

OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR ANTIMONY AND ITS COMPOUNDS (as Sb)

INTRODUCTION

"Antimony" is defined as elemental antimony and all antimony compounds with the exception of the gas stibine. This guideline summarizes pertinent information about antimony and its compounds for workers, employers, and occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs. Recommendations may be superseded by new developments in these fields; therefore, readers are advised to regard these recommendations as general guidelines.

SUBSTANCE IDENTIFICATION

- **Formula:** Sb
- **Synonyms:** Antimony regulus, stibium
- **Identifiers:** CAS 7440-36-0; RTECS CC402500; DOT 2871, label required: "St. Andrew's Cross (X)"
- **Appearance:** Silvery, white solid

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data for elemental antimony

1. Molecular weight: 121.75
2. Boiling point (at 760 mmHg): 1,635°C (2,975°F)
3. Specific gravity (water = 1): 6.68
4. Melting point: 630.5°C (1,116.9°F)
5. Insoluble in water

• Reactivity

Incompatibilities: Oxidizing materials and acids, especially halogenated acids, can react with antimony and alloys containing antimony to produce stibine gas (antimony hydride), which is more toxic than the antimony metal alone.

• Flammability

1. Extinguishant: Dry graphite, sodium chloride, or potassium chloride
2. Antimony is combustible in powder form or by chemical reaction with nitrates or halogenated compounds.

• Warning properties

Evaluation of warning properties for respirator selection: Based on lack of information on the odor threshold and eye irritation

levels, antimony should be considered to have poor warning properties.

EXPOSURE LIMITS

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for antimony and its compounds (as Sb) is 0.5 milligrams per cubic meter of air (mg/m^3) as a time-weighted average (TWA) concentration over an 8-hour workshift. The National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit (REL) for antimony and its compounds (as Sb) is 0.5 mg/m^3 as a TWA for up to a 10-hour workshift, 40-hour workweek. The American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV[®]) is 0.5 mg/m^3 as a TWA for a normal 8-hour workday and a 40-hour workweek for antimony and its compounds (as Sb) including antimony trioxide during handling and use. The ACGIH has given antimony trioxide production an A2 designation (an A2 substance is a suspected human carcinogen) without having sufficient evidence to assign a TLV (Table 1).

Table 1.—Occupational exposure limits for antimony and its compounds

	Antimony and compounds (as Sb), mg/m^3	Antimony trioxide production, mg/m^3
OSHA PEL TWA	0.5	—
NIOSH REL TWA	0.5	—
ACGIH TLV [®] TWA	0.5	(A2)*

* (A2): Suspected human carcinogen.

HEALTH HAZARD INFORMATION

• Routes of exposure

Antimony may cause adverse health effects following exposure via inhalation, ingestion, or dermal or eye contact.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health
Division of Standards Development and Technology Transfer

- **Summary of toxicology**

1. *Effects on animals:* Intraperitoneal injection of antimony or its compounds into rats produced an increase in blood eosinophil count, acute congestion of the heart, liver, and kidneys, and death (due to heart failure). Subchronic inhalation of antimony trisulfide by rats and rabbits caused degeneration of the heart muscle and changes in electrocardiograms; subcutaneous injections in rats caused fatty degeneration of the liver and swelling of kidney tubules. Chronic inhalation of antimony trioxide by guinea pigs, rats, or rabbits produced extensive lung inflammation, decreased white blood cell and eosinophil counts, enlargement of splenic follicles, and fatty degeneration of the liver.

2. *Effects on humans:* Exposure of workers to antimony trichloride, antimony trisulfide, or antimony trioxide has caused fibrosis of the lungs (pneumoconiosis), electrocardiogram changes, heart muscle changes, and death due to heart disease. Increased rates of spontaneous late abortions, premature births, and gynecologic problems have been reported for female metallurgical workers exposed to antimony trioxide, antimony pentasulfide, or metallic dust.

- **Signs and symptoms of exposure**

1. *Short-term (acute):* Exposure to antimony and its compounds can cause gastrointestinal pain, cough, loss of appetite, itching, skin eruptions, and irritation of the skin, eyes, nose, and throat.

2. *Long-term (chronic):* Exposure to antimony and its compounds can cause headache, sleeplessness, dizziness, metallic taste, ulcers, weight loss, nausea, vomiting, diarrhea, impairment of sense of smell, and pain or tightness in the chest.

RECOMMENDED MEDICAL PRACTICES

- **Medical surveillance program**

Workers with potential exposures to chemical hazards should be monitored in a systematic program of medical surveillance intended to prevent or control occupational injury and disease. The program should include the education of employers and workers about work-related hazards, placement of workers in jobs that do not jeopardize their safety and health, earliest possible detection of adverse health effects, and referral of workers for diagnostic confirmation and treatment. The occurrence of disease (a "sentinel health event," SHE) or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e.g., industrial hygiene monitoring, engineering controls, and personal protective equipment). A medical surveillance program is intended to supplement, not replace, such measures.

A medical surveillance program should include the systematic collection and epidemiologic analysis of relevant environmental and biologic monitoring, medical screening, morbidity, and mortality data. This analysis may provide information about the relatedness of adverse health effects and occupational exposure that cannot be discerned from results in individual workers. Sensitivity, specificity, and predictive values of biologic monitoring and medical screening tests should be evaluated on an industry-wide basis prior to application in any given worker group. Intrinsic to a surveillance program is the dis-

semination of summary data to those who need to know, including employers, occupational health professionals, potentially exposed workers, and regulatory and public health agencies.

- **Preplacement medical evaluation**

Prior to placing a worker in a job with a potential for exposure to antimony, the physician should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks. These should concentrate on the function and integrity of the eyes, skin, and cardiovascular, reproductive, and respiratory systems. Medical surveillance for respiratory disease should be conducted by using the principles and methods recommended by NIOSH and the American Thoracic Society (ATS).

A preplacement medical evaluation is recommended in order to detect and assess preexisting or concurrent conditions which may be aggravated or result in increased risk when a worker is exposed to antimony at or below the NIOSH REL. The examining physician should consider the probable frequency, intensity, and duration of exposure, as well as the nature and degree of the condition, in placing such a worker. Such conditions, which should not be regarded as absolute contraindications to job placement, include a history and physical or other findings suggestive of cardiovascular or chronic skin disease. The physician should obtain baseline values for electrocardiographic studies appropriate for the age and medical history of the worker.

- **Periodic medical screening and/or biologic monitoring**

Occupational health interviews and physical examinations should be performed at regular intervals. Additional examinations may be necessary should a worker develop symptoms that may be attributed to exposure to antimony. The interviews, examinations, and appropriate medical screening and/or biologic monitoring tests should be directed at identifying an excessive decrease or adverse trend in the physiologic function of the eyes, skin, and cardiovascular, reproductive, and respiratory systems as compared to the baseline status of the individual worker or to expected values for a suitable reference population. The following tests should be used and interpreted according to standardized procedures and evaluation criteria recommended by NIOSH and ATS: standardized questionnaires and tests of lung function.

- **Medical practices recommended at the time of job transfer or termination**

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic and laboratory tests which were conducted at the time of placement should be repeated at the time of job transfer or termination. Any changes in the worker's health status should be compared to those expected for a suitable reference population. Because occupational exposure to antimony may cause diseases of prolonged induction-latency, the need for medical surveillance may extend beyond termination of employment.

- **Sentinel health events**

Acute SHE's include: Contact and/or allergic dermatitis.

MONITORING AND MEASUREMENT PROCEDURES

• TWA exposure evaluation

Measurements to determine worker exposure to antimony should be taken so that the TWA exposure is based on a single entire workshift sample or an appropriate number of consecutive samples collected during the entire workshift. Under certain conditions it may be appropriate to collect several short-term interval samples (up to 30 minutes each) to determine the average exposure level. Air samples should be taken in the worker's breathing zone (air that most nearly represents that inhaled by the worker).

• Method

Sampling and analysis of antimony may be performed by collecting with a cellulose membrane filter, digesting with nitric, sulfuric, and perchloric acids, and analyzing by atomic absorption spectrophotometry. Detailed sampling and analytical methods for antimony may be found in the *NIOSH Manual of Analytical Methods* (method numbers 189 and 261).

PERSONAL PROTECTIVE EQUIPMENT

Chemical protective clothing (CPC) should be selected after utilizing available performance data, consulting with the manufacturer, and then evaluating the clothing under actual use conditions.

Workers should be provided with and required to use CPC, gloves, face shields (8-inch minimum), and other appropriate protective clothing necessary to prevent skin contact with antimony.

Workers should be provided with and required to use dust- and splash-proof safety goggles where antimony may come in contact with the eyes.

SANITATION

Clothing which is contaminated with antimony should be removed immediately and placed in closed containers for storage until it can be discarded or until provision is made for the removal of antimony from the clothing. If the clothing is to be laundered or cleaned, the person performing the operation should be informed of antimony's hazardous properties.

Change and shower rooms should be provided with separate locker facilities for street and work clothes.

Skin that becomes contaminated with antimony should be promptly washed with soap and water.

The storage, preparation, dispensing, or consumption of food or beverages, the storage or application of cosmetics, the storage or smoking of tobacco or other smoking materials, or the storage or use of products for chewing should be prohibited in work areas.

Workers who handle antimony should wash their faces, hands, and forearms thoroughly with soap and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

Common operations in which exposure to antimony may occur and control methods which may be effective in each case are listed in Table 2.

Table 2.—Operations and methods of control for antimony

Operations	Controls
During crushing and transferring antimony ore	Process enclosure, dilution ventilation, and dust control with water
During production of lead/antimony alloys	Local exhaust ventilation
During machining, grinding, buffing, and polishing of metal products containing antimony	Local exhaust ventilation, personal protective clothing
During the manufacture of paints, pigments, enamels, glazes, ceramics, and glass	Local exhaust ventilation

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, remove the victim from further exposure, send for medical assistance, and initiate emergency procedures.

• Eye exposure

Where there is any possibility of a worker's eyes being exposed to antimony, an eye-wash fountain should be provided within the immediate work area for emergency use.

If antimony gets into the eyes, flush them immediately with large amounts of water for 15 minutes, lifting the lower and upper lids occasionally. Get medical attention as soon as possible. Contact lenses should not be worn when working with this chemical.

• Skin exposure

Where there is any possibility of a worker's body being exposed to antimony, facilities for quick drenching of the body should be provided within the immediate work area for emergency use.

If antimony gets on the skin, wash it immediately with soap and water. If antimony penetrates the clothing, remove the clothing immediately and wash the skin with soap and water. Get medical attention promptly.

• Rescue

If a worker has been incapacitated, move the affected worker from the hazardous exposure. 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.

SPILLS AND LEAKS

Workers not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed.

If antimony is spilled or leaked, the following steps should be taken:

1. Ventilate area of spill or leak.
2. For small quantities of liquids containing antimony, absorb on paper towels and place in an appropriate container.
3. Large quantities of liquids containing antimony may be absorbed in vermiculite, dry sand, earth, or a similar material and placed in an appropriate container.
4. If in solid form, antimony may be collected and placed in an appropriate container.
5. Antimony may be collected by vacuuming with an appropriate system.

WASTE REMOVAL AND DISPOSAL

U.S. Environmental Protection Agency, Department of Transportation, and/or state and local regulations shall be followed to assure that removal, transport, and disposal of antimony and its compounds are in accordance with existing regulations.

RESPIRATORY PROTECTION

It must be stressed that the use of respirators is the least preferred method of controlling worker exposure and should not normally be used as the only means of preventing or minimizing exposure during routine operations. However, there are some exceptions for which respirators may be used to control exposure: when engineering and work practice controls are not technically feasible, when engineering controls are in the process of being installed, or during emergencies and certain maintenance operations, including those requiring confined-space entry (Table 3).

In addition to respirator selection, a complete respiratory protection program should be instituted which as a minimum complies with the requirements found in the OSHA Safety and Health Standards, 29 CFR 1910.134. A respiratory protection program should include as a minimum an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, fit testing, periodic environmental monitoring, maintenance, inspection, and cleaning. The implementation of an adequate respiratory protection program, including selection of the correct respirators, requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly.

Only respirators that have been approved by the Mine Safety and Health Administration (MSHA, formerly Mining Enforcement and Safety Administration) and by NIOSH should be used. **Remember! Air-purifying respirators will not protect from oxygen-deficient atmospheres.**

For each level of respiratory protection, only those respirators that have the minimum required protection factor and meet

other use restrictions are listed. All respirators that have higher protection factors may also be used.

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Table 3.—Respiratory protection for antimony and its compounds

Condition	Minimum respiratory protection*†
Concentration:	
Less than or equal to 5.0 mg/m ³	Any dust and mist respirator except single-use and quarter-mask respirators, if not present as fume Any supplied-air respirator Any self-contained breathing apparatus
Less than or equal to 12.5 mg/m ³	Any powered air-purifying respirator with dust and mist filter, if not present as fume Any supplied-air respirator operated in a continuous flow mode
Less than or equal to 25 mg/m ³	Any air-purifying full facepiece respirator with a high-efficiency particulate filter Any powered air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter Any supplied-air respirator with a tight-fitting facepiece and operated in a continuous flow mode Any self-contained breathing apparatus with a full facepiece Any supplied-air respirator with a full facepiece
Less than or equal to 80 mg/m ³	Any supplied-air respirator with a full half-mask and operated in a pressure-demand or other positive pressure mode
Planned or emergency entry into environments containing unknown concentrations or levels above 80 mg/m ³	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode
Firefighting	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode
Escape only	Any air-purifying full facepiece respirator with a high-efficiency particulate filter Any appropriate escape-type self-contained breathing apparatus

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

†The respiratory protection listed for any given condition is the minimum required to meet the NIOSH REL of 0.5 mg/m³ (TWA).