

The following information was generated from the Hazardous Substances Data Bank (HSDB), a database of the National Library of Medicine's TOXNET system (<http://toxnet.nlm.nih.gov>) on June 18, 2011.

Query: The chemical name was identified.
The following terms were added from ChemIDplus:
metallic arsenic
colloidal arsenic
arsenic black
CAS Registry Number: 7440-38-2

1
NAME: ARSENIC, ELEMENTAL

HSN: 509

RN: 7440-38-2

NOTE:
This record contains information for arsenic in its zero valence state only. For general toxicity and environmental fate of arsenic ions and arsenic compounds, refer to the ARSENIC COMPOUNDS record; for compound specific information, refer to the appropriate individual records, e.g., arsenic trichloride, diethyl arsine, etc.

HUMAN HEALTH EFFECTS:

EVIDENCE FOR CARCINOGENICITY:
CLASSIFICATION: A; human carcinogen. BASIS FOR CLASSIFICATION:
Based on sufficient evidence from human data. An increased lung cancer mortality was observed in multiple human populations exposed primarily through inhalation. Also, increased mortality from multiple internal organ cancers (liver, kidney, lung, and bladder) and an increased incidence of skin cancer were observed in populations consuming drinking water high in inorganic arsenic. HUMAN CARCINOGENICITY DATA: Sufficient.
ANIMAL
CARCINOGENICITY DATA: Inadequate. /based on former classification

download.txt
system/[U.S. Environmental Protection Agency's Integrated Risk
Information
System (IRIS). Summary on Arsenic, Inorganic (7440-38-2).
Available from,
as of March 15, 2000: <http://www.epa.gov/iris/>] **PEER
REVIEWED**

A1: Confirmed human carcinogen. /Arsenic and inorganic
compounds, as
As/[American Conference of Governmental Industrial Hygienists.
Threshold
Limit Values of Chemical Substances and Biological Exposure
Indices,
ACGIH, Cincinnati, OH 2009, p. 12] **QC REVIEWED**

Evaluation: There is sufficient evidence in humans that arsenic
in
drinking-water causes cancers of the urinary bladder, lung and
skin ...
Overall evaluation: Arsenic in drinking-water is carcinogenic
to humans
(Group 1). /Arsenic in drinking-water/[IARC. Monographs on the
Evaluation
of the Carcinogenic Risk of Chemicals to Man. Geneva: World
Health
Organization, International Agency for Research on Cancer,
1972-PRESENT.
(Multivolume work). Available at:
<http://monographs.iarc.fr/index.php>, p.
v84 (2004)] **QC REVIEWED**

Arsenic compounds, inorganic: known to be a human
carcinogen.[U.S.
Department of Health & Human Services/National Toxicology
Program;
Eleventh Report on Carcinogens: Arsenic Compounds, Inorganic
(January
2005). Available from, as of July 24, 2009:
<http://ntp.niehs.nih.gov/ntp/roc/toc11.html>] **QC REVIEWED**

Classification of carcinogenicity: 1) evidence in humans:
sufficient; 2)
evidence in animals: limited. Overall summary evaluation of
carcinogenic
risk to humans is Group 1: Carcinogenic to humans. NOTE: This
evaluation
applies to the group of chemicals as a whole and not
necessarily to all
individual chemicals within the group. /Arsenic and arsenic
compounds/[IARC. Monographs on the Evaluation of the
Carcinogenic Risk of
Chemicals to Man. Geneva: World Health Organization,

download.txt

International Agency

for Research on Cancer, 1972-PRESENT. (Multivolume work).

Available at:

<http://monographs.iarc.fr/index.php>, p. S7 57 (1987)] **QC

REVIEWED**

HUMAN TOXICITY EXCERPTS:

Among smelter workers exposed to a mixture of metals including arsenic, the frequency of congenital malformations did not differ from non-exposed populations. However, mean birth wt were reported to be decr in offspring

of female employees of the smelter.[Friberg, L., Nordberg, G.F., Kessler, E. and Vouk, V.B. (eds). Handbook of the Toxicology of Metals. 2nd ed.

Vols I, II.: Amsterdam: Elsevier Science Publishers B.V., 1986., p. VI

414] **PEER REVIEWED**

The low toxicity of elemental arsenic is attributed to its virtual insolubility in water or in body fluids.[USEPA; Ambient Water Quality Criteria Doc: Arsenic p.A-1 (1980) EPA 440/5-80-021] **PEER

REVIEWED**

MEDICAL SURVEILLANCE:

The urinary excretion, in mg/L, of elements that are freely eliminated by

this route, such as ... arsenic, is at most 2.5-5 times the occupation

exposure in mg/cu m of air /SRP: for an 8 hour day/. It is apparent that

biological monitoring for arsenic by urinalysis would be of limited value

in determining whether or not the NIOSH recommended standard ... was being

met or exceeded.[American Conference of Governmental Industrial Hygienists, Inc. Documentation of the Threshold Limit Values

and

Biological Exposure Indices. 6th ed. Volumes I, II, III.

Cincinnati, OH:

ACGIH, 1991., p. 83] **PEER REVIEWED**

PROBABLE ROUTES OF HUMAN EXPOSURE:

Ceramic artists can be exposed to many hazardous materials, generally

related to dry clays, glazes and kiln use. Glazes can contain lead,

antimony, arsenic, barium, beryllium, boron, chromium, cobalt,

download.txt

cadmium,
copper, vanadium and other materials. ...[Hart C; J Environ
Health 49 (5):
282-6 (1987)] **PEER REVIEWED**

Heavy metals such as lead, arsenic, antimony, cadmium,
chromium, cobalt,
manganese, and mercury ... used as color pigments in paints can
be
ingested by contamination of hands, fingernails, food, cups,
cigarettes
and by holding paint brushes in the mouth.[Hart C; J Environ
Health 49
(5): 282 (1987)] **PEER REVIEWED**

REPORTED FATAL DOSE:

Fatal human dose 70-180 mg depending on weight. Estimated
lethal dose for
a 70 kg human as As (III).[NIH/EPA; OHM/TADS (1985)] **PEER
REVIEWED**

EMERGENCY MEDICAL TREATMENT:

EMERGENCY MEDICAL TREATMENT:

EMT COPYRIGHT DISCLAIMER:

Portions of the POISINDEX(R) and MEDITEXT(R) database have been
provided here
for general reference. THE COMPLETE POISINDEX(R) DATABASE OR
MEDITEXT(R)
DATABASE SHOULD BE CONSULTED FOR ASSISTANCE IN THE DIAGNOSIS OR
TREATMENT OF
SPECIFIC CASES. The use of the POISINDEX(R) and MEDITEXT(R) databases
is at your
sole risk. The POISINDEX(R) and MEDITEXT(R) databases are provided
"AS IS" and
"as available" for use, without warranties of any kind, either
expressed or
implied. Micromedex makes no representation or warranty as to the
accuracy,
reliability, timeliness, usefulness or completeness of any of the
information
contained in the POISINDEX(R) and MEDITEXT(R) databases. ALL IMPLIED
WARRANTIES
OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE OR USE ARE
HEREBY
EXCLUDED. Micromedex does not assume any responsibility or risk for
your use of
the POISINDEX(R) or MEDITEXT(R) databases. Copyright 1974-2011
Thomson

MICROMEDEX. All Rights Reserved. Any duplication, replication, "downloading," sale, redistribution or other use for commercial purposes is a violation of

Micromedex' rights and is strictly prohibited.<p>The following Overview, ***

ARSENIC ***, is relevant for this HSDB record chemical.

LIFE SUPPORT:

- o This overview assumes that basic life support measures have been instituted.

CLINICAL EFFECTS:

0.2.1 SUMMARY OF EXPOSURE

0.2.1.1 ACUTE EXPOSURE

- A) USES: Arsenic compounds are used as pesticides and in a variety of occupations (eg, glass/ceramic manufacturing, metallurgy, semiconductor manufacture). However, environmental contamination of groundwater accounts for the majority of modern exposures outside the United States. Organic arsenic (melarsoprol) is used to treat the meningoencephalitis stage of African Trypanosomiasis. Arsenic trioxide is used to treat acute promyelocytic leukemia. Please refer to "ARSENIC TRIOXIDE" document for more information.
- B) PHARMACOLOGY: Inorganic arsenic reduces cellular apoptosis via damage of mitochondrial membranes and down-regulation of BCL2, a pro-survival protein. Arsenic is actively transported into Trypanosomes by a purine transporter resulting in inhibition of trypanothione production and subsequent parasite lysis.
- C) TOXICOLOGY: Trivalent arsenic (As³⁺) disrupts oxidative phosphorylation, leading to free radical formation via inhibition of pyruvate dehydrogenase, which subsequently decreases gluconeogenesis due to lack of acetyl-CoA. Pentavalent arsenic may be transformed to arsenic or substitute for inorganic phosphate in glycolysis, leading to uncoupling of oxidative phosphorylation and loss of ATP formation. Chronically, arsenic may cause DNA damage, mutation in the p-53 suppressor gene, and inhibition of DNA repair mechanisms leading to cancer. Arsenic-containing metals are considered non-toxic due to their low solubility. Organic arsenic has relatively low toxicity when compared to the inorganic trivalent and pentavalent forms.
- D) EPIDEMIOLOGY: Toxicity from arsenic is uncommon and major effects are rare.
- E) WITH POISONING/EXPOSURE
 - 1) ACUTE OVERDOSE: Arsenic compounds are mainly absorbed through the gastrointestinal tract, but some absorption may occur through intact skin or inhalation. Acute arsenic ingestion generally produces signs and symptoms within 30 minutes but symptoms may

download.txt

be delayed for several hours if ingested with food. Many arsenic compounds are severe irritants of the skin, eye, and mucous membranes; some may be corrosive. Contact produces local hyperemia, followed by vesicular or pustular eruptions. Trivalent compounds are particularly caustic. Acute inhalation exposures have resulted in irritation of the upper respiratory tract.

- 2) MILD TO MODERATE TOXICITY: Gastrointestinal symptoms occur rapidly after acute ingestion. Initial signs and symptoms include burning lips, throat constriction, and dysphagia. Excruciating abdominal pain, severe nausea, vomiting, and profuse "rice water-like" diarrhea that may lead to hypovolemia follows these symptoms. In addition, hypovolemia from capillary leakage (third-spacing of fluids) is a common early effect. QTC prolongation may occur. Muscle cramps, facial edema, bronchitis, dyspnea, chest pain, dehydration, intense thirst, and fluid-electrolyte disturbances are also common following significant exposures. A garlic-like odor of the breath and feces may also develop. Subacute toxicity can produce neuropathies, both motor and sensory, and can progress to a Guillain-Barre like syndrome.
- 3) SEVERE TOXICITY: Hypotension and tachycardia are common early signs of severe poisoning. Hypotension may be resistant to fluid resuscitation and multi-organ failure may ensue. Fever and tachypnea may occur. These patients can develop ventricular dysrhythmias including torsade de pointes. Encephalopathy, seizures and coma have been reported. Acute renal failure, hemolytic anemia, rhabdomyolysis, and hepatitis may occur several days after ingestion.
- 4) CHRONIC TOXICITY: Inhalation is the most common route of exposure in arsenic workers. The sequence of chronic poisoning involves weakness, anorexia, hepatomegaly, jaundice, and gastrointestinal complaints, followed by conjunctivitis, irritation of the upper respiratory tract, hyperpigmentation, and eczematoïd and allergic dermatitis. A hoarse voice and chronic upper respiratory septum is a common result after prolonged inhalation of white arsenic dust or fume. Peripheral nervous system symptoms may include numbness, burning, and tingling of the hands and feet; pain; paresthesias; tenderness; muscle fasciculations; gross tremors; ataxia; discoloration; and mental confusion. Muscular weakness, limb tenderness and difficulty walking may follow. The final phase consists of peripheral sensory neuropathy of the hands and feet. Associated motor neuropathy may occur as well. Certain arsenic compounds are known human carcinogens. Chronic exposure in either occupational

download.txt

settings or by drinking contaminated groundwater can cause poisoning and carries an increased risk of skin, lung, bladder, and possibly liver cancers.

0.2.3 VITAL SIGNS

0.2.3.1 ACUTE EXPOSURE

- A) Hypotension and tachycardia are common early signs. Fever and tachypnea may occur. Hypertension has been associated with chronic environmental arsenic exposure.

0.2.4 HEENT

0.2.4.1 ACUTE EXPOSURE

- A) Trivalent arsenic is corrosive to the eyes, mouth, and mucous membranes. Perforation of the nasal septum can occur.

0.2.5 CARDIOVASCULAR

0.2.5.1 ACUTE EXPOSURE

- A) Hypovolemic or hemorrhagic shock, torsades de pointes, ventricular fibrillation or tachycardia, QTC prolongation, and T-wave changes may be seen after acute ingestion. Myocarditis has been reported in chronic arsenic poisoning.

0.2.6 RESPIRATORY

0.2.6.1 ACUTE EXPOSURE

- A) Respiratory tract irritation may occur. Cardiogenic or noncardiogenic pulmonary edema and respiratory failure may develop in severe poisonings.

0.2.7 NEUROLOGIC

0.2.7.1 ACUTE EXPOSURE

- A) Altered mental status, seizures, toxic delirium, encephalopathy, and delayed peripheral neuropathy are complications of acute arsenic poisoning.

0.2.8 GASTROINTESTINAL

0.2.8.1 ACUTE EXPOSURE

- A) Acute toxicity results in early symptoms of abdominal pain, severe vomiting and diarrhea, as well as dryness of the oral and nasal cavities.

0.2.9 HEPATIC

0.2.9.1 ACUTE EXPOSURE

- A) Hepatocellular injury occurs rarely after acute poisoning, but has occurred following chronic exposure.

0.2.10 GENITOURINARY

0.2.10.1 ACUTE EXPOSURE

- A) Hematuria and acute tubular necrosis may occur.

0.2.12 FLUID-ELECTROLYTE

0.2.12.1 ACUTE EXPOSURE

- A) Rapid volume depletion from vomiting, diarrhea, and third spacing of fluids is common.

0.2.13 HEMATOLOGIC

0.2.13.1 ACUTE EXPOSURE

- A) Acute hemolysis and anemia may occur after acute poisoning. Pancytopenia, aplastic anemia, or leukemia may occur following chronic exposure. Bone marrow depression can occur.

0.2.14 DERMATOLOGIC

0.2.14.1 ACUTE EXPOSURE

- A) Skin findings may include hyperpigmentation, keratoses, and epidermoid carcinomas. Mees' lines (thin white bands transversing the width of the nail) of the nails are common. Trivalent arsenic compounds are corrosive to the skin. Arsenic pentoxide are sensitizers.

0.2.15 MUSCULOSKELETAL

0.2.15.1 ACUTE EXPOSURE

- A) Muscular cramps may occur and progress to rhabdomyolysis.

0.2.20 REPRODUCTIVE HAZARDS

- A) Inorganic arsenic crosses the placenta and may result in spontaneous abortion or stillbirth with either acute or chronic poisoning.

0.2.21 CARCINOGENICITY

0.2.21.1 IARC CATEGORY

- A) IARC Carcinogenicity Ratings for CAS7440-38-2 (IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2006; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2007; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2010; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2010a; IARC Working Group on the Evaluation of Carcinogenic Risks to Humans, 2008; IARC, 2004):

1) IARC Classification

- a) Listed as: Arsenic and inorganic arsenic compounds
- b) Carcinogen Rating: 1

- 1) The agent (mixture) is carcinogenic to humans. The exposure circumstance entails exposures that are carcinogenic to humans. This category is used when there is sufficient evidence of carcinogenicity in humans. Exceptionally, an agent (mixture) may be placed in this category when evidence of carcinogenicity in humans is less than sufficient but there is sufficient evidence of carcinogenicity in experimental animals and strong evidence in exposed humans that the agent (mixture) acts through a relevant mechanism of carcinogenicity.

0.2.21.2 HUMAN OVERVIEW

- A) Chronic therapeutic, occupational, and environmental arsenic exposure have been associated with lung, bladder, skin, and other cancers in humans.
- B) Exposures as little as 1 gram per year have been associated with CANCER (HSDB).

0.2.22 GENOTOXICITY

- A) Arsenic induced DNA damage in human cells.
- B) Conflicting genetic effects have been found for arsenicals. Chromosome aberrations were elevated in the white blood cells of persons exposed to arsenic and possibly other substances (Nordenson, 1978) Burgdorf et

download.txt

al, 1977), but sister chromatid exchanges were not (Friberg et al, 1986). Sodium arsenite did induce sister chromatid exchanges in vitro, however (Friberg et al, 1986).

LABORATORY:

- A) Testing must be correlated with the time of exposure and care must be taken to eliminate possible confounding factors such as food-derived arsenic (fish) or accumulated arsenic in those with chronic renal failure.
- B) Diagnosis is based on elevated urinary arsenic levels. A spot urine may be done as a screen prior to chelation but arsenic excretion is intermittent, therefore a 24-hour urine arsenic collection is necessary for definitive diagnosis. A 24-hour urinary arsenic collection exceeding 100 mcg is usually abnormal, even after chelation.
- C) Monitor CBC, serum electrolytes, liver enzymes, renal function tests, and a blood arsenic concentration in symptomatic patients.
- D) Serial ECGs should be obtained to follow the QTc interval and continuous cardiac monitoring should be instituted in symptomatic patients.
- E) Most arsenic compounds are radio-opaque, therefore abdominal X-rays may confirm acute ingestions and guide decontamination.

TREATMENT OVERVIEW:

0.4.2 ORAL EXPOSURE

A) MANAGEMENT OF MILD TO MODERATE TOXICITY

- 1) Fluid resuscitation should be initiated immediately, but care must be taken to recognize pulmonary and cerebral edema when present. When a significant acute ingestion is confirmed, chelation therapy should be initiated immediately prior to laboratory confirmation. This will minimize time delay to treatment associated with prolonged laboratory result turn around. In chronic toxicity, the decision to chelate must be based upon patient condition and laboratory evaluation.

B) MANAGEMENT OF SEVERE TOXICITY

- 1) Aggressive life support measures should be instituted immediately. Anti-arrhythmic medications that prolong the QTc should be avoided. In severely ill patients, combined therapy with both BAL and an oral agent should be considered. If renal failure exists, the dose of BAL should be decreased after the loading dose.
- 2) INHALATION EXPOSURE: Inhalation is the most common exposure in arsenic workers. OSHA has set an "action level" of 5 mcg/m³ of inorganic arsenic in the air over an 8-hour period. Initial treatment should be to remove the patient from the exposure and refer the patient to an occupational specialist for 24-hour urine collection. The decision to chelate will depend upon the patient's clinical status and urine arsenic concentration.

download.txt

- 3) DERMAL EXPOSURE: Occasionally arsenic can cause a contact dermatitis or an exfoliative rash. Wash the area thoroughly and avoid further dermal contact. Topical steroid creams may decrease inflammation in these cases.
- 4) EYE EXPOSURE: Copious irrigation and ophthalmology follow-up.
- C) DECONTAMINATION
 - 1) PREHOSPITAL: Remove the contaminated clothing and wash the patient thoroughly.
 - 2) HOSPITAL: Activated charcoal does not bind arsenic well. Gastric lavage and whole bowel irrigation should be considered for confirmed significant ingestions.
- D) AIRWAY MANAGEMENT
 - 1) Should be considered for patients with severe CNS depression at risk of aspiration.
- E) ANTIDOTE
 - 1) BAL and succimer are chelating agents used as antidotal therapy for arsenic toxicity. BAL: Symptomatic patients unable to tolerate oral medication should be treated with BAL 3 to 5 mg/kg/dose IM every 4 to 6 hours. The dose and frequency depend on the degree of toxicity seen. Higher doses of BAL invariably cause adverse effects. SUCCIMER: Should be used as soon as the patient is able to tolerate oral medication. DOSE: 10 mg/kg every 8 hours for 5 days, then decrease dosing to every 12 hours for 14 days. It may be more effective and causes fewer side effects than BAL. Chelation therapy should be stopped when the urinary arsenic level falls below 50 mcg per 24 hours.
- F) ENHANCED ELIMINATION
 - 1) Arsenic is poorly dialyzable. Hemodialysis should only be considered for arsenic toxicity accompanied by renal failure.
- G) PATIENT DISPOSITION
 - 1) ADMISSION CRITERIA: All patients with acute arsenic toxicity should be admitted.
 - 2) CONSULT CRITERIA: Consult a medical toxicologist and/or poison center for all potentially significant arsenic exposures.
- H) PITFALLS
 - 1) Failure to consider arsenic poisoning in patients with prolonged gastrointestinal illness and cardiac conduction abnormalities. Failure to remove fish or other arsenic sources from the diet prior to testing urine arsenic levels.
- I) DIFFERENTIAL DIAGNOSIS
 - 1) Infectious gastroenteritis may have a similar clinical presentation, though arsenic toxicity usually lasts longer and has more multi-organ system involvement. Toxic plant and mushroom ingestion may lead to a severe gastritis though most lack the systemic toxicity seen

download.txt

with arsenic. Theophylline overdose may have a similar presentation though diarrhea is not as predominant a feature as it is with arsenic poisoning.

0.4.3 INHALATION EXPOSURE

- A) Inhalation is the most common exposure in arsenic workers. OSHA has set an "action level" of 5 mcg/m³ of inorganic arsenic in the air over an 8-hour period. Initial treatment should be to remove the patient from the exposure and refer the patient to an occupational specialist for 24-hour urine collection. The decision to chelate will depend upon the patient's clinical status and urine arsenic concentration.

0.4.4 EYE EXPOSURE

- A) Copious irrigation and ophthalmology follow-up.

0.4.5 DERMAL EXPOSURE

A) OVERVIEW

- 1) Occasionally arsenic can cause a contact dermatitis or an exfoliative rash. Wash the area thoroughly and avoid further dermal contact. Topical steroid creams may decrease inflammation in these cases.

RANGE OF TOXICITY:

- A) TOXICITY: Trivalent arsenic (arsenite) is more toxic than pentavalent arsenic (arsenate). Acute ingestion of more than 100 mg of inorganic arsenic is likely to cause significant toxicity. Airborne concentrations of 5 mg As/m³ are considered immediately dangerous to life and health.

ANIMAL TOXICITY STUDIES:

EVIDENCE FOR CARCINOGENICITY:

CLASSIFICATION: A; human carcinogen. BASIS FOR CLASSIFICATION:

Based on

sufficient evidence from human data. An increased lung cancer mortality

was observed in multiple human populations exposed primarily through

inhalation. Also, increased mortality from multiple internal organ cancers

(liver, kidney, lung, and bladder) and an increased incidence of skin

cancer were observed in populations consuming drinking water high in

inorganic arsenic. HUMAN CARCINOGENICITY DATA: Sufficient.

ANIMAL

CARCINOGENICITY DATA: Inadequate. /based on former

classification

system/[U.S. Environmental Protection Agency's Integrated Risk Information

System (IRIS). Summary on Arsenic, Inorganic (7440-38-2).

download.txt

Available from,
as of March 15, 2000: <http://www.epa.gov/iris/>] **PEER
REVIEWED**

A1: Confirmed human carcinogen. /Arsenic and inorganic
compounds, as
As/[American Conference of Governmental Industrial Hygienists.
Threshold
Limit Values of Chemical Substances and Biological Exposure
Indices,
ACGIH, Cincinnati, OH 2009, p. 12] **QC REVIEWED**

Evaluation: There is sufficient evidence in humans that arsenic
in
drinking-water causes cancers of the urinary bladder, lung and
skin ...

Overall evaluation: Arsenic in drinking-water is carcinogenic
to humans
(Group 1). /Arsenic in drinking-water/[IARC. Monographs on the
Evaluation
of the Carcinogenic Risk of Chemicals to Man. Geneva: World
Health
Organization, International Agency for Research on Cancer,
1972-PRESENT.
(Multivolume work). Available at:
<http://monographs.iarc.fr/index.php>, p.
v84 (2004)] **QC REVIEWED**

Arsenic compounds, inorganic: known to be a human
carcinogen.[U.S.
Department of Health & Human Services/National Toxicology
Program;
Eleventh Report on Carcinogens: Arsenic Compounds, Inorganic
(January
2005). Available from, as of July 24, 2009:
<http://ntp.niehs.nih.gov/ntp/roc/toc11.html>] **QC REVIEWED**

Classification of carcinogenicity: 1) evidence in humans:
sufficient; 2)
evidence in animals: limited. Overall summary evaluation of
carcinogenic
risk to humans is Group 1: Carcinogenic to humans. NOTE: This
evaluation
applies to the group of chemicals as a whole and not
necessarily to all
individual chemicals within the group. /Arsenic and arsenic
compounds/[IARC. Monographs on the Evaluation of the
Carcinogenic Risk of
Chemicals to Man. Geneva: World Health Organization,
International Agency
for Research on Cancer, 1972-PRESENT. (Multivolume work).
Available at:

<http://monographs.iarc.fr/index.php>, p. S7 57 (1987)] **QC
REVIEWED**

NON-HUMAN TOXICITY EXCERPTS:

Metallic arsenic in lanolin was injected into the femur marrow of 25 male rats & 6 rabbits. The doses were 0.43 mg & 0.65 mg, respectively.

Only 4 rats survived 18 mo & one of these developed a spindle cell sarcoma at the site of injection. None of the rabbits showed any metaplastic reactions. No tumors were produced at the site of injection in

25 rats injected intrapleurally once a mo for 6 mo resulting in a total

dose of 0.65 mg of arsenic. Similar results were obtained after nasal

sinus injection of 0.65 mg of arsenic in 20 rats.[Hueper WC; JNCI 15:

113-24 (1954) as cited in WHO; Environ Health Criteria: Arsenic p.126

(1981)] **PEER REVIEWED**

The mineralization of glucose in sediments was less at pH 4 & 5 than

at pH 7, & was less at 0 deg than at 20 deg C. Most of the bacteria

isolated from the sediments incubated at 0 & 20 deg C were psychrophilic & most of them were resistant to lead (Pb)

& selenium (Se); a smaller proportion was resistant to mercury (Hg) &

arsenic (As). Many of the bacteria were resistant to > 1 of the

elements. Pb & Hg were more toxic to bacterial growth at pH 4.5 than

at 7.5, but Se & As were slightly more toxic at the higher pH.[Baker

MD et al; Water Res 17 (8): 925-30 (1983)] **PEER REVIEWED**

The toxicity of 3 doses of a mixture of 10 heavy metals arsenic, cadmium,

chromium, copper, iron, lead, mercury, nickel, selenium, and zinc at 0.5,

1, or 2 fold the maximum recommended concn to size fractionated natural

phytoplankton from the North American Great Lakes was determined.[Munawar

M et al; Ergeb Limnol 25: 123-39 (1987)] **PEER REVIEWED**

NON-HUMAN TOXICITY VALUES:

download.txt

of LD50 Rat oral 763 mg/kg[Lewis, R.J. Sax's Dangerous Properties
Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van
Nostrand Reinhold, 1996., p. 271] **PEER REVIEWED**

of LD50 Rat ip 13,390 ug/kg[Lewis, R.J. Sax's Dangerous Properties
Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van
Nostrand Reinhold, 1996., p. 271] **PEER REVIEWED**

LD50 Mouse oral 145 mg/kg[Lewis, R.J. Sax's Dangerous
Properties of
Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van
Nostrand Reinhold, 1996., p. 271] **PEER REVIEWED**

LD50 Mouse ip 46,200 ug/kg[Lewis, R.J. Sax's Dangerous
Properties of
Industrial Materials. 9th ed. Volumes 1-3. New York, NY: Van
Nostrand Reinhold, 1996., p. 271] **PEER REVIEWED**

METABOLISM/PHARMACOKINETICS:

ABSORPTION, DISTRIBUTION & EXCRETION:

Normal values of arsenic in urine, ... vary from 0.013-0.046
mg/L, to 0.13
mg/L, to 0.25 mg/L. The urinary excretion, in mg/L, of elements
that are
freely eliminated by this route, such as ... arsenic, is at
most 2.5-5
times the occupation exposure in mg/cu m of air. It is apparent
that
biological monitoring for arsenic by urinalysis would be of
limited value
in determining whether or not the NIOSH recommended standard
... was being
met or exceeded.[American Conference of Governmental Industrial
Hygienists, Inc. Documentation of the Threshold Limit Values
and
Biological Exposure Indices. 6th ed. Volumes I, II, III.
Cincinnati, OH:
ACGIH, 1991., p. 83] **PEER REVIEWED**

INTERACTIONS:

When selenium is injected almost simultaneously with arsenic
into test
animals biliary excretion of both elements is enhanced seven to

download.txt

tenfold.[Nat'l Research Council Canada; Effect of Arsenic in
the Canadian
Environment p.215 (1978) NRCC No.15391] **PEER REVIEWED**

The effects of selenium and arsenic on tumor size and tumor
number were
examined in mice using the urethane pulmonary adenoma model.
Female Swiss
cross mice were administered the metals in drinking water at
levels of 3
ug/ml selenium and 80 ug/ml arsenic on alternate days for 15
weeks. The
urethane was administered after 3 weeks of the metal treatment,
and the
incidence and size of pulmonary adenomas were determined 12
weeks later.
Weight gain was diminished in mice exposed to arsenic but not
selenium. No
other clinical signs were present due to metal exposure.
Urethane induced
sleeping times were significantly reduced in animals given both
metals
relative to those administered either arsenic or selenium. Both
arsenic
and selenium administered alone reduced tumor size; the effect
of arsenic
was greater than that of selenium and arsenic treatment also
resulted in a
decreased number of tumors per animal. No interactive effects
between the
metals were determined with regard to tumor production. Both
arsenic and
selenium alter urethane induced adenoma formation.[Blakely BR;
Drug-Nutrient Interactions 5 (2): 97-102 (1987)] **PEER
REVIEWED** <a

href="http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?cmd=Retrieve&db=p
ubmed&dopt=Abstract&list_uids=3608832"
target=new>PubMed Abstract

PHARMACOLOGY:

INTERACTIONS:

When selenium is injected almost simultaneously with arsenic
into test
animals biliary excretion of both elements is enhanced seven to
tenfold.[Nat'l Research Council Canada; Effect of Arsenic in
the Canadian
Environment p.215 (1978) NRCC No.15391] **PEER REVIEWED**

download.txt

The effects of selenium and arsenic on tumor size and tumor number were examined in mice using the urethane pulmonary adenoma model. Female Swiss cross mice were administered the metals in drinking water at levels of 3 ug/ml selenium and 80 ug/ml arsenic on alternate days for 15 weeks. The urethane was administered after 3 weeks of the metal treatment, and the incidence and size of pulmonary adenomas were determined 12 weeks later. Weight gain was diminished in mice exposed to arsenic but not selenium. No other clinical signs were present due to metal exposure. Urethane induced sleeping times were significantly reduced in animals given both metals relative to those administered either arsenic or selenium. Both arsenic and selenium administered alone reduced tumor size; the effect of arsenic was greater than that of selenium and arsenic treatment also resulted in a decreased number of tumors per animal. No interactive effects between the metals were determined with regard to tumor production. Both arsenic and selenium alter urethane induced adenoma formation.[Blakely BR; Drug-Nutrient Interactions 5 (2): 97-102 (1987)] **PEER REVIEWED** PubMed Abstract

REPORTED FATAL DOSE:

Fatal human dose 70-180 mg depending on weight. Estimated lethal dose for a 70 kg human as As (III).[NIH/EPA; OHM/TADS (1985)] **PEER REVIEWED**

ENVIRONMENTAL FATE & EXPOSURE:

PROBABLE ROUTES OF HUMAN EXPOSURE:

Ceramic artists can be exposed to many hazardous materials, generally related to dry clays, glazes and kiln use. Glazes can contain lead, antimony, arsenic, barium, beryllium, boron, chromium, cobalt,

download.txt

cadmium,
copper, vanadium and other materials. ...[Hart C; J Environ
Health 49 (5):
282-6 (1987)] **PEER REVIEWED**

Heavy metals such as lead, arsenic, antimony, cadmium,
chromium, cobalt,
manganese, and mercury ... used as color pigments in paints can
be
ingested by contamination of hands, fingernails, food, cups,
cigarettes
and by holding paint brushes in the mouth.[Hart C; J Environ
Health 49
(5): 282 (1987)] **PEER REVIEWED**

NATURAL POLLUTION SOURCES:

Aquatic Fate: Arsenic as a free element (0-oxidation state) is
rarely
encountered in natural waters.[USEPA; Ambient Water Quality
Criteria Doc:
Arsenic p.A-1 (1980) EPA 440/5-80-021] **PEER REVIEWED**

ENVIRONMENTAL FATE:

Aquatic Fate: Arsenic as a free element (0-oxidation state) is
rarely
encountered in natural waters. Soluble inorganic arsenate
(+5-oxidation
state) predominates under normal conditions since it is
thermodynamically
more stable in water than arsenite (+3 oxidation state).[USEPA;
Ambient
Water Quality Criteria Doc: Arsenic p.A-1 (1980) EPA
440/5-80-021] **PEER
REVIEWED**

ENVIRONMENTAL STANDARDS & REGULATIONS:

FIFRA REQUIREMENTS:

Tolerances for total residues of combined arsenic (calculated
as As) in
food are established as follows: (a) In edible tissues & in
eggs of
chickens & turkeys: 0.5 ppm in uncooked muscle tissue; 2
ppm in
uncooked edible by-products; & 0.5 ppm in eggs. (b) In
edible tissues
of swine: 2 ppm in uncooked liver & kidney; 0.5 ppm in
uncooked muscle
tissue & by-products other than liver & kidney.
/Arsenic/[21 CFR

download.txt

556.60 (4/1/2001)] **PEER REVIEWED**

If material involved in fire: Extinguish fire using agent suitable for type of surrounding fire. (Material itself does not burn or burns with difficulty.) Use water in flooding quantities as fog. Use foam, dry chemical, or carbon dioxide. /Arsenical compd, solid, NOS/[Association of American Railroads. Emergency Handling of Hazardous Materials in Surface Transportation. Washington, DC: Association of American Railroads, Bureau of Explosives, 1994., p. 105] **PEER REVIEWED**

CERCLA REPORTABLE QUANTITIES:

Persons in charge of vessels or facilities are required to notify the National Response Center (NRC) immediately, when there is a release of this designated hazardous substance, in an amount equal to or greater than its reportable quantity of 1 lb or 0.454 kg. The toll free number of the NRC is (800) 424-8802; In the Washington D.C. metropolitan area (202) 426-2675. The rule for determining when notification is required is stated in 40 CFR 302.4 (section IV. D.3.b). No reporting of releases of this hazardous substance is required if the diameter of the pieces of the solid metal released is equal to or exceeds 100 micrometers (0.004 inches).[40 CFR 302.4 (7/1/2000)] **PEER REVIEWED**

RCRA REQUIREMENTS:

D004; A solid waste containing arsenic may or may not become characterized as a hazardous waste when subjected to the Toxicity Characteristic Leaching Procedure listed in 40 CFR 261.24, and if so characterized, must be managed as a hazardous waste.[40 CFR 261.24 (7/1/2001)] **PEER REVIEWED**

ATMOSPHERIC STANDARDS:

Inorganic arsenic has been designated as a hazardous air pollutant under section 112 of the Clean Air Act. /Inorganic Arsenic/[40 CFR
Page 18

61.01

(7/1/2001)] **PEER REVIEWED**

(a) The owner or operator of an existing glass melting furnace subject to the provisions of this subpart shall comply with either paragraph (a)(1) or (a)(2) of this section ... (1) Uncontrolled total arsenic emissions from the glass melting furnace shall be less than 2.5 Mg (2.7 ton) per year, or ... (2) Total arsenic emissions from glass melting furnace shall be conveyed to a control device and reduced by at least 85%.
/Total arsenic/[40 CFR 61.162(a) (7/1/2001)] **PEER REVIEWED**

(b) The owner or operator of a new or modified glass melting furnace subject to the provisions of this subpart shall comply with either paragraph (b)(1) or (b)(2) of this section ... (1) Uncontrolled total arsenic emissions from the glass melting furnace shall be less than 0.4 Mg (0.44 ton) per year, or ... (2) Total arsenic emissions from glass melting furnace shall be conveyed to a control device and reduced by at least 85%.
/Total arsenic/[40 CFR 61.162(b) (7/1/2001)] **PEER REVIEWED**

The owner or operator of each copper converter subject to the provisions of this subpart shall reduce inorganic arsenic emissions to the atmosphere by meeting the following design, equipment, work practice, and operational requirements: (1) Install, operate, and maintain a secondary hood system on each copper converter. Each secondary hood system shall consist of a hood enclosure, air curtain fan(s), exhaust system fan(s), and ductwork that conveys the captured emission to a control device ... (2) Optimize the capture of secondary inorganic arsenic emission by operating the copper converter and secondary hood systems at all times ...
/Inorganic arsenic/[40 CFR 61.172(b) (7/1/2001)] **PEER REVIEWED**

download.txt

From Arsenic

Trioxide and Metallic Arsenic Production Facilities. (a) within 30 days after the effective date of this subpart, the owner or operator of each source to which this subpart applies shall identify and submit to the Administrator a list of potential sources (equipment and operations) of inorganic arsenic emissions. /Inorganic arsenic/[40 CFR 61.182(a) (7/1/2001)] **PEER REVIEWED**

National Emission Standards for Inorganic Arsenic Emissions
From Arsenic

Trioxide and Metallic Arsenic Production Facilities. (b) The owner or operator shall submit a description of an inspection, maintenance, and housekeeping plan for control of inorganic arsenic emissions ... (c) The owner or operator shall implement the plan ... (d) At all times ... the owner or operator ... shall operate and maintain the source incl associated air pollution control equipment in a manner consistent with good air pollution control practice for minimizing emissions of inorganic arsenic to the atmosphere to the maximum extent possible /Inorganic Arsenic/[40 CFR 61.182(b) (7/1/2001)] **PEER REVIEWED**

Listed as a hazardous air pollutant (HAP) generally known or suspected to cause serious health problems. The Clean Air Act, as amended in 1990, directs EPA to set standards requiring major sources to sharply reduce routine emissions of toxic pollutants. EPA is required to establish and phase in specific performance based standards for all air emission sources that emit one or more of the listed pollutants. Arsenic is included on this list.[Clean Air Act as amended in 1990, Sect. 112 (b) (1) Public Law 101-549 Nov. 15, 1990] **PEER REVIEWED**

CLEAN WATER ACT REQUIREMENTS:

For the maximum protection of human health from the potential carcinogenic

download.txt

effects due to exposure of arsenic through ingestion of contaminated water
& contaminated aquatic organisms, the ambient water concn should be zero based on the nonthreshold assumption for this chemical. However, zero level may not be attainable at the present time. Therefore, the levels which may result in incremental increase of cancer risk over the lifetime are estimated at 1×10^{-5} , 1×10^{-6} , & 1×10^{-7} . The corresponding criteria are 22 ng/l, 2.2 ng/l, & .22 ng/l, respectively For consumption of aquatic organisms only, excluding consumption of water, the levels are 175 ng/ml, 17.5 ng/l, & 1.75 ng/l, respectively.
/Arsenic/[USEPA; Quality Criteria for Water 1986: Arsenic: Human Health Criteria (May 1, 1986) EPA 440/5-86-001] **QC REVIEWED**

Toxic pollutant designated pursuant to section 307(a)(1) of the Federal Water Pollution Control Act and is subject to effluent limitations.
/Arsenic & compd/[40 CFR 401.15 (7/1/2001)] **QC REVIEWED**

D004; A solid waste containing arsenic may or may not become characterized as a hazardous waste when subjected to the Toxicity Characteristic Leaching Procedure listed in 40 CFR 261.24, and if so characterized, must be managed as a hazardous waste.[40 CFR 261.24 (7/1/2001)] **QC REVIEWED**

FEDERAL DRINKING WATER STANDARDS:

Maximum Contaminant Level: 0.010 mg/L /Arsenic/[40 CFR 141.62 (USEPA); U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of June 9, 2009: <http://www.gpoaccess.gov/ecfr>] **QC REVIEWED**

10 ug/L[USEPA/Office of Water; Federal-State Toxicology and Risk Analysis Committee (FSTRAC). Summary of State and Federal Drinking Water Standards and Guidelines (11/93) To Present] **QC REVIEWED**

STATE DRINKING WATER GUIDELINES:

download.txt

(AZ) ARIZONA 10 ug/L[USEPA/Office of Water; Federal-State
Toxicology and
Risk Analysis Committee (FSTRAC). Summary of State and
Federal
Drinking Water Standards and Guidelines (11/93) To Present]

**QC

REVIEWED**

(CT) CONNECTICUT 10 ug/L[USEPA/Office of Water; Federal-State
Toxicology
and Risk Analysis Committee (FSTRAC). Summary of State and
Federal
Drinking Water Standards and Guidelines (11/93) To Present]

**QC

REVIEWED**

FDA REQUIREMENTS:

Tolerances for total residues of combined arsenic (calculated
as As) in
food are established as follows: (a) In edible tissues & in
eggs of
chickens & turkeys: 0.5 ppm in uncooked muscle tissue; 2
ppm in
uncooked edible by-products; & 0.5 ppm in eggs. (b) In
edible tissues
of swine: 2 ppm in uncooked liver & kidney; 0.5 ppm in
uncooked muscle
tissue & by-products other than liver & kidney.
/Arsenic/[21 CFR
556.60 (4/1/2001)] **PEER REVIEWED**

ALLOWABLE TOLERANCES:

Tolerances for total residues of combined arsenic (calculated
as As) in
food are established as follows: (a) In edible tissues & in
eggs of
chickens & turkeys: 0.5 ppm in uncooked muscle tissue; 2
ppm in
uncooked edible by-products; & 0.5 ppm in eggs. (b) In
edible tissues
of swine: 2 ppm in uncooked liver & kidney; 0.5 ppm in
uncooked muscle
tissue & by-products other than liver & kidney.
/Arsenic/[21 CFR
556.60 (4/1/2001)] **PEER REVIEWED**

CHEMICAL/PHYSICAL PROPERTIES:

MOLECULAR FORMULA:

AS **PEER REVIEWED**

MOLECULAR WEIGHT:

74.9216[Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 134] **PEER REVIEWED**

COLOR/FORM:

IT EXISTS IN THREE ALLOTROPIC FORMS, THE YELLOW (ALPHA), BLACK (BETA) AND GREY (GAMMA) FORMS[International Labour Office. Encyclopedia of Occupational Health and Safety. Volumes I and II. New York: McGraw-Hill Book Co., 1971., p. 115] **PEER REVIEWED**

Silver-gray or tin-white, brittle ... solid.[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 97-140. Washington, D.C. U.S. Government Printing Office, 1997., p. 20] **PEER REVIEWED**

Allotropic forms: alpha-form, metallic, steel-gray, shiny, brittle, rhombohedral crystal structure; beta-form, dark gray, amorphous solid[Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 135] **PEER REVIEWED**

Yellow, and gray or metallic[Lide, DR (ed.). CRC Handbook of Chemistry and Physics. 81st Edition. CRC Press LLC, Boca Raton: FL 2000, p. 4-4] **PEER REVIEWED**

ODOR:

... Odorless ...[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 97-140. Washington, D.C. U.S. Government Printing Office, 1997., p. 20] **PEER REVIEWED**

TASTE:

NEARLY TASTELESS[Gosselin, R.E., R.P. Smith, H.C. Hodge. Clinical Toxicology of Commercial Products. 5th ed. Baltimore: Williams and Wilkins, 1984., p. III-42] **PEER REVIEWED**

download.txt

CRITICAL TEMPERATURE & PRESSURE:

Critical temperature: 1673 deg K[Weast, R.C. (ed.) Handbook of Chemistry and Physics, 68th ed. Boca Raton, Florida: CRC Press Inc., 1987-1988., p. F-64] **PEER REVIEWED**

Critical pressure: 22.3 MPa[Lide, DR (ed.). CRC Handbook of Chemistry and Physics. 81st Edition. CRC Press LLC, Boca Raton: FL 2000, p. 6-48] **PEER REVIEWED**

DENSITY/SPECIFIC GRAVITY:

5.778 @ 25 deg C[Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 135] **PEER REVIEWED**

HEAT OF VAPORIZATION:

11.2 kcal/g-atom[Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 135] **PEER REVIEWED**

SOLUBILITIES:

Insol in caustic and nonoxidizing acids[Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p. 93] **PEER REVIEWED**

Insoluble in water[Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 135] **PEER REVIEWED**

VAPOR PRESSURE:

7.5X10⁻³ mm Hg @ 280 deg C; 7.5X10⁻² @ 323 deg C; 0.75 mm Hg @ 373 deg C; 7.5 mm Hg @ 433 deg C; 75 mm Hg @ 508 deg C; 750 mm Hg @ 601 deg C[Lide, DR (ed.). CRC Handbook of Chemistry and Physics. 81st Edition. CRC Press LLC, Boca Raton: FL 2000, p. 6-65] **PEER REVIEWED**

OTHER CHEMICAL/PHYSICAL PROPERTIES:

A yellow modification which has no metallic properties is obtained by

download.txt

sudden cooling of arsenic-vapor. This yellow arsenic is converted back to the gray modification upon very short exposure to ultraviolet light.[Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 135] **PEER REVIEWED**

vaporization becomes apparent at 100 deg C and is already rapid at 450 deg C; Brinell hardness: 147; Mohs' scale: 3.5; heat of sublimation: 30.5 kcal/g-atom; 7.63 kcal/g-atom; specific heat: 0.0822 for 0 deg C to 100 deg C; heat of fusion: 22.4 kcal/g-atom; 6.620 kcal/g-atom; not attacked by cold sulfuric acid or hydrochloric acid; converted by HNO₃ or hot H₂SO₄ into arsenous or arsenic acid; dielectric constant: 10.23 @ 20 deg C and 60 cycles[Budavari, S. (ed.). The Merck Index - An Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co., Inc., 1996., p. 135] **PEER REVIEWED**

Triple point: 817 deg C; sublimes at 614 deg C; specific gravity: 1.97 (yellow modification), 5.73 (gray or metallic modification)[Lide, DR (ed.). CRC Handbook of Chemistry and Physics. 81st Edition. CRC Press LLC, Boca Raton: FL 2000, p. 4-4] **PEER REVIEWED**

CHEMICAL SAFETY & HANDLING:

DOT EMERGENCY GUIDELINES:

/GUIDE 152: SUBSTANCES - TOXIC (COMBUSTIBLE)/ Health: Highly toxic, may be fatal if inhaled, swallowed or absorbed through skin. Contact with molten substance may cause severe burns to skin and eyes. Avoid any skin contact. Effects of contact or inhalation may be delayed. Fire may produce irritating, corrosive and/or toxic gases. Runoff from fire control or dilution water may be corrosive and/or toxic and cause pollution.[U.S.

download.txt

Department of Transportation. 2004 Emergency Response
Guidebook. A Guide
book for First Responders During the Initial Phase of a
Dangerous
Goods/Hazardous Materials Incident. Washington, D.C. 2004] **QC
REVIEWED**

/GUIDE 152: SUBSTANCES - TOXIC (COMBUSTIBLE)/ Fire or
Explosion:
Combustible material: may burn but does not ignite readily.
Containers may
explode when heated. Runoff may pollute waterways. Substance
may be
transported in a molten form.[U.S. Department of
Transportation. 2004
Emergency Response Guidebook. A Guide book for First Responders
During the
Initial Phase of a Dangerous Goods/Hazardous Materials
Incident.
Washington, D.C. 2004] **QC REVIEWED**

/GUIDE 152: SUBSTANCES - TOXIC (COMBUSTIBLE)/ Public Safety:
CALL
Emergency Response Telephone Number As an immediate
precautionary
measure, isolate spill or leak area in all directions for at
least 50
meters (150 feet) for liquids and at least 25 meters (75 feet)
for solids.
Keep unauthorized personnel away. Stay upwind. Keep out of low
areas.[U.S.
Department of Transportation. 2004 Emergency Response
Guidebook. A Guide
book for First Responders During the Initial Phase of a
Dangerous
Goods/Hazardous Materials Incident. Washington, D.C. 2004] **QC
REVIEWED**

/GUIDE 152: SUBSTANCES - TOXIC (COMBUSTIBLE)/ Protective
Clothing: wear
positive pressure self-contained breathing apparatus (SCBA).
wear chemical
protective clothing that is specifically recommended by the
manufacturer.
It may provide little or no thermal protection. Structural
firefighters'
protective clothing provides limited protection in fire
situations ONLY;
it is not effective in spill situations where direct contact
with the
substance is possible.[U.S. Department of Transportation. 2004
Emergency

download.txt

Response Guidebook. A Guide book for First Responders During
the Initial
Phase of a Dangerous Goods/Hazardous Materials Incident.
Washington, D.C.
2004] **QC REVIEWED**

/GUIDE 152: SUBSTANCES - TOXIC (COMBUSTIBLE)/ Evacuation: ...
Fire: If
tank, rail car or tank truck is involved in a fire, ISOLATE for
800 meters
(1/2 mile) in all directions; also, consider initial evacuation
for 800
meters (1/2 mile) in all directions.[U.S. Department of
Transportation.
2004 Emergency Response Guidebook. A Guide book for First
Responders
During the Initial Phase of a Dangerous Goods/Hazardous
Materials
Incident. Washington, D.C. 2004] **QC REVIEWED**

/GUIDE 152: SUBSTANCES - TOXIC (COMBUSTIBLE)/ Fire: Small
fires: Dry
chemical, CO2 or water spray. Large fires: water spray, fog or
regular
foam. Move containers from fire area if you can do it without
risk. Dike
fire control water for later disposal; do not scatter the
material. Use
water spray; do not use straight streams. Fire involving tanks
or
car/trailer loads: Fight fire from maximum distance or use
unmanned hose
holders or monitor nozzles. Do not get water inside containers.
Cool
containers with flooding quantities of water until well after
fire is out.
Withdraw immediately in case of rising sound from venting
safety devices
or discoloration of tank. ALWAYS stay away from tanks engulfed
in fire.
For massive fire, use unmanned hose holders or monitor nozzles;
if this is
impossible, withdraw from area and let fire burn.[U.S.
Department of
Transportation. 2004 Emergency Response Guidebook. A Guide book
for First
Responders During the Initial Phase of a Dangerous
Goods/Hazardous
Materials Incident. Washington, D.C. 2004] **QC REVIEWED**

/GUIDE 152: SUBSTANCES - TOXIC (COMBUSTIBLE)/ Spill or Leak:
ELIMINATE all

download.txt

ignition sources (no smoking, flares, sparks or flames in immediate area).

Do not touch damaged containers or spilled material unless wearing

appropriate protective clothing. Stop leak if you can do it without risk.

Prevent entry into waterways, sewers, basements or confined areas. Cover

with plastic sheet to prevent spreading . Absorb or cover with dry earth,

sand or other non-combustible material and transfer to containers. DO NOT

GET WATER INSIDE CONTAINERS.[U.S. Department of Transportation. 2004

Emergency Response Guidebook. A Guide book for First Responders During the

Initial Phase of a Dangerous Goods/Hazardous Materials Incident.

Washington, D.C. 2004] **QC REVIEWED**

/GUIDE 152: SUBSTANCES - TOXIC (COMBUSTIBLE)/ First Aid: Move victim to

fresh air. Call 911 or emergency medical service. Give artificial

respiration if victim is not breathing. Do not use mouth-to-mouth method

if victim ingested or inhaled the substance; give artificial respiration

with the aid of a pocket mask equipped with a one-way valve or other

proper respiratory medical device. Administer oxygen if breathing is

difficult. Remove and isolate contaminated clothing and shoes. In case of

contact with substance, immediately flush skin or eyes with running water

for at least 20 minutes. For minor skin contact, avoid spreading material

on unaffected skin. Keep victim warm and quiet. Effects of exposure

(inhalation, ingestion or skin contact) to substance may be delayed.

Ensure that medical personnel are aware of the material(s) involved and

take precautions to protect themselves.[U.S. Department of Transportation.

2004 Emergency Response Guidebook. A Guide book for First Responders

During the Initial Phase of a Dangerous Goods/Hazardous Materials

Incident. Washington, D.C. 2004] **QC REVIEWED**

FIRE POTENTIAL:

CAN BE HEATED TO BURN IN AIR WITH BLUISH FLAME, GIVING OFF AN ODOR OF

GARLIC AND DENSE WHITE FUMES OF ARSENIC TRIOXIDE (AS₂O₃). [The Merck Index.

10th ed. Rahway, New Jersey: Merck Co., Inc., 1983., p. 116]

**PEER

REVIEWED**

FIRE HAZARD: MODERATE IN FORM OF DUST WHEN EXPOSED TO HEAT OR FLAME OR BY

CHEMICAL REACTION WITH POWERFUL OXIDIZERS ... [Lewis, R.J.

Sax's

Dangerous Properties of Industrial Materials. 9th ed. Volumes 1-3. New

York, NY: Van Nostrand Reinhold, 1996., p. 271] **PEER

REVIEWED**

FIRE FIGHTING PROCEDURES:

If material involved in fire: Extinguish fire using agent suitable for

type of surrounding fire. (Material itself does not burn or burns with

difficulty.) Use water in flooding quantities as fog. Use foam, dry

chemical, or carbon dioxide. /Arsenical compd, liquid, NOS/[Association of

American Railroads. Emergency Handling of Hazardous Materials in Surface

Transportation. Washington, DC: Association of American Railroads, Bureau

of Explosives, 1994., p. 104] **PEER REVIEWED**

If material involved in fire: Extinguish fire using agent suitable for

type of surrounding fire. (Material itself does not burn or burns with

difficulty.) Use water in flooding quantities as fog. Use foam, dry

chemical, or carbon dioxide. /Arsenical compd, solid, NOS/[Association of

American Railroads. Emergency Handling of Hazardous Materials in Surface

Transportation. Washington, DC: Association of American Railroads, Bureau

of Explosives, 1994., p. 105] **PEER REVIEWED**

Personnel protection: ... Wear positive pressure self-contained breathing

apparatus when fighting fires involving this material.

/Arsenical compd,

solid, NOS/[Association of American Railroads. Emergency

Handling of
Hazardous Materials in Surface Transportation. Washington, DC:
Association
of American Railroads, Bureau of Explosives, 1994., p. 105]

**PEER
REVIEWED**

TOXIC COMBUSTION PRODUCTS:

Fire may produce poisonous or irritating gases.[Kayser, R., D.
Sterling,
D. Viviani (eds.). Intermedia Priority Pollutant Guidance
Documents.
Washington, DC: U.S.Environmental Protection Agency, July
1982., p. 8-1]

PEER REVIEWED

When arsenic is heated in air it will burn and form a white
smoke
consisting of arsenic trioxide (As_2O_3).[International Labour
Office.
Encyclopedia of Occupational Health and Safety. vols. I&II.
Geneva,
Switzerland: International Labour Office, 1983., p. 179] **PEER
REVIEWED**

EXPLOSIVE LIMITS & POTENTIAL:

SLIGHTLY EXPLOSIVE IN THE FORM OF DUST WHEN EXPOSED TO
FLAME.[Lewis, R.J.
Sax's Dangerous Properties of Industrial Materials. 9th ed.
Volumes 1-3.
New York, NY: Van Nostrand Reinhold, 1996., p. 271] **PEER
REVIEWED**

HAZARDOUS REACTIVITIES & INCOMPATIBILITIES:

Arsine is formed when any inorganic arsenic bearing material is
brought in
contact with zinc and sulfuric acid.[Kirk-Othmer Encyclopedia
of Chemical
Technology. 3rd ed., volumes 1-26. New York, NY: John Wiley and
Sons,
1978-1984., p. 3(78) 252] **PEER REVIEWED**

Arsine may be accidentally formed by the reaction of arsenic
impurities in
commercial acids stored in metal tanks. ...[Kirk-Othmer
Encyclopedia of
Chemical Technology. 3rd ed., volumes 1-26. New York, NY: John
wiley and
Sons, 1978-1984., p. 3(78) 252] **PEER REVIEWED**

... The /bromine azide/ liquid explodes on contact with
arsenic.

...[Bretherick, L. Handbook of Reactive Chemical Hazards. 4th ed. Boston, MA: Butterworth-Heinemann Ltd., 1990, p. 50] **PEER REVIEWED**

... /Rubidium acetylide/ ignites with arsenic. ...[Bretherick, L. Handbook of Reactive Chemical Hazards. 4th ed. Boston, MA: Butterworth-Heinemann Ltd., 1990, p. 328] **PEER REVIEWED**

Incandescence is caused by contact with ... arsenic /and bromine trifluoride/. [Bretherick, L. Handbook of Reactive Chemical Hazards. 4th ed. Boston, MA: Butterworth-Heinemann Ltd., 1990, p. 91] **PEER REVIEWED**

The finely powdered element /arsenic/ inflames in gaseous chlorine or liquid chlorine. [Bretherick, L. Handbook of Reactive Chemical Hazards. 4th ed. Boston, MA: Butterworth-Heinemann Ltd., 1990, p. 50] **PEER REVIEWED**

Bromine pentafluoride ... /contact/ with ... /arsenic/ at ambient or slightly elevated temperatures is violent, ignition often occurring. ...[Bretherick, L. Handbook of Reactive Chemical Hazards. 4th ed. Boston, MA: Butterworth-Heinemann Ltd., 1990, p. 92] **PEER REVIEWED**

Chlorine trifluoride is a hypergolic oxidizer with recognized fuels, and contact with arsenic at ambient or slightly elevated temperatures is violent, ignition often occurring. [Bretherick, L. Handbook of Reactive Chemical Hazards. 4th ed. Boston, MA: Butterworth-Heinemann Ltd., 1990, p. 944] **PEER REVIEWED**

Palladium or zinc & arsenic react on heating with evolution of heat & light, & platinum with vivid incandescence. [Bretherick, L. Handbook of Reactive Chemical Hazards. 4th ed. Boston, MA: Butterworth-Heinemann Ltd., 1990, p. 50] **PEER REVIEWED**

... /Arsenic/ will initiate the violent and often explosive decomposition of nitrogen trichloride. [Bretherick, L. Handbook of Reactive

Chemical

Hazards. 4th ed. Boston, MA: Butterworth-Heinemann Ltd., 1990, p. 1041]

PEER REVIEWED

A finely divided mixture with excess nitrate ignited when shaken out on to paper.[Bretherick, L. Handbook of Reactive Chemical Hazards. 4th ed.

Boston, MA: Butterworth-Heinemann Ltd., 1990, p. 12] **PEER REVIEWED**

The heat sensitivity of dichlorine oxide may explain the explosions which

occur on contact of arsenic with this powerful oxidant.[Bretherick, L.

Handbook of Reactive Chemical Hazards. 4th ed. Boston, MA: Butterworth-Heinemann Ltd., 1990, p. 1023] **PEER REVIEWED**

... Readily oxidizable materials (arsenic) form explosive mixtures /with

sodium peroxide/. [Bretherick, L. Handbook of Reactive Chemical Hazards.

4th ed. Boston, MA: Butterworth-Heinemann Ltd., 1990, p. 1383]

**PEER

REVIEWED**

An explosive variety (or compd) of arsenic was produced as surface layer on

exposed iron surface of corroded lead-lined vessel which contained 35%

sulfuric acid with high arsenic content.[Bretherick, L. Handbook of

Reactive Chemical Hazards. 4th ed. Boston, MA:

Butterworth-Heinemann Ltd., 1990, p. 50] **PEER REVIEWED**

... /Arsenic/ explodes on grinding in a mortar with the solid /potassium

permanganate/. ... [Bretherick, L. Handbook of Reactive Chemical Hazards.

4th ed. Boston, MA: Butterworth-Heinemann Ltd., 1990, p. 1296]

**PEER

REVIEWED**

Flammable in the form of dust when exposed to heat or flame or by chemical

reaction with powerful oxidizers such as bromates, chlorates, iodates,

peroxides, lithium, NCl_3 , KNO_3 , KMnO_4 , Rb_2C_2 , AgNO_4 , NOCl , IF_5 , CrO_3 ,

ClF_3 , ClO , BrF_3 , BrF_5 , BrN_3 , RbC_3BCH , CsC_3BCH . Slightly

download.txt

explosive in the
form of dust when exposed to flame. When heated or on contact
with acid or
acid fumes, it emits highly toxic fumes; can react vigorously
on contact
with oxidizing materials. Incompatible with bromine azide,
dirubidium
acetylide, halogens, palladium, zinc, platinum, NCl_3 , AgNO_3 ,
 CrO_3 , Na_2O_2 ,
hexafluoroisopropylideneamino lithium. [Lewis, R.J. Sax's
Dangerous
Properties of Industrial Materials. 9th ed. volumes 1-3. New
York, NY: Van
Nostrand Reinhold, 1996., p. 271] **PEER REVIEWED**

... WHEN WATER SOLN OF ARSENICALS ARE IN CONTACT WITH ACTIVE
METALS SUCH
AS ARSENIC, IRON, ALUMINUM, ZINC, ... HIGHLY TOXIC FUMES OF
ARSENIC
/INCLUDING ARSINE ARE RELEASED/. /ARSENIC CMPD/[Lewis, R.J.
Sax's
Dangerous Properties of Industrial Materials. 9th ed. volumes
1-3. New
York, NY: Van Nostrand Reinhold, 1996., p. 275] **PEER
REVIEWED**

Strong oxidizers, bromide azide [Note: Hydrogen gas can react
with
inorganic arsenic to form the highly toxic gas arsine.]
/Arsenic
(inorganic compounds, as As)/[NIOSH. NIOSH Pocket Guide to
Chemical
Hazards. DHHS (NIOSH) Publication No. 97-140. Washington, D.C.
U.S.
Government Printing Office, 1997., p. 20] **PEER REVIEWED**

HAZARDOUS DECOMPOSITION:
When arsenic is heated in air it will burn and form a white
smoke
consisting of arsenic trioxide (As_2O_3). [International Labour
Office.
Encyclopedia of Occupational Health and Safety. vols. I&II.
Geneva,
Switzerland: International Labour Office, 1983., p. 179] **PEER
REVIEWED**

DANGEROUS WHEN HEATED TO DECOMP ... IT EMITS TOXIC FUMES OF
ARSENIC /SRP:
INCLUDING ARSINE/. /ARSENIC CMPD/[Lewis, R.J. Sax's Dangerous
Properties
of Industrial Materials. 9th ed. volumes 1-3. New York, NY: Van
Nostrand

download.txt

Reinhold, 1996., p. 275] **PEER REVIEWED**

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH:

5 mg/cu m (as AS); NIOSH considers arsenic (inorganic cmpd, as AS) to be a potential occupational carcinogen. /Arsenic (inorganic cmpd, as AS)/[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 97-140. Washington, D.C. U.S. Government Printing Office, 1997., p. 20] **PEER REVIEWED**

PROTECTIVE EQUIPMENT & CLOTHING:

Wear appropriate personal protective clothing to prevent skin contact.[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 97-140. Washington, D.C. U.S. Government Printing Office, 1997., p. 21] **PEER REVIEWED**

Wear appropriate eye protection to prevent eye contact.[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 97-140. Washington, D.C. U.S. Government Printing Office, 1997., p. 21] **PEER REVIEWED**

Eyewash fountains should be provided in areas where there is any possibility that workers could be exposed to the substance; this is irrespective of the recommendation involving the wearing of eye protection.[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 97-140. Washington, D.C. U.S. Government Printing Office, 1997., p. 21] **PEER REVIEWED**

Facilities for quickly drenching the body should be provided within the immediate work area for emergency use where there is a possibility of exposure. [Note: It is intended that these facilities provide a sufficient quantity or flow of water to quickly remove the substance from any body areas likely to be exposed. The actual determination of what constitutes an adequate quick drench facility depends on the specific circumstances. In certain instances, a deluge shower should be readily

available, whereas
in others, the availability of water from a sink or hose could
be
considered adequate.][NIOSH. NIOSH Pocket Guide to Chemical
Hazards. DHHS
(NIOSH) Publication No. 97-140. Washington, D.C. U.S.
Government Printing
Office, 1997., p. 21] **PEER REVIEWED**

Recommendations for respirator selection. Condition: At
concentrations
above the NIOSH REL, or where there is no REL, at any
detectable
concentration. Respirator Class(es): Any self-contained
breathing
apparatus that has a full facepiece and is operated in a
pressure-demand
or other positive pressure mode. Any supplied-air respirator
that has a
full facepiece and is operated in pressure-demand or other
positive
pressure mode in combination with an auxiliary self-contained
breathing
apparatus operated in pressure-demand or other positive
pressure
mode.[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS
(NIOSH)
Publication No. 97-140. Washington, D.C. U.S. Government
Printing Office,
1997., p. 21] **PEER REVIEWED**

Recommendations for respirator selection. Condition: Escape
from suddenly
occurring respiratory hazards: Respirator Class(es): Any
air-purifying,
full-facepiece respirator (gas mask) with a chin-style, front-
or
back-mounted acid gas canister having a high-efficiency
particulate
filter. Any appropriate escape-type, self-contained breathing
apparatus.[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS
(NIOSH)
Publication No. 97-140. Washington, D.C. U.S. Government
Printing Office,
1997., p. 21] **PEER REVIEWED**

wear mechanical filter respirator with hard rubber frame and
surgical
sheet wadding over nose and cheeks, ... boots, and long-sleeved
coveralls.
/Arsenic/[ITII. Toxic and Hazardous Industrial Chemicals Safety
Manual.

download.txt

Tokyo, Japan: The International Technical Information
Institute, 1982., p.
51] **PEER REVIEWED**

PREVENTIVE MEASURES:

SRP: Contaminated protective clothing should be segregated in such a manner so that there is no direct personal contact by personnel who handle, dispose, or clean the clothing. Quality assurance to ascertain the completeness of the cleaning procedures should be implemented before the decontaminated protective clothing is returned for reuse by the workers. All contaminated clothing should not be taken home at end of shift, but should remain at employee's place of work for cleaning. **PEER REVIEWED**

Engineering controls are recommended to maintain arsenic concn below the occupational environment limit. Compliance should not be achieved by the use of respirators except during the time period necessary to install or test the required engineering controls, for nonroutine operations (such as a brief exposure to concn in excess of the limit as a result of maintenance or repair activities), or during emergencies when air concn of arsenic exceed the limit.[NIOSH; Current Intelligence Bulletin Inorganic Arsenic-Respiratory Protection #14 p.2 (1976)] **PEER REVIEWED**

Shower baths shall be cleaned following use after each work shift. /Inorganic arsenic/[NIOSH; Criteria Document: Inorganic Arsenic p.9 (1975)
DHEW Pub. NIOSH 75-149] **PEER REVIEWED**

Arsine may be accidentally formed by the reaction of arsenic impurities in commercial acids stored in metal tanks, so that a test should be made for arsine before entry is made into such vessels.[Kirk-Othmer Encyclopedia of Chemical Technology. 3rd ed., volumes 1-26. New York, NY: John Wiley and Sons, 1978-1984., p. 3(78) 252] **PEER REVIEWED**

download.txt

SRP: The scientific literature for the use of contact lenses in industry is conflicting. The benefit or detrimental effects of wearing contact lenses depend not only upon the substance, but also on factors including the form of the substance, characteristics and duration of the exposure, the uses of other eye protection equipment, and the hygiene of the lenses.

However, there may be individual substances whose irritating or corrosive properties are such that the wearing of contact lenses would be harmful to the eye. In those specific cases, contact lenses should not be worn. In any event, the usual eye protection equipment should be worn even when contact lenses are in place. **PEER REVIEWED**

IN PLANTS WITH ARSENIC HAZARD, FLOORS ... SHOULD BE ... IMPERMEABLE ... TO PREVENT ABSORPTION & ... FLUSHED DOWN FREQUENTLY WITH WATER. WORKROOM SHOULD BE WELL VENTILATED & ALL POISONOUS FUMES SHOULD BE CONDENSED & DUST CONTENT REMOVED. ... EXHAUST HOODS ... WORKTABLES ... EQUIPPED WITH DOWN DRAFT ... VENTILATION.[International Labour Office. Encyclopedia of Occupational Health and Safety. Volumes I and II. New York: McGraw-Hill Book Co., 1971., p. 117] **PEER REVIEWED**

The worker should immediately wash the skin when it becomes contaminated.[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 97-140. Washington, D.C. U.S. Government Printing Office, 1997., p. 21] **PEER REVIEWED**

The worker should wash daily at the end of each work shift.[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 97-140. Washington, D.C. U.S. Government Printing Office, 1997., p. 21] **PEER REVIEWED**

work clothing that becomes wet or significantly contaminated should be removed and replaced.[NIOSH. NIOSH Pocket Guide to Chemical

Hazards. DHHS

(NIOSH) Publication No. 97-140. Washington, D.C. U.S.
Government Printing
Office, 1997., p. 21] **PEER REVIEWED**

Workers whose clothing may have become contaminated should
change into
uncontaminated clothing before leaving the work
premises.[NIOSH. NIOSH
Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No.
97-140.
Washington, D.C. U.S. Government Printing Office, 1997., p. 21]
**PEER
REVIEWED**

IN ... /FACTORIES/ WITH ARSENIC HAZARD, FLOORS ... SHOULD BE
...
IMPERMEABLE ... TO PREVENT ABSORPTION & ... FLUSHED DOWN
FREQUENTLY
WITH WATER. /ARSENIC CMPD/[Budavari, S. (ed.). The Merck Index
-
Encyclopedia of Chemicals, Drugs and Biologicals. Rahway, NJ:
Merck and
Co., Inc., 1989., p. 117] **PEER REVIEWED**

Lockers should be provided with separate compartments for work
&
personal clothes, & adjacent sanitary facilities of a high
standard
should be made available. Smoking, eating, & drinking at
the workplace
should not be allowed. /Arsenic & cmpd/[International
Labour Office.
Encyclopedia of Occupational Health and Safety. vols. I&II.
Geneva,
Switzerland: International Labour Office, 1983., p. 182] **PEER
REVIEWED**

Clean work clothes should be supplied daily and the workers
should shower
prior to changing to street clothes. /Arsenic and arsenic
cmpd/[Sittig, M.
Handbook of Toxic and Hazardous Chemicals and Carcinogens,
1985. 2nd ed.
Park Ridge, NJ: Noyes Data Corporation, 1985., p. 89] **PEER
REVIEWED**

SRP: Contaminated protective clothing should be segregated in
such a
manner so that there is no direct personal contact by personnel
who
handle, dispose, or clean the clothing. Quality assurance to

download.txt

ascertain the completeness of the cleaning procedures should be implemented before the decontaminated protective clothing is returned for reuse by the workers. Contaminated clothing should not be taken home at end of shift, but should remain at employee's place of work for cleaning. **PEER REVIEWED**

STABILITY/SHELF LIFE:

LOSES ITS LUSTER ON EXPOSURE TO AIR, FORMING A BLACK MODIFICATION + AS203[The Merck Index. 10th ed. Rahway, New Jersey: Merck Co., Inc., 1983., p. 116] **PEER REVIEWED**

SHIPMENT METHODS AND REGULATIONS:

No person may /transport,/ offer or accept a hazardous material for transportation in commerce unless that person is registered in conformance ... and the hazardous material is properly classed, described, packaged, marked, labeled, and in condition for shipment as required or authorized by ... /the hazardous materials regulations (49 CFR 171-177)./[49 CFR 171.2; U.S. National Archives and Records Administration's Electronic Code of Federal Regulations. Available from, as of February 15, 2006: <http://www.gpoaccess.gov/ecfr/>] **QC REVIEWED**

The International Air Transport Association (IATA) Dangerous Goods

Regulations are published by the IATA Dangerous Goods Board pursuant to IATA Resolutions 618 and 619 and constitute a manual of industry carrier regulations to be followed by all IATA Member airlines when transporting hazardous materials.[International Air Transport Association. Dangerous Goods Regulations. 47th Edition. Montreal, Quebec Canada. 2006., p. 144] **QC REVIEWED**

The International Maritime Dangerous Goods Code lays down basic principles for transporting hazardous chemicals. Detailed recommendations

download.txt

individual substances and a number of recommendations for good practice are included in the classes dealing with such substances. A general index of technical names has also been compiled. This index should always be consulted when attempting to locate the appropriate procedures to be used when shipping any substance or article.[International Maritime Organization. International Maritime Dangerous Goods Code. London, UK. 2004., p. 73] **QC REVIEWED**

CLEANUP METHODS:

Solvent extraction with high molecular weight amines and quaternary ammonium compounds may be a promising technique for the removal of toxic elements like ... arsenic ... from industrial effluents.[De AK et al; Indian J Chem Sect A Inorg Phys Theor Anal 23 (2): 140-2 (1984)] **PEER REVIEWED**

Prompt cleanup and removal are necessary. Control runoff and isolate discharged material for proper disposal.[Fire Protection Guide to Hazardous Materials. 12 ed. Quincy, MA: National Fire Protection Association, 1997., p. 49-23] **PEER REVIEWED**

DISPOSAL METHODS:

SRP: At the time of review, criteria for land treatment or burial (sanitary landfill) disposal practices are subject to significant revision. Prior to implementing land disposal of waste residue (including waste sludge), consult with environmental regulatory agencies for guidance on acceptable disposal practices. **PEER REVIEWED**

Arsenic elemental arsenic wastes should be placed in long term storage or returned to suppliers or manufacturers for reprocessing.[Sittig, M. Handbook of Toxic and Hazardous Chemicals and Carcinogens, 1985. 2nd ed. Park Ridge, NJ: Noyes Data Corporation, 1985., p. 89] **PEER REVIEWED**

download.txt

Arsenic bearing sludges from the purification process in the production of antimony oxide are poor candidates for incineration.[USEPA; Engineering Handbook for Hazardous Waste Incineration p.3-19 (1981) EPA 68-03-3025]

PEER REVIEWED

An analysis of the health hazards associated with the operation of municipal sludge incinerators was done on the multiple hearth incinerator design, which comprises approximately 80 percent of the total number of sludge incinerators in the USA. Parameters discussed included sludge rate contaminant concentration, source characteristics, emission estimates, dispersion parameters, and health risk values.

Estimates of environmental contamination by cadmium, chromium, copper, nickel, lead, and zinc due to emission loss from the incinerator were calculated. In addition, the human cancer risk (calculated as the effect index) associated with inhalation of incinerator emissions was calculated. The index values were greater than unity for arsenic, beryllium, cadmium, chromium, mercury, nickel, and lead.[Fradkin L et al; J Air Pollution Control Assoc 37 (4): 395-9 (1987)]

PEER REVIEWED

The following wastewater treatment technology has been investigated for

arsenic: Concentration process: Activated Carbon.

/Arsenic/[USEPA;

Management of Hazardous Waste Leachate, EPA Contract

No.68-03-2766 p.E-162

(1982)] **PEER REVIEWED**

The following wastewater treatment technology has been investigated for

arsenic: Concentration process: Miscellaneous Sorbents.

/Arsenic/[USEPA;

Management of Hazardous Waste Leachate, EPA Contract

No.68-03-2766 p.E-202

(1982)] **PEER REVIEWED**

Dissolve in a minimum amt of concentrated hydrochloric acid.
Add to water

download.txt

until the appearance of white precipitate. Add 6M-HCl just to dissolve again. Saturate with hydrogen sulfide. After filtration, wash the precipitate, dry, package and return to suppliers.
/Arsenic/[ITII. Toxic and Hazarous Industrial Chemicals Safety Manual. Tokyo, Japan: The International Technical Information Institute, 1982., p. 51]
PEER REVIEWED

Generators of waste (equal to or greater than 100 kg/mo) containing this contaminant, EPA hazardous waste number D004, must conform with USEPA regulations in storage, transportation, treatment and disposal of waste.
/Arsenic/[40 CFR 240-280, 300-306, 702-799 (7/1/2000)] **PEER REVIEWED**

The following wastewater treatment technology has been investigated for arsenic: Concentration process: Chemical Precipitation.
/Arsenic/[USEPA; Management of Hazardous Waste Leachate, EPA Contract No.68-03-2766 p.E-68 (1982)] **PEER REVIEWED**

OCCUPATIONAL EXPOSURE STANDARDS:

OSHA STANDARDS:

8 hr Time-Weighted avg: 10 ug/cu m./Arsenic, inorganic cmpd (as As)/[29 CFR 1910.1018 (7/1/2001)] **PEER REVIEWED**

THRESHOLD LIMIT VALUES:

8 hr Time weighted Avg (TWA) 0.01 mg/cu m /Arsenic and inorganic compounds, as As/[American Conference of Governmental Industrial Hygienists TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH, 2008, p. 12] **QC REVIEWED**

Excursion Limit Recommendation: Excursions in worker exposure levels may exceed 3 times the TLV-TWA for no more than a total of 30

minutes during a work day, and under no circumstances should they exceed 5 times the TLV-TWA, provided that the TLV-TWA is not exceeded. /Arsenic and inorganic compounds, as As/[American Conference of Governmental Industrial Hygienists TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH, 2008, p. 5] **QC REVIEWED**

A1: Confirmed human carcinogen. /Arsenic and inorganic compounds, as As/[American Conference of Governmental Industrial Hygienists TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH, 2008, p. 12] **QC REVIEWED**

BEI (Biological Exposure Index): Determinant: Inorganic arsenic plus methylated metabolites in urine; Sampling Time: end of workweek; BEI: 35 ug As/L. The determinant may be present in biological specimens collected from subjects who have not been occupationally exposed, at a concentration which could affect interpretation of the result. Such background concentrations are incorporated in the BEI value. /Arsenic, elemental and soluble inorganic compounds/[American Conference of Governmental Industrial Hygienists TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. Cincinnati, OH, 2008, p. 102] **QC REVIEWED**

NIOSH RECOMMENDATIONS:
5 mg/cu m (as As); NIOSH considers arsenic (inorganic cmpd, as As) to be a potential occupational carcinogen. /Arsenic (inorganic cmpd, as As)/[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS (NIOSH) Publication No. 97-140. Washington, D.C. U.S. Government Printing Office, 1997., p. 20] **PEER REVIEWED**

download.txt

Recommended Exposure Limit: 15 Ceiling Limit: (0.002 mg/cu m).
/Arsenic
(inorganic cmpd, as As)/[NIOSH. NIOSH Pocket Guide to Chemical
Hazards.
DHHS (NIOSH) Publication No. 97-140. Washington, D.C. U.S.
Government
Printing Office, 1997., p. 20] **PEER REVIEWED**

NIOSH usually recommends that occupational exposures to
carcinogens be
limited to the lowest feasible concentration. /Arsenic
(inorganic
compounds, as As)/[NIOSH. NIOSH Pocket Guide to Chemical
Hazards. DHHS
(NIOSH) Publication No. 97-140. Washington, D.C. U.S.
Government Printing
Office, 1997., p. 20] **PEER REVIEWED**

IMMEDIATELY DANGEROUS TO LIFE OR HEALTH:

5 mg/cu m (as AS); NIOSH considers arsenic (inorganic cmpd, as
As) to be a
potential occupational carcinogen. /Arsenic (inorganic cmpd, as
As)/[NIOSH. NIOSH Pocket Guide to Chemical Hazards. DHHS
(NIOSH)
Publication No. 97-140. Washington, D.C. U.S. Government
Printing Office,
1997., p. 20] **PEER REVIEWED**

OTHER STANDARDS REGULATIONS AND GUIDELINES:

... The following countries had adopted the ... TLV of 0.5
mg/cu m:
Austria, Belgium, Finland, Japan, and Holland. Czechoslovakia,
East
Germany, Hungary and Poland ... USSR ... 0.3 mg/cu m; Romania
and
Switzerland, 0.2 mg/cu m; Sweden 0.05 mg/cu m; and Italy 0.25
mg/cu m.
/Arsenic and sol cmpd/[American Conference of Governmental
Industrial
Hygienists. Documentation of the Threshold Limit Values and
Biological
Exposure Indices. 5th ed. Cincinnati, OH: American Conference
of
Governmental Industrial Hygienists, 1986., p. 37] **PEER
REVIEWED**

MANUFACTURING/USE INFORMATION:

MAJOR USES:

ALLOYING CONSTITUENT[SRI] **PEER REVIEWED**

COMPONENT OF ALLOYS; COMPONENT OF ELECTRICAL DEVICES[SRI]

**PEER

REVIEWED**

In metallurgy for hardening copper, lead, nonferrous alloys;
automotive
body solder; in semiconductor materials; in the manufacture of
low-melting
glass[Budavari, S. (ed.). The Merck Index - An Encyclopedia of
Chemicals,
Drugs, and Biologicals. Whitehouse Station, NJ: Merck and Co.,
Inc.,
1996., p. 116] **PEER REVIEWED**

Wood preservative[Budavari, S. (ed.). The Merck Index - An
Encyclopedia of
Chemicals, Drugs, and Biologicals. Whitehouse Station, NJ:
Merck and Co.,
Inc., 1996., p. 135] **PEER REVIEWED**

Herbicide, pesticide /Former use/[Budavari, S. (ed.). The Merck
Index - An
Encyclopedia of Chemicals, Drugs, and Biologicals. Whitehouse
Station, NJ:
Merck and Co., Inc., 1996., p. 135] **PEER REVIEWED**

To make gallium arsenide for dipoles and other electronic
devices; doping
agent in germanium and silicon solid state products; special
solders;
medicine.[Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical
Dictionary.
13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p.
93] **PEER
REVIEWED**

(76)As radioactive tracer in toxicology[The Merck Index. 10th
ed. Rahway,
New Jersey: Merck Co., Inc., 1983., p. 116] **PEER REVIEWED**

Used as a catalyst in the manufacture of ethylene
oxide.[Kirk-Othmer
Encyclopedia of Chemical Technology. 3rd ed., Volumes 1-26. New
York, NY:
John Wiley and Sons, 1978-1984., p. V9 (1980) 455] **PEER
REVIEWED**

In the manufacture of chemicals; in the manufacture of
photoreceptor
arsenic-selenium alloys for xerographic plain paper copiers; in
III-V

download.txt

compounds, such as InAs, GaAs, AlAs, etc.[Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V3 (1992) 628] **PEER REVIEWED**

Used in semiconductor devices[IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-PRESENT. (Multivolume work). Available at: <http://monographs.iarc.fr/index.php>, p. V23 49 (1980)] **PEER REVIEWED**

MEDICATION **PEER REVIEWED**

MEDICATION (VET) **PEER REVIEWED**

METHODS OF MANUFACTURING:

Arsenic "metal" is produced either by roasting the sulfide to form the oxide and then reducing the oxide with carbon or by heating arsenopyrite in the absence of air. When arsenic containing ores are smelted the arsenic becomes gaseous and burns in air to arsenic trioxide. This is trapped by electrostatic precipitators as a crude dust, which is roasted so as to drive off arsenic trioxide. The purified arsenic trioxide is collected in a cooling chamber.[International Labour Office. Encyclopedia of Occupational Health and Safety. Vols. I&II. Geneva, Switzerland: International Labour Office, 1983., p. 179] **PEER REVIEWED**

Flue dust of copper and lead smelters, from which it is obtained as white arsenic (arsenic trioxide) in varying degrees of purity. This is reduced with charcoal. Commercial grade is not made in the US.[Lewis, R.J., Sr (Ed.). Hawley's Condensed Chemical Dictionary. 13th ed. New York, NY: John Wiley & Sons, Inc. 1997., p. 93] **PEER REVIEWED**

Metallic arsenic can be obtained by the direct smelting of the minerals arsenopyrite or loellingite. The arsenic vapor is sublimed when

download.txt

these

minerals are heated to about 650-700 deg C in the absence of air. The

metal can also be prepared commercially by the reduction of arsenic

trioxide with charcoal. The oxide and charcoal are mixed and placed into a

horizontal steel retort jacketed with firebrick which is then gas-fired.

The reduced arsenic vapor is collected in a water-cooled condenser. In a

process by Boliden Aktuebolag, the steel retort, heated to 700-800 deg C

in an electric furnace, is equipped with a demountable air-cooled

condenser.[Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed.

Volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V3 (1992)

626] **PEER REVIEWED**

GENERAL MANUFACTURING INFORMATION:

Production of arsenic trioxide and metal at the Tacoma, WA, copper smelter

were terminated by the end of 1985.[Bureau of Mines, Mineral Commodity

Summaries p.13 (1987)] **PEER REVIEWED**

China accounts for nearly all the world's production of commercial grade

arsenic metal.[USGS; Mineral Commodity Summaries - Arsenic (1999).

Available from, as of June 15, 2001:

<http://minerals.usgs.gov/minerals/pubs/commodity/arsenic/160499.pdf>

PEER REVIEWED

Since the closure of the last domestic producer of arsenic in 1985, all

arsenic has been derived from imported sources.[USDI; The Materials Flow

of Arsenic in the United States. Washington, DC: Department of the

Interior (1994). Available from, as of June 15, 2001:

<http://greenwood.cr.usgs.gov/pub/min-info-pubs/usbm-ic/ic-9382/arsenic.pdf>

PEER REVIEWED

FORMULATIONS/PREPARATIONS:

Grades: technical; crude (90-95%); refined (99%); semiconductor grade

download.txt

99.999%; single crystals.[Lewis, R.J., Sr (Ed.). Hawley's
Condensed
Chemical Dictionary. 13th ed. New York, NY: John Wiley &
Sons, Inc.
1997., p. 93] **PEER REVIEWED**

Commercial arsenic metal is sold at a typical purity of 99% in
fragment or
lump (5-7.5 cm) form; in high purity (ranging from 99.99% to in
excess of
99.999%+) forms for semiconductor applications; high purity
forms are
normally packaged in fragmented form in evacuated and sealed
glass ampules
to prevent oxidation.[Kirk-Othmer Encyclopedia of Chemical
Technology. 4th
ed. Volumes 1: New York, NY. John Wiley and Sons,
1991-Present., p. V3
(1992) 628] **PEER REVIEWED**

-6 mm to -325 mesh particles size, 99 to 99.999% purity grade;
lumps
99.9999% grade[Kuney, J.H. and J.N. Nullican (eds.)
Chemyclopedia.
Washington, DC: American Chemical Society, 1988., p. 174]
**PEER
REVIEWED**

CONSUMPTION PATTERNS:

90% AS AN ALLOYING ADDITIVE; 7% IN ELECTRONIC DEVICES
(LEAD-BASE BATTERY
GRIDS AND CABLE SHEATHING); 3% AS AN INTERMEDIATE FOR
ARSENICALS USED IN
VETERINARY MEDICINE (1971)[SRI] **PEER REVIEWED**

Approximately 10 tons of high-purity arsenic metal was used /in
1986/ in
the electronics industry for the production of semiconductor
materials.[BUREAU OF MINES. MINERAL COMMODITY SUMMARIES 1987
p.12] **PEER
REVIEWED**

Demand for arsenic metal is limited[Kirk-Othmer Encyclopedia of
Chemical
Technology. 4th ed. Volumes 1: New York, NY. John Wiley and
Sons,
1991-Present., p. V3 (1992) 628] **PEER REVIEWED**

U. S. PRODUCTION:

(1986) No domestic production of arsenic or arsenic
trioxide.[Bureau of
Mines, Mineral Commodity Summaries p.12 (1987)] **PEER

REVIEWED**

U. S. IMPORTS:

(1973) 4.87X10+8 GRAMS (METAL)[SRI] **PEER REVIEWED**

In 1990, the U.S. requirement for metallic arsenic was supplied by the People's Republic of China.[Kirk-Othmer Encyclopedia of Chemical Technology. 4th ed. volumes 1: New York, NY. John Wiley and Sons, 1991-Present., p. V3 (1992) 628] **PEER REVIEWED**

Import sources in 1996-99: China, 87%; Hong Kong, 5%; Japan, 3%; and other, 5%.[USGS; Mineral Commodity Summaries - Arsenic (7440-38-2).

January 2001. Available from, as of April 5, 2001:

<http://minerals.usgs.gov/minerals/pubs/commodity/arsenic/160301.pdf>
PEER REVIEWED

Imports for consumption: (1996) 252 metric tons; (1997) 909 metric tons; (1998) 997 metric tons; (1999) 1,300 metric tons; (2000) 1,000 metric tons.[USGS; Mineral Commodity Summaries - Arsenic (7440-38-2). January 2001. Available from, as of April 5, 2001:

<http://minerals.usgs.gov/minerals/pubs/commodity/arsenic/160301.pdf>
PEER REVIEWED

U. S. EXPORTS:

(1996) 36 metric tons; (1997) 61 metric tons; (1998) 177 metric tons; (1999) 1,350 metric tons; (2000) 40 metric tons.[USGS; Mineral Commodity Summaries - Arsenic (7440-38-2). January 2001. Available from, as of April 5, 2001:

<http://minerals.usgs.gov/minerals/pubs/commodity/arsenic/160301.pdf>
PEER REVIEWED

LABORATORY METHODS:

SPECIAL REFERENCES:

download.txt

SPECIAL REPORTS:

USEPA; Ambient Water Quality Criteria Doc: Arsenic p.A-1 (1980)
EPA
440/5-80-021

U.S. Environmental Protection Agency's Integrated Risk
Information System
(IRIS) on Arsenic, inorganic (7440-38-2).[Available from the
Database
Query page at, as of June 30, 2009:
<http://www.epa.gov/iris/subst/index.html>]

IARC. Monographs on the Evaluation of the Carcinogenic Risk of
Chemicals
to Man. Geneva: World Health Organization, International Agency
for
Research on Cancer, 1972-PRESENT. (Multivolume work). Volume 84
(2004).
Some Drinking-water Disinfectants and Contaminants, including
Arsenic.[Available from, as of July 22, 2009:
<http://monographs.iarc.fr/ENG/Monographs/vol84/volume84.pdf>]

National Toxicology Program. Eleventh Report on Carcinogens
(2005). The
Report on Carcinogens is an informational scientific and public
health
document that identifies and discusses substances (including
agents,
mixtures, or exposure circumstances) that may pose a
carcinogenic hazard
to human health. Inorganic Arsenic Compounds are listed as
known to be
human carcinogens. /Arsenic Compounds, Inorganic/[Available
from, as of
July 31, 2009:
<http://ntp.niehs.nih.gov/ntp/roc/eleventh/profiles/s015arse.pdf>]

SYNONYMS AND IDENTIFIERS:

RELATED HSDB RECORDS:

6994 [ARSENIC COMPOUNDS]

SYNONYMS:

ARSEN[IARC. Monographs on the Evaluation of the Carcinogenic
Risk of
Chemicals to Man. Geneva: World Health Organization,
International Agency
for Research on Cancer, 1972-PRESENT. (Multivolume work).
Page 50

download.txt

Available at:

<http://monographs.iarc.fr/index.php>, p. V23 39 (1980)] **PEER
REVIEWED**

ARSENIC-75 **PEER REVIEWED**

ARSENIC BLACK **PEER REVIEWED**

COLLOIDAL ARSENIC **PEER REVIEWED**

Merck Gray arsenic[The Merck Index. 10th ed. Rahway, New Jersey:
Co.,
Inc., 1983., p. 116] **PEER REVIEWED**

Metallic arsenic **PEER REVIEWED**

FORMULATIONS/PREPARATIONS:

Grades: technical; crude (90-95%); refined (99%); semiconductor
grade
99.999%; single crystals.[Lewis, R.J., Sr (Ed.). Hawley's
Condensed
Chemical Dictionary. 13th ed. New York, NY: John Wiley &
Sons, Inc.
1997., p. 93] **PEER REVIEWED**

Commercial arsenic metal is sold at a typical purity of 99% in
fragment or
lump (5-7.5 cm) form; in high purity (ranging from 99.99% to in
excess of
99.999%+) forms for semiconductor applications; high purity
forms are
normally packaged in fragmented form in evacuated and sealed
glass ampules
to prevent oxidation.[Kirk-Othmer Encyclopedia of Chemical
Technology. 4th
ed. Volumes 1: New York, NY. John Wiley and Sons,
1991-Present., p. V3
(1992) 628] **PEER REVIEWED**

-6 mm to -325 mesh particles size, 99 to 99.999% purity grade;
lumps
99.9999% grade[Kuney, J.H. and J.N. Nullican (eds.)
Chemyclopedia.
Washington, DC: American Chemical Society, 1988., p. 174]
**PEER
REVIEWED**

SHIPPING NAME/ NUMBER DOT/UN/NA/IMO:
UN 1558; Arsenic

IMO 6.1; Arsenic

download.txt

STANDARD TRANSPORTATION NUMBER:

49 232 07; Arsenic, solid (arsenic metallic)

EPA HAZARDOUS WASTE NUMBER:

D004; A waste containing arsenic may or may not be characterized as a hazardous waste following testing by the Toxicity Characteristic Leaching Procedure as prescribed by the Resource Conservation and Recovery Act (RCRA) regulations. /Arsenic/

ADMINISTRATIVE INFORMATION:

HAZARDOUS SUBSTANCES DATABANK NUMBER: 509

LAST REVISION DATE: 20050823

LAST REVIEW DATE: Reviewed by SRP on 9/15/2001

UPDATE HISTORY:

Field Update on 2010-06-02, 4 fields added/edited/deleted

Field Update on 2010-04-27, 1 fields added/edited/deleted

Field Update on 2009-08-12, 2 fields added/edited/deleted

Field Update on 2008-09-02, 2 fields added/edited/deleted

Field Update on 2008-08-15, 25 fields added/edited/deleted

Field Update on 2007-06-07, 1 fields added/edited/deleted

Field Update on 2006-04-18, 2 fields added/edited/deleted

Field Update on 2006-04-17, 2 fields added/edited/deleted

Complete Update on 2005-08-23, 2 fields added/edited/deleted

Field Update on 2005-04-29, 4 fields added/edited/deleted

Complete Update on 02/14/2003, 1 field added/edited/deleted.

Complete Update on 11/08/2002, 1 field added/edited/deleted.

Complete Update on 10/16/2002, 1 field added/edited/deleted.

Complete Update on 06/11/2002, 2 fields added/edited/deleted.

Complete Update on 05/15/2002, 1 field added/edited/deleted.

download.txt

Complete Update on 05/13/2002, 1 field added/edited/deleted.
Complete Update on 03/26/2002, 81 fields added/edited/deleted.
Field Update on 01/14/2002, 1 field added/edited/deleted.
Field Update on 08/08/2001, 1 field added/edited/deleted.
Field Update on 05/16/2001, 1 field added/edited/deleted.
Complete Update on 03/22/2000, 1 field added/edited/deleted.
Complete Update on 02/11/2000, 1 field added/edited/deleted.
Complete Update on 02/08/2000, 1 field added/edited/deleted.
Complete Update on 02/02/2000, 1 field added/edited/deleted.
Complete Update on 11/18/1999, 1 field added/edited/deleted.
Complete Update on 09/21/1999, 1 field added/edited/deleted.
Complete Update on 08/26/1999, 1 field added/edited/deleted.
Complete Update on 07/20/1999, 7 fields added/edited/deleted.
Complete Update on 05/04/1999, 1 field added/edited/deleted.
Complete Update on 03/29/1999, 1 field added/edited/deleted.
Complete Update on 02/11/1999, 1 field added/edited/deleted.
Complete Update on 11/23/1998, 1 field added/edited/deleted.
Complete Update on 11/12/1998, 2 fields added/edited/deleted.
Complete Update on 06/02/1998, 1 field added/edited/deleted.
Complete Update on 03/25/1998, 8 fields added/edited/deleted.
Field Update on 02/25/1998, 1 field added/edited/deleted.
Field Update on 10/17/1997, 1 field added/edited/deleted.
Field Update on 08/11/1997, 5 fields added/edited/deleted.
Field Update on 05/08/1997, 1 field added/edited/deleted.
Field Update on 05/01/1997, 2 fields added/edited/deleted.
Complete Update on 02/26/1997, 1 field added/edited/deleted.

download.txt

Complete Update on 01/24/1997, 1 field added/edited/deleted.
Complete Update on 10/12/1996, 1 field added/edited/deleted.
Complete Update on 06/21/1996, 2 fields added/edited/deleted.
Complete Update on 06/07/1996, 1 field added/edited/deleted.
Complete Update on 05/10/1996, 1 field added/edited/deleted.
Complete Update on 04/09/1996, 8 fields added/edited/deleted.
Field Update on 01/19/1996, 1 field added/edited/deleted.
Complete Update on 07/12/1995, 2 fields added/edited/deleted.
Field Update on 05/26/1995, 1 field added/edited/deleted.
Complete Update on 03/10/1995, 1 field added/edited/deleted.
Complete Update on 01/25/1995, 1 field added/edited/deleted.
Complete Update on 12/21/1994, 1 field added/edited/deleted.
Complete Update on 11/03/1994, 1 field added/edited/deleted.
Complete Update on 09/23/1994, 1 field added/edited/deleted.
Complete Update on 08/17/1994, 1 field added/edited/deleted.
Complete Update on 05/05/1994, 1 field added/edited/deleted.
Complete Update on 03/25/1994, 1 field added/edited/deleted.
Complete Update on 02/02/1994, 1 field added/edited/deleted.
Complete Update on 11/05/1993, 1 field added/edited/deleted.
Complete Update on 10/28/1993, 1 field added/edited/deleted.
Complete Update on 08/07/1993, 1 field added/edited/deleted.
Field update on 12/13/1992, 1 field added/edited/deleted.
Complete Update on 12/02/1992, 1 field added/edited/deleted.
Complete Update on 11/27/1992, 2 fields added/edited/deleted.
Complete Update on 11/25/1992, 1 field added/edited/deleted.
Complete Update on 04/29/1992, 1 field added/edited/deleted.

download.txt

Complete Update on 04/27/1992, 1 field added/edited/deleted.

Complete Update on 04/01/1992, 1 field added/edited/deleted.

Complete Update on 01/23/1992, 1 field added/edited/deleted.

Complete Update on 01/07/1991, 3 fields added/edited/deleted.

Field Update on 01/15/1990, 1 field added/edited/deleted.

Complete Update on 01/11/1990, 3 fields added/edited/deleted.

Complete Update on 07/13/1989, 100 fields added/edited/deleted.

Complete Update on 05/08/1986

Created 19830315 by DS