# SAFETY DATA SHEET

Updated on 03/09/2024

## 1. Material Identification

**Product Name** : 1,4-Dioxane
**Catalog Number** : io-2283
**CAS Number** : 123-91-1
**Identified uses** : Laboratory chemicals, manufacture of chemical compounds
**Company** : Ionz

**>> R&D Use only**

## 2. Hazards Identification

### GHS Classification:

Flammable liquid ( category 2 )
Acute toxicity, oral (Category 3)
Acute toxicity, dermal (Category 3)
Acute toxicity, inhalation (Category 3)
Specific target organ toxicity, single exposure (Category 1)

**Pictogram(s)**

**GHS Hazard Statements**

>> H225 (100%): Highly Flammable liquid and vapor [Danger Flammable liquids]

>> H319 (100%): Causes serious eye irritation [Warning Serious eye damage/eye irritation]

>> H335 (100%): May cause respiratory irritation [Warning Specific target organ toxicity, single exposure; Respiratory tract irritation]

>> H350 (18.78%): May cause cancer [Danger Carcinogenicity]

>> H351 (77.23%): Suspected of causing cancer [Warning Carcinogenicity]

**Precautionary Statement Codes**

>> P203, P210, P233, P240, P241, P242, P243, P261, P264+P265, P271, P280, P303+P361+P353, P304+P340, P305+P351+P338, P318, P319, P337+P317, P370+P378, P403+P233, P403+P235, P405, and P501

**NFPA 704 Diamond**


**NFPA Health Rating**

>> 2 - Materials that, under emergency conditions, can cause temporary incapacitation or residual injury.

**NFPA Fire Rating**

>> 3 - Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials produce hazardous atmospheres with air under almost all ambient temperatures or, though unaffected by ambient temperatures, are readily ignited under almost all conditions.

**NFPA Instability Rating**

>> 1 - Materials that in themselves are normally stable but that can become unstable at elevated temperatures and pressures.

### Health Hazards:

>> No significant irritation from brief exposure of skin; prolonged or repeated exposure may cause a rash or burn and absorption of toxic amounts leading to serious injury of liver and kidney. Chemical has poor warning properties; illness may be delayed. Moderately irritating to eyes; overexposure may cause corneal injury. (USCG, 1999)

**ERG 2024, Guide 127 (Dioxane)**

>> Inhalation or contact with material may irritate or burn skin and eyes.

>> Fire may produce irritating, corrosive and/or toxic gases.

>> Vapors may cause dizziness or asphyxiation, especially when in closed or confined areas.

>> Runoff from fire control or dilution water may cause environmental contamination.

>> Special Hazards of Combustion Products: Toxic vapors are generated when heated.

>> Behavior in Fire: Vapor is heavier than air and may travel to a source of ignition and flash back. (USCG, 1999)

**ERG 2024, Guide 127 (Dioxane)**

>> HIGHLY FLAMMABLE: Will be easily ignited by heat, sparks or flames.

>> CAUTION: Ethanol (UN1170) can burn with an invisible flame. Use an alternate method of detection (thermal camera, broom handle, etc.)

>> Vapors may form explosive mixtures with air.

>> Vapors may travel to source of ignition and flash back.

>> Most vapors are heavier than air. They will spread along the ground and collect in low or confined areas (sewers, basements, tanks, etc.).

>> Vapor explosion hazard indoors, outdoors or in sewers.

>> Those substances designated with a (P) may polymerize explosively when heated or involved in a fire.

>> Runoff to sewer may create fire or explosion hazard.

>> Containers may explode when heated.

>> Many liquids will float on water.

>> Highly flammable. Gives off irritating or toxic fumes (or gases) in a fire. Vapour/air mixtures are explosive. Risk of fire and explosion on contact with incompatible substances. See Chemical Dangers.

## 3. Composition/Information On Ingredients

**Chemical name** : 1,4-Dioxane
**CAS Number** : 123-91-1
**Molecular Formula** : C4H8O2
**Molecular Weight** : 88.1100 g/mol

## 4. First Aid Measures

### First Aid:

>> EYES: First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center. Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician. IMMEDIATELY transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop.

>> SKIN: IMMEDIATELY flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water. IMMEDIATELY call a hospital or poison control center even if no symptoms (such as redness or irritation) develop. IMMEDIATELY transport the victim to a hospital for treatment after washing the affected areas.

>> INHALATION: IMMEDIATELY leave the contaminated area; take deep breaths of fresh air. IMMEDIATELY call a physician and be prepared to transport the victim to a hospital even if no symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, Self-Contained Breathing Apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Protective Clothing.

>> INGESTION: DO NOT INDUCE VOMITING. If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and IMMEDIATELY call a hospital or poison control center. Be prepared to transport the victim to a hospital if advised by a physician. If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. DO NOT INDUCE VOMITING. IMMEDIATELY transport the victim to a hospital.

>> OTHER: Since this chemical is a known or suspected carcinogen you should contact a physician for advice regarding the possible long term health effects and potential recommendation for medical monitoring. Recommendations from the physician will depend upon the specific compound, its chemical, physical and toxicity properties, the exposure level, length of exposure, and the route of exposure. (NTP, 1992)

**ERG 2024, Guide 127 (Dioxane)**

>> General First Aid:

>> Call 911 or emergency medical service.

>> Ensure that medical personnel are aware of the material(s) involved, take precautions to protect themselves and avoid contamination.

>> Move victim to fresh air if it can be done safely.

>> Administer oxygen if breathing is difficult.

>> If victim is not breathing:

>> DO NOT perform mouth-to-mouth resuscitation; the victim may have ingestedor inhaled the substance.

>> If equipped and pulse detected, wash face and mouth, then give artificial respiration using a proper respiratory medical device (bag-valve mask, pocket mask equipped with a one-way valve or other device).

>> If no pulse detected or no respiratory medical device available, provide continuouscompressions. Conduct a pulse check every two minutes or monitor for any signs of spontaneous respirations.

>> Remove and isolate contaminated clothing and shoes.

>> For minor skin contact, avoid spreading material on unaffected skin.

>> In case of contact with substance, remove immediately by flushing skin or eyes with running water for at least 20 minutes.

>> For severe burns, immediate medical attention is required.

>> Effects of exposure (inhalation, ingestion, or skin contact) to substance may be delayed.

>> Keep victim calm and warm.

>> Keep victim under observation.

>> For further assistance, contact your local Poison Control Center.

>> Note: Basic Life Support (BLS) and Advanced Life Support (ALS) should be done by trained professionals.

>> Specific First Aid:

>> Wash skin with soap and water.

>> In case of burns, immediately cool affected skin for as long as possible with cold water. Do not remove clothing if adhering to skin.

>> In Canada, an Emergency Response Assistance Plan (ERAP) may be required for this product. Please consult the shipping paper and/or the "ERAP" section.

**First Aid Measures**

**Inhalation First Aid**

>> Fresh air, rest. Refer immediately for medical attention.

**Skin First Aid**

>> Remove contaminated clothes. Rinse skin with plenty of water or shower.

**Eye First Aid**

>> Rinse with plenty of water for several minutes (remove contact lenses if easily possible).

**Ingestion First Aid**

>> Rinse mouth. Do NOT induce vomiting. Seek medical attention if you feel unwell.

## 5. Fire Fighting Measures

>> ... Vapor is heavier than air ... and may travel considerable distance to source of ignition and flash back. ...

>> Excerpt from ERG Guide 127 [Flammable Liquids (Water-Miscible)]:

>> CAUTION: The majority of these products have a very low flash point. Use of water spray when fighting fire may be inefficient. CAUTION: For fire involving UN1170, UN1987 or UN3475, alcohol-resistant foam should be used. CAUTION: Ethanol (UN1170) can burn with an invisible flame. Use an alternate method of detection (thermal camera, broom handle, etc.).

>> SMALL FIRE: Dry chemical, CO2, water spray or alcohol-resistant foam.

>> LARGE FIRE: Water spray, fog or alcohol-resistant foam. Avoid aiming straight or solid streams directly onto the product. If it can be done safely, move undamaged containers away from the area around the fire.

>> FIRE INVOLVING TANKS, RAIL TANK CARS OR HIGHWAY TANKS: Fight fire from maximum distance or use unmanned master stream devices or monitor nozzles. 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 in direct contact with flames. For massive fire, use unmanned master stream devices or monitor nozzles; if this is impossible, withdraw from area and let fire burn. (ERG, 2024)

>> Use powder, alcohol-resistant foam, water spray, carbon dioxide. In case of fire: keep drums, etc., cool by spraying with water.

## 6. Accidental Release Measures

### Isolation and Evacuation:

Isolation and evacuation measures to take when a large amount of this chemical is accidentally released in an emergency.

>> Excerpt from ERG Guide 127 [Flammable Liquids (Water-Miscible)]:

>> IMMEDIATE PRECAUTIONARY MEASURE: Isolate spill or leak area for at least 50 meters (150 feet) in all directions.

>> LARGE SPILL: Consider initial downwind evacuation for at least 300 meters (1000 feet).

>> FIRE: If tank, rail tank car or highway tank 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. (ERG, 2024)

**Evacuation: ERG 2024, Guide 127 (Dioxane)**

>> Immediate precautionary measure

>> Isolate spill or leak area for at least 50 meters (150 feet) in all directions.

>> Large Spill

>> Consider initial downwind evacuation for at least 300 meters (1000 feet).

>> Fire

>> If tank, rail tank car or highway tank 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.

### Spillage Disposal:

Methods for containment and safety measures to protect workers dealing with a spillage of this chemical.

>> Personal protection: filter respirator for organic gases and vapours adapted to the airborne concentration of the substance. Collect leaking liquid in sealable air tight containers. Absorb remaining liquid in sand or inert absorbent. Then store and dispose of according to local regulations. Do NOT wash away into sewer.

**Accidental Release Measures**

**Public Safety: ERG 2024, Guide 127 (Dioxane)**

>> CALL 911. Then call emergency response telephone number on shipping paper. If shipping paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.

>> Keep unauthorized personnel away.

>> Stay upwind, uphill and/or upstream.

>> Ventilate closed spaces before entering, but only if properly trained and equipped.

**Spill or Leak: ERG 2024, Guide 127 (Dioxane)**

>> ELIMINATE all ignition sources (no smoking, flares, sparks or flames) from immediate area.

>> All equipment used when handling the product must be grounded.

>> Do not touch or walk through spilled material.

>> Stop leak if you can do it without risk.

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

>> A vapor-suppressing foam may be used to reduce vapors.

>> Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers.

>> Use clean, non-sparking tools to collect absorbed material.

>> Large Spill

>> Dike far ahead of liquid spill for later disposal.

>> Water spray may reduce vapor, but may not prevent ignition in closed spaces.

## 7. Handling And Storage

### Safe Storage:

>> Fireproof. Separated from strong oxidants, strong acids and incompatible materials. Cool. Dry. Well closed. Keep in the dark. Store only if stabilized. Store in an area without drain or sewer access.

### Storage Conditions:

>> Store in a cool, dry, well-ventilated location. Store away from heat, oxidizing materials, and sunlight. Outside or detached storage is preferred. Inside storage should be in a standard flammable liquids storage warehouse, room, or cabinet.

## 8. Exposure Control/ Personal Protection

**REL-C (Ceiling)**

>> 1 ppm (3.6 mg/m³) [30 minutes]

>> Ca C 1 ppm (3.6 mg/m3) [30-minute] See Appendix A

>> 100.0 [ppm]

**PEL-TWA (8-Hour Time Weighted Average)**

>> 100 ppm (360 mg/m³)

>> 20.0 [ppm]

>> 20 ppm as TWA; (skin); A3 (confirmed animal carcinogen with unknown relevance to humans).

**TLV-TWA (Time Weighted Average)**

>> 20 ppm [1996]

**EU-OEL**

>> 73 mg/m

**MAK (Maximale Arbeitsplatz Konzentration)**

>> 37 mg/m

**Emergency Response: ERG 2024, Guide 127 (Dioxane)**

>> CAUTION: The majority of these products have a very low flash point. Use of water spray when fighting fire may be inefficient.

>> CAUTION: For fire involving UN1170, UN1987 or UN3475, alcohol-resistant foam should be used.

>> CAUTION: Ethanol (UN1170) can burn with an invisible flame. Use an alternate method of detection (thermal camera, broom handle, etc.)

>> Small Fire

>> Dry chemical, CO2, water spray or alcohol-resistant foam.

>> Large Fire

>> Water spray, fog or alcohol-resistant foam.

>> Avoid aiming straight or solid streams directly onto the product.

>> If it can be done safely, move undamaged containers away from the area around the fire.

>> Fire Involving Tanks, Rail Tank Cars or Highway Tanks

>> Fight fire from maximum distance or use unmanned master stream devices or monitor nozzles.

>> 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 in direct contact with flames.

>> For massive fire, use unmanned master stream devices or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

## Inhalation Risk:

>> A harmful contamination of the air can be reached rather quickly on evaporation of this substance at 20 °C , on spraying or dispersing much faster.

## Effects of Short Term Exposure:

>> The substance is irritating to the eyes and respiratory tract. If swallowed the substance may cause vomiting and could result in aspiration pneumonitis. Exposure at high levels could cause lowering of consciousness.

## Effects of Long Term Exposure:

>> The substance defats the skin, which may cause dryness or cracking. The substance may have effects on the central nervous system, kidneys and liver. This substance is possibly carcinogenic to humans.

### Fire Prevention

>> NO open flames, NO sparks and NO smoking. NO contact with strong oxidizing agents. NO contact with hot surfaces. Closed system, ventilation, explosion-proof electrical equipment and lighting. Prevent build-up of electrostatic charges (e.g., by grounding). Do NOT use compressed air for filling, discharging, or handling. Use non-sparking handtools.

### Exposure Prevention

>> PREVENT GENERATION OF MISTS!

### Inhalation Prevention

>> Use ventilation (not if powder), local exhaust or breathing protection.

### Skin Prevention

>> Protective gloves. Protective clothing.

### Eye Prevention

>> Wear face shield or eye protection in combination with breathing protection.

### Ingestion Prevention

>> Do not eat, drink, or smoke during work.

### Exposure Control and Personal Protection

### Protective Clothing: ERG 2024, Guide 127 (Dioxane)

>> Wear positive pressure self-contained breathing apparatus (SCBA).

>> Structural firefighters' protective clothing provides thermal protection but only limited chemical protection.

### Maximum Allowable Concentration (MAK)

>> 10.0 [ppm]

## 9. Physical And Chemical Properties

**Molecular Weight:**

>> 88.11

**Exact Mass:**

>> 88.052429494

**Physical Description:**

>> Dioxane appears as a clear colorless liquid with a faint ethereal odor. Flash point 55 °F. Slightly denser than water and soluble in water. Vapors heavier than air. Susceptible to autooxidation to form peroxides.

>> COLOURLESS LIQUID WITH CHARACTERISTIC ODOUR.

**Color/Form:**

>> Colorless liquid or solid (below 53 degrees F)

**Odor:**

>> Faint pleasant odor

**Boiling Point:**

>> 214 °F at 760 mmHg (NTP, 1992)

>> 101 °C

**Melting Point:**

>> 53.2 °F (NTP, 1992)

>> 12 °C

**Flash Point:**

>> 54 °F (NTP, 1992)

>> 12 °C c.c.

**Solubility:**

>> greater than or equal to 100 mg/mL at 68 °F (NTP, 1992)

>> Solubility in water: miscible

**Density:**

>> 1.036 at 68 °F (USCG, 1999) - Denser than water; will sink

>> Relative density (water = 1): 1.03

**Vapor Density:**

>> 3.03 (NTP, 1992) - Heavier than air; will sink (Relative to Air)

>> Relative vapor density (air = 1): 3.0

**Vapor Pressure:**

>> 29 mmHg at 68 °F ; 37 mmHg at 77 °F (NTP, 1992)

>> Vapor pressure, kPa at 20 °C: 3.9

**LogP:**

>> log Kow = -0.27

>> -0.27

**Stability/Shelf Life:**

>> Stable under recommended storage conditions. Test for peroxide formation before distillation or evaporation. Test for peroxide formation or discard after 1 year. Stable under recommended storage conditions.

**Autoignition Temperature:**

>> 356 °F (USCG, 1999)

>> 180 °C

**Decomposition:**

>> When heated to decomposition it emits acrid smoke and irritating fumes.

**Viscosity:**

>> 0.0120 centipoise at 25 °C

>> 1.17 $mm^2/s$ at 25 °C

**Heat of Combustion:**

>> 581 kcal/mol

**Heat of Vaporization:**

>> 34.15 kJ/mol at 101.5 °C; 38.60 kJ/mol at 25 °C

**Surface Tension:**

>> 32.75 mN/m at 25 °C; 29.28 mN/m at 50 °C

**Ionization Potential:**

>> 9.13 eV

**Odor Threshold:**

>> Odor Threshold Low: 0.8 [mmHg]

>> Odor Threshold High: 172.0 [mmHg]

>> Detection odor threshold from AIHA (mean = 12 ppm)

**Refractive Index:**

>> Index of refraction: 1.4224 20 °C

**Dissociation Constants:**

**Relative Evaporation Rate:**

The rate at which a material will vaporize (evaporate, change from liquid to vapor), compared to the rate of vaporization of a specific known material.

>> 2.7 (Butyl acetate = 1)

## 10. Stability And Reactivity

>> Highly flammable. When exposed to air it undergoes autooxidation with formation of peroxides. In the distillation process peroxides will concentrate causing violent explosion. Water soluble.

**CSL No**

>> CSL00034

**Reactants/Reagents**

>> THIONYL CHLORIDE + 1,4-DIOXANE

**Warning Message**

>> Explosive decomposition when heated in a steel vessel

**GHS Category**

>> Explosive

**Reaction Class**

>> Chlorination

**Reference Source**

>> User-Reported

**Modified Date**

>> 5/31/18

**Create Date**

>> 4/19/17

## Peroxide Forming Chemical:

Peroxide-forming chemicals (PFCs) are chemicals that can "auto-oxidize" with atmospheric oxygen under ambient conditions to form organic peroxides (contains an -O-O- bond). Peroxide formation can be initiated by exposure to air, self-polymerization, or solvent impurities. Once formed, organic peroxides are sensitive to thermal or mechanical shock and can be violently explosive in concentrated solutions or as solids.

**Chemical**

>> 1,4-Dioxane

**Class (* = UMN Designation)**

>> B: Compounds that form peroxides on concentration (distillation/evaporation)

**Peroxide Concentration Over Time**

>> 18 samples had 0- >100 ppm peroxide; age >1-24 yrs

>> Moderate peroxides found in new commerically available containers

**Reference(s)**

>> Burfield - JOC

**Additional Reference(s)**

>> Dasler,W.etal.,Ind.Eng.Chem.(Anal.Ed.),1946,18,52

## 11. Toxicological Information

**Toxicity Summary:**

>> IDENTIFICATION AND USE: 1,4-Dioxane is a colorless liquid or solid. It is used as a stabilizer for chlorinated solvents, particularly, 1,1,1-trichloroethane. 1,4-Dioxane is used as a solvent for cellulose acetate, ethyl cellulose, benzyl cellulose, resins, oils, waxes, and fats; in spectroscopic and photometric measurements; and in the pulping of wood. Other uses of 1,4-dioxane include the manufacture of adhesives, cements, deodorant fumigants, cosmetics, drugs, cleaning preparations, magnetic tape, plastic, rubber, insecticides, and herbicides, and as a chemical intermediate, as a polymerization catalyst, in the purification of drugs, and in the extraction of animal and vegetable oils. In the laboratory, it is used in the preparation of histological sections for microscopic examination and as a liquid scintillation counting medium. HUMAN EXPOSURE AND TOXICITY: Short-term inhalation exposure to 1,4-dioxane may cause irritation of the eyes, nose, throat, and lungs. Symptoms of acute exposure include coughing, drowsiness, vertigo, headache, nausea, vomiting, stomach pains, coma, and death. There is a report of a fatal case of acute poisoning by inhalation that led to hepatic and renal lesions, and demyelination and edema of the brain. Workplace exposures to high concentrations of 1,4-dioxane have resulted in death. The deaths occurred 5-8 days after the initial symptoms of illness. Postmortem evaluation revealed extensive liver and kidney damage and in three out of five cases described in one study, kidney disease was considered to be the direct cause of death. A small prospective study of 165 U.S. workers exposed intermittently to low levels of 1,4-dioxane found no excess of death from cancer; however, the study was limited by the small number of cancer deaths (3) among the exposed workers. ANIMAL STUDIES: Oral exposure to 1,4-dioxane caused tumors in several species of experimental animals and at several different tissue sites. Inhalation exposure of male rats to 1,4-dioxane caused benign liver tumors (hepatocellular adenoma), nasal cancer (squamous-cell carcinoma), and mesothelioma of the peritoneum. 1,4-Dioxane was not mutagenic to Salmonella typhimurium with and without metabolic activation. 1,4-Dioxane has a non-genotoxic, yet unknown, mode of action. 1,4-Dioxane induced meiotic non-disjunction in mature oocytes from 3- and 6-day-old Drosophila melanogaster females. ECOTOXICITY STUDIES: A long-term static renewal test (7 days) with Ceriodaphnia dubia has been carried out. A NOEC of 625 mg/L(nominal) was found in this test.

**Evidence for Carcinogenicity:**

Evidence that this chemical does or may cause cancer. The information here is collected from various sources by the Hazardous Substances Data Bank (HSDB).

>> Evaluation: There is inadequate evidence in humans for the carcinogenicity of 1,4-dioxane. There is sufficient evidence in experimental animals for the carcinogenicity of 1,4-dioxane. Overall evaluation: 1,4-Dioxane is possibly carcinogenic to humans (Group 2B).

**Carcinogen Classification:**

This section provides the International Agency for Research on Cancer (IARC) Carcinogenic Classification and related monograph links. In the IARC Carcinogenic classification, chemicals are categorized into four groups: Group 1 (carcinogenic

to humans), Group 2A (probably carcinogenic to humans), Group 2B (possibly carcinogenic to humans), and Group 3 (not classifiable as to its carcinogenicity to humans).

**IARC Carcinogenic Agent**

>> 1,4-Dioxane

**IARC Carcinogenic Classes**

>> Group 2B: Possibly carcinogenic to humans

**IARC Monographs**

>> Volume 11: (1976) Cadmium, Nickel, Some Epoxides, Miscellaneous Industrial Chemicals and General Considerations on Volatile Anaesthetics

>> Volume Sup 7: Overall Evaluations of Carcinogenicity: An Updating of IARC Monographs Volumes 1 to 42, 1987; 440 pages; ISBN 92-832-1411-0 (out of print)

>> Volume 71: (1999) Re-evaluation of Some Organic Chemicals, Hydrazine and Hydrogen Peroxide (Part 1, Part 2, Part 3)

>> 2B, possibly carcinogenic to humans. (L135)

**Health Effects:**

>> 1,4-Dioxane for short period of time cause eye and nose irritation at low levels, and severe kidney and liver effects and possibly death at very high levels. For long-term exposure, studies in animals have shown that breathing vapors of 1,4-dioxane, swallowing liquid 1,4-dioxane or contaminated drinking water, or having skin contact with liquid 1,4-dioxane affects mainly the liver and kidneys. Studies in workers did not indicate whether 1,4-dioxane causes cancer, but animal studies suggest that it is a probable human carcinogen. (L1189)

**Exposure Routes:**

>> The substance can be absorbed into the body by inhalation of its vapour and through the skin.

>> inhalation, skin absorption, ingestion, skin and/or eye contact

**Inhalation Exposure**

>> Cough. Sore throat. Nausea. Dizziness. Headache. Drowsiness. Vomiting. Unconsciousness. Abdominal pain.

**Skin Exposure**

>> MAY BE ABSORBED!

**Eye Exposure**

>> Redness. Pain.

**Ingestion Exposure**

>> See Inhalation.

>> irritation eyes, skin, nose, throat; drowsiness, headache; nausea, vomiting; liver damage; kidney failure; [potential occupational carcinogen]

**Target Organs:**

Organs that are affected by exposure to this chemical. Information in this section reflects human data unless otherwise noted.

>> Cancer, Developmental (effects while organs are developing), Hepatic (Liver), Ocular (Eyes), Renal (Urinary System or Kidneys), Respiratory (From the Nose to the Lungs)

>> Hepatic

>> Nervous

>> Respiratory

>> Urinary

**Cancer Sites:**

The site in which cancer develops due to exposure to this compound. Cancers are casually referred to based on their primary sites (e.g., skin, lung, breasts, prostate, colon and rectum).

>> Gastrointestinal

>> Hepatic

>> Reproductive

>> Respiratory

>> Urinary

>> [in animals: lung, liver & nasal cavity tumors]

**Adverse Effects:**

An adverse effect is an undesired harmful effect resulting from a medical treatment or other intervention.

>> Neurotoxin - Acute solvent syndrome

>> Occupational hepatotoxin - Secondary hepatotoxins: the potential for toxic effect in the occupational setting is based on cases of poisoning by human ingestion or animal experimentation.

>> Nephrotoxin - The chemical is potentially toxic to the kidneys in the occupational setting.

>> Skin Sensitizer - An agent that can induce an allergic reaction in the skin.

>> IARC Carcinogen - Class 3: Chemicals are not classifiable by the International Agency for Research on Cancer.

>> NTP Carcinogen - Reasonably anticipated to be a human carcinogen.

>> ACGIH Carcinogen - Confirmed Animal.

**Toxicity Data:**

>> LC50 (rat) = 46,000 mg/m3/2 hr

**Interactions:**

>> ... /In Swiss Webster mice/ skin paintings /with 0.2 mL of unspecified concn of 1,4-dioxane/ were preceded 1 wk earlier by application of 50 ug 7,12-dimethylbenzanthracene (DMBA); 4 males and 5 females survived 59 wk of treatment. Among 15 mice examined, 8 skin tumors were observed (2 papillomas, 2 squamous-cell carcinomas and 4 sarcomas); in addition 24 other tumors (mainly malignant lymphomas and lung tumors) occurred. 8 skin papillomas and 1 malignant lymphoma occurred in 55 animals receiving 50 ug DMBA followed by thrice weekly paintings with acetone alone.

**Antidote and Emergency Treatment:**

>> Exposures of the eye... must be flushed immediately with water. Likewise, any clothing that becomes contaminated with dioxane should be removed and contaminated skin irrigated with soap and water.

**Human Toxicity Excerpts:**

>> /HUMAN EXPOSURE STUDIES/ Irritation from dioxane vapors occurs at somewhere between a 0.1% and 3.0% vapor concentration, which can produce CNS depression and, if the exposure continues, pulmonary edema and death. Renal and hepatic injury can occur after toxic exposure to dioxane. Dioxane is an acute health hazard and is highly toxic by inhalational, dermal, and GI routes. Lethal concentrations for humans can occur at 470 ppm.

**Non-Human Toxicity Excerpts:**

>> /LABORATORY ANIMALS: Acute Exposure/ ... /After single oral dose of 5.66, 5.17 and 3.90 g/kg to/ mice, rats and guinea pigs ... symptoms progressed from weakness, depression, incoordination, and coma to death. Autopsy revealed hemorrhagic areas in pyloric region of the stomach, bladders distended with urine, enlarged kidneys, slight proteinuria, but no hematuria.

**Human Toxicity Values:**

Quantitative human toxicity values (e.g., lethal dose) for this compound.

>> Lethal concentrations for humans can occur at 470 ppm.

**Non-Human Toxicity Values:**

>> LD50 Guinea pig oral 3150 mg/kg

**National Toxicology Program Studies:**

Reports from the National Toxicology Program, an interagency program supported by three government agencies (NIH, FDA, and CDC) within the Department of Health and Human Services. This program plays a critical role in generating, interpreting, and sharing toxicological information about chemicals of public health concerns.

>> A bioassay of 1,4-dioxane for possible carcinogenicity was conducted by administering the test chemical in the drinking water to Osborne-Mendel rats and B6C3F1 mice. Groups of 35 rats and 50 mice of each sex were administered 1,4-dioxane at concentrations of either 0.5% or 1.0% (v/v) in drinking water. ... The rats were dosed for 110 wk and the mice for 90 wk. Matched controls consisted of 35 untreated rats and 50 untreated mice of each sex. All surviving rats were killed at 110-117 wk and all surviving mice at 90-93 wk. ... Under the conditions of this bioassay, 1,4-dioxane induced hepatocellular adenomas in female Osborne-Mendel rats. 1,4-Dioxane was carcinogenic in both sexes of rats, producing squamous cell carcinomas of the nasal turbinate, and in both sexes of B6C3F1 mice, producing hepatocellular carcinomas. Levels of Evidence of Carcinogenicity: Male Rats: Positive; Female Rats: Positive; Male Mice: Positive; Female Mice: Positive.

**TSCA Test Submissions:**

Under the Toxic Substances Control Act (TSCA), EPA has broad authority to issue regulations designed to require manufacturers (including importers) or processors to test chemical substances and mixtures for health and environmental effects. This section provides information on test reports submitted for this chemical under TSCA.

>> 1,4-Dioxane (DX) was evaluated for the potential to induce peroxisomal beta-oxidation of fatty acids in rats by administering 2000 mg/kg/day to 7 male Fischer 344 rats for 9 nine non-consecutive days over a period of 11 days. Another group of 7 rats received 500 mg/kg sodium benzoate in saline, while the vehicle control (7 rats) and positive control (2 rats) groups received 5.7 mL/kg/day of 0.9% saline solution or 200 mg/kg/day clofibrate in corn oil (1 mL/kg), respectively. Rats were fasted overnight (16 hours) immediately prior to sacrifice and livers were removed and prepared for FAOX activity assays. There were no reported mortalities for any group and the appearance and behavior of treated animals were comparable with vehicle controls. DX treated animals showed a slight decrease in average body weight over the dosing period compared to control animals or those treated with sodium benzoate. Animals treated with DX also were shown to have increased average absolute and relative liver weights (25% and 43%, respectively), but no change in liver protein levels was reported. There were no significant differences in liver weights or hepatic proteins between controls and animals receiving sodium benzoate. Assays for hepatic peroxisomal FAOX activity revealed that rats treated with 1,4-dioxane or sodium benzoate had 22% and 42%, respectively, lower FAOX activity than controls. The findings from the positive control group, however, were consistent with treatment with a peroxisome-inducing agent. The average liver weight from animals treated with clofibrate was increased nearly two-fold over controls, and the specific activity of FAOX in hepatic tissue was nearly 4-fold over controls. Under the conditions of this study, 1,4-dioxane did not induce the proliferation of hepatic peroxisomes in rats.

## 12. Ecological Information

**Resident Soil (mg/kg)**

>> 5.30e+00

**Industrial Soil (mg/kg)**

>> 2.40e+01

**Resident Air (ug/m3)**

>> 5.60e-01

**Industrial Air (ug/m3)**

>> 2.50e+00

**Tapwater (ug/L)**

>> 4.60e-01

**MCL (ug/L)**

>> 7.00e+00

**Risk-based SSL (mg/kg)**

>> 9.4e-05

**Oral Slope Factor (mg/kg-day)-1**

>> 1.00e-01

**Inhalation Unit Risk (ug/m3)-1**

>> 5e-06

**Chronic Oral Reference Dose (mg/kg-day)**

>> 3.00e-02

**Chronic Inhalation Reference Concentration (mg/m3)**

>> 3.00e-02

**Volatile**

>> Volatile

**Mutagen**

>> Mutagen

**Fraction of Contaminant Absorbed in Gastrointestinal Tract**

>> 1

**Soil Saturation Concentration (mg/kg)**

>> 1.16e+05

## 13. Disposal Considerations

**Spillage Disposal**

>> Personal protection: filter respirator for organic gases and vapours adapted to the airborne concentration of the substance. Collect leaking liquid in sealable air tight containers. Absorb remaining liquid in sand or inert absorbent. Then store and dispose of according to local regulations. Do NOT wash away into sewer.

**Disposal Methods**

>> Generators of waste (equal to or greater than 100 kg/mo) containing this contaminant, EPA hazardous waste number U108, must conform with USEPA regulations in storage, transportation, treatment and disposal of waste.

>> Good candidate for rotary kiln incineration with a temperature range of 820-1,600 °C with residence times for liquids and gases: seconds; solids: hours. Also, a good candidate for liquid injection incineration with a temperature range of 650-1,600 °C with residence times of 0.1-2.0 seconds. Also, a good candidate for fluidized bed incineration with a temperature range of 450-980 °C with residence times for liquids and gases: seconds; solids: longer.

>> This compound should be susceptible to removal from waste water by air stripping.

>> PRECAUTIONS FOR "CARCINOGENS": There is no universal method of disposal that has been proved satisfactory for all carcinogenic compounds and specific methods of chem destruction ... published have not been tested on all kinds of carcinogen-containing waste. ... summary of avail methods and recommendations ... /given/ must be treated as guide only. /Chemical Carcinogens/

>> For more Disposal Methods (Complete) data for 1,4-DIOXANE (11 total), please visit the HSDB record page.

## 14. Transport Information

**DOT**

1,4-Dioxane
3
UN Pack Group: II
Reportable Quantity of 100 lb or 45

**IATA**

1,4-Dioxane
3,
UN Pack Group: II

## 15. Regulatory Information

**Regulatory Information**

**The Australian Inventory of Industrial Chemicals**

>> Chemical: 1,4-Dioxane

>> Specific Information Requirement: Obligations to provide information apply. You must tell us within 28 days if the circumstances of your importation or manufacture (introduction) are different to those in our assessment.

**REACH Registered Substance**

>> Status: Active Update: 04-10-2022 https://echa.europa.eu/registration-dossier/-/registered-dossier/15842

**REACH Substances of Very High Concern (SVHC)**

>> Substance: 1,4-dioxane

>> EC: 204-661-8

>> Date of inclusion: >08-Jul-2021

>> Reason for inclusion: Carcinogenic (Article 57a); Equivalent level of concern having probable serious effects to human health (Article 57(f) - human health); Equivalent level of concern having probable serious effects to the environment (Article 57(f) - environment)

**New Zealand EPA Inventory of Chemical Status**

>> 1,4-Dioxane: HSNO Approval: HSR001140 Approved with controls

## 16. Other Information

### Toxic Combustion Products:

Toxic products (e.g., gases and vapors) produced from the combustion of this chemical.

>> Carbon oxides

**Other Safety Information**

**Chemical Assessment**

>> Evaluation - 1,4-Dioxane

>> PEC / SN / Other assessments - 1,4-Dioxane: Health and Environment

"The information provided is believed to be accurate but is not comprehensive and should be used as a reference. It reflects our current knowledge and is intended for safety guidance related to the product. This document does not constitute a warranty of the product's properties. Ionz is not responsible for any damages resulting from handling or contact with the product incorrectly."