

Occupational Health Guideline for Zinc Chloride Fume

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data; rather, it presents pertinent information and data in summary form.

SUBSTANCE IDENTIFICATION

- Formula: $ZnCl_2$
- Synonyms: None
- Appearance and odor: White fume with an acrid odor.

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for zinc chloride fume is 1 milligram of zinc chloride fume per cubic meter of air (mg/m^3) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

• Routes of exposure

Zinc chloride fume can affect the body if it is inhaled or if it comes in contact with the eyes.

• Effects of overexposure

1. *Short-term Exposure:* Exposure to zinc chloride fume may cause shortness of breath, a feeling of constriction in the chest, abdominal pain, watering of the eyes, burning of the eyes and throat, and coughing with phlegm and bloody sputum. It may also cause a blue color of the skin and lips. In addition, it may cause pneumonia. Breathing difficulties may not appear for several hours after exposure has ceased. Fatal exposures have occurred.

2. *Long-term Exposure:* None known.

3. *Reporting Signs and Symptoms:* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to zinc chloride fume.

• Recommended medical surveillance

The following medical procedures should be made available to each employee who is exposed to zinc chloride fume at potentially hazardous levels:

1. *Initial Medical Examination:*

—A complete history and physical examination: The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring. Examination of the respiratory system should be stressed. The skin should be examined for evidence of chronic disorders.

—14" x 17" chest roentgenogram: Zinc chloride fume causes human lung damage. Surveillance of the lungs is indicated.

—FVC and FEV (1 sec): Zinc chloride fume is reported to cause decreased pulmonary function. Periodic surveillance is indicated.

2. *Periodic Medical Examination:* The aforementioned medical examinations should be repeated on an annual basis, except that an x-ray is considered necessary only when indicated by the results of pulmonary function testing. Determination of zinc in the urine may be helpful in evaluating the extent of absorption.

• Summary of toxicology

Zinc chloride fume irritates the eyes, mucous membranes, and skin, and causes delayed pulmonary edema. Ten deaths and 25 cases of non-fatal injury occurred among 70 persons exposed to a high concentration of zinc chloride released from smoke generators; presenting symptoms were conjunctivitis (two with burns of the corneas), irritation of nose and throat, cough with copious sputum, dyspnea, constrictive sensation in the chest, stridor, retrosternal pain, nausea, epigastric pain, and pale gray cyanosis. Of the 10 fatalities, a few died immediately or in a few hours from pulmonary edema, while those who survived longer developed bronchopneumonia. Between the second and fourth days after exposure, almost all cases developed moist, adventitious sounds in the lungs, and the majority continued to

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program. However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations.

present a pale cyanotic color; a prominent feature was the disparity between the severe symptoms and the paucity of physical signs in the lungs; recovery occurred within 1 to 6 weeks after the incident. A firefighter was fatally exposed to a high but undetermined concentration of zinc chloride fume from a smoke generator; on admission to the hospital, the patient complained of nausea, sore throat, and chest tightness aggravated by deep inspiration. He initially improved but then developed tachypnea, substernal soreness, fever, cyanosis, and coma; the lung fields were clear on auscultation despite diffuse pulmonary infiltrations seen on the chest roentgenogram; death occurred 18 days after exposure, and autopsy revealed active fibroblastic proliferation and cor pulmonale. Injection of zinc chloride solution into the testes of 49 Syrian hamsters resulted in areas of necrosis occupying about 25% of each testis; two embryonal carcinomata of the testis were found 10 weeks later at necropsy.

CHEMICAL AND PHYSICAL PROPERTIES

• Physical data

1. Molecular weight: 136.3
2. Boiling point (760 mm Hg): 732 C (1350 F) (for solid)
3. Specific gravity (water = 1): 2.91 (solid)
4. Vapor density (air = 1 at boiling point of zinc chloride fume): Not applicable
5. Melting point: 283 C (541 F) (for solid)
6. Vapor pressure at 20 C (68 F): Not applicable
7. Solubility in water, g/100 g water at 25 C (77 F): 81
8. Evaporation rate (butyl acetate = 1): Not applicable

• Reactivity

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

• Flammability

1. Not combustible

• Warning properties

Grant states that "dilute solutions (0.2% to 1%) have long been used as astringent eye drops without difficulty, but concentrated solutions and pastes such as encountered industrially have caused very severe injuries of the cornea in numerous cases of accidental splash in the eye. . . . Guillery found that applying 10% zinc chloride solution for 4 to 5 minutes to a rabbit's eye caused loss of corneal endothelium and extensive infiltration." No information is available concerning the effects on the eye specifically of the fume of zinc chloride.

The *Documentation of TLV's* reports, "Elkins stated that zinc chloride is an irritant Ferry, in investigating a borderline condition, found that levels between 0.07 and 0.4 mg/m³ for 30 minutes did not result in sensory

effects. The fume is corrosive to metals at these levels, however."

MONITORING AND MEASUREMENT PROCEDURES

• General

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples. Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

• Method

At the time of publication of this guideline, no measurement method for zinc chloride fume had been published by NIOSH.

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level. However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented. Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health.

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to zinc chloride fume may occur and control methods which may be effective in each case:

Operation

Controls

Liberation from fluxing iron/steel prior to galvanizing

Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment

Liberation from arc welding of galvanized iron and steel pipes

Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment

Liberation from fluxing agent in some solder composition

Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment

Liberation from vulcanizing and reclaiming processes for rubber

Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment

Liberation from solutions in glass and metal etching

Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment

Liberation from manufacture of dry cell batteries

Process enclosure; general dilution ventilation; local exhaust ventilation; personal protective equipment

Liberation from petroleum refining operations

Process enclosure; general dilution ventilation; local exhaust ventilation

rescue procedures. Do not become a casualty. Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

LEAK PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of releases until cleanup has been completed.
- If potentially hazardous amounts of zinc chloride fume are inadvertently released, ventilate the area of the release to disperse the fume.

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EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance.

• Breathing

If a person breathes in large amounts of zinc chloride fume, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible.

• Rescue

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency

RESPIRATORY PROTECTION FOR ZINC CHLORIDE FUME

Condition	Minimum Respiratory Protection* Required Above 1 mg/m³
Particulate Concentration	
10 mg/m ³ or less	Any fume respirator or high efficiency particulate filter respirator. Any supplied-air respirator. Any self-contained breathing apparatus.
50 mg/m ³ or less	A high efficiency particulate filter respirator with a full facepiece. Any supplied-air respirator with a full facepiece, helmet, or hood. Any self-contained breathing apparatus with a full facepiece.
1000 mg/m ³ or less	A powered air-purifying respirator with a full facepiece and a high efficiency particulate filter.
2000 mg/m ³ or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode.
Greater than 2000 mg/m ³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode. A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode.
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode.
Escape	A high efficiency particulate filter respirator. Any escape self-contained breathing apparatus.

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