Occupational Health Guideline for Boron Oxide

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: B_2O_3
- Synonyms: Anhydrous boric acid; boric anhydride; boric oxide
- Appearance and odor: Colorless glassy granules or flakes with no odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for boron oxide is 15 milligrams of boron oxide per cubic meter of air (mg/m³) averaged over an eight-hour work shift. The American Conference of Governmental Industrial Hygienists has recommended for boron oxide a Threshold Limit Value of 10 mg/m³.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Boron oxide can affect the body if it is inhaled or if it comes in contact with the eyes or skin. It can also affect the body if it is swallowed.

- **Effects of overexposure**

Exposure to boron oxide has caused irritation of the eyes, nose, and skin of animals. It may have the same effects on humans.

- **Reporting signs and symptoms**

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to boron oxide.

- **Recommended medical surveillance**

Routine medical examinations should be provided to each employee who is exposed to boron oxide at potentially hazardous levels.

- **Summary of toxicology**

Boron oxide aerosol is of low toxicity; at high levels, it is mildly irritating to the mucous membranes of animals. Repeated exposure of rats to an aerosol at a concentration of 470 mg/m³ for 10 weeks caused only mild nasal irritation; repeated exposure of rats to 77 mg/m³ for 23 weeks resulted in elevated creatinine and boron content of the urine, in addition to increased urinary volume. Conjunctivitis resulted when the dust was applied to the eyes of rabbits, probably the result of the exothermic reaction of boron oxide with water to form boric acid; topical application of boron oxide dust to the clipped backs of rabbits produced erythema that persisted for 2 to 3 days.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
  1. Molecular weight: 69.9
  2. Boiling point (760 mm Hg): 2550 C (4622 F)
  3. Specific gravity (water = 1): 1.84
  4. Vapor density (air = 1 at boiling point of boron oxide): Not applicable
  5. Melting point: 450 C (842 F) (approximate)
  6. Vapor pressure at 20 C (68 F): Essentially zero
  7. Solubility in water, g/100 g water at 20 C (68 F): 2.77
  8. Evaporation rate (butyl acetate = 1): Not applicable
- **Reactivity**
  1. Conditions contributing to instability: None
  2. Incompatibilities: None
  3. Hazardous decomposition products: None
  4. Special precautions: None
- **Flammability**
  1. Not combustible

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• **Warning properties**

Grant states that boron oxide "tested on rabbit eyes in the form of a dust has been found to cause almost immediate irritation of the conjunctiva."

MONITORING AND MEASUREMENT PROCEDURES

• **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• **Method**

Sampling and analyses may be performed by collection of boron oxide on a filter, followed by gravimetric analysis. An analytical method for boron oxide is in the *NIOSH Manual of Analytical Methods*, 2nd Ed., Vol. 3, 1977, available from the Government Printing Office, Washington, D.C. 20402 (GPO No. 017-033-00261-4).

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with boron oxide or liquids containing boron oxide.

• Non-impervious clothing which becomes contaminated with boron oxide should be removed promptly and not reworn until the boron oxide is removed from the clothing.

• Employees should be provided with and required to use dust- and splash-proof safety goggles where boron oxide or non-aqueous liquids containing boron oxide may contact the eyes.

SANITATION

• Skin that becomes contaminated with boron oxide should be promptly washed or showered with soap or mild detergent and water to remove any boron oxide.

• Employees who handle boron oxide or non-aqueous liquids containing boron oxide should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to boron oxide may occur and control methods which may be effective in each case:

Operation	Controls
Use in manufacture of metal borates and in preparation of fluxes; use in manufacture of glass for heat-resistance	Process enclosure; local exhaust ventilation; personal protective equipment
Application as a herbicide	Personal protective equipment
Use in production of surface coatings as fire-resistant additive in enamel and paints	Process enclosure; local exhaust ventilation; personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• **Eye Exposure**

If boron oxide or non-aqueous liquids containing boron oxide get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention immediately. Contact lenses should not be worn when working with this chemical.

• **Skin Exposure**

If boron oxide or liquids containing boron oxide get on the skin, promptly flush the contaminated skin with water. If boron oxide or liquids containing boron oxide penetrate through the clothing, remove the clothing immediately and flush the skin with water. If irritation persists after washing, get medical attention.

• **Breathing**

If a person breathes in large amounts of boron oxide, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration.

Keep the affected person warm and at rest. Get medical attention as soon as possible.

• **Swallowing**

When boron oxide or non-aqueous liquids containing boron oxide have been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately.

• **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed.

• If boron oxide is spilled, the following steps should be taken:

1. Ventilate area of spill.
2. Collect spilled material in the most convenient and safe manner for reclamation or for disposal in sealed containers in a secured sanitary landfill.

• Waste disposal method:

Boron oxide may be disposed of in sealed containers in a secured sanitary landfill.

• Respiratory Protection for Chemical Hazards

• Personal Protection and Sanitation for Chemical Hazards

These documents are available through the NIOSH Division of Technical Services, 4676 Columbia Parkway, Cincinnati, Ohio 45226.

REFERENCES

• American Conference of Governmental Industrial Hygienists: "Boron Oxide," *Documentation of the Threshold Limit Values for Substances in Workroom Air* (3rd ed., 2nd printing), Cincinnati, 1974.

• Deichmann, W. B., and Gerarde, H. W.: *Toxicology of Drugs and Chemicals*, Academic Press, New York, 1969.

• Grant, W. M.: *Toxicology of the Eye* (2nd ed.), C. C. Thomas, Springfield, Illinois, 1974.

• International Labour Office: *Encyclopedia of Occupational Health and Safety*, McGraw-Hill, New York, 1971.

• Sax, N. I.: *Dangerous Properties of Industrial Materials* (3rd ed.), Van Nostrand Reinhold, New York, 1968.

• Wilding, J. L., et al.: "The Toxicity of Boron Oxide," *American Industrial Hygiene Association Journal*, 20:284-289, 1959.

RESPIRATORY PROTECTION FOR BORON OXIDE

Condition	Minimum Respiratory Protection* Required Above 15 mg/m³
Dust Concentration	
75 mg/m³ or less**	Any dust respirator, except single-use.
150 mg/m³ or less**	Any dust respirator, except single-use or quarter-mask respirator.
Dust or Fume Concentration	
150 mg/m³ or less**	Any fume respirator or high efficiency particulate filter respirator. Any supplied-air respirator. Any self-contained breathing apparatus.
750 mg/m³ or less	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
7500 mg/m³ or less	A powered air-purifying respirator with a full facepiece, helmet, or hood and a high efficiency particulate filter. A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 7500 mg/m³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.

*Only NIOSH-approved or MSHA-approved equipment should be used.

**If eye irritation occurs, full-facepiece respiratory protective equipment should be used.