NIOSH/OSHA STANDARDS COMPLETION PROGRAM

DRAFT TECHNICAL STANDARD AND SUPPORTING DOCUMENTATION FOR

*** BORON OXIDE ***

NIOSH/OSHA Draft Technical Standard and Supporting Documentation for BORON OXIDE

The basic text of this document contains the draft technical standard approved by the Joint Review Committee of the NIOSH/OSHA Standards Completion Program and the supporting documentation for the substance BORON OXIDE.

The SCP draft technical standards are recommendations to the Department of Labor for its consideration in rulemaking and have no legal status until final rules have been promulgated by that agency. This draft standard is provided for your information only.

The References and Sources, Respirator Table Documentation and Use/Exposure and Control Documentation are the working documents used by the various SCP working groups during the development of the draft technical standard and serve as the technical foundation for the standard. The classification for each substance and the regulatory statements were derived following a decision logic established for the various sections of the standard.

(a) Definitions. (1) "Permissible exposure" means exposure of employees to airborne concentrations of boron oxide not in excess of 15 milligrams per cubic meter (mg/M3) averaged over an eight-hour work shift (time weighted average), as stated in $ 1910.1000, Table Z-1.

(2) "Action level" means one-half of the permissible exposure for boron oxide averaged over an eight-hour work shift.

(b) Initial determination and exposure measurement. (1) Each employer who has a place of employment in which boron oxide is released into the workplace air shall determine if there is any possibility that any employee may be exposed to airborne concentrations of boron oxide above the permissible level. The initial determination shall be made each time there is a change in production, process, or control measures which may result in an increase in airborne concentrations of boron oxide.

(2) A written record of the initial determination shall be made and shall contain at least the following information:

(i) Any information, observations, or calculations which may indicate employee exposure to boron oxide;

(ii) Any measurements of boron oxide taken;

(iii) Any employee complaints of symptoms which may be attributable to exposure to boron oxide; and

(iv) Date of initial determination, work being performed at the time, location within work site, and employees considered.

(3) If the employer determines that any employee may be exposed to boron oxide above the permissible exposure, the exposure of the employee in each work operation who is believed to have the greatest exposure shall be measured. The exposure measurement shall be representative of the maximum eight-hour time weighted average exposure of the employee.

(4) If the exposure measurement taken pursuant to paragraph (b) (3) of this section reveals employee exposure to boron oxide above the action level, the employer shall:

(i) Identify all employees who may be exposed above the permissible level; and

(ii) Measure the exposure of the employees so identified.

(5) If an employee exposure measurement reveals that an employee is exposed to boron oxide above the action level, but not above the permissible exposure, the exposure of that employee shall be measured at least every three months.

(6) If an employee exposure measurement reveals that an employee is exposed to boron oxide above the permissible exposure, the employer shall:

(i) Measure the exposure monthly of the employee so exposed; and

(ii) Institute control measures as required by paragraph (d) of this section; and

(iii) Individually notify, in writing, within five days, every employee who is found to be exposed to boron oxide above the permissible exposure. The employee shall also be notified of the results of the exposure measurements and of the corrective action being taken to reduce the exposure to below the permissible exposure.

(7) If two consecutive employee exposure measurements taken at least one week apart reveal that the employee is exposed to boron oxide below the action level, the employer may terminate measurement for the employee.

(8) For purposes of this paragraph, employee exposure is that which would occur if the employee were not using a respirator.

(c) Methods of measurement. (1) An employee's exposure shall be obtained by any combination of long term or short term samples which represents the employee's actual exposure averaged over an eight-hour work shift (See Appendix B (IV) of this section).

(2) The method of measurement shall have an accuracy, to a confidence level of 95 percent, of not less than that given in Table 1.

Table 1

Concentration	Required Accuracy
Above permissible exposure	± 25%
At or below permissible exposure and above the action level	± 35%
At or below the action level	± 50%

(d) Compliance. (1) No employee shall be exposed to boron oxide above the permissible exposure as defined in paragraph (a)(1) of this section.

(2) Employee exposures to airborne concentrations of boron oxide shall be controlled to at or below the permissible exposure by engineering and work practice controls.

(i) Engineering and work practice controls shall be instituted to reduce exposures to at or below the permissible exposure, except to the extent that such controls are not feasible.

(ii) Wherever engineering and work practice controls are not sufficient to reduce exposures to at or below the permissible exposure, they shall nonetheless be used to reduce exposure to the lowest level feasible and shall be supplemented by respirators in accordance with paragraph (d)(4) of this section.

(3) Engineering controls. When local exhaust is used to control exposure, measurements which demonstrate system effectiveness, for example, air velocity or static pressure, shall be made at least every three months. Measurements of system effectiveness shall also be made within five days of any change in production, process, or control which might result in an increase in airborne concentrations of boron oxide.

(4) Compliance with the permissible exposure shall not be achieved by the use of respirators except:

(i) During the time period necessary to install or implement engineering or work practice controls; or

(ii) In work situations in which engineering and work practice controls are not feasible; or

(iii) To supplement engineering and work practice controls when such controls fail to reduce airborne concentrations of boron oxide to at or below the permissible exposure; or

(iv) For operations which require entry into tanks or closed vessels; or

(v) In emergencies.

(5) Where respirators are needed and permitted under this paragraph to reduce employee exposure, the employer shall select and provide the appropriate respirator from Table 2 and shall ensure that the employee uses the respirator provided. When an employee informs his employer that he is experiencing eye irritation from boron oxide while wearing a respirator allowed in Table 2, the employer shall provide and ensure that the employee use an equivalent respirator with a full facepiece, helmet or hood.

TABLE 2 RESPIRATORY PROTECTION FOR BORON OXIDE

CONDITION	PERMISSIBLE RESPIRATORY PROTECTION
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 entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece or 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.

(6) Respirators shall be approved by the Mining Enforcement and Safety Administration (formerly Bureau of Mines) or by the National Institute for Occupational Safety and Health under the provisions of 30 CFR Part 11.

(7) The employer shall institute a respiratory protection program in accordance with § 1910.134(b), (d), (e), and (f).

(e) Fire and safety. The employer shall familiarize himself with the information contained in the Substance Technical Guidelines (Appendix B of this section) for boron oxide.

(f) Personal protective equipment. (1) Employers shall provide and ensure that employees use appropriate protective clothing and equipment necessary to prevent repeated or prolonged skin contact with boron oxide or liquids containing boron oxide. Face shields shall comply with § 1910.133(a)(2),(a)(4), (a)(5), and (a)(6).

(2) Employers shall ensure that non-impervious clothing which becomes contaminated with boron oxide be removed promptly and not reworn until the boron oxide is removed from the clothing.

(3) Employers shall provide and ensure that employees use safety goggles which comply with § 1910.133(a)(2)-(a)(6) where boron oxide or non-aqueous liquids containing boron oxide may contact the eyes.

(g) Spills and disposal. In the event that boron oxide is spilled the employer shall immediately provide available ventilation and then clean up the spill.

(h) Sanitation. (1) Employers shall ensure that employees whose skin becomes contaminated with boron oxide promptly wash or shower with soap or mild detergent and water to remove any boron oxide from the skin.

(2) Employers shall ensure that employees who handle boron oxide or non-aqueous liquids containing boron oxide wash their hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.

(i) Training and information. (1) Each employer who has a workplace in which boron oxide is present shall keep a copy of this regulation with Appendixes A, B and C at the workplace. This material shall be made readily available to affected employees.

(2) Each employer who has employees exposed to boron oxide above the action level without regard to the use of respirators, or employees who may have repeated or prolonged skin contact or who may have eye contact with boron oxide or non-aqueous liquids containing boron oxide, or employees who work where a spill of boron oxide may occur, shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for boron oxide (Appendix A of this section);

(ii) Advise affected employees as to the signs and symptoms of exposure to boron oxide.

(iii) Instruct affected employees to advise the employer of the development of signs and symptoms of overexposure to boron oxide which are listed in Appendix A of the section; and

(iv) Provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to boron oxide.

(j) Medical surveillance. (Reserved.)

(k) RecordKeeping. (1) Exposure determination. (i) The employer shall keep an accurate record of all determinations required to be made pursuant to paragraph (b)(1) of this section.

(ii) This record shall include the written determination required in paragraph (b)(2) of this section.

(iii) This record shall be maintained until replaced by a more recent record.

(2) Exposure measurements. (i) The employer shall keep an accurate record of all measurements taken to determine employee exposure to boron oxide.

(ii) This record shall include:

(A) The date of measurement;

(B) Operations involving exposure to boron oxide which are being monitored;

(C) Sampling and analytical methods used and evidence of their accuracy, including the method, results and date of calibration of sampling equipment;

(D) Number, duration, and results of samples taken; and

(E) Name, social security number and exposure of the employee monitored.

(iii) This record shall be maintained until replaced by a more recent record but in no event for less than one year.

(3) Mechanical ventilation. (i) When mechanical ventilation is used as an engineering control, the employer shall maintain an accurate record of the measurements demonstrating the effectiveness of such ventilation required by paragraph (d)(3)(i) of this section.

(ii) This record shall include:

(A) Date of measurement;

(B) Type of measurement taken;

(C) Result of measurement.

(iii) These records shall be maintained for at least one year.

(4) Employee training and information. (i) The employer shall keep an accurate record of all employee training and information required by paragraph (i) of this section.

(ii) This record shall include:

(A) Date of training;

(B) Name and social security number of employee trained;

(C) Content or scope of training provided.

(iii) This record shall be maintained until replaced by a more recent record.

(5) Access to records. (i) All records required to be maintained by this section shall be made available upon request to authorized representatives of the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health.

(ii) Employee exposure determination and exposure measurement records required to be maintained by this section shall be made available to employees and former employees and their designated representatives.

(iii) Employee medical records required to be maintained by this section shall be made available upon written request to a physician designated by the employee or former employee.

(l) Employee observation of measurement. (1) The employer shall give affected employees or their representatives an opportunity to observe any measurement of employee exposure to boron oxide which is conducted pursuant to this section.

(2) When observation of monitoring of employee exposure to boron oxide requires entry into an area where the use of personal protective devices, including respirators, is required, the observer shall be provided with and required to use such equipment and comply with all other applicable safety procedures.

(3) Without interfering with the measurement, observers shall be entitled to:

(i) Receive an explanation of the measurement procedure.

(ii) Visually observe all steps related to the measurement of the airborne concentration of boron oxide that are being performed at the place of exposure; and

(iii) Record the results obtained.

NOTE: The information contained in the following appendix for boron oxide is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligation. To the extent the information supplements this regulation for boron oxide, it is advisory in nature.

APPENDIX A

SUBSTANCE SAFETY DATA SHEET FOR BORON OXIDE

I. SUBSTANCE IDENTIFICATION

A. Substance: Boron oxide

B. Permissible Exposure: 15 milligrams of boron oxide per cubic meter of air (mg/M3) averaged over an eight-hour work shift.

C. Appearance and Odor: Colorless glassy granules or flakes with no odor

II. HEALTH HAZARD DATA

A. Ways in which the chemical affects your body: Boron oxide can affect your body if you inhale it or if it comes in contact with your eyes or skin. It may also affect your body if you swallow it.

B. Effects of Overexposure:

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

2. Reporting Symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by exposure to boron oxide.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure: If boron oxide or non-aqueous liquids containing boron oxide get into your eyes, wash your eyes immediately with large amounts of water, lifting the lower and upper lids occasionally. If irritation is present after washing, get medical attention immediately.

B. Skin Exposure: If boron oxide or liquids containing boron oxide get on your skin, promptly flush the contaminated skin with water. If boron oxide or liquids containing boron oxide penetrate through your clothing, remove the clothing promptly and flush the skin with water. If irritation is present after washing, get medical attention.

C. Breathing: If you or any other person breathes in large amounts of boron oxide move the exposed person to fresh air at once.

D. 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.

E. Rescue: Move 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 yourself. Understand your emergency rescue procedures and know the locations of the emergency rescue equipment before the need arises.

IV. RESPIRATORS AND PROTECTIVE CLOTHING

A. Respirators: Respirators are not the best way to control exposure to boron oxide. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for non-routine activities or in emergencies. If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a

Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. If you experience difficulty breathing while wearing a respirator, tell your employer.

B. Protective Clothing: You must wear appropriate protective clothing and equipment to prevent repeated or prolonged skin contact with boron oxide or non-aqueous liquids containing boron oxide. Replace or repair impervious clothing that has developed leaks.

C. Eye Protection: You must wear splash-proof safety goggles where non-aqueous liquids containing boron oxide may contact you eyes. You must wear dust-resistant safety goggles where boron oxide may contact your eyes.

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

A. Boron oxide must be stored in tightly closed containers in a well ventilated area.

B. You must promptly remove any non-impervious clothing that becomes contaminated with boron oxide and this clothing must not be reworn until the boron oxide is removed from the clothing.

C. If your skin becomes contaminated with boron oxide, you must promptly wash or shower with soap or mild detergent and water to remove the boron oxide from your skin.

D. If you handle boron oxide or liquids containing boron oxide, you must wash your hands thoroughly with soap or mild detergent and water before eating, smoking or using toilet facilities.

E. Ask your supervisor where boron oxide is used in your work area and for any additional safety and health rules.

VI. ACCESS TO INFORMATION

A. Each year your employer is required to inform you of the information contained in this Substance Safety Data Sheet for boron oxide. In addition, your employer must instruct you in the safe use of boron oxide, emergency procedures, and the correct use of protective equipment.

B. Your employer is required to determine whether you are being exposed to boron oxide. You or your representative have the right to observe employee exposure measurements and to record the results obtained. If your employer determines that you are being overexposed, he is required to inform you of the exposure and the actions which are being taken to reduce your exposure.

C. Your employer is required to keep records of your exposure for at least one year. Your employer is required to make the exposure data available to you upon your request.

NOTE: The information contained in the following appendix for boron oxide is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligation. To the extent

that the information supplements this regulation for boron oxide, it is advisory in nature.

APPENDIX B

SUBSTANCE TECHNICAL GUIDELINES FOR BORON OXIDE

I. PHYSICAL AND CHEMICAL DATA

A. Substance Identification

1. Synonyms: Anhydrous boric acid; boric anhydride; boric oxide
2. Formula: B_2O_3
3. Molecular weight: 69.9

B. Physical Data

1. Boiling point (760 mm Hg): 2550 C (4622 F)
2. Specific gravity (water = 1): 1.84
3. Vapor density (air = 1 at boiling point of boron oxide): Not applicable
4. Melting point: 450 C (842 F) (approximate)
5. Vapor pressure at 20 C (68 F): Essentially zero
6. Solubility in water, % by weight at 20 C (68 F): 2.77
7. Evaporation rate (butyl acetate = 1): Not applicable
8. Appearance and odor: Colorless glassy granules or flakes with no odor

II. FIRE, EXPLOSION AND REACTIVITY HAZARD DATA

A. Fire

1. Not combustible

B. Reactivity

1. Conditions contributing to instability: None
2. Incompatibilites: None.
3. Hazardous decomposition products: None.
4. Special precautions: None.

III. SPILL AND DISPOSAL PROCEDURES

A. 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.

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

C. Waste disposal methods: Boron oxide may be disposed in sealed containers in a secured sanitary landfill.

IV. MONITORING AND MEASUREMENT PROCEDURES

A. EXPOSURE ABOVE THE ACTION LEVEL: Measurements taken for the purpose of determining employee exposure under this section

are best taken such that the eight-hour exposure may be determined from a single eight-hour sample or 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). Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR part 84, portable direct-reading instruments, dosimeters, or by collection of particulates using a high efficiency membrane filter with subsequent chemical analysis. The method of measurement must determine the concentration of boron oxide to plus or minus 35%.

B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring and measurements under this section should be essentially the same as described under paragraph IV. A. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association. The method of measurement must determine the concentration of boron oxide to plus or minus 25%.

C. METHODS: Methods meeting these accuracy requirements are available from the National Technical Information Service, U. S. Department of Commerce, Springfield, Virginia 22161 under the title "NIOSH Analytical Methods for Set S" (Order number XXXXXXXXXX).

D. QUALIFIED PERSONS: Since many of the duties relating to employee protection are dependent on the results of monitoring and measuring procedures, employers should assure that the evaluation of employee exposures is performed by a competent industrial hygienist or other technically qualified person.

V. MISCELLANEOUS PRECAUTIONS

A. Store boron oxide in tightly closed containers in a well ventilated area.

B. Employers should advise employees of all areas and operations where their exposure to boron oxide could occur.

VI. COMMON OPERATIONS

Common operations in which exposure to boron oxide is likely to occur are: During its production and its use in the manufacture of herbicides, ceramics, fluxes, surface coatings, glass manufacture; and in metallurgical operations.

NOTE: The information contained in the following appendix for boron oxide is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligations. To the extent the information supplements this regulation for boron oxide, it is advisory in nature.

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for BORON OXIDE

APPENDIX C - MEDICAL SURVEILLANCE GUIDELINES

I. ROUTE OF ENTRY

Inhalation.

II. 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.

III. SIGNS AND SYMPTOMS

By analogy to effects caused in animals, prolonged exposure may cause nasal irritation; dust in the eyes may cause conjunctivitis and on the skin, erythema.

IV. SPECIAL TESTS

None in common usage.

V. TREATMENT

Remove from exposure. Promptly flush eyes with water and wash skin with soap or mild detergent and water.

VI. SURVEILLANCE AND PREVENTIVE CONSIDERATIONS

A. GENERAL

Boron oxide is of low toxicity but may cause eye and skin irritation.

B. PREPLACEMENT

None required.

C. PERIODIC EXAMINATIONS

None required.

VII. REFERENCES

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for BORON OXIDE

1. American Conference of Governmental Industrial Hygienists: "Boron Oxide," Documentation of the Threshold Limit Values for Substances in Workroom Air (3d ed., 2d printing), Cincinnati, 1974, p. 26.

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

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for BORON OXIDE

REFERENCES AND SOURCES
BORON OXIDE
1910.1000

(f) Personal Protective Equipment, and, (h) Sanitation

Eye: Grant, "Toxicology of the Eye;" "Documentation of the Threshold Limit Values for Substances in Workroom Air," ACGIH; Deichmann and Gerarde, "Toxicology of Drugs and Chemicals;" Encyclopedia of Occupational Health and Safety," International Labour Office

Skin: Sax, "Dangerous Properties of Industrial Materials;" "Documentation of the Threshold Limit Values for Substances in Workroom Air," ACGIH; Deichmann and Gerarde, "Toxicology of Drugs and Chemicals;" "Encyclopedia of Occupational Health and Safety," International Labour Office

Ingestion: "Documentation of the Threshold Limit Values for Substances in Workroom Air," ACGIH; Deichmann and Gerarde, "Toxicology of Drugs and Chemicals;" "Encyclopedia of Occupation Health and Safety," International Labour Office

COMMENTS

Eye - Classifications: 2 and 6
Output statement numbers: 10 and 12 combined
Exceptions: None

Grant reports that "boron oxide tested on rabbit eyes in the form of a dust has been found to cause almost immediate irritation of the conjunctiva. However, this substance appears to pose no practical problem as an atmospheric contaminant." The Documentation of TLV's agrees with Grant but adds that "these effects are probably the result of the exothermic reaction of boron oxide with water." Deichmann and Gerarde state that a product of reaction is boric acid, as does the ILO.

Classifications of 2 and 6 are concluded to be most appropriate.

Skin - Classification: 2 and 6
Output statement numbers: 2, 17g, 17i, 20a
Exceptions: None

Sax lists the chronic systemic effects of skin absorption to be of moderate toxic hazard for boron compounds in general. He adds that boron is one of a group of elements, such as lead, manganese and arsenic, which affects the central nervous system.

The Documentation of TLV's reports that "topical application of boron oxide dust to the clipped backs of rabbits resulted in erythema persisting for several days." Deichmann and Gerarde add that irritation is due to conversion of the oxide to boric acid.

The ILO reports that "prolonged absorption of boron oxide leads to loss of weight, dysproteinaemia, carbohydrate metabolis disorders, moderate changes of the liver and kidneys, and vascular disorders."

Boron oxide has a melting point of 842 degrees F. It is 2.77% soluble in water.

Classifications of 2 and 6 are concluded to be most appropriate for this substance, however statements 5b and 7a are not considered to be necessary.

Ingestion - Classification: 0
Output statement numbers: None
Exceptions: None

The Documentation of TLV's reports that "intragastric intubation of a 10% slurry of boron oxide in water to rats for three weeks did not cause retardation of growth or other observable effects; however, rats refused to drink water containing 1 to 1.5% boron oxide, and consequently lost weight."

Deichmann and Gerarde state that boron oxide has a low order of toxicity by ingestion. The ILO notes that its LD50 for laboratory animals is 3.16 g/kg.

Ingestion, in the context of this standard, does not appear to present a hazard in the industrial environment. The substance is, therefore, assigned a classification of zero.

SUBSTANCE TECHNICAL GUIDELINES

The references cited for this document include:

Stauffer Chemical Co., Technical Bulletin and Product Safety Information (Stauff)

"Encyclopedia of Occupational Health and Safety," International Labour Offic

Sources of data items used:

I. A. 1. Synonyms: Stauff
2. Formula: Stauff
3. Molecular weight: Stauff

B. 1. Boiling point: ILO
2. Specific gravity: Stauff
3. Vapor density: Not applicable
4. Melting point: Stauff
5. Vapor pressure: ADL
6. Solubility in water: Stauff
7. Evaporation rate: Not applicable
8. Appearance and odor: Stauff

II. A. 1. Flash point: Not combustible

B. 1. Conditions contributing to instability: ADL
2. Incompatibilities: None
3. Hazardous decomposition products: None
4. Special precautions: None

III. A. Steps if released or spilled: ADL

C. Waste disposal method: ADL

V. Miscellaneous precautions: Stauff

USE/EXPOSURE AND CONTROL DOCUMENT

References used in the preparation of this document include:

Hawley, G. G., "The Condensed Chemical Dictionary," 8th edition, Van Nostrand, 1971 (Hawley)

Kirk, R. and Othmer, D. "Encyclopedia of Chemical Technology," Interscience Publishers, Division of John Wiley, 2nd edition, 1972 (K-O)

Sax, N. I., "Dangerous Properties of Industrial Minerals," 3rd edition, Van Nostrand, 1968 (Sax)

References for Specific Use/Exposure

NIOSH/OSHA Draft Technical Standard
and Supporting Documentation for BORON OXIDE

1. K-O
2. K-O, Hawley
3. ADL estimate
4. Sax, Hawley
5. Hawley, K-O

References for Specific Control Methods

ADL estimate was the reference used in all the Specific Control Methods.

RESPIRATOR TABLE DOCUMENTATION

SUBSTANCE: Boron oxide

D. O. L. STANDARD: 15 mg/M3

Eye Irritation Level: 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."

For the purposes of this standard, quarter- and half-facepiece respirators are permitted up to 150 mg/M3 (PF = 10), unless eye irritation occurs. If eye irritation occurs, a full facepiece respirator must be worn.

IDLH: There is no evidence in the available toxicological information that an acute exposure to a high concentration of boron oxide would impede escape or cause any irreversible health effects within one-half hour. For the purposes of this standard, therefore, respirators have been assigned on the basis of the protection factor afforded by each device. It is recognized, however, that for some substances for which there does not appear to exist a concentration immediately dangerous to life and health, the determination of allowable respiratory protection based on protection factors may result in the selection of a concentration which is not likely to be encountered in the occupational environment. Therefore, for all such particulate substances it has been arbitrarily determined that only those respirators allowed for use above IDLH concentrations are permitted for use in concentrations exceeding 500 times the permissible exposure.

Other Toxicological Information: The ILO states that boron oxide "has a lower order of toxicity either by inhalation of ingestion, with an LD50 for laboratory animals of 3.16 g/kg. It has an irritant effect on the skin and mucous membranes of the eyes of rabbits. Prolonged absorption leads to loss of weight, dysproteinaemia, carbohydrate metabolism disorders, moderate changes of the liver and kidneys, and vascular disorders."

The Documentation of TLV's states that "Wilding and co-workers exposed rats for six hours a day, five days a week to aerosols of boron oxide at concentrations of 470 mg/M3 for ten weeks, 175 mg/M3 for 12 weeks, and at 77 mg/M3 for 24 weeks; in addition dogs were exposed at 57 mg/M3 for 23 weeks. The mass-median diameters of the particles were 1.9 to 2.5 u. There were no deaths or other signs of intoxication other than mild nasal irritation in the exposures at 470 mg/M3. In dogs exposed at 57 mg/M3, the urine was greater in volume and in acidity; there was also an increase in creatinine coefficient . . .

"In view of the very low toxicity of boron oxide aerosols, a threshold limit value of 10 mg/M3 is recommended."

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USE/EXPOSURE AND CONTROL DOCUMENT
BORON OXIDE

	Use/Exposure	Principal Route of Entry	Currently Used Control Methods
1.	Inhalation of dust or vapor during metallurgical operations (including manufacture of metal borates, borides, master alloys, boron and preparation of fluxes)	A	Process enclosure; local exh ventilation; personal protec equipment (respiratory prote tive devices)
2.	Inhalation of dust and vapor during glass manufacture (including heat-resistant glassware)	A	Process enclosure; local exh ventilation; personal protec equipment (respiratory prote tive devices)
3.	Inhalation of dust during synthesis and handling of substance	A	Process enclosure; local exh ventilation; personal protec equipment (respiratory prote tive devices)
4.	Inhalation of dust and vapor during preparation and handling of herbicide	A	Process enclosure; local exh ventilation; personal protec equipment (respiratory prote tive devices)
5.	Inhalation of dust during production of surface coatings (including use as a fire - resistant additive in paints and in specialty enamels)	A	Process enclosure; local exh ventilation; personal protec equipment (respiratory prote tive devices)

A -- Inhalation
B -- Skin and eye contact resulting in localized irritation
C -- Ingestion
D -- Skin contact resulting in absorption and subsequent systemic poisoning

------ JES2 JOB STATISTICS ------

921 CARDS READ

0 SYSOUT PRINT RECORDS

0 SYSOUT PUNCH RECORDS

0.00 MINUTES EXECUTION TIME

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*** JES2 NJE *A*    FWMMITS  OSH      JOB 1204     END     PRINTER8   MITS-PERIF-0205     2.43.01
*** JES2 NJE *A*    FWMMITS  OSH      JOB 1204     END     PRINTER8   MITS-PERIF-0205     2.43.01
*** JES2 NJE *A*    FWMMITS  OSH      JOB 1204     END     PRINTER8   MITS-PERIF-0205     2.43.01
*** JES2 NJE *A*    FWMMITS  OSH      JOB 1204     END     PRINTER8   MITS-PERIF-0205     2.43.01
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*** JES2 NJE *A*    FWMMITS  OSH      JOB 1204     END     PRINTER8   MITS-PERIF-0205     2.43.01
*** JES2 NJE *A*    FWMMITS  OSH      JOB 1204     END     PRINTER8   MITS-PERIF-0205     2.43.01
*** JES2 NJE *A*    FWMMITS  OSH      JOB 1204     END     PRINTER8   MITS-PERIF-0205     2.43.01
*** JES2 NJE *A*    FWMMITS  OSH      JOB 1204     END     PRINTER8   MITS-PERIF-0205     2.43.01
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*** JES2 NJE *A*    FWMMITS  OSH      JOB 1204     END     PRINTER8   MITS-PERIF-0205     2.43.01
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