

NIOSH

CRITERIA FOR A
RECOMMENDED STANDARD.....

OCCUPATIONAL
EXPOSURE TO

ANTIMONY

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health



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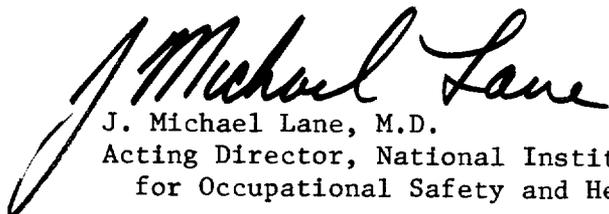
PREFACE

The Occupational Safety and Health Act of 1970 emphasizes the need for standards to protect the health and provide for the safety of workers occupationally exposed to an ever-increasing number of potential hazards. The National Institute for Occupational Safety and Health (NIOSH) evaluates all available research data and criteria and recommends standards for occupational exposure. The Secretary of Labor will weigh these recommendations along with other considerations, such as feasibility and means of implementation, in promulgating regulatory standards.

NIOSH will periodically review the recommended standards to ensure continuing protection of workers and will make successive reports as new research and epidemiologic studies are completed and as sampling and analytical methods are developed.

The contributions to this document on antimony by NIOSH staff, other Federal agencies or departments, the review consultants, the reviewers selected by the American Industrial Hygiene Association and the American Medical Association, and Robert B. O'Connor, M.D., NIOSH consultant in occupational medicine, are gratefully acknowledged.

The views and conclusions expressed in this document, together with the recommendations for a standard, are those of NIOSH. They are not necessarily those of the consultants, the reviewers selected by professional societies, or other Federal agencies. However, all comments, whether or not incorporated, were considered carefully and were sent with the criteria document to the Occupational Safety and Health Administration for consideration in setting the standard. The review consultants and the Federal agencies which received the document for review appear on pages v, vi, and vii.


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The Division of Criteria Documentation and Standards Development (DCDSD), National Institute for Occupational Safety and Health, had primary responsibility for development of the criteria and recommended standard for antimony. Allan S. Susten, Ph.D., served as criteria manager during the initial development and Barbara L. Wilkes during the final development of this criteria document. The DCDSD review was provided by Douglas L. Smith, Ph.D. (Chairman), Paul E. Caplan, and Keith H. Jacobson, Ph.D., with Carl Zenz, M.D.

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I. RECOMMENDATIONS FOR AN ANTIMONY STANDARD

NIOSH recommends that employee exposure to antimony and its compounds in the workplace be controlled by compliance with the following sections. The recommended standard is designed to protect the health and provide for the safety of employees for up to a 10-hour workshift, 40-hour workweek, over a working lifetime. Compliance with all sections of the recommended standard should prevent adverse effects of antimony or antimony compounds on the health of employees and provide for their safety. The standard is measurable by techniques that are reproducible and available to industry and government agencies. Sufficient technology exists to permit compliance with the recommended standard. Although NIOSH considers the workplace environmental limit to be safe based on current information, employers should regard it as the upper boundary of exposure and make every effort to maintain exposure as low as is technically feasible. The criteria and recommended standard will be reviewed and revised as necessary.

"Antimony" refers to elemental antimony and all antimony compounds except the gas stibine (SbH_3). Stibine is excluded from the standard because it evolves as a byproduct of operations involving other sources of antimony. The "action level" is defined as one-half the appropriate recommended time-weighted average (TWA) concentration limit. "Occupational exposure to antimony" is defined as exposure to antimony at a concentration greater than one-half the recommended environmental limit. Exposures to airborne antimony concentrations equal to or less than one-half the TWA workplace environmental limit, as determined in accordance with Section 8(a), will require adherence to all sections of the recommended standard except Sections 2(b), 4(c), 8(b), and the monitoring provisions of 8(c). If exposure to other chemicals occurs (for example, from contamination of antimony with arsenic or free silica), provisions of any applicable standards for the other chemicals shall also be followed.

The recommended environmental limit is based on data which indicate that exposure to antimony may cause cardiac and respiratory changes and irritation of the skin and mucous membranes. Compliance with the following sections should provide worker protection from these hazards. Some data on antimony workers raise the possibilities of reproductive and carcinogenic effects; however, these hazards ascribed to antimony have not been confirmed.

Section 1 - Environmental (Workplace Air)

(a) Concentrations

Exposure to antimony shall be controlled so that employees are not exposed to antimony at a concentration greater than 0.5 milligram per cubic meter of air (0.5 mg/cu m), determined as a time-weighted average concentration limit for up to a 10-hour workshift in a 40-hour workweek.

(b) Sampling and Analysis

Environmental samples shall be collected and analyzed for antimony as described in Appendices I and II or by any methods at least equivalent in accuracy, precision, and sensitivity.

Section 2 - Medical

Medical surveillance as outlined below shall be made available to workers subject to exposure to antimony.

(a) Preplacement examinations shall include at least:

(1) Comprehensive medical and work histories, with special emphasis directed to skin, respiratory, cardiac, and reproductive systems.

(2) Comprehensive physical examinations, with particular attention to the skin, mucous membranes, and pulmonary and cardiac systems.

(3) Clinical tests including a 14- x 17-inch postero-anterior chest roentgenogram, electrocardiogram, and pulmonary function tests including forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV1).

(4) A judgment of the employee's ability to use positive and negative pressure respirators.

(b) Periodic examinations shall be made available at least annually. These examinations shall include at least:

(1) Interim medical and work histories.

(2) A physical examination and tests as outlined in paragraphs (a)(2) and (a)(3) of this section.

(c) During or after examinations, applicants or employees having medical conditions such as dermatitis or pulmonary disease that would be directly or indirectly aggravated by exposure to antimony shall be counseled on the increased risk of impairment of their health from working with these materials. In addition, employees shall be advised that one report has indicated possible hazards to reproduction in both humans and animals due to antimony exposure.

(d) Pertinent medical records shall be maintained for all employees exposed to antimony and shall be kept for at least 30 years after the last work-related exposure to antimony. Records of environmental exposures applicable to an employee shall be included in that employee's medical records. These records and copies, if requested, shall be made available to the designated medical representatives of the Secretary of Health, Education, and Welfare, of the Secretary of Labor, of the employer, and of the employee or former employee.

Section 3 - Labeling and Posting

All warning signs shall be printed both in English and in the predominant language of non-English-reading workers. Workers unable to read the labels and signs provided shall receive information regarding hazardous areas and shall be informed of the instructions printed on labels and signs.

(a) Labeling

Containers of antimony compounds shall carry labels that bear the trade names of the products, the chemical name(s) of the compound(s) contained therein, and information on the effects of the particular product(s) on human health. The trade names and pertinent information shall be arranged as in the following examples.

For Antimony Oxides and Sulfides:

TRADE NAME
(CHEMICAL NAME)
MAY BE HARMFUL IF INHALED OR SWALLOWED
MAY CAUSE SKIN AND RESPIRATORY TRACT IRRITATION

Do not get in eyes, on skin, on clothing.
Avoid breathing dust, fume, vapor.

For Antimony Halides:

TRADE NAME
(CHEMICAL NAME)
DANGER
CAUSES SEVERE BURNS
VAPOR HAZARDOUS

Do not get in eyes, on skin, on clothing.
Do not breathe vapor.
Keep container closed.

Immediately flush with copious amounts of water and remove contaminated clothing. For eyes, get medical attention. Wash contaminated clothing before reuse.

(b) Posting

Readily visible signs containing information on the effects of antimony on human health shall be posted in work areas and at entrances to work areas or building enclosures where antimony is present. Warnings shall follow these examples:

For Antimony Oxides and Sulfides:

TRADE NAME
(CHEMICAL NAME)
MAY BE HARMFUL IF INHALED OR SWALLOWED
MAY CAUSE SKIN AND RESPIRATORY TRACT IRRITATION

Avoid breathing or swallowing dust.
Work with adequate ventilation.
Wash hands thoroughly after handling, and before eating or smoking.
Keep skin clean to avoid irritation.

For Antimony Halides:

TRADE NAME
(CHEMICAL NAME)
DANGER
SEVERE INHALATION, SKIN, AND EYE HAZARD
CAUSES BURNS
DO NOT BREATHE DUST, FUME, OR VAPOR
DO NOT GET IN EYES, ON SKIN, OR ON CLOTHING

In case of contact, immediately flush skin or eyes with copious amounts of water and remove contaminated clothing. For eyes, get medical attention. Wash clothing before reuse.

Section 4 - Personal Protective Clothing and Equipment

(a) Protective Clothing

(1) Work and protective clothing appropriate for the work situation shall be provided by the employer. This may include underwear, cloth or calfskin gloves, coveralls or long-sleeved shirts and trousers, and head and neck protection. When antimony halides are being processed in a manner that may result in skin contact, gloves with gauntlets and aprons made of rubber or other material resistant to penetration by antimony halides shall be used. The employer shall ensure that appropriate clothing is worn by every employee.

(2) The employer shall ensure that a change of clothing is immediately available to any employee whose clothes become grossly contaminated or lose their protective quality.

(3) If protective clothing becomes grossly contaminated, or in the case of halides, if the resistant material is penetrated, this clothing must be removed immediately and not be reworn until the antimony compound is removed.

(4) Protective clothing shall be changed at least daily at the end of the shift.

(5) Contaminated clothing must be stored in closed containers until washed or discarded.

(6) The employer shall inform persons involved in laundering or handling the contaminated clothing of the hazardous properties of the contaminant.

(b) Eye and Face Protection

(1) Chemical safety goggles meeting the requirements listed in 29 CFR 1910.133 and ANSI Z87.1-1968 shall be provided by the employer and shall be worn during any operation in which there is a reasonable possibility of antimony entering the eyes.

(2) Where antimony halides may contact the eyes, employers shall provide an eye wash fountain or other source of water within the immediate work area for flushing the eyes in an emergency.

(c) Respiratory Protection

(1) Engineering controls shall be used when needed to keep concentrations of airborne antimony at or below the environmental limit. Compliance with this standard by the use of respirators is permitted only during installation and testing of engineering controls, during performance of nonroutine maintenance or repair, or during emergencies.

(2) When a respirator is permitted, it shall be selected and used in accordance with the following requirements:

(A) The employer shall establish and enforce a respiratory protective program meeting the requirements of 29 CFR 1910.134.

(B) The employer shall provide respirators in accordance with Table I-1 and shall ensure that, when needed, employees use the respirators provided. The respiratory protective devices provided shall be those approved by NIOSH and the Mine Safety and Health Administration (MSHA). Initial selection and assignment of negative pressure respirators shall be made on the basis of qualitative or quantitative facepiece fit tests. The employer shall ensure that respirators are properly cleaned, maintained, and stored when not in use.

(3) Respirators specified for use in higher airborne concentrations of antimony may be used in atmospheres of lower concentrations.

(4) The employer shall ensure that employees are properly instructed in the use of respirators assigned to them and in ways to test for leakage, proper fit, and proper operation.

(d) The employer shall perform a routine periodic check of all personal protective equipment to maintain it in a safe state of repair and shall store it properly to prevent damage by heat, degrading chemicals, or other harmful agents.

TABLE I-1

RESPIRATOR SELECTION GUIDE FOR PROTECTION AGAINST ANTIMONY

Dust Concentration	Respirator Type Approved Under 30 CFR 11
Less than or equal to 5 mg/cu m	(1) Half-mask respirator with replaceable high efficiency filter(s)* (2) Type C supplied-air respirator, demand type (negative pressure) with half-mask facepiece**
Less than or equal to 25 mg/cu m	(1) Full facepiece respirator with replaceable high efficiency filter(s) (2) Type C supplied-air respirator, demand type (negative pressure) with full facepiece (3) Self-contained breathing apparatus in demand mode (negative pressure) with full facepiece
Less than or equal to 500 mg/cu m	Powered air-purifying (positive pressure) respirator with high efficiency filter(s)
Greater than 500 mg/cu m	(1) Self-contained breathing apparatus with positive pressure in full facepiece (2) Combination supplied-air respirator, pressure demand type with auxiliary self-contained air supply
For antimony halides:	
No concentration limit	(1) Self-contained breathing apparatus with positive pressure in full facepiece (2) Combination supplied-air respirator, pressure demand type with auxiliary self-contained air supply

*A high-efficiency filter is a filter having an efficiency of at least 99.97% against 0.3 μ m dioctyl phthalate.

**If eye irritation occurs with half-mask, a full facepiece respirator should be worn.

Section 5 - Informing Employees of Hazards from Antimony

(a) All new and current employees working with antimony shall be informed of the hazards, relevant signs and symptoms of overexposure, appropriate emergency procedures (including first aid), and proper conditions and precautions concerning safe use and handling of the hazardous material(s). Employees shall be informed, preferably by medical personnel, that antimony can irritate the skin and mucous membranes, cause respiratory and cardiac changes, and possibly cause reproductive problems.

(b) The employer shall institute a continuing education program, conducted by persons qualified by experience or training, to ensure that all employees have current knowledge of job hazards, preventive sanitation and work practices, proper maintenance and cleanup methods, and proper use of personal protective equipment. The instructional program shall include a description of the general nature of the environmental and medical surveillance procedures and of the advantage to the employee of participating in these surveillance procedures. Educational programs for employees engaged in maintenance and repair shall include instruction on those work situations in which they will be exposed to antimony.

(c) Instructional material in written or published form shall be kept on file at each establishment or department where employees are exposed to antimony. Each employee shall be informed of the availability of the required information, which shall include, as a minimum, that prescribed in Appendix III.

(d) Required information shall be recorded on the "Material Safety Data Sheet" shown in Appendix III or on a similar form approved by the Occupational Safety and Health Administration, US Department of Labor, and shall be kept on file, readily accessible to employees.

Section 6 - Work Practices

(a) Engineering controls shall be used wherever needed to keep concentrations of airborne antimony within the recommended environmental limit. Ventilation systems shall be designed to prevent the entry, accumulation, or recirculation of these materials in the breathing zones of employees.

(b) Exhaust ventilation systems discharging to the outside air shall conform to applicable local, state, and Federal air pollution regulations.

(c) Ventilation systems shall be subject to regular preventive maintenance and cleaning to ensure their continuing effectiveness. Continuous airflow indicators, such as appropriately mounted and calibrated water or oil manometers (marked to indicate acceptable airflow), are recommended and should be checked frequently and recorded at least quarterly. If such indicators are not used, the efficiency of the ventilation system should be verified by airflow measurements taken at intervals determined by the documented maintenance history of the system.

(d) Procedures for emergencies shall be established. Necessary emergency equipment, including appropriate respiratory protective devices, shall be kept in readily accessible locations.

(e) Where there is possibility of skin contact with antimony halides, employers shall provide facilities for quick drenching of the body within the immediate work area. Eye wash facilities shall also be conveniently located.

(f) Where antimony dust accumulates on work surfaces, it shall be removed by vacuum cleaning or wet methods. Cleaning may be performed by washing down

with a hose, provided that a fine spray of water has first been laid down. Sweeping or other methods which can stir the dust into the air shall not be used.

(g) Waste materials contaminated with antimony shall be disposed of in a safe manner. The disposal method must conform to applicable local, state, and Federal regulations.

(h) Antimony compounds shall be stored so as to minimize exposures due to accidental leaks and spills. Storage areas must be cool, dry, well ventilated, and protected from sunlight. Antimony halides must be stored in glass carboys protected by wooden frames. Storage areas for halides must be isolated from manufacturing or production areas.

Section 7 - Sanitation Practices

(a) The pertinent requirements for plant sanitation, stated in 29 CFR 1910.141, shall be complied with. The subsections entitled General (a), Toilet Facilities (c), Washing Facilities (d), Change Rooms (e), and Consumption of Food and Beverages on the Premises (g) are especially relevant to antimony.

(b) Employees exposed to antimony shall be provided with separate lockers or other storage facilities for street clothes and for work clothes.

(c) Employees exposed to antimony shall not wear work clothing away from the plant.

(d) Showers shall be provided for employees exposed to antimony. Workers shall shower before changing into street clothes.

(e) If accidental skin contact with antimony halides occurs, the exposed worker shall shower immediately.

(f) Employees shall wash their hands and mouths before eating or smoking during the workshift.

(g) No smoking or food shall be permitted in areas where antimony is present.

Section 8 - Environmental Monitoring and Recordkeeping

(a) Industrial Hygiene Surveys

After the promulgation of a standard based on these recommendations, employers shall determine by an industrial hygiene survey whether exposure to airborne antimony is in excess of the action level. Records of these surveys shall be retained until the next survey has been completed. If an employer concludes that there is no occupational exposure to antimony, the records shall show the basis for this conclusion. Surveys shall be repeated at least annually and within 14 days after any process change likely to result in occupational exposure to antimony.

(b) Personal Monitoring

If it has been determined that occupational exposure to antimony occurs, the employer shall institute environmental monitoring.

(1) A program of personal monitoring shall be instituted to identify and measure, or to permit calculation of, the exposure of each employee. Source and area monitoring may be used to supplement personal monitoring.

(2) In all personal monitoring, samples representative of exposure in breathing zones of the employees shall be collected.

(3) For each determination of the concentration of antimony, a sufficient number of samples shall be taken to characterize the employee's work and production schedules, location, and duties. Changes in production schedules shall be considered in deciding when samples are to be collected.

(4) Each operation shall be sampled at least once every 6 months. For intermittent operations, ie, those lasting less than 6 months, at least one monitoring regimen shall be conducted during each operation period, and monitoring should coincide with the periods of maximum potential exposure to antimony during these intermittent operations.

(5) If an employee is found to be exposed to antimony at concentrations exceeding the recommended TWA concentration limit, control measures shall be initiated, the exposure of that employee shall be measured at least once every week, and the employee shall be notified of the exposure and of the control measures being implemented. Such monitoring shall continue until two consecutive determinations, at least 1 week apart, indicate that the control measures have been effective and that the employee's exposure no longer exceeds the recommended exposure limit; routine semiannual monitoring may then be resumed.

(c) Recordkeeping

Records of environmental monitoring and other pertinent records shall be kept for at least 30 years after the employee's last work-related exposure to antimony. Records of environmental monitoring shall include an identification of the employee being monitored, duties and job locations within the worksite, time and dates of sampling and analysis, sampling and analytical methods used and available evidence of their precision and accuracy, the number, duration, and results of samples taken, TWA concentrations determined from these samples, and the type of personal protective equipment used by the employee. Employees shall have access to data on their environmental exposures and be permitted to obtain copies of the data. Records shall be made available to the designated representatives of the Secretary of Labor, of the Secretary of Health, Education, and Welfare, of the employer, and of the employee or former employee.

II. INTRODUCTION

This report presents the criteria and the recommended standard based thereon that were prepared to meet the need for preventing occupational disease or injury arising from exposure to antimony, excluding stibine. The criteria document fulfills the responsibility of the Secretary of Health, Education, and Welfare, under Section 20(a)(3) of the Occupational Safety and Health Act of 1970, to "develop criteria dealing with toxic materials and harmful physical agents and substances which will describe...exposure levels at which no employee will suffer impaired health or functional capacities or diminished life expectancy as a result of his work experience."

After reviewing data and consulting with others, NIOSH formalized a system for the development of criteria on which standards can be established to protect the health and provide for the safety of workers from exposure to hazardous chemical and physical agents. The criteria and recommended standard should enable management and labor to develop better engineering controls and more healthful work practices, and simply complying with the recommended environmental limit should not be the final goal.

These criteria for a recommended standard for antimony are part of a continuing series of documents developed by NIOSH. The proposed standard applies only to workplace exposure to antimony arising from the processing, manufacture, handling, and use of antimony. The standard is not designed for the population-at-large, and any extrapolation beyond the occupational environment is not warranted. It is intended to (1) protect workers against the adverse effects of exposure to antimony especially on the heart, lungs, and skin, (2) be measurable by techniques that are valid, reproducible, and available to industry and government agencies, and (3) be attainable with existing technology.

The major hazards associated with occupational exposure to antimony are cardiac changes, respiratory changes including pneumoconiosis, and irritation of the skin and mucous membranes. One study suggested that antimony exposure may exert an adverse effect on reproductive capacity. The possibility also has been raised that antimony exposure may increase the risk of lung cancer. The carcinogenic, mutagenic, and teratogenic potentials of antimony compounds, along with possible effects of antimony on reproduction, remain to be determined.