume until surface swipe levels are satisfactorily reduced to the limits stated in Table I.

NOTE: Surface swipe limits are set as an index of surface cleanliness and do not necessarily indicate a beryllium hazard.

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Waste Disposal. Beryllium shipping and storage containers and beryllium-contaminated clothing, equipment, surfaces, and waste must be conspicuously marked with appropriate warning labels, which are available from the Specialized Fabrication Group (MEC-10). Separate nonradioactive beryllium waste from radioactively contaminated beryllium waste. (See AR 10-3, "Chemical, Hazardous, and Mixed Waste," for more information.)

NOTE: Oil or water used in beryllium operations could become beryllium contaminated and could require special disposal procedures. Contact the Waste Management Group (EM-7) for information about disposal procedures.

Approvals. Beryllium operations not performed in specially designed facilities (such as special venting) or those conducted outdoors (such as hydrotesting) must be approved by HS-5 and EM-8.

Documentation

Beryllium Worker Identification. Line managers, with the assistance of HS-5, must identify beryllium workers and provide the Occupational Medicine Group (HS-2) with a list of those employees. HS-2 maintains the list of beryllium workers.

Janitorial Personnel. Janitorial personnel who work in beryllium areas are beryllium workers.

Accident/Incident Reporting. Beryllium workers who are injured on the job or experience an exposure in excess of the OEL must report the incident to their supervisor and to HS-2 in accordance with AR 1-1, "Accident/Incident Reporting."

Work Place Sampling. HS-5 conducts work place and personal monitoring, provides the line manager with work place sampling results, and maintains records of the evaluation. The line manager must notify the affected employees of sampling results in writing.

Medical Surveillance

An employee may not begin working in a beryllium operation until HS-2 has completed a comprehensive preplacement examination and the employee's line manager has received formal HS-2 approval to begin work. Regardless of future work assignments, beryllium workers must remain under medical surveillance by HS-2 while they are employed by the Laboratory.

Training

Supervisors must provide initial and periodic job-specific training for their beryllium workers informing them of the hazards of beryllium work, the adverse symptoms of beryllium overexposure, appropriate emergency procedures, maintenance procedures, housekeeping/cleanup methods, use of protective equipment, and the precautionary measures needed to help ensure a safe work place when working with beryllium. Upon request, HS-5 and HS-2 will assist supervisors in this training effort. All environment, safety, and health (ES&H) training must be documented, whether it is a course or on-the-job training. See AR 1-4, "Health and Safety Training," for more information on training records.

Labeling

Beryllium operation areas must be posted, "DANGER: BERYLLIUM AREA, UNAUTHORIZED PERSONS KEEP OUT." Line managers must ensure that storage, shipping, and waste containers that include beryllium, and beryllium-

contaminated equipment and surfaces are conspicuously marked with the following words: "BERYLLIUM—WARNING, INHALATION OF DUST MAY CAUSE LUNG DAMAGE, SUSPECT CARCINOGEN, MAY PREVENT HEALING OF OPEN WOUNDS." Signs can be obtained through MEC-10.

Personal Protective Equipment

Respiratory Protective Equipment. Line managers must ensure that their employees are provided with respiratory protective equipment when engineering or work place controls will not effectively reduce the exposure to beryllium aerosols below the OEL. General requirements for respiratory protection are given in AR 12-1, "Personal Protective Equipment." Specific respiratory protective equipment requirements for beryllium workers are provided by HS-5 and must be included in SOPs and SWPs.

Protective Clothing. To help prevent beryllium contamination of personal clothing, beryllium workers shall wear protective clothing and shoe covers while in beryllium operations areas.

Beryllium Workers. Special blue or appropriately labeled coveralls, beryllium-labeled underwear, and booties (used to cover safety shoes) are required for beryllium workers. Single-use (disposable) coveralls may be used but must be disposed of as beryllium waste. Protective clothing must be removed at the end of the employee's shift. In radioactively contaminated work areas, anti-C clothing can be substituted for blue coveralls and beryllium-labeled underwear. Once removed, potentially beryllium-contaminated clothing must be stored in a bag-lined container, which can be easily closed for shipment to the laundry.

Personnel with Minimal Beryllium Exposure. Supervisors and other employees whose work involves minimal beryllium exposure (for example, supervisors or support personnel who enter a beryllium operations area for a short time or personnel who perform minor beryllium operations with documented minimal exposure) may substitute blue or appropriately labeled laboratory coats for coveralls as specified in the approved SOP.

Hand Protection. Beryllium workers with open cuts on their hands or those working with soluble beryllium compounds (for example, beryllium fluoride) must use latex gloves. When there is a risk for skin cuts, cloth or leather gloves are required.

Laundrying. Clothing worn by beryllium workers must be laundered according to the following requirements.

Beryllium-Contaminated Clothing. This clothing is placed in Melt-A-Way bags (which dissolve in water and are available from stock for this purpose). The Melt-A-Way bags must be securely enclosed in a polyethylene or other impervious, nonreusable plastic bag, labeled, and placed inside a Department of Transportation (DOT) 17C metal drum and shipped to the TA-16 laundry. See Technical Bulletin 607 for specific shipping requirements.

Beryllium- and Radiation-Contaminated Clothing. When radioactive beryllium and beryllium-contaminated materials are used and anti-C coveralls and booties are required, the clothing may become contaminated with beryllium and radiation; it must be collected separately and labeled as beryllium-contaminated. The operating group must notify the off-site laundry of possible beryllium contamination before the clothing is shipped. This notification is coordinated through the Health Physics Operations Group (HS-1) and the Health Physics Policy and Programs Group

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(HS-12). Shipment of radiation-contaminated laundry from the Laboratory will be made in compliance with "Transportation of Hazardous Materials," 49 CFR 173.401. Final monitoring, marking, and labeling of outgoing shipments of laundry are handled by the Packaging and Transportation Safety Section of HS-3 (HAZPACT).

Protective Eye Wear. Personnel must wear safety glasses when the operation could involve beryllium contamination of the eyes.

Contamination Controls

Ventilation. Exhaust ventilation systems shall be designed and maintained to reduce employee exposure to airborne beryllium and be equipped with air cleaning devices to meet conditions in the appropriate air quality permit. Any deviation from this requirement must be approved by HS-5 and EM-8. The employee must ensure that the exhaust ventilation system meets minimum operating specifications as stated in the SOP before and frequently throughout the operation. To ensure adequate operating efficiency, air cleaning devices (exhaust filters and vacuum cleaners) must be tested annually, following maintenance that could effect filter efficiency, or when static pressure monitoring shows changes out of the normal operating range.

Operating organizations with state air quality permits must maintain

- a log of filter static pressure readings,
- records of filter and vacuum cleaner efficiencies, and
- a log of beryllium process rates.

Specifications for beryllium exhaust ventilation are provided by HS-5 and are in accordance with the DOE Order 5480.1A that cites the American Conference of Governmental Industrial Hygienists ventilation manual. EM-8 determines the need for exhaust air cleaning and stack sampling.

Housekeeping. Dry sweeping is prohibited in beryllium operations areas; instead, wet methods and/or vacuums with filtering systems that are 99.97% efficient must be used. Housekeeping frequency shall be determined by the line manager but must be often enough to keep surface contamination below the prescribed limits. (See "Surface Swipe Limits" above.)

Disposal. Beryllium waste and scraps must be disposed of in properly sealed and labeled containers through EM-7. For specific requirements, see AR 10-3, "Chemical, Hazardous, and Mixed Waste."

Food Preparation, Eating, Drinking, and Smoking. No eating, drinking, smoking, food preparation, or food storage shall be permitted in beryllium operations areas.

Controlled Access. To keep the number of persons entering a beryllium operations area to a minimum, line managers must control access to the area. Line managers must identify a contact person who shall restrict entry into the beryllium operations area to beryllium workers and those approved by the line manager.

Locker and Toilet Facilities. Line managers must provide separate locker and toilet facilities for workers involved in routine beryllium operations. These facilities must be arranged in a manner that demarcates the clean areas from the contaminated ones.

Showers. Beryllium workers must shower before dressing in street clothing and after each work shift.

References

- "Accident/Incident Reporting," Administrative Requirement 1-1, in *Environment, Safety, and Health Manual*, Los Alamos National Laboratory Manual, Chapter 1 (most recent edition).
- "Air Pollution Control," Administrative Requirement 9-1, in *Environment, Safety, and Health Manual*, Los Alamos National Laboratory Manual, Chapter 1 (most recent edition).
- "Beryllium," Technical Bulletin 607, in *Environment, Safety, and Health Manual*, Los Alamos National Laboratory Manual, Chapter 1 (most recent edition).
- "Chemical, Hazardous, and Mixed Waste," Administrative Requirement 10-3, in *Environment, Safety, and Health Manual*, Los Alamos National Laboratory Manual, Chapter 1 (most recent edition).
- Clean Air Act, Public Law 101-549 (most recent edition).
- "Health and Safety Training," Administrative Requirement 1-4, in *Environment, Safety, and Health Manual*, Chapter 1 (most recent edition).
- "Industrial Hygiene," Department of Energy Order 5480.1B (most recent edition).
- Industrial Ventilation: A Manual of Recommended Practice*, 20th ed. (American Conference of Governmental Industrial Hygienists, Lansing, Michigan, 1989).
- "National Emissions Standards for Hazardous Air Pollutants," 40 CFR 61 (most recent edition).
- New Mexico Air Quality Control Act , 74-2-1, New Mexico Statutes Annotated 1978 (as amended 1990).
- "Occupational Safety and Health Standards," 29 CFR 1910 (most recent edition).
- "Personal Protective Equipment," Administrative Requirement 12-1, in *Environment, Safety, and Health Manual*, Los Alamos National Laboratory Manual, Chapter 1 (most recent edition).
- "Standard Operating Procedures and Special Work Permits," Administrative Requirement 1-3, in *Environment, Safety, and Health Manual*, Los Alamos National Laboratory Manual, Chapter 1 (most recent edition).
- "Transportation of Hazardous Materials," 49 CFR 173.401 (most recent edition).

Referrals

- Air Quality Bureau of the New Mexico Environment Department, 827-0070
- Environmental Protection Group (EM-8), 7-5021
- Field Operations Group (ENG-5), 7-4657
- Health Physics Operations Group (HS-1), 7-7137
- Health Physics Policy and Programs Group (HS-12), 7-5296
- Industrial Hygiene Group (HS-5), 7-5231
- Occupational Medicine Group (HS-2), 7-7251
- Operational Safety Section of the Safety and Risk Assessment Group (HS-3), 7-4644

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Packaging and Transportation Safety Section of the Safety and Risk Assessment
Group (HS-3), 7-4127

Specialized Fabrication Group (MEC-10), 7-7497

Waste Management Group (EM-7), 7-7391